ATHI WATER SERVICES BOARD

NAIROBI METROPOLITAN SERVICES IMPROVEMENT PROJECT

NAMSIP

CONSTRUCTION OF SEWERAGE SYSTEM FOR RUIRU MUNICIPALITY

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

NOVEMBER 2012
Report Submission Details

CLIENT Athi Water Services Board

ASSIGNMENT Construction of Proposed Sewerage System for Ruiru Municipality

REPORT TITLE: Environmental Impact Assessment Report

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Disclaimer:
This Environmental Impact Assessment Project Report is based on literature review and findings from field assessment. It strictly confidential Athi Water Services Board and any materials thereof should strictly be used in accordance with agreement from the management. It is however, subject to conditions in the Environmental Management and Coordination Act 1999, Environmental (Impact Assessment and Audit) Regulations, 2003, WaSSIP AF EMSF 2011 and World Bank OP 4.01 Environment Assessment.
Environmental Assessment Report
Ruiru Sewerage System
Athi Water Services Board

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<th>Description</th>
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<tbody>
<tr>
<td>AWSB</td>
<td>Athi Water Services Board</td>
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<tr>
<td>BOD</td>
<td>Biological Oxygen Demand</td>
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<tr>
<td>CBO</td>
<td>Community Based Organization</td>
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<tr>
<td>CCN</td>
<td>City Council of Nairobi</td>
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<td>Ministry of Water and Irrigation</td>
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a. **Project Information**

Ruiru Sewerage Project is expected to be financed by the third Nairobi Metropolitan Services Improvement Project (NaMSIP) which is a program of the World Bank. This will finance investments in infrastructure and service delivery in Kenya’s largest and most economically important urban conurbation (accounting for some 17 percent of the country’s population and about 50 percent of its GDP). Together, the three programs will comprehensively address core issues that are constraining the development potential, efficiency, equity, and competitiveness of Kenya’s urban areas. In addition, the NaMSIP will create synergies with the Bank’s National Urban Transport Improvement Project (NUTIP) currently under preparation by improving access to transport hubs and integrating land use planning into transport and overall urban planning, especially around commuter rail stations.

Ruiru town has an existing sewage collection network and treatment system that utilizes septic tanks. Several medium sized industrial processing factories located in the town have their own waste treatment system. As an example, the firm of Spinners and Spinners utilizes the Ion exchange method to remove color from waste water generated from their dying activities prior to disposal while Devki Steel Mills applies the oil separators to remove oil and grease from wastewater. The diffuse nature of waste treatment in the Municipality has contributed to significant environmental degradation especially pollution of the adjacent water bodies. This calls for a centralized system of wastewater management which is one of the objectives of the proposed project.

b. **Project Justifications**

Nairobi Sewerage Master Plan projects population growth population to an approximate 1.4 million people in the entire Nairobi Metropolitan Region, infrastructure development does not match the population growth rate that is currently estimated at 7.8% per annum in the urban regions of NMR. The master plan proposes development of Ruiru II Sewerage Treatment Works for the growing population of Ruiru municipality estimated to grow to 237,413 persons from 174,877 persons *2009 Population and Housing census*

Development of Ruiru Sewerage project is a step toward achieving Millennium Development Goal 7: Ensuring Environmental Sustainability. The interventions adopted from the Millennium Project Model include (a) water supply access through household connections, public stand posts, boreholes with hand pumps, rainwater collection (roof catchments), and protected dug wells; and (b) sanitation access through conventional sewerage, septic tank, pour flush toilet, ventilated improved pit latrine, and improved pit latrine.

The aim Nairobi Metropolitan Development Strategy stipulates the goal of improving the quality of life in the NMR which is currently characterized by
intense pressure on land, water, roads, sewerage and other basic infrastructure need in any developing urban centres. Developing the Ruiru Sewerage Infrastructure is a mail stone towards achieving the goals of the key strategic goals

c. Study Scope
This study has been carried out within the framework of the guidelines and procedures spelt out in the Environmental (Impact Assessment and Audit) Regulations 2003 and Environmental Impact Assessment guidelines and Administrative procedures, and as a result of consultations with the project proponent.

World Bank OP 4.01- Environmental Assessment- of the World Bank has been triggered in order to identify, avoid, and mitigate the potential negative environmental impacts associated with construction of Ruiru Sewerage project.

World Bank OP 4.12 – Involuntary Resettlement - will also be triggered to ensure that the any involuntary resettlement or loss of livelihood caused to persons under this project are adequately compensated based on full market replacement cost of their assets and ensuring that proper channels are provided for redress of their grievances.

The scope of the study included the carrying out of environmental investigations within the current legislative framework, This was done in line with the requirements of Environmental Management and Coordination Act (EMCA) 1999 and Environmental (Impact Assessment and Audit) Regulations 2003 among other legal and regulatory frameworks and World Bank OP  4.01 The study covered the physical extent of the project site and its immediate environs, implementation works of the proposed development (ground preparations, laying of pipes) among other activities and installation of key utilities and other facilities required for the project to function optimally.

d. Objectives of the Study
The general objective of the proposed project is to design and construct a sewerage system for Ruiru Municipality and its environs, key objectives of this study include the following:
- To determine the compatibility of the proposed development with the neighbouring land uses.
- To identify and evaluate the significant environmental impacts of the proposed project:
- To describe appropriate mitigation measures for the proposed impacts
- To assess and analyze the environmental costs and benefits associated with the proposed project
- To evaluate and select the best project alternative from the various options available
- To incorporate environmental management plans and monitoring mechanisms during implementation, operation and decommissioning phases of the project
- In cooperate the findings of public consultations

e. **Terms of Reference**

The following Terms of Reference (TORs) apply to the project:
- Hold appropriate meetings with the project proponent to establish the procedures, define requirements, responsibilities and a time frame.
- Produce an EIA report that contains among other issues potential negative and positive impacts and recommendation of appropriate mitigation measures to minimize or prevent adverse impacts
- Carry out a systematic environmental assessment at the proposed project site and the surrounding area following the gazetted regulations
- Provide a description of the proposed activities throughout the entire implementation process of the project with special focus on potential impacts to the surrounding environment
- Develop an Environmental Management Plan and cost estimates for the proposed project
- Hold consultations with the relevant stakeholders to ensure that their views concerning the project are included in the study.

f. **Project Description**

Construction of Ruiru sewers involves the construction and maintenance (during the defects liability period) of approximately **56.5 Km of sewer lines** of various sizes ranging from 225mm to 1200mm spigot and socket flexible jointed concrete pipes, construction of 1050mm to 1500mm manholes and other auxiliary works. The works also involve construction of **20,736 m$^3$/day** Waste Water Stabilization Pond sewerage treatment system at Ruiru at a cost estimate of KES 1,020,000,000.00 which is approximately USD 11,971,830.99

The works involve construction of trunk and tertiary sewers in Murera, Ruiru, Mugutha, Gitambaya, Membley, Peponi and the surrounding areas. The system will be connected to Ruiru Trunk Sewer that forms part of the scope. The system will empty the load to the newly constructed Ruiru Sewerage Treatment Plant.

Leaders meeting held in April 2012 and June 2012 confirmed availability of the site for the Treatment works, the meetings were convened by the District Physical Planner chaired by the District Commissioner for Ruiru District with representation of the Worship the Mayor Ruiru Municipality, area Member of Parliament, Public Health Officer for Ruiru District, NEMA officials, District Water Officer Ruiru AWSB and RUJWASCO representation, Githunguri Land Buying Company and Town Clerk Ruiru Municipality

g. **Policy and Legislative Framework**

The proposed project will be prepared within Kenyan legislation framework and the requirement of the World Bank Operation Policy 4.01 on Environmental
Assessment and Operation Policy 4.12 on Involuntary Resettlement (for which Compensation Note will be prepared)


Legal framework under which government acquires land for development of infrastructure for public good has been discussed under the new constitution, land Acquisition Act Cap 288 and Way leaves Act Cap 292


h. Potential Project Impacts

The following impacts were observed in the course of the study:

- Discharges of untreated sewage to the Ruiru River from various sources within Ruiru town.
- Active quarrying activities are ongoing at the proposed site therefore possible need for a Resettlement Action Plan preparation for persons who might lose livelihood due to the project, unless these persons can be relocated to adjacent quarry with no loss of livelihood or drop in welfare.
- Poor waste disposal infrastructure leading to environmental pollution and damage to health from wastewater from blocked sewers.

Potential Positive Impacts include

Short Term Potential Positive Impacts

- Boost to small businesses in the area during construction especially in the upcoming Juja Farm Shopping centre
- Creation of job opportunities during construction phase especially the unskilled labour from the region

Long Term Potential Positive Impacts

- Ruiru Municipality will ultimately benefit from sewerage infrastructure therefore boost to economic growth of the town
- There is significant positive impact to be gained through elimination of discharges of untreated sewage to the Ruiru River, and this (assuming suitable mitigation measures are incorporated) far outweighs any other negative impacts associated with the proposed development.
- The project will lead to the rehabilitation of the quarry sites and associated benefits
- The project will provide wastewater management infrastructure for Ruiru town. This will lead to environmental conservation and management as pollution from septic tank leakages will be eliminated.
- Provision of employment opportunities during both construction and operation phases of the project.
- The proposed project will centralize wastewater treatment system in the town which will make pollution monitoring easy.
- Step towards realizing Nairobi Metro vision 2030 as a central hub for business for the east and southern Africa region.
- Improved health of the people living within NMR
- Improved water quality in Nairobi River, Athi River, Ruiru River and Thiririka River.
- Improved aesthetic value of the area due to cleaning up of the mess that is currently experienced in Storm water drains in the towns.
- Sludge from the Waste Water Treatment Works (WWTW) is a rich resource that can be utilized by the community around as fertilizers provided proper purification is done.
- Plans are underway of conducting feasibility study on production of energy from the anaerobic ponds once the facility is commissioned.

**Potential Negative Environmental Impacts**

**Short Term Potential Negative Impacts**
- Water contaminations from effluents from construction machinery
- Influx of heavy trucks and machinery in the area
- Loss of vegetation through stripping of top vegetation
- Soil erosion and destabilization of soil structure by heavy machineries
- Atmospheric pollution by dust particles, noise and vibrations

- Risks of exposure to occupational Health and Safety issues

**Long-term Potential Negative Impacts**
- Possibility of continual river contamination by unsatisfactory treated effluents from the WWTW, broken sewer trunks and blocked manholes
- Possibility of Crocodile and Hippos infestation in the WWTW, this is because the technology that has been finally adopted will be the waste water stabilization ponds as opposed the earlier proposal of trickling filters.
- Nuisance from foul smell from hydrogen Sulphide gases and other gases
- Possibilities of habitation of the area by Marabou stock, cattle egret and Hadada ibis species of birds common in the tropics of Africa causing danger to flights in the area.
- Possibility of the local communities puncturing the trunks to use raw sewage for irrigation during dry spells.
- Mosquitoes breeding with the waste water bodies within the WWTW

i. **Mitigation Measures for Negative Environmental Impacts**
A competent and qualified contractor shall be picked through competitive bidding to undertake the work. Insurance against injury for the contractor’s workmen shall be a specific provision in the contract. The contractor shall therefore ensure that employees work in an environment devoid of any danger and that they are medically covered. The safety of the workers shall be taken care of as is provided for in the Occupational Health and Safety Act (OSHA) of 2007 to avoid accidents and injuries. This shall be done through:

- Ensuring that proper personnel protective equipment such as safety boots, helmet, goggles, ear muffs, and respiratory equipment and gloves are used at all times.
- Contractor and his agents shall use barriers and guards as necessary to protect employees from physical hazards. Danger warning signs shall be placed in strategic locations as necessary.
- More importantly, accidents shall be prevented by:
  - Ensuring that operational manuals are available and accessible for every machinery/equipment.
  - Only properly trained employees to be used to operate equipment or machinery and proper instructions in the safe operations of the machinery shall be provided.
  - There shall be provided and maintained so as to be readily accessible, a well stocked first aid kit of prescribed standard. This shall be placed under the charge of a responsible officer who shall be readily available during working hours.
  - In case of an accident/injury while on duty, the contractor shall ensure that the injured person receives adequate medical treatment in approved medical facility. Adequate compensation will be provided through insurance to the individual in case of incapacitation resulting from an accident or injuries sustained while on duty. This will however be subject to the provisions of the laws guiding workman compensation.
  - During the construction phase, the contractor shall put in place effective and efficient solid and liquid waste disposal systems. Waste, including excavated soil and debris shall be properly disposed of by backfilling and landscaping. The contractor shall provide acceptable and standard sanitary conveniences to the workers during construction period.
  - Capacity building and training of personnel with respect to environment, health and safety shall be observed. Personnel protective equipment as per health safety regulations and medical checkup of workers as is required by Occupational Health and Safety Act (OSHA) of 2007 shall be observed.
  - To reduce noise pollution, portable barriers to shield compressor and other small stationary equipment where necessary will have noise suppressor or silencers. Noise shield e.g. corrugated iron sheet structure to control noise propagation shall be provided. Workers will be sensitized on the need to switch off engines when not in use and all machinery will be well maintained through regular oiling.
- Proper servicing of machineries on site proper liquid waste collection system should be provided on site, stabilizing lagoons could be constructed to hold waste water before releasing into the river to avoid pollution of water resources.
- Murraming of access roads, maintenance and servicing of the all trunks to ensure efficient performance.
- Minimizing vegetation stripping to sites where civil works are to be conducted, re-vegetation of site after civil works with complete reinstatement of the site to better status
- Thorough vegetation of the sites after completion of the civil works, proper berming of loss areas with gabions and mesh to limit the quantity of top soil lost by runoff
- Regular wetting of the working area to control dust, provision of PPE to workers to avoid exposing them to gaseous pollutants
- Enlighten staff on the requirement of OSHA 2007 through arranging regular training sessions; provision of PPE to staff including fire fighting equipments on site.
- Regular inspection of the system to ensure performance is maintained at high levels and prompt repair of breakdowns
- Proper fencing of the facility, maintain the plant hygiene at high standards and consult involvement of KWS in the event wildlife is spotted in the area.
- Tapping 100% of methane gas and other gases generated from the facility-the gases could be used to generate electricity need to run the facility.
- Maintain high standard of hygiene in the facility, inlet works to the facility should be enclosed in a building and prompt disposal of solid wastes from the facility in proper sanitary landfill.
- Enlightening the communities of the dangers of using raw sewerage for irrigation through sensitization forums and regular inspection of the trunks and arresting and prosecution of culprits
- Regular fumigation of the pond and sedimentation tanks to kill mosquitoes and other crawling insects

j. Recommendations from the Environment Assessment
- The design should ensure comprehensive waste water treatment to allowable limits by NEMA and WHO standards and the World Bank Environmental Health and Safety Guidelines, before releasing into the river,
- Involvement of all relevant stakeholders is proposed throughout the process to ensure project acceptability
- Proper measures should be taken into account to ensure the compensation process is done properly according to the law and OP 4.12 on Involuntary Resettlement.
- All construction waste will be properly disposed off in a timely manner, the excavated material wherever possible will be used as raw material for a range of activities, such as road repair or construction, and for use as building material e.g. stones
- Provisional Budget of Kenya Shilling 5,000,000 should be included in the bidding documents to help in implementation mitigation measures proposed in the study.

Ruiru County Council, NEMA and District Public Health Office should ensure that all industries located in Ruiru have an effluent pre-treatment system.

The overall objective of constructing Ruiru Sewerage infrastructure is a Social Uplifting Project (SUP) according to NEMA Kenya Categorization and therefore recommended for implementation provided the mitigation measures indentified in the study for the potential negative impacts are properly addressed.
CHAPTER ONE
BACKGROUND INFORMATION

1.1 Introduction
Nairobi Metropolitan extends over 32000 square kilometres that depends on Nairobi City for employment and social amenities. This is spurred by rapid population growth around Kiambu, Thika, Murang’a Machakos and Kajiado, it will therefore difficult to separate development Nairobi city from the metropolitan region in terms of development and planning.


Nairobi Metropolitan area growth rate is estimated to be growing at an average 7.8% per annum creating a need for Integrated roads, bus and rail infrastructure for Metropolitan Area, Efficient Mass Transport System for Nairobi Metropolitan Area, Replacement of Slums with Affordable Low cost/rental Housing Provision of adequate Housing, Development and Enforcement of Planning and Zoning Regulations, Efficient Water Supply and Waste Management Infrastructure, Promotion, Development and Investment in Sufficient Public Utilities, Public Services and World Class Infrastructure for Transforming Nairobi Into a Global Competitive City for Investment and Tourism.

Legal requirements contained in the Environmental Management and Coordination Act, EMCA 1999 Environmental (Impact Assessment and Audit) Regulations 2003 and World Bank OP 4.01 requires that an EIA for the proposed project be carried out. This is in an effort to find out the likely negative impacts of the proposed development to the environment and resources thereof. This project covers a wide area, and it is important that all the potential environmental issues inconsistent with EMCA 1999 and World Bank OP 4.01-Environment Assessment are addressed before the project is implemented.

1.2 Project Information
The government of Kenya has requested help from the Bank to help with its urban transformation. As one project is not enough, it has asked for support for three Bank-financed projects, each addressing a different element of urban development. The first is the Kenya Municipal Program (KMP), approved in May 2010 and effective in June 2010. This program focuses on strengthening the essential institutions of urban management—budgeting, financial management, participatory
planning, project management, operations and maintenance, and good governance—in 15 of Kenya’s largest cities, while also financing investments in city-wide infrastructure.

The Kenya Informal Settlement Improvement Project (KISIP), the second of the programs, was approved in March 2011 and became effective in June 2011. It is working in the same 15 municipalities as the KMP, and financing strengthening of tenure security, participatory planning, and settlement infrastructure.

The KMP and KISIP are co-funded with the Agence Française Development and the Swedish International Development Cooperation Agency.

The third is the Nairobi Metropolitan Services Improvement Project (NaMSIP), which is estimated to start in 2012. This will finance investments in infrastructure and service delivery in Kenya’s largest and most economically important urban conurbation (accounting for some 17 percent of the country’s population and about 50 percent of its GDP). Together, the three programs will comprehensively address core issues that are constraining the development potential, efficiency, equity, and competitiveness of Kenya’s urban areas.

In addition, the NaMSIP will create synergies with the Bank’s National Urban Transport Improvement Project (NUTIP) currently under preparation by improving access to transport hubs and integrating land use planning into transport and overall urban planning, especially around commuter rail stations.

1.3 Project Justification

1.3.1 Implementation of Nairobi Sewerage Master Plan.

Peri urban boundaries of Nairobi is constantly growing at a projected population of 350,000 people in 1989 to 1.4 million people in 2020, this poses a major challenge to the Local Authority and the Central Government due to unavailability of sewerage system in the area

The present sewerage network most of the built up areas of the city, Ruiru, Juja and Thika regions which are in the Northern Part of the city, the areas are partially sewered with the sewer system available for Kenyatta University, Jomo Kenyatta University of Science and Technology, the other areas are entirely on Septic tanks, conservancy tanks and pit latrines.

The report indicates that, to meet the envisaged development for Nairobi and its environs, there will be need to provide sewerage services through construction of own local sewerage treatment systems or by employing privately owned, on site.

The master plan proposes development of Ruiru II Sewerage Treatment Works are the area downstream the confluence of Ruiru River (Master plan), validation exercise carried out in December 2011 indicates that the proposed sewer system can drain Ruiru and Juja townships.

1.3.2 Nairobi Metropolitan Development Strategy
The rising population in the NMR is an indicator of regional development through the purchasing power. NMR is strategically located as a getaway to east and central Africa region as well as positioning in the Northern corridor to Cape Town which provides markets to the region, NRM are characterised by extreme pressure on base resources including water resources, land and services including transportation, solid waste management, water supply, street lighting, sewerage infrastructure, housing and development of social amenities. The goals of Nairobi Metropolitan Development Strategy to be achieved by implementation the project will include: the Key Result Area four with an overall goal of enhancing the quality of life in the region through eradicating poverty and rising the income levels, provision of opportunities and services for the the community to realise economic and social progress (in this context construction of proper sewerage infrastructure) and provision of clean safe and living environment to the people living within NMR.

The project is therefore referred to as categorized as Socially Uplifting Project (SUP) to the persons living with the NRM of Ruiru and Juja who currently depend on septic tanks and pit latrines

1.3.4 Millennium Development Goal 7: Ensuring Environmental Sustainability

Government of Kenya is also committed to realization of the Millennium Development Goals (MDG) more specifically Part 1 water and Sanitation Services with the target of halving by 2015 the proportion of people without sustainable access to safe drinking water and sanitation services”. Access to safe water is currently estimated at 89.7% in urban areas and 43.5% in rural areas, or a national average of about 57%. In addition, about 81% of the population has access to safe sanitary means, with 94.8% in urban areas and 76.6% in the rural areas. However, access to safe water supply and sanitation varies greatly from region to region and with considerable disparities within regions.

The interventions adopted from the Millennium Project Model include (a) water supply access through household connections, public stand posts, boreholes with hand pumps, rainwater collection (roof catchments), and protected dug wells; and (b) sanitation access through conventional sewerage, septic tank, pour flush toilet, ventilated improved pit latrine, and improved pit latrine.

Implementation of Ruiru sewerage System is a major milestone towards attaining the Millennium Development Goal number 7 on environmental sustainability target 7c which intends to half the proportion to population without safe basic water and sanitation services.

1.3.5 Need for sewerage infrastructure for growing population in NMR
Ruiru municipality population is projected to rise to 237,417 by 2015 with a growth rate of an average of 7.8% per annum, from the study it was established that the area has no proper sewerage infrastructure for the region hence there is an urgent need of setting up an offsite treatment facility to handle the waste generated by the population.

With the rapid increase in the population of Ruiru town due to the increase in Rural-Urban migration, and the subdivision of ranches surrounding the town into small units, there is need for provision of adequate infrastructural facilities to take care of wastes generated within the town.

Ruiru is a dormitory town for the nation's capital, and is connected to the capital city by both rail and road. According to 2009 census, Ruiru had a population of 174,877 and is projected to rise to 237,413 by 2015, the town has struggled to adapt to the influx of people and modernizing its sewerage system is of paramount importance.

1.4 Objectives of the EIA study

The objective of the EIA study was to carry out a systematic examination of the present environmental situation within the project area to determine whether the proposed project will have adverse environmental impacts to the surrounding area. The study included collection and analysis of environmental baseline data, identification of impacts (both positive and negative) analyses and evaluation of impacts, formulation of mitigation measures for significant negative impacts, analysis of project alternatives and development of environmental management and monitoring plans. Specifically, the study aimed at achieving the following specific objectives:

- To determine the compatibility of the proposed development with the neighbouring land uses.
- To identify and evaluate the significant environmental impacts of the proposed project with special emphasis on:
- To assess and analyze the environmental costs and benefits associated with the proposed project
- To evaluate and select the best project alternative from the various options available
- To incorporate environmental management plans and monitoring mechanisms during implementation, operation and decommissioning phases of the project
- To incorporate stakeholder consultations into the environmental management process.

1.5 Study Scope

The study has been conducted to evaluate the potential and foreseeable impacts of the proposed sewerage project. The physical scope is limited to the proposed site and the immediate environment as may be affected by or may affect the proposed
project. Any potential impacts, (localized or extended) are also evaluated as guided by EMCA 1999, Environmental (Impact assessment and Audit) Regulations 2003 and World Bank OP 4.01- Environmental Assessment. This report includes an assessment of impacts of the proposed site and its environs with reference to the following:

- A review of policy, legal and administrative framework
- Description of the proposed project.
- Review of the baseline information.
- Assessment of the potential environmental impacts.
- Proposition of project alternatives including no project option.
- Development of mitigative measures.
- Public Consultations
- Environmental Management and Monitoring plan for project construction and implementation

-
CHAPTER TWO
PROJECT DESCRIPTION

2.0 Project Activities and Budget

Construction of Ruiru sewers involves the construction and maintenance (during the defects liability period) of approximately 56.5 Km of sewer lines of various sizes ranging from 225mm to 1200mm spigot and socket flexible jointed concrete pipes, construction of 1050mm to 1500mm manholes and other auxiliary works. The works also involve construction of 20,736 m$^3$/day Waste Water Stabilization Pond sewerage treatment system at Ruiru at a cost estimate of KE 1,020,000,000.00 which is approximately USD 11,971,830.99

The works involve construction of trunk and tertiary sewers in Murera, Ruiru, Mugutha, Gitambaya, Membley, Peponi and the surrounding areas. The system will be connected to Ruiru Trunk Sewer that forms part of the scope. The system will empty the load to the newly constructed Ruiru Sewerage Treatment Plant. GPS coordinates of the proposed project site are (280254E 986992N). The site is relatively an ideal site for setting up a treatment facility as the land was set aside in the 90s by Ruiru Municipal Council for construction of Sewerage system for Ruiru town. The land was originally 75 acres but due to encroachment, the land has reduced to 25 acres.

Leaders meeting held in April 2012 and June 2012 confirmed availability of the site for the Treatment works, the meetings were convened by the District Physical Planner chaired by the District Commissioner for Ruiru District with representation of the Worship the Mayor Ruiru Municipality, area Member of Parliament, Public Health Officer for Ruiru District, NEMA officials, District Water Officer Ruiru AWSB and RUJWASCO representation, Githunguri Land Buying Company and Town Clerk Ruiru Municipality.

2.1 Location of the project

The project is located within Ruiru town in Thika District of Kenya’s Central Province. Located within three kilometers of Nairobi’s city boundary, Ruiru is a dormitory town for the nation's capital, and is connected by both rail and road to the Capital City. The town covers an area of 292 km$^2$, and is surrounded by numerous coffee plantations. According to 2009 census, Ruiru had a population of 174, 877 and is project to rise to 237,413 by 2015.
Ruiru Municipality is located on the 0.5°N Latitude and 37°E Longitude lines. The town stands on the Nairobi-Thika highway, which is a section of A2 Nairobi-Addis Ababa trunk road. It is situated 16 km North-East of Nairobi town and it borders Nairobi City. The Ruiru Municipality covers 292 square kilometers. The major roads crossing through the town are Nairobi-Thika highway, Kenyatta highway joining Kiambu Municipality and Ruiru Municipality and Kwa Maiko road joining Ruiru and Githunguri.

Ruiru Municipality is accessible by both railway and National trunk roads and has a fertile hinterland. Its location nationally plays a significant role as a satellite town of Nairobi linking the Northern parts of Kenya with the City through Thika road and the Nairobi-Ruiru railway line.

The Municipality of Ruiru is administratively divided into four sub-locations namely Kiuu, Theta, Mugutha and Ruiru and further divided into five wards namely Githurai, Kahawa Sukari, Gitothua, Murera and Biashara.

The study area generally is the area bounded by Theta River to the North, Kamiti River to the South, the entire Ruiru town CBD and Ruiru East settled area.

2.3 Climate

The climate of Ruiru can be characterized as Tropical climate. Due to its location on the slopes of the Aberdare Range, the climate and temperatures within the project area are influenced by altitude; with cooler coffee-zone areas located North of Thika Road, while the more arid zones are located to the south.

Rainfall is bimodal with long rains occurring from March to June, and the short rains from October to December. The mean annual rainfall averages between 600mm-1100mm per annum and falls in two maxims i.e. Short rains from October to December and Long rains from March to May. The temperature is generally high, the mean annual temperature averaging between 18°C-20°C. The mean annual potential for evaporation ranges between 1550-2200mm.

2.4 Topography

Located on the extreme south-eastern fringes of the Aberdare Range within the Athi River drainage area, the project area is characterized by relatively gentle terrain with a general fall towards Athi River. However, the higher areas to the North West of Thika Road are characterized by deeply dissected topography with numerous streams and ridges, while the south eastern parts are lowlands with fewer streams, shallower and wider valleys. The average altitude is about 1520 m above mean sea level. The highest elevation in the project area is 1550m.a.s.l and is located around the Ruiru Prison and
Training School while the lowest elevation is 1500m.a.s.l around the proposed Sewage Treatment Works site.

Ruiru town is located on the transitional zone of the Upper Athi basin and the Kikuyu dissected plateau. The land is generally undulating with a general drainage pattern towards the Athi River basin. Ruiru River divides the township into two parts. To the North-West the town's topography is generally steep and dissected by Mukuyu and Ruiru rivers. However, these areas offer good locations for farming and also housing developments. The area between the CBD and Majengo estate is trough shaped and liable to floods during heavy rains. The area south of Nairobi-Thika road is generally flat and offers a good location for industrial development.

### 2.5 Soils and Geology

The geology of Ruiru Municipality comprises of tertiary volcanic rocks, the most important being what is termed as Nairobi Stone. The Nairobi stone is a tertiary volcanic rock used extensively for building purposes. Soils resulting from tertiary volcanic rocks are dark reddish brown, well drained, friable and very calcareous.

The soils in the study area are derived from volcanic rocks that gradually occur on levels between 1200 to 2000m.a.s.l. The general nature of the soil ranges from shallow to red friable clays. In geological terms, these are youthful soils formed after removal of black clays by erosion process. However there are patches of black cotton soils. Thus apart from the areas with black cotton soils, the other areas have soils with high safe-bearing capacity, which can support foundations at even shallow depths. The soils also support shrub vegetation and hence the area is zoned as medium potential and favorable for urban development.

### 2.6 Demographic Information

Ruiru has a population of 174, 877 and is projected to rise to 237,413 by 2015, this is according to the 2009 census data, table 2-1 below shows current population of Ruiru and projections to 2030.
### Table 2-1 Population Projection of Ruiru

<table>
<thead>
<tr>
<th>Name of Location</th>
<th>Growth Rate % p.a.</th>
<th>Name of sub-location</th>
<th>Type</th>
<th>1,999</th>
<th>Current 2005</th>
<th>Initial 2010</th>
<th>2,015</th>
<th>Future 2020</th>
<th>2,025</th>
<th>Ultimate 2030</th>
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<tr>
<td></td>
<td>2021 to 2030</td>
<td>2011 to 2020</td>
<td>1999 to 2010</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kalimoni</td>
<td>3.9</td>
<td>4.4</td>
<td>4.9</td>
<td>Rural</td>
<td>17,744</td>
<td>23,643</td>
<td>30,032</td>
<td>37,246</td>
<td>46,194</td>
<td>55,933</td>
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<td>Kiora</td>
<td>6.8</td>
<td>7.3</td>
<td>7.8</td>
<td>Urban</td>
<td>19,049</td>
<td>29,894</td>
<td>43,519</td>
<td>61,898</td>
<td>88,039</td>
<td>122,330</td>
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<td>Komo</td>
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<td>7.3</td>
<td>7.8</td>
<td>Urban</td>
<td>4,246</td>
<td>6,663</td>
<td>9,700</td>
<td>13,797</td>
<td>19,624</td>
<td>27,267</td>
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<td>41,039</td>
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<td>83,251</td>
<td>112,941</td>
<td>153,857</td>
<td>205,529</td>
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<td>Kiuu</td>
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<td>7.3</td>
<td>7.8</td>
<td>Urban</td>
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<td>22,656</td>
<td>32,982</td>
<td>46,912</td>
<td>66,724</td>
<td>92,712</td>
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<tr>
<td>Mugutha</td>
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<td>4.4</td>
<td>4.9</td>
<td>Rural</td>
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<td>20,252</td>
<td>25,724</td>
<td>31,904</td>
<td>39,569</td>
<td>47,910</td>
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<td>Ruiru</td>
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<td>7.3</td>
<td>7.8</td>
<td>Urban</td>
<td>11,608</td>
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<td>26,519</td>
<td>37,719</td>
<td>53,649</td>
<td>74,545</td>
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<tr>
<td>Theta</td>
<td>3.9</td>
<td>4.4</td>
<td>4.9</td>
<td>Rural</td>
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<td>5,038</td>
<td>6,399</td>
<td>7,937</td>
<td>9,843</td>
<td>11,918</td>
</tr>
<tr>
<td>Ruiru</td>
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<td></td>
<td></td>
<td></td>
<td>45,025</td>
<td>66,163</td>
<td>91,626</td>
<td>124,472</td>
<td>169,785</td>
<td>227,086</td>
</tr>
<tr>
<td>Total for Ruiru</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>86,064</td>
<td>126,364</td>
<td>174,877</td>
<td>237,413</td>
<td>323,642</td>
<td>432,615</td>
</tr>
</tbody>
</table>
2.7 **Water Supply**

Ruiru town which has a resident population of about 110,000 people is served by water from the nearby Ruiru River through the recently constructed gravity Water Supply System by Athi Water Services Board under the Water Services and Sanitation Improvement Programme. Water from the source undergoes full treatment before supply. The Athi Water Services Board has licensed the Ruiru-Juja Water and Sanitation Company (RUJWASCO) to operate and maintain the water supply and sanitation facilities within the region.

Ruiru gets its water from surface and sub-surface/underground water sources. These include rivers Ruiru, Theta, Gatharaini and Kamiti. Three agents namely the Ministry of Water and Irrigation (MWI) through Athi Water Services Board, Nairobi City Council facilities now owned by Athi Water Services Board after enactment of Water Act 2002 and private borehole operators supply Ruiru Municipality with water. Within parts of the old Municipal boundaries, the Athi Water Services Board through Ruiru-Juja Water and Sanitation Company is the major supplier.

Athi Water Services Board through Support of the World Bank under Water and Sanitation Services Improvement Program has constructed a gravity water system to supply Ruiru Town with approximately 13000 cubic meters of water per day and Juja town 4000 cubic meters of water per.

However, there is a poor reticulation network and in some places it is not metered. At other places, there are water points for commercial services. Biashara ward where the Central Business District (CBD) is located gets its supply from the Ruiru-Juja Water and Sanitation Company connections and private boreholes, one is in the town center and the other at Gitambaya, accounting for 89.9% while 8.2% rely on water vendors and 2% on river water.

In addition to the private boreholes, wells and rainwater harvesting as well as rivers and dams are other sources of water. The Ruiru-Juja Water and Sanitation Company provides water to parts of Githurai and Kahawa. Worth noting are the numerous privately owned earth dams especially near coffee estates that are used for irrigating the coffee farms in dry seasons.

2.8 **Waste Water Management**

Waste water management involves the mechanism of handling all waste water products in the Town. In Ruiru, the disposal of domestic waste water is done through the sewer, septic tanks, cesspools, pit latrines, bucket latrines and in bushes. There is widespread use of septic tanks as a method of disposing domestic waste water in the CBD and in some individual households.
Ruiru Municipality does not have water borne sewerage system, has no waste water treatment plant nor does it have a proper waste disposal site. At present the modes of waste/sewage disposal in the area is through pit latrines, septic tanks and compost pits among others. The rapid population growth and migration to the area has caused tremendous expansion of the town requiring the provision of adequate sewerage services.

Adequate storm water drainage systems are lacking leading to flooding in some areas. Mitigating efforts by government and municipal council include public awareness and participatory approach towards improving sanitary conditions of the town and the environment. There are a total of 11 septic tanks in Ruiru which were constructed in 1968 by Ruiru County Council.

Biashara ward is only served by 3 septic tanks of inadequate capacity, located within Kangangi council estate, Majengo estate and the market. There are reported cases of overflowing septic tanks and pit latrines observed in high density areas. Private Service providers are the sole providers of exhauster services though the Ruiru Water and Sanitation Company has launched initiatives of licensing them, through Athi Water Services Board under Water and Sanitation Services Improvement Programme Ruiru Water and Sanitation Company has acquired a 8tonne exhauster truck.

### 2.9 Solid Waste Management

The management of solid waste in Ruiru Municipality is the responsibility of the Municipal Council of Ruiru. However, the private sector has been increasingly involved in refuse collection and disposal for example companies like Bins Nairobi Limited. Youth groups have also taken an initiative to collect waste. Most industries have their own waste and disposal structures e.g. Bogani Industries.

The Municipal Council does not have a large enough and easy to access disposal site and thus solid waste disposal is poorly organized and poor handling techniques are utilized. Solid waste is dumped in an abandoned quarry in Murera ward. The Municipal Council of Ruiru has got only two trucks and one tractor for solid waste collection and this is inadequate considering the size of the municipality and the population.

### 2.10 Energy Sources

Only about 43% (from the questionnaires interpretation) of households use electricity for lighting. Most people especially in Kahawa Sukari area have financed their own electricity networks. However, most areas like Gitohua are poorly supplied with electricity. Githurai Kimbo and the CBD are well supplied with power because of their proximity to the City of Nairobi and thus there is provision of street lighting.
2.11 Site Description

2.11.1 Existing sewerage and sanitation facilities

The town has an existing sewerage collection network and treatment system that utilizes septic tanks. The town’s several medium sized industrial processing factories have their own waste treatment systems. As an example, the firm of Spinners and Spinners utilizes the Ion exchange method to remove color in their dyeing waste prior to disposal and the firm of Devki Steel Mills applies oil separators to remove oily waste from their waste.

The main sources of waste water in Ruiru town include residential areas, industrial zones, market place and the commercial CBD. The waste generation rate varies with time during the day. From the desk study, it was realized that the volume of waste water also vary with the rainy seasons.

The following was observed about the town with regards to collection and conveyance of sewage:

- In the CBD, grey water was collected in open channels that drained to the gardens and the storm water drainage system. It was also observed that blockages in the existing sewerage system caused an influx of the black water into the open channels.

- In the residential areas along the Ruiru-Githunguri-Uplands Road, all the waste water is collected and conveyed via closed circular sewer lines. This is then conveyed to the septic tank located adjacent to the residential estate. This system serves the Police station and other facilities close to it.

- Along the Ruiru-Kiambu Road, it was observed that the area had a number of industries, old, new and upcoming residential estates, as well as the Ruiru town’s market. Some of the old housing estates, Majengo and MoPW staff quarters, had waste water collection systems that were suspected to have stalled, and the newer estates had no system in place.

- Along the Thika Dual Carriage way, no sewage collection and conveyance system is in place for the time being, due possibly to the fact that the area is sparsely populated.
Plate 2.1: An open Channel designed for collection and conveyance of storm and grey water but also conveys black water due to sewer blockages (Ecosite)

Plate 2.2: Unhygienic stagnant grey water in the new developments along Ruiru-Kiambu Road (Ecosite)

2.11.2 Existing sewerage and sanitation facilities

The only form of sewage treatment in the town is the septic tanks that can be found mainly in the CBD area and its environs. The following septic tanks were noted during the site visit.

- Septic Tank at the Ruiru Stadium: - This handles waste mainly from the CBD and is strategically located next to the Ruiru Stadium, behind the main bus stop, where most of the shops are located.
- Septic Tank along Ruiru-Githunguri-Uplands Road: - The entire sewage collected in the region west of the town and bound by the Mukuyu River is treated by this septic tank.
- Septic Tank along Ruiru-Thika Road: - This is used for treatment of the waste waters from the northern part of the Township where the land slopes towards the Ruiru River. It is located in a manner that all the waste produced by the commercial and residential units bound by the Ruiru-Githunguri-Uplands Road and the road out of the town to the Thika Road is collected into it.
2.11.3 Waste Water Disposal
Most of the waste water from the town is disposed of in to the Ruiru River, with little or no treatment. Current information on water quality is provided in chapter 3 on baseline information.

Plate 3.5: Septic Tank along Ruiru-Githunguri-Uplands Road (Ecosite)

Sites of the proposed sewage treatment works and the sewerage infrastructure are under the management of Ruiru Municipality.

2.12 Baseline Water Quality Information: Ruiru River
On December 15th, 2011, water samples from Ruiru River were collected and analyzed for microbial and physical – chemical load which was compared to the required water quality standards in the rivers by Water Resources Management Authority (WRMA).

The sample results indicate high levels of microbial and chemical load beyond the required threshold due to the current state of poor waste disposal in Ruiru Municipality, necessitating immediate interventions to address the problem.

Table 2-2: Summary of the results of Ruiru River.

<table>
<thead>
<tr>
<th></th>
<th>Status</th>
<th>Required threshold KEBS</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. Coli</td>
<td>$14 \times 10^4$</td>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>26.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>6.7</td>
<td>6.5-8.5</td>
<td></td>
</tr>
<tr>
<td>Conductivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOD</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COD</td>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy Metals</td>
<td></td>
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</tr>
</tbody>
</table>
Sampling results of bacteriological and Physical Chemical analysis of water samples from Ruiru River are provided separately as annexes.
CHAPTER THREE
PROJECT ALTERNATIVES

3.1 Site Selection

The best site for setting up of Waste Water Treatment Works would be a site that allows waste water to flow freely by gravity from the urban areas to the treatment facility. Site identification was based on previous studies done for waste water management for the Ruiru and Juja. The studies include designs prepared by Wanjohi Consulting Engineers in association with Ecosite Development Consultants 2009 and Nairobi Sewerage Master Plan of 1998.

3.1.1 Site A: Ruiru Municipal Council Site (Proposed Site)

Field visits were conducted in November 2011 to the proposed site GPS coordinate (280254E 986992N). The site is relatively an ideal site for setting up a treatment facility as the land was set aside in the 90s by Ruiru Municipal Council for construction of Sewerage system for Ruiru town. The land was originally 75 acres but due to encroachment, the land has reduced to 25 acres.

The land currently is an active quarry where building blocks are mined by individual entrepreneurship with authority of the Ruiru Municipal council.

The site is considered ideal for setting up a treatment plant for that Serves Ruiru municipality, some of the benefits of putting up the treatment works at the point will be

- No cases of land acquisition as the land belong to Ruiru Municipal Council and was set aside for the facility. (though the quarry workers may need to be compensated unless they can find equivalent employment opportunities at the neighbouring quarry site)

- No pumping will be required as the Sewer will flow by gravity from Ruiru town to the treatment works hence saving on energy required for pumping.

* proposed site by Ruiru Municipal Council now an active quarry and a Water fall on Ruiru River adjacent to the site*
4.1.2 Site B: Gikomari Sub Location Juja Farm (Proposed Site)

The site was identified as the most appropriate site for developing the WWTW for combined Ruiru and Juja Municipalities, the site is located 7km after the confluence of Ruiru and Thiririka River before the rivers merge with Nairobi River at GPS coordinates $1^011'11.06"S$ and $37^005'40.298"E$ at an elevation of 1438m HAE.

The site was considered ideal in order to serve both municipalities for the following reasons,

a. The area is the specifically indicated in the Nairobi Sewerage Master plan as an appropriate site for construction of Ruiru II WWTW (Master plan)

b. The elevation allows for ease of drain of both Ruiru and Juja Townships

c. The area is non settled therefore no resettlement will be encountered

From the above analysis, the site B becomes the most probable ideal site for setting up of a WWTW to serve Ruiru and Juja Townships.

*Proposed site in Gikomari Sub Location 3km after the confluence of Ruiru and Thiririka River*

However, given the high cost of extending the trunk sewers out to the location, and given the lifetime of a WWTW is estimated at 20 years, and the population growth will necessitating the use of this site will not occur for the next ten years, it was decided for cost reasons to focus on site A at present. Therefore, from the analysis it is recommended that site A was the most appropriate site for developing a treatment plant for Ruiru Municipality, for future development, site B will be ideal for draining both Ruiru and Juja Municipalities. It is recommended that the proposed site B be fenced off to avoid encroachment necessitating compensation at a later date, and that the community be informed that no compensation will be paid to any encroachers after a cut-off date is established.
3.2 Technology Design Analysis – Technical Project Alternatives

3.2.1 Option 1 – Conventional Wastewater Treatment (Trickling Filters)

The first option entails the use of the following facilities and techniques for the waste water treatment process;

a. Fine and coarse screens for removal of large solid particles. This will be provided so as to remove from the sewage gross solids, such as rags, timbers, maize cobs, etc. This will ensure that blockages or damage to the subsequent pipes and treatment processes do not occur. A 100mm clear opening coarse screen will precede a 25mm clear opening fine screen. So as to reduce the costs of construction, operation and maintenance, hand raked (manually operated) screens will be provided placed at an angle of $45^0$ from the horizontal.

b. The waste will then pass through a grit chamber where mineral matter will be removed by the process of settlement of heavier particles due to the reduction of the flow velocity hence increment of the settling velocities of the heavier particles. Grit removal is vital in that it ensures that reduced wear on machineries and attrition of pipeline linings, it facilitates sludge treatment and handling, and also prevents excessive accumulations of grit in tanks, pipework and channels.

c. Primary sedimentation will be applied so as to effect reduction of the organic load to the facility by removal of sludge (sludge is the one responsible for the high levels of organic loading in the sewage) by a similar process as for the grit removal.

d. Once removed, the sludge will be processed by using anaerobic sludge digesters and open-air sludge drying beds. Here, pumping might be necessary.

e. The remaining effluent from the primary sedimentation will be passed through a trickling filter unit.

f. The effluent of the trickling filters will be directed to a humus (secondary sedimentation).

g. Due to the stringent environmental management standards that are becoming tighter day after day, a constructed wetland is proposed as a final waste treatment for this alternative.

h. The technology is highly mechanical, therefore the client should ensure the availability of spare parts for machinery installed, availability of the software in the market for computerized system and adequate regular training of the operator.

This option can achieve the highest removal of pollutants in the waste stream compared with the other options and requiring the lowest land requirements. The possibility of generating electricity through the capture of methane could lead to revenue from carbon credits and sale of electricity to the grid. This option will be explored.

3.2.2 Option 2 – Waste Stabilization Ponds

The second option entails the use of the following facilities and techniques for the waste treatment process;
a. Fine and coarse screens for removal of large solid particles. This will be provided so as to remove from the sewage gross solids, such as rags, timbers, maize cobs, etc. This will ensure that blockages or damage to the subsequent pipes and treatment processes do not occur. A 100mm clear opening coarse screen will precede a 25mm clear opening fine screen. So as to reduce the costs of construction, operation and maintenance, hand raked (manually operated) screens will be provided placed at an angle of $45^0$ from the horizontal.

b. The effluent of the screening process will be emptied into a waste stabilization ponds system. This will consist of anaerobic ponds, facultative ponds and maturation ponds.

c. Due to the stringent environmental management standards that are becoming tighter day after day, additional polishing ponds are proposed as final waste treatment technique. These are proposed due to their cost effectiveness as compared to the other options.

d. The design of the system should ensure that the ponds are well accommodated buy limited available land available at the Githunguri Ranch, this can achieved by laying the ponds in a horizontal position with Ruiru River and ensuring that the inlet to the works faces the wind direction which blows from the nearby Kilimambogo mountain.

This option is highly cost effective in term of construction, operation and maintenance costs. If well designed, at the prevailing environmental conditions in the project area, this can be a very effective system in pathogen removal.

It is limited by the land requirements which tend to be more compared with the conventional system but lesser compared to the constructed wetlands options. Therefore due to land requirement the above option is not feasible in the project area

3.2.3 Option 3 – Constructed Wetlands
The third option entails the use of constructed wetlands to treat the waste water after preliminary screening and grit removal. This comprises of:-

a. Screening to remove the large solid materials;

b. Grit removal by use of a horizontal flow grit chamber;

c. Subjecting the effluent of the pre-treatment process to a free water surface (FWS) system of constructed wetland, where the flow of water is above the ground, and plants are rooted in the sediment layer at the base of water column. This option is highly preferred since it is eco-friendly and can remove a number of pollutants including organic materials, suspended solids, nutrients, pathogens,
heavy metals and other toxic or hazardous pollutants. Different types of this system can be used effectively to treat primary, secondary or tertiary sewage. This option is a practical alternative to the conventional treatment of sewerage but not to the waste stabilization ponds.

This option is disadvantaged in that it requires a very big space of land for the treatment process. This option also requires thorough operation and maintenance activities therefore making the operation costs very expensive. The capacity of the wetlands to treat wastewater is limited, both in terms of the quantity of water, and the total quantity of the pollutants. Also, the chemical and biological processes occur at a rate highly dependent on environmental factors, including temperature, oxygen and pH. A slight change in the above parameters greatly affects the treatment process.

### 3.2.4 Option 4 - Septic tanks

A septic tank, the key component of a septic system, is a small scale sewage treatment system common in areas with no connection to main sewage pipes provided by private corporations or local governments. A septic tank generally consists of tanks between the size of 1,000 and 2,000 gallons (4000 - 7500 litres) which is connected to an inlet wastewater pipe at one end and a septic drain field at the other. These pipe connections are generally made via a T pipe which allows liquid entry and egress without disturbing any crust on the surface. Today the design of the tank usually incorporates two chambers (each of which is equipped with a manhole cover) which are separated by means of a dividing wall which has openings located about midway between the floor and roof of the tank.

This proposal will involve individual plot owners constructing standard septic tanks for liquid waste management. They will then be making subsequent arrangements with RUJWASCO to be draining the septic tanks periodically. This proposal will entail RUJWASCO setting up a monitoring system to ensure that prompt draining of the tanks is carried out.

Apart from the financial implications of this alternative, there are a number of environmental and operational problems that militate against this alternative. Operational problems associated with septic system include the following among others:

a. Excessive dumping of cooking oils and grease can fill up the upper portion of the septic tank and can cause the inlet drains to block. Oils and grease are often difficult to degrade and can cause odor problems and difficulties with the periodic emptying.

b. Flushing non-biodegradable products such as sanitary towels, cloth, plastic bags / paper, polythene materials, wood, and cotton buds may rapidly fill or clog a septic tank
c. Excessive water entering the system will overload it and cause it to fail.

d. Even well maintained septic tanks release mucus-producing anaerobic gut bacteria to the drainage field. The mucus "slime" will slowly clog the soil pores surrounding the drain pipe and percolation can slow to the point where backups or surfacing effluent can occur. This slime is called biomat and such a failure is referred to as "Biomat failure".

e. Trees in the vicinity of a concrete septic tank have the potential to penetrate the tank as the system ages and the concrete begins to develop cracks and small leaks. Tree roots can cause serious flow problems due to plugging and blockage of drain pipes, but the trees themselves tend to grow extremely vigorously due to the continuous influx of nutrients into the septic system.

Apart from the above mentioned operational problems associated with a septic tank, there are several environmental problems that result from the use of this wastewater treatment technology. Some pollutants, especially sulfates, under the anaerobic conditions of septic tanks, are reduced to hydrogen sulfide, a pungent and toxic gas. Likewise, nitrates and organic nitrogen compounds are reduced to ammonia. Because of the anaerobic conditions, fermentation processes take place, which ultimately generate carbon dioxide and methane. The fermentation processes cause the contents of a septic tank to be anoxic with a low redox potential, which keeps phosphate in a soluble and thus mobilized form. Because phosphate can be the limiting nutrient for plant growth in many ecosystems, the discharge from a septic tank into the environment can trigger prolific plant growth including algal blooms which can also include blooms of potentially toxic cyanobacteria.

Soil capacity to retain phosphorus is large compared with the load through a normal residential septic tank. An exception occurs when septic drain fields are located in sandy or coarser soils on property adjoining a water body. Because of limited particle surface area, these soils can become saturated with phosphate. Phosphate will progress beyond the treatment area, posing a threat of eutrophication to surface waters. In areas with high population density, groundwater pollution levels often exceed acceptable limits. This is a likely scenario if this technology is to be pursued.

### 3.3 Final Effluents Disposal Methods

#### 3.3.1 Effluent disposal

Among the existing options for the final waste disposal after treatment, the most economical, environmentally and financially sound option is the disposal of the final
effluent from the treatment works to the Ruiru River. This is the most cost effective method of disposing of the waste as opposed to ground water recharge or irrigation. An outfall trunk sewer will be used to dispose the effluent to the river at a point away from domestic and livestock water abstraction points. However, the treated water will have a low BOD which will be further reduced through the process of dilution.

3.3.2 Sludge disposal
The treated and dried sludge may be disposed of by using it to fertilize lands in the nearby coffee and tea estates. Composting of the sludge will be an appropriate way of adding nutrient value to the sludge prior to use in the agricultural activity. Green solid waste, i.e. organic waste from plants like food left-overs and throw-aways, can be very good materials for blending the fertilizer.

3.4 No project alternatives
Under the “No Project” alternative, the proposed project shall not be constructed. This would mean that the negative impacts associated with poor wastewater management within Ruiru and Juja Municipality will continue. This alternative would also mean that the resultant socio-economic benefits that would accrue from the proposed development would be foregone. Looked at from the point of view of the benefits that are likely to accrue to the general public in terms of revenue and taxes to the Central Government and Local government, and employment opportunities to the local people, this alternative is not recommended.

3.5 Comparison of Alternatives
From the above discussion, four alternative technologies have been considered and their relative merits discussed. The technologies include Conventional Wastewater Treatment; Waste Stabilization Ponds; Constructed Wetlands; Septic tanks and the “No project” alternatives. Based on the various disadvantages of other options that has been discussed above, both conventional Waste Water Treatment Plant and Waste Water Stabilization Ponds are ideal for the proposed Ruiru Sewerage System, the client should ensure that the cost of setting up each technology is cost effective as analyzed in the feasibility Study report Prepared for the Project by Athi Water Services Board in December 2011.
CHAPTER FOUR
POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

4.1 Introduction
The management of domestic waste is dealt with under several laws, By-laws, regulations and Acts of parliament, as well as policy documents and it is not possible to bring all those statutes under one heading. This section is therefore aimed at assessing the existing policies and legislative framework, economic tools and enforcement mechanisms for the management of solid waste at different stages. In so doing, the discussion will be based on the following legislations:

4.2 Existing Laws and Acts of Parliament

4.2.1 Environmental Management and Co-ordination Act, 1999
According to the Environmental Management and Co-ordination Act (EMCA, 1999, Second Schedule Part XII) and subsequent Environmental (Impact and Audit) Regulations, 2003, it is mandatory to get environmental clearance for certain development projects. Among these projects are;

Waste disposal projects including:
   a) Sites for solid wastes disposal;
   b) Sites for hazardous waste disposal;
   c) Sewage works disposal
   d) Works involving major atmospheric emissions
   e) Works emitting offensive odours

The proposed project therefore falls in the category of those that require clearance from NEMA before development.

Relevance to the proposed project

Section 3 – Entitlement to Clean and Healthy Environment
The Sewer Project shall be entitled to maintain a clean and healthy environment and has a duty to safeguard and enhance environmental management in accordance with sub-sections 1, 2, 3, 4, and 5.

Section 50 – Biological Diversity
The proposed Sewer project shall ensure that at the operation phases, conservation of biological diversity shall be observed as prescribed in (a) to (g) of this section

Section 78 – Air quality
The proponent shall enforce air quality standards and be maintained as per NEMA’s Standard and Enforcement Review Committee requirements.

Section 87 – Handling and Disposal of Wastes
The proponent shall adhere to the disposal of wastes requirement in such a manner as not to cause pollution to the environment or ill health.

4.2.2 Water Act, 2002
This Act prohibits the pollution of water. Part II, section 3 states:” Every water resource is hereby vested in the State subject to any rights of user granted by or under this Act or any other written law. Under Section 5, the right to the use of water from any water resource is vested in the minister for the time being in charge of water resources except to the extent that it is alienated by or under the Act or any other written law. Consequently, a water permit must be obtained before using any water resource.

Relevance to the proposed project
Water is significant to the general operation of the proposed project. The construction would mean that more water would be needed for various activities. Management of this resource is therefore significant for the success of operations of the project. Pollution of water in the adjacent stream should also be avoided.

4.2.3 The Public Health Act (Cap 242)
The Public Health Act is the principle instrument for ensuring the health and safety of the people. Its core function is the prevention of disease, treatment and care of the sick (curative services) and control of nuisance. The Act therefore makes regulations and lays standards for a healthy living environment. Part XI Section 129 of the Act places the responsibility of protecting water supplies on the local authorities.

The Ministry of Health is in charge of administration of the Act with the Director of medical services as the Principal Officer. However, where a municipality is capable of discharging responsibilities under the Act, such a municipality is designated as a local health authority in such a situation the relevant powers under the Act are delegated to the municipality but the Director of Medical Services may take over if the Authority is in default.

Relevance to the proposed project
Section 115- During construction, a nuisance is prohibited especially for all conditions liable to be injurious or dangerous to health.
Section 118- Outlines nuisance liable to be dealt with i.e. accumulation or deposit of refuse, offal, manure or any other which is offensive or injurious or dangerous to health and an accumulation of stone, timber or other machine likely to harbor rats or rodents.
Section 126 rule 62 – Drainage & latrine rules- It is a statutory requirement that drainage, latrines, septic and conservancy tanks and any other pre-treatment methods of sewerage effluents seek written permission or/and approval from the local authority and be built in conformity to provisions of sub-rules (a) to (e) of this section.
Sections 136 – 143 Breeding places of mosquitoes-The civil and building contractors will ensure that during construction, breeding places of mosquitoes and nuisance yards are kept free from bottles, whole or broken. The project area shall not be overgrown by grass, the wells etc to be covered together with the less pits. The gutters may be perforated; larva destroyed to eradicate mosquitoes completely as mere presence of mosquito larvae is an offence.

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

4.2.4 The Physical Planning Act, 1996
The Act provides for the preparation and implementation of physical development plans and other related purposes. Its provisions apply to all parts of the country except those areas as the Minister may specify. Thus the Act directs, regulates and harmonizes development and use of land over the country. In addition, the Act provides a vital link with the Environment Management and Co-ordination Act. For example, Section 36 of the Act states that” In connection with a development application a local authority is of the opinion that proposals for industrial location, dumping sites, sewerage treatment, quarries or any other development activity will have injurious impact on the environment, the applicant will be required to submit together with the application an environmental impact assessment report”. This reinforces EIA requirements under EMCA (1999).

The Act creates the office of the Director of Physical Planning who is an appointee of the Public Service Commission. The Director is the chief advisor to the government on all matters relating to the physical planning and in addition performs such functions as are conferred upon him by or under the Act. However the Director at his discretion may delegate in writing any of his functions without diverting himself of such functions.

Under the act the director is assigned the responsibility of preparation of development plans. However, the control of development is vested in the respective local authorities. In the preparation of development plans, the act provides for the participation of the communities affected by such plans.

The Act establishes Physical Planning Liaison Committee at four levels namely; National, City of Nairobi, District and Municipality. The National Physical Planning Committee has the role of determining appeals lodged by aggrieved parties resolving matters referred to it and generally advising the Minister. The other committees deal with complaints against the Directors, arbitration on claims, development applications and appeals by aggrieved parties against the Director or local authorities. The property
 owners therefore are accorded the right of appeal against adverse decisions of planning authorities.

**Relevance to the proposed project**

This Act provides for order in terms of development execution which each region,

### 4.2.5 Local Authority Act Chapter 265

**Section 160** helps local authorities ensure effective utilization of the sewages systems. It states in part that municipal authorities have powers to establish and maintain sanitary services for the removal and destruction of, or otherwise deal with kinds of refuse and effluent and where such service is established, compel its use by persons to whom the services is available.

However, to protect against illegal connections, section 173 states that any person who, without prior consent in writing from the council, erects a building on; excavate or opens-up; or injures or destroys a sewers, drains or pipes shall be guilty of an offence. Any demolitions and repairs thereof shall be carried out at the expense of the offender.

**Section 170**, allows the right to access to private property at all times by local authorities its officers and servants for purposes of inspection, maintenance and alteration or repairs of sewers.

To ensure sustainability in this regard, the local authority is empowered to make by laws in respect of all such matters as are necessary or desirable for maintenance of health, safety, and well being of the inhabitants of its area as provided for under Section 201 of the Act.

The Act under **section 176** gives powers to local authority to regulate sewage and drainage, fix charges for use of sewers and drains and require connecting premises to meet the related costs. According to section 174, any charges so collected shall be deemed to be charges for sanitary services and will be recoverable from the premise owner connected to the facility. Section 264 also requires that all charges due for sewage sanitary and refuse removal shall be recovered jointly and severally from the owner and occupier of the premises in respect of which the services were rendered. This in part allows for application of the “polluter-pays-principle”.

**Relevance to the Project**

The Act is relevant during the operation of the facility which will be a responsibility of RUJWASCO which took over the responsibility of the local Authorities after the enactment of Water Act 2002.

### 4.2.6 Occupational Health and Safety Act 2007

This legislation provides for protection of workers during construction and operation phases. It is tailored at implementation of the EHS plan in compliance with the relevant sections of this Act.
**Subsection 17** - Drainage of floors. Where any process is carried on which renders the floor liable to be wet to such an extent that the wet is capable of being removed by drainage, effective means shall be provided and maintained for draining off the wet.

**Subsection 18** - Sanitary conveniences - Sufficient and suitable sanitary conveniences for persons employed in the factory/work places shall be provided, maintained and kept clean, and effective provision shall be made for lighting the conveniences and where persons of both sexes are, such conveniences shall afford proper separate accommodation for persons of each sex.

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

a. Head and tailrace of every water wheel and of every water turbine shall be securely fenced.

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

**Subsection 22** - Transmission Machinery- Every part of transmission machinery shall be securely fenced unless it is in such a position or of such construction as to be safe to every person employed or working in the premises, as it would be if securely fenced.

a. Efficient devices or appliances shall be provided and maintained in every room or place where work is carried on by which the power can promptly be cut-off from transmission machinery in that room or place.

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

**Subsection 25** - Construction and maintenance of fencing

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

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

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

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

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

4.3 **Legal provision for involuntary land acquisition in Kenya**
The Kenyan law has an explicit provision for expropriation of land under any of the three categories as follows:

**4.3.1 Provisions under the Constitution:**

In Kenya, expropriation is provided for in the Constitution under section 75 for private land and sections 117 and 118 for unregistered Trust Land. Section 75(1) provides that the Government can take possession of private land if this is necessary in the interest of town planning among other public interests, or if the development and utilization of the said land is to promote public benefit:-

- The development and utilization of the property will promote public benefit among other things.
- The necessity for expropriation is great enough to justify any hardship caused to any persons
- Law for prompt payment of full compensation makes the provision

The constitution however only provides general guidelines, and detailed procedures for land acquisition are elaborated under the Land Acquisition Act in Chapter 295 for private land and Chapter 288 for unregistered Trust Lands

**4.3.2 Procedures under Chapter 295**

In approaching expropriation, a formal request from the Commissioner of Lands will be made by the benefiting authority, e.g. a municipal council in case of urban areas. Any other public body or Government may request for acquisition this way. The Commissioner will then forward the application to the Minister in charge of lands. If the minister is convinced that the land is required for public purpose, the Minister will write to the Commissioner to that effect, and directs the Commissioner to acquire the land (Section 6(1). The Commissioner will then give “Notice of Intention” to acquire the land (section 6(2) in the “Kenya Gazette” side by side with the “Notice of Inquiry”.
The public announcements will be made widely announced in standard mass communication avenues such as newspapers and on the radio.

The “Notice of Intention” must mention the public body or the public purpose for which the land is to be acquired. The “Notice of Inquiry” must mention places and fixed dates when persons interested in the subject land are to submit their claims to the Commissioner of Lands or his appointee (a “Valuation Officer” also known as “Collector of compensation”) according to Section 9. Meanwhile, the Collector of Compensation will inspect the said land and value it for compensation. After the inquiry the Collector will issue an award depending on his own assessment and the representations of interested parties as submitted at the inquiry (Section 10 and 11). The award is issued in the prescribed form indicating the amount of compensation awarded while the statement form gives the landowners option of acceptance or rejection of the award. If the landowner accepts the award, the collector will issue a cheque in settlement together with a formal “Notice of Taking Possession and Vesting” (section 19). The notice instructs the landowner to take his/her title for amendment or cancellation. It is copied to the Government Surveyor and the Land Registrar to make necessary changes to the affected deed. On the other hand, if the owner rejects the award, the collector deposits the money in court pending the former’s appeal. Privately owned property, would have to be compensated for at the market value. The general guiding principle is that whoever was using the land to be acquired would be provided alternative land of equal size and quality. An option for cash compensation in lieu of land may also be provided in case alternative land is not possible or not available. Replacement cost means replacement of assets with an amount sufficient to cover full cost of lost assets and related transaction costs. The cost is to be based on Market rate (commercial rate) according to Kenyan law for sale of land or property. Replacement cost for agricultural land implies the market value of land of equal productive potential or use located in the vicinity of the affected land, plus the costs of preparing the land to levels similar to those of the affected land; and any registration and transfer taxes.

4.3.3 Procedures for land Acquisition under Cap 288

Cap 288 allows for the expropriation of Trust Land on condition that:-The development and utilization of the property will promote public benefit among other things. The necessity for expropriation is great enough to justify any hardship caused to any persons Law for prompt payment of full compensation makes the provision. Procedures under Cap 288 start with a proposal to a Full Council Meeting where proposed acquisition is deliberated and consent given vide a Council Minute. The “District Commissioner” in charge of the affected area will then proceed to ascertain interests, determine areas and assess compensation for the land after which he is to issue an award.
Section 12 of Cap 295 allows for in-kind compensation as follows:- Notwithstanding anything contained in the Government Lands Act, where the land is acquired for the Government the Commissioner may agree with the person whom he has determined to be the proprietor of the land that that person, instead of receiving an award, shall receive a grant of land, not exceeding in value the amount of compensation which the Commissioner considers would have been awarded, and upon the conclusion of the agreement that person shall, subject to section 18, be deemed conclusively to have been awarded and to have received all the compensation to which he is entitled in respect of his interest. An agreement under subsection (1) shall be recorded in the award.

It should be noted that, other than the in-kind compensation allowed for under section 12 of Cap 295, GoK policies seem to favour compensation based on issue of cash awards and only payable to people determined to be proprietors of the land or tenants to the land. There is no other policy provision for Resettlement and rehabilitation under the GoK system. Therefore the principles of OP 4.12 are taken into account in design of the Resettlement and rehabilitation assistance.

Section 8.(1) of Cap 288 allows for compensation as follows:- Where land is set apart under section 7 of this Act, full compensation shall be promptly paid by the Government to any resident of the area of land set apart who under African customary law for the time being in force and applicable to the land has any right to occupy any part thereof; or is otherwise than in common with all other residents of the land, in some other way prejudicially affected by the setting apart.

A notice of setting apart published under section 7 of this Act shall also be published by displaying a copy at the District Commissioner's office and at some other public or conspicuous place in the area concerned.

Under section 9.(1), a person who claims to be entitled to compensation under section 8 of Cap 288 shall apply therefore to the District Commissioner once satisfied after consultation shall award the applicant a sum of compensation in accordance with subsection (3) of this section; and if he is not so satisfied the District Commissioner shall reject the application. The compensation to be awarded shall be assessed by the District Commissioner after consultation with the Divisional Board, and shall be assessed in respect of the loss of the right of occupation referred to in paragraph (a), or in respect of the applicant having been otherwise prejudicially affected as referred to in paragraph (b), of section 8 (1) of this Act. The District Commissioner shall give notice in writing to the applicant of the award or of the rejection of the application as the case may be.

4.3.4 Provisions of the Way-leaves Act (Cap 292):
Under Section 3 of this Act, the Government may carry any sewer, drain or pipeline into, through, over or under any lands whatsoever but may not in so doing interfere with any existing building. Under Section 4(1), the Government shall, at least one month before carrying any sewer, drain or pipeline into, through, over or under any private land without the consent of the owner of the land, give notice of the intended work, either by notice in the Gazette or in such other manner as the Minister may in any case direct. The notice shall describe the nature of the intended work and shall name a place where the plan of the intended work is open for inspection at all reasonable hours. A copy of the notice shall either be served on every person resident in Kenya whose place of residence is known and who is known or believed to be the owner of any private land through, over or under which it is intended that any sewer, drain or pipeline shall be carried, or shall be posted in a conspicuous position on that land.

Section 6(1) of this Act requires the Government to make good all damage done, and shall pay compensation to the owner of any tree or crops destroyed or damaged, in the execution of any power conferred by this Act. In the event of disagreement as to the amount of the compensation to be paid or as to the person entitled to receive compensation, any person interested may apply to the District Commissioner, who shall award to the person entitled to receive compensation such compensation as he thinks reasonable; and that award, subject to appeal to the Provincial Commissioner, shall be final.

4.3 Policies and other Planning Documents

4.3.1 The National Environmental Action Plan (NEAP) 1994

According to this plan, it's recognized that the development projects on the environment i.e. industrial, economic and social development programs that do not take care of environmental considerations in their operations are not sustainable. Under the NEAP process, EIA was introduced and among the key targets recognized were the industrialists, business community and local authorities.

4.3.2 The National Water Resources Management Policy (1999)

It enhances the systematic development of water resources for all the sectors in promotion of the country’s socio-economic development. It also recognizes the by-products of these developments as wastewater and therefore calls for development of appropriate sanitation systems to protect the people’s health and water resources from institutional pollution.

It is therefore imperative that these activities be accompanied by appropriate waste management plans. The policy also recommends that all such developments should
undergo comprehensive EIA that will provide measures to protect environment and people’s health in the neighborhood of the project including the downwind communities. As its predecessor, the EMCA (1999) calls for annual Environmental Audits (EA) to ensure continuous implementation of Environmental Management Plans (EMP) proposed in the EIA and any other recommendations and issues arising. The policy requires that those who pollute water bodies must pay the full cost of remediation of the contaminated water; in tandem with the “Polluter Pays Principle.”

4.3.3 Sessional Paper No. 6 (1999)

Policy guidelines on environment and development – the key policy objectives of this paper includes:

a. Ensuring that all development projects at the inception stage and programs, as well as policies consider environmental considerations.

b. Ensuring that an EIA report is prepared for any undertaking or development project before implementation.

c. Coming up with effluent treatment standards that will conform with acceptable health guidelines

d. It’s important to note that issues of waste water management and human settlements are given prominence and therefore, the policy recommends re-use and recycling of residues i.e. waste water, use of low waste generation technologies and increasing public awareness on benefits of a clean environment. It also recognizes the role of stakeholders in all these initiatives within their localities.

e. The paper encourages better planning in rural and urban areas in provision of needs i.e. water, drainage system, waste disposal facilities et al.

Such documents included the Seasonal Paper No. 1 of 1999 and Vision 2030.

4.3.4 National Policy on Water Resources Management and Development (Sessional Paper No. 1 of 1999)

The paper strive to restore order and prosperity in the water sector by ensuring sustainable water schemes while noting that the realization of this goal depends on the application of alternative management options and technologies that are participatory, rather than wholly recipient in nature.

Chapter two paragraphs 2.6 addresses water quality issues and aim at protecting the available water resources from pollution. The cardinal sources of such pollution according to the paragraph are land use practices which have been carried out in total disregard of the need to conserve the water resources.

Another threat to the water resources according to the policy document are other human activities. In this regard, though proudly, the solid waste management could be
considered as one of the land uses or human activities that could pose great danger to the available water resources if not well handled. In so viewing, the policy document provides for the consideration of an integrated approach in its actualization process.

4.3.5 Vision 2030

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

Under the Social Strategy, paragraph 5.4 of the strategy envisions Kenya becoming a nation that has a clean, secure and sustainable environment by 2030. So as to realize this strategy, the document explains that one of the specific strategies will be to improve pollution and waste management through the design and application of economic incentives, and the commissioning of public-private partnerships (PPPs) for improved efficiency in water and sanitation delivery.

4.4 World Bank Safeguards Triggered by the Project

4.4.1 Environmental Assessment OP 4.01

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

Operational Policy 4.01 further requires that the EA report must be disclosed as a separate and stand alone document by the Government of Kenya and the World Bank.

The disclosure should be both in Kenya where it can be accessed by the general public and local communities and at the InfoShop of the World Bank and the date for disclosure must precede the date for appraisal of the project.

The World Bank assigns a project to one of three project categories, as defined below:

- **Category “A” Projects**
  An EIA is always required for projects that are in this category. Impacts are expected to be ‘adverse, sensitive, irreversible and diverse with attributes such as pollutant discharges large enough to cause degradation of air, water, or soil; large-scale physical disturbance of the site or surroundings; extraction, consumption or conversion of
substantial amounts of forests and other natural resources; measurable modification of hydrological cycles; use of hazardous materials in more than incidental quantities; and involuntary displacement of people and other significant social disturbances.

- **Category “B” Projects**
  Although an EIA is not always required, some environmental analysis is necessary. Category B projects have impacts that are ‘less significant, not as sensitive, numerous, major or diverse. Few, if any, impacts are irreversible, and remedial measures can be more easily designed.’ Typical projects include rehabilitation, maintenance, or upgrades, rather than new construction.

- **Category “C” Projects**
  No EIA or other analysis is required. Category C projects result in negligible or minimal direct disturbance of the physical environment. Typical projects include education, family planning, health, and human resource development.

The Ruiru Sewerage project has been assigned a Category A.

**4.4.2 Involuntary Resettlement (OP 4.12)**

The objective of this policy to avoid where feasible, or minimize, exploring all viable alternative project designs, to avoid resettlement. This policy is triggered in situations involving involuntary taking of land and involuntary restrictions of access to legally designated parks and protected areas. The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts.

This policy covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by (a) the involuntary taking of land resulting in (i) relocation or loss of shelter; (ii) loss of assets or access to assets, or (iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or (b) the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

The policy prescribes compensation and other resettlement measures to achieve its objectives and requires that borrowers prepare adequate resettlement planning instruments prior to project appraisal of proposed projects. The objective of this policy to avoid where feasible, or minimize, exploring all viable alternative project designs, to avoid resettlement. The policy requires the displaced persons and their communities, and any host communities receiving them, are provided timely and relevant information, consulted on resettlement options, and offered opportunities to participate in planning, implementing, and monitoring resettlement. Appropriate and accessible grievance mechanisms are established for these groups. In new resettlement sites or host communities, infrastructure and public services are provided as necessary to improve, restore, or maintain accessibility and levels of service for the displaced persons and host communities.

This policy is triggered when a project activity causes the involuntary taking of land and other assets resulting in:
1) Relocation or loss of shelter,
2) Loss of assets or access to assets,
3) Loss of income sources or means of livelihood, whether or not the affected persons must move to another location,
4) Loss of land,

**4.4.5 Bank Operational Policy 4.11-Physical Cultural Resources**

The objective of this policy is to assist in preserving physical cultural resources (PCR) and avoiding their destruction or damage. PCR includes archaeological, paleontological, architecturally significant, and religious sites including graveyards, burial sites, and sites of unique natural value.

Initial indications are that no observed physical or cultural resources will be affected by the project. Nevertheless, the Contractor is responsible for familiarizing themselves with the following “Chance Finds Procedures”, in case culturally valuable materials are uncovered during excavation, including:

1. Stop work immediately following the discovery of any materials with possible archeological, historical, paleontological, or other cultural value, announce findings to project manager and notify relevant authorities;
2. Protect artifacts as well as possible using plastic covers, and implement measures to stabilize the area, if necessary, to properly protect artifacts
3. Prevent and penalize any unauthorized access to the artifacts
4. Restart construction works only upon the authorization of the relevant authorities.

All contracts should include a Chance Finds Procedure clause.
CHAPTER FIVE
ENVIRONMENTAL IMPACTS AND MANAGEMENT PLAN

5.1  EIA Methodology
The purpose of conducting the EIA study was to ensure that the proposed project is environmentally sound and fits well with the surrounding developments. The study therefore described and quantified the impacts of the proposed facility on the physical environment, and neighbouring populations. The assessors have proposed mitigation and compensatory measures for any negative impacts identified and have developed an environmental management and monitoring plan. In order to achieve the objectives of the EIA study, the following strategies were adopted:

- Qualitative assessments of the state of the environment in the project area
- Prediction and evaluation of positive and negative environmental impacts
- Identification of the mitigation measures for the adverse environmental impacts, and
- Formulation of an Environmental Management Plan
The EIA activities consisted of desk studies, fieldwork, interviews, and questionnaires among others leading to the preparation of this project report. Specifically, the following activities were undertaken during the study:

5.2  Literature review
A desk study to review the available reports, development plans and maps in order to compile relevant biophysical and socio-economic information about the study area was conducted. These pieces of information were obtained from libraries and project documents in the custody of the proponent and his consultants. Special emphasis was placed on the following:

- Climate, hydrology and soils
- Water quality and quantity
- National environmental laws and regulations
- Waste management infrastructure
- Pollution levels
- Human population and settlements
- Socioeconomic infrastructure

5.3  Field visits
Field visits were conducted in the study area in order to collect and evaluate site specific information on the biophysical and socio economic environment and to cross check the secondary data that were compiled during the desktop studies. In particular, the following issues among others were accorded special emphasis:

- The existing water supply infrastructure
- Waste management infrastructure within the area
- Existing land uses within the project vicinity
- The settlement trends

Environmental data were recorded and potential impacts identified

5.4 Description of the existing and anticipated impacts

5.4.1 Existing impacts.
Domestic waste water is disposed of through sewers that outfall into septic tanks or cesspools, and through pit latrines. There is widespread use of septic tanks as a method of disposing of domestic waste water in the CBD and in some individual households. There are several reported cases of overflowing septic tanks and pit latrines observed in high density areas. Private providers are the sole providers of exhauster services, though the Municipal Council does not license them. This is primarily because the council does not provide a dumping site for the waste. This means that the wastes exhausted are dumped in non-approved areas leading to pollution of water resources within the vicinity.

The municipality lacks a comprehensive storm water drainage system, leading to flooding in some areas. This provides breeding places for mosquitoes especially during the rainy season.

Most of the waste water from the town is disposed of in to the Ruiru River, with little or no treatment. This has led to significant pollution of this resource.

The quarrying activities at the proposed location of the treatment ponds have led to scarification of land leaving deep open gulleys. This has led to land degradation in the area.
A quarry site at the proposed location of the treatment ponds (Ecosite)

In the CBD, grey water is collected in open channels that drain into the gardens and the storm water drainage system. It was also observed that blockages in the existing sewerage system caused an influx of the black water into the open channels. This water finds its way into Ruiru River ultimately contaminating it.

Along the Ruiru-Kiambu Road, there are a number of industries, old, new and upcoming residential estates, as well as the Ruiru town’s market. Some of the old housing estates, Majengo and MoPW staff quarters, had waste water collection system that is suspected to have stalled, and the newer estates had no system in place. This has invariably led to pollution of the adjacent water bodies.

5.4.2 Anticipated impacts.
The anticipated impacts of the proposed project on the environmental elements are both positive and negative. The magnitude of each impact is described in terms of being significant, minor or permanent, short-term or long term, specific (localized) or widespread, reversible or irreversible. The assessment criteria for the significant impacts are as shown in the table below:

<table>
<thead>
<tr>
<th>Key</th>
<th>Type of impact</th>
<th>Key</th>
<th>Type of impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>++</td>
<td>Major positive impact.</td>
<td>+</td>
<td>Minor positive impact.</td>
</tr>
<tr>
<td>- -</td>
<td>Major negative impact</td>
<td>-</td>
<td>Minor negative impact.</td>
</tr>
</tbody>
</table>

Table 5.1: Assessment criteria for significant impacts
On the basis of information gathered during both the desktop and field study, the potential environmental impacts of the proposed project are as tabulated below.

**Table 5.2: Potential Environmental Impacts**

<table>
<thead>
<tr>
<th>Impacts on Or due to</th>
<th>Constructio n</th>
<th>Occupation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise Pollution</td>
<td>-</td>
<td>0</td>
<td>• During construction, hooting of construction vehicles and communication from workers may generate noise and vibration that may have negative effect to the neighborhood. This will however be very minimal and will be restricted to the construction stage of the project.</td>
</tr>
</tbody>
</table>
| Oil waste pollution | -             | -          | • Petroleum oils and grease used in vehicles and construction machinery may spill or leak on/into the ground hence into the soil or water system within the neighbourhood
• Oil waste will not be a major issue during operation phase of the project. |
| Air/Dust Pollution  | -T, R         | -          | • During construction, dust and exhaust emission from the construction activities and machinery, may Pollute the ambient air. |
| Soil erosion        | -T            | 0          | • Earth works during project construction usually influence soil erosion. By incorporating appropriate soil conservation measures and proper drainage facilities both during construction and operation phases of the |
5.5 Potential Positive Impacts

There are a number of positive benefits associated with the proposed project. They include the following:

- There is significant positive impact to be gained through elimination of discharges of untreated sewage to the Ruiru River, and this (assuming suitable mitigation measures are incorporated) far outweighs any other negative impacts associated with the proposed development.
- The project will lead to the rehabilitation of the quarry sites and associated benefits.
- The project will provide wastewater management infrastructure for Ruiru town. This will lead to environmental conservation and management as pollution from septic tank leakages will be eliminated.
- Provision of employment opportunities during both construction and operation phases of the project.
- The proposed project will centralize the town’s wastewater treatment and will make pollution monitoring easy and more effective.
- Step towards realizing Nairobi Metro vision 2030 as a central hub for business for the east and southern Africa. This will be achieved due to the fact that potential investors will develop the region as they will be guaranteed of good infrastructure of sewer disposal.
- Improved health of the people- Reduced cases of respiratory and water borne diseases associated by poor sanitation due poor domestic waste water management.
- Improved water quality in Nairobi River, Athi River, Ruiru River and Thiririka River, downstream environment that depend on Athi River will be sustained
- Improved aesthetic value of the area of the area due to cleaning up of the mess that is currently experienced in Storm water drains in the towns.
- Creation of job opportunities during implementation phase for the plant operators
- Sludge from the WWTW is a rich resource that can be utilized by the community around as fertilizers, but RUJWASCO should put stringent measures to ensure that no effluents from industries are disposed into the sewer system before pretreatment.
Community sensitization and enlightenment is also needed to ensure that the communities accept use of human wastes as fertilizer.

5.6. Potential Negative environmental Impacts

5.6.1 Short term negative impacts
- Disruption of socio-economic activities in the area especially for the persons quarrying construction rock along the river riparian
- Water contaminations from effluents from construction machinery, contamination include oil leaks and fuel leaks
- Influx of heavy trucks and machinery in the area could cause nuisance, noise, dust and destruction of roads
- Loss of vegetation through stripping of top vegetation
- Soil erosion and destabilization of soil structure
- Atmospheric pollution by dust particles
- Increased noise and vibrations
- Influx of people in the area

5.6.8 Potential Negative Impacts

5.7.1 Long Term Impacts
- Possibility of continual river contamination by unsatisfactory treated effluents from the WWTW
- The proposed technology will involve construction of oxidation ponds, then chances of Hippos and crocodiles from Nairobi River are likely to infest the ponds and could cause a health risk to the people living round the plant and workers. The final design that has been approved for the project is for 20,736 m3/day waste water stabilization ponds, it therefore mean the works contract will have to include a comprehensible Bill of Quantity on fencing the facility and more important is to ensure that the facility operates optimally so as to avoid eutrophication of the receiving Ruiru River which attracts wildlife.
- Possibilities of foul smell from the WWTW is inevitable if improper technologies are adopted, for example tapping of Methane gas from BOD, odour could be a nuisance to the community living around the WWTW and operators running the facility
- Possibilities of habitation of the area by Marabou stock, cattle egret and Hadada ibis species of birds common in the tropics of Africa causing danger to flights in the area.
- Loss of livelihood for the individuals who work in the quarries at the proposed site.
- Possibility of river contamination by overflowing manholes blocked sewer trunks during operation phase, history of sewer puncturing to irrigate
- Possibility of underground contamination of ground water resources (aquifers) within the proposed site for WWTW
- Use of raw sewage to irrigate farmland along river basin where the trunks will be constructed, this has been experienced in Nairobi especially during dry seasons, and this poses a major health risk to downstream ecology and persons consuming vegetables irrigated by raw sewage.
- Possibility of mosquitoes breeding in the ponds and pools of waste water in the WWTW could be a health hazard to the persons living around the proposed site and operators in the plant.

5.7 Mitigation for Proposed Negative Impacts

5.7.2 Short-Term Impacts

a) Disruption of socio-economic activities in the area especially for the persons quarrying construction rock along the river riparian

**Mitigation**

Notices to be issued to the persons quarrying within the proposed riparian, the notices should be issued early enough to allow for adequate time to move. The impact to the persons is extremely because the persons are few and majority is quarrying away from the river. A Compensation note / Resettlement Action Plan to be prepared and the persons quarrying stone in the proposed site to be compensated adequately. Athi Water Services Board is in the final Stages of engaging a consultant who will undertake the preparation of Resettlement Action Plan

b) Water contaminations from effluents from construction machinery, contamination include oil leaks and fuel leaks

**Mitigation**

Proper servicing of machineries on site according to manufactures details, proper liquid waste collection system should be provided on site, stabilizing lagoons could be constructed to hold waste water before releasing into the river

c) Influx of heavy trucks and machinery in the area could cause nuisance, noise, dust and destruction of roads

**Mitigation**

Murraraming of access roads from Eastern Bypass road to the site. Regular wetting of the road to avoid dust nuisance, maintenance and servicing of the all trunks to ensure efficient performance.

d) Loss of vegetation through stripping of top vegetation

**Mitigation**

Minimizing vegetation stripping to sites where civil works are to be conducted, re-vegetation of site after civil works with complete reinstatement of the site to better status
e) Soil erosion and destabilization of soil structure
   **Mitigation**
   Thorough vegetation of the sites after completion of the civil works, proper berming of loss areas with gabions and mesh to limit the quantity of top soil lost by runoff

f) Atmospheric pollution by dust particles due to construction activities in the area
   **Mitigation**
   Regular wetting of the working area to control dust, provision of PPE to workers to avoid exposing them to gaseous pollutants

g) Risks of exposure to occupational Health and Safety issues.
   **Mitigation**
   Enlighten staff on the requirement of OSHA 2007 through arranging regular training sessions; provision of PPE to staff including fire fighting equipments on site.

   The contractor should appoint an Environment Liaison Person to work closely with an Environment Compliance Officer from the client side to ensure mitigation measures proposed in the report are strictly compliant to, regular Environmental Audit will also be required on a twice per year to ensure the mitigation measures proposed the Environment Management Plan are being followed.

5.7.3 **Long-term Impacts**
a. Possibility of continual river contamination by unsatisfactory treated effluents from the WWTW
   **Mitigation**
   Regular inspection of the system to ensure performance is maintained at high levels; Blockages should be detected and promptly replaced; Regular monitoring and sampling of the waste water at influent and effluent points as well as in the receiving water bodies

   The final design that has been approved for the project is for 20,736 m3/day waste water stabilization ponds. The risk of the ponds being inhabited by hippos and crocodile is inevitable. **Mitigation**
   Ensure that the plant operates optimally, and no eutrophication of Ruiru River downstream by partially treated waste water, nutrients saturation in the river downstream will attract the wild animals.
   The Plant if not properly fenced could attract wildlife like hyenas, wild dogs and rodents such as squirrels, crocodiles and Hippos; Proper fencing of the Plant to keep off wildlife is recommended;
   Maintaining high standards of hygiene at the site throughout the operation phase of the facility;
   Constant consultations with KWS in event that wildlife is spotted in the area
The plant should be properly fenced to avoid accessibility by the wild animals

b. Possibilities of foul smell from the WWTW is inevitable if improper technologies are adopted, for example tapping of Methane gas from BOD and Hydrogen Sulphide, odour could be a nuisance to the community living around the WWTW and operators running the facility

Mitigation
Tapping 100% of methane gas generated from the facility to generate electric, this will be tapped by covering the un-aerobic ponds with a polythelyne materials to tap the gases which will be eventually be purified and used to run electricity generators, hydrogen Sulphide HS$_2$ responsible for the foul smell will also be tapped.
The assessment proposes installation of windblown mixers or under water aerators in the facultative to increase oxygen circulation in the ponds
*Case Study: of A Conventional Anaerobic-Facultative-Maturation Lagoons Wastewater Treatment Plant in the City of Santa Cruz, Bolivia: AWSB team visit June 2010*

c. Possibilities of inhabitation of the area by Marabou stock, cattle egret and Hadada ibis. The birds could be a nuisance both to the community and charter plans flying in the area.

**Mitigation**
Maintain high standards of hygiene within the WWTW, experience from DESTW (current Dandora Estate Sewerage Treatment Works) indicate that bird are concentrated at the inlet works due to the solid wastes screened from the raw sewerage flowing to the treatment works.

The solid wastes should be promptly removed from site and disposed appropriately in a designated landfill.

d. Anticipated Loss of livelihood for communities whose quarry at the proposed site for the project.

**Mitigation**
Resettlement Action Plan for the persons who will loss sources of livelihood, AWSB is finalizing procurement of consultant to prepare a comprehensive RAP report for the PAPs quarrying at the proposed site in line with requirements of Involuntary Resettlement OP 4.12

e. Possibility of river contamination by overflowing manholes blocked sewer trunks during operation phase, history of sewer puncturing to irrigate

**Mitigation**
Regular inspection of the system to ensure performance is maintained at high levels; Blockages should be detected and promptly replaced; Regular monitoring and sampling of the waste water at influent and effluent points as well as in the receiving water bodies.

Communities living within the river basins where the trunk sewers will be constructed should be enlightened on dangers of using raw sewerage to irrigate farmlands.

Training secession should be organized by NEMA and AWSB through the supervising firm assigned to the project, the cost of the training should be included in the bidding documents under environmental restoration item to be included in the Preliminary and General
### Matrix 5-1 Planning and Pre – Construction Environmental Management

<table>
<thead>
<tr>
<th>Activity / Issue</th>
<th>Action required</th>
<th>Performance Indicator</th>
<th>Monitoring Parameters</th>
<th>Responsibility</th>
<th>Provisional Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Planning</td>
<td>a. Construction of Ruiru Sewerage must all relevant permits needed prior to constructions; these include NEMA, Ruiru County Council, WRMA, Public Health Department, Mine and Geology approvals among others.</td>
<td>a. relevant permits and licences issued (Environment licence, Noise Permit, Ruiru County Council Approval of Construction Plans, Work Permits for foreign Employees from Ministry of Immigration, Department of Occupational Health and Safety Approvals,)</td>
<td>a. Conflicts over land ownership</td>
<td>AWSB MoNMP RJWSCO Ruiru County Council</td>
<td>Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance</td>
</tr>
<tr>
<td>b. Traffic Control</td>
<td>b. Construction activities are likely to increase the traffic of heavy trucks and machineries in the area,</td>
<td>b. Number of accidents reported due to unsecured / fenced working area</td>
<td></td>
<td></td>
<td>KES 5,000,000</td>
</tr>
<tr>
<td>c. Appointment of project team</td>
<td>c. Proper measures should be put in place to control the traffic in the area.</td>
<td>c. Number of occasions where Civil works is stopped because of lack of a legal permit.</td>
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<td></td>
<td>d. Proper access roads to be put in place in the region to de-congest the existing roads.</td>
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<td></td>
<td>e. AWSB must appoint an independent Environmental Control Officer (ECO) who must monitor the contractor’s compliance with the environmental</td>
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<td></td>
<td></td>
<td>KES 5,000,000</td>
</tr>
<tr>
<td>Environmental Impact Assessment Report</td>
<td>Ruiru Sewerage System</td>
<td>Athi Water Services Board</td>
<td>Chapter 5: Environmental Impacts and Mitigation Measures</td>
<td></td>
<td></td>
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<td>----------------------------------------</td>
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<td>-----------------------------------------------</td>
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<tr>
<td>management plan throughout the</td>
<td>g. credible</td>
<td>AWSB MoNMP RJWSCO</td>
<td>Budget to be determined during preparation of</td>
<td></td>
<td></td>
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<tr>
<td>construction period</td>
<td>contractor and consultant procured</td>
<td>Ruiru County Council</td>
<td>RAP report.</td>
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<td>f. Appointment of competent consultants</td>
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<td>to supervise the construction works</td>
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<tr>
<td><em>Loss of livelihoods for persons who</em></td>
<td>a. Intensively engage the persons through consultative forums as specified in OP 4.12 on involuntary resettlement</td>
<td></td>
<td></td>
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<tr>
<td><em>derive income from the quarry at the</em></td>
<td>b. Prepare a compensation note / Resettlement Action Plan Report</td>
<td></td>
<td></td>
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<tr>
<td><em>proposed site.</em></td>
<td>c. Implement the Settlement Action Plan Report before start of civil works</td>
<td></td>
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<tr>
<td></td>
<td>a. Persons deriving livelihood from the quarry adequately compensated</td>
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<tr>
<td></td>
<td>b. Persons deriving livelihood from the quarry successful assisted to relocate to other public quarries nearby.</td>
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</tr>
<tr>
<td></td>
<td>a. Grievance redress mechanisms documents</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>b. Post Resettlement Audit report</td>
<td></td>
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</tbody>
</table>
### Method Statement

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>The contractor should submit a method statement of how he intends to undertake key assignments on the project which has an impact on the environment. The activities include:</td>
</tr>
<tr>
<td>i.</td>
<td>Concrete pre-cast and batching operation (if applicable)</td>
</tr>
<tr>
<td>ii.</td>
<td>Storage facilities for any hazardous substances</td>
</tr>
<tr>
<td>iii.</td>
<td>Emergency procedures</td>
</tr>
<tr>
<td>iv.</td>
<td>Site establishment</td>
</tr>
<tr>
<td>v.</td>
<td>Removal and clearing of vegetation</td>
</tr>
<tr>
<td>vi.</td>
<td>Materials, equipment and staffing requirements (camp establishment)</td>
</tr>
<tr>
<td>vii.</td>
<td>Transporting the materials and/or equipment to, from and within the site</td>
</tr>
<tr>
<td>viii.</td>
<td>The storage provisions for the materials and/or equipment</td>
</tr>
<tr>
<td>ix.</td>
<td>The proposed rehabilitation procedure designed to implement the relevant Environmental Specifications</td>
</tr>
</tbody>
</table>

### Existing Services and Infrastructure

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>The location of existing services should be determined to prevent accidental damage to and or duplication of these. The services</td>
</tr>
</tbody>
</table>

### a. Inception Report

- **Report / Method statement report prepared**
- **Environment licence conditions in cooperation in the method statement before civil works begin**

### a. Chapters / sections in the inception Report / Method statement report addressing environment compliance requirements

### b. Compliance Environment audits conducted to ascertain compliance to the EMP & Environment licence

### Preliminary and General Item of the Bills of Quantity should have

| ITEM – Environment Compliance KES | 5,000,000 |

### Contractor, Supervising Consultant, ECO

### Records of essential services relocated, rerouted and plans on how relocations will

| Contractor Supervising Consultant ECO |   |

### Budget of relocation of services included in the
### Site Boundaries
The contractor should fence or demarcate the site boundaries prior commencement of civil works. Access to the site should be restricted to ensure that members of the public are not able to gain access other than via the designated, controlled access points.

**Activities**
- No trespass through the site
- No cases of missing items / machineries reported

**Responsible Parties**
- Site record book
- Site record book

**Budget**
- Contractors bid price

### Site Layout
Specific areas should be set-aside within the site for various types of activities. The location of the contractor’s camp, toilet facilities and storage areas should be agreed to prior to the commencement of work at the site and should be agreed in conjunction with the ECO, Engineer and Contractor. These should all be kept in good condition throughout the project to prevent environmental degradation.

**Activities**
- Site plans in place and mobilisation in accordance with the approved plans

**Responsible Parties**
- Contractors bid price

**Best management practices – cost within the contract bid price**

### Working Hour
Normal working hours apply as laid out in the Kenya legislation. These should be agreed prior to the start of the project and should be in line with Kenyan labour laws.

**Activities**
- Works concluded with required working hours 8am to 6pm.

**Responsible Parties**
- Contractors bid price

**Records of complaints from workers, neighbours and all interested stakeholders.**

**Best management practices – cost within the contract bid price**
### Matrix 5-2 Construction Environmental Management Plan

<table>
<thead>
<tr>
<th>Activity / Issue</th>
<th>Action required</th>
<th>Performance Indicator</th>
<th>Monitoring Requirements</th>
<th>Responsibility</th>
<th>Provisional Budget KES</th>
</tr>
</thead>
</table>
| Site establishment | a. The land ownership of the proposed site must be addressed and proper documentation secured.  
b. The area must be properly demarcated prior to establishment. The camp must be properly fenced off during construction phase to prevent public access.  
c. Civil works for Ruiru Sewerage will be restricted within the riparian of Ruiru, Theta, Thiririka Rivers and road reserves and storm water drainage for Ruiru Municipality  
d. The site for setting up of the sewer Project is already set aside by Ruiru County Council, | a. Availability of land ownership documents  
b. Approved program of works for site establishment  
c. A signed contract for construction of the civil works  
l. All required permits available, (Environment licence, Noise Permit, Ruiru County Council Approval of Construction Plans, Work Permits for foreign Employees from Ministry of Immigration, Department of Occupational Health | d. Conflicts over land ownership  
e. Number of accidents reported due to unsecured / fenced working area  
f. Number of occasions where Civil works is stopped because of lack of a legal permit. | AWSB, RJWSCO MoNMP | Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000 |
### Environmental Impacts and Mitigation Measures

<table>
<thead>
<tr>
<th>g. The working width of the construction area must be clearly demarcated by the installation of coloured pegs prior to construction.</th>
<th>and Safety Approvals,</th>
<th>h. A general project board must be erected at the site entrance.</th>
<th>No Accidents reported during the construction period</th>
</tr>
</thead>
</table>

### General: wastes from construction Activities

<table>
<thead>
<tr>
<th>a. All solid waste will be collected at a central location at each site and will be stored temporarily until removal to an appropriately permitted disposal site in the vicinity of the site.</th>
<th>a. Hygiene standards of the construction site.</th>
<th>Records and documentation of waste disposal recorded at on a weekly by the Contractors Environment Liaison Person</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>b. No dumping within the surrounding area is to be permitted. Where potentially hazardous substances are being disposed of, a chain of custody document should be kept with the environmental register as proof of final disposal.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>b. Waste generated at the site should be categorised by the contractor and disposed of in a suitable manner into different waste streams (including general and hazardous waste). Wherever possible recycling should be carried out</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>b. Litter generated by the construction crew must be collected in rubbish bins and disposed of weekly at registered waste disposal sites</th>
</tr>
</thead>
</table>

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**Chapter 5 - 64**
### Environmental Impacts and Mitigation Measures

#### 1. Waste Water from construction activities

- **a.** The contractor shall ensure that any wastewater generated during construction of the Sewer Trunks is properly collected through drains and stabilized in lagoons before safe disposal to the river.
- **b.** No untreated waste water should be released into the river and environment before pre-treatment.
- **c.** Storm water should be managed in such a way that no overland flow is possible onto the site from any adjacent area. Storm water drains in the area should be routinely inspected by the environmental officer for solid waste to avoid blockages and associated problems.

#### 2. Fire prevention and control

- **a.** The Contractor shall take all reasonable and precautionary steps to ensure that uncontrolled fires are not started as a consequence of his activities on site.

### Environmental Compliance

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Expected Status</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. status of hygiene of the working site in regards to waste water</td>
<td>a. zero reports of fire incidences on site</td>
<td>ECO Contractor Supervising Consultant</td>
</tr>
<tr>
<td>a. Reports on how waste water is managed at the site.</td>
<td>b. Presence of fire proper / relevant fighting equipment on site</td>
<td>Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000</td>
</tr>
<tr>
<td>b. Documented health related cases of workers who have suffered water borne diseases especially diarrhoea</td>
<td>b. Service schedules of fire parameter on site</td>
<td>Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000</td>
</tr>
<tr>
<td>a. Records of fire reported on site.</td>
<td>b. Service schedules of fire parameter on site.</td>
<td>Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000</td>
</tr>
<tr>
<td>a. zero reports of fire incidences on site</td>
<td>b. Presence of fire proper / relevant fighting equipment on site</td>
<td>Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000</td>
</tr>
</tbody>
</table>
### Chapter 5: Environmental Impacts and Mitigation Measures

<table>
<thead>
<tr>
<th>3. Soil Erosion Control, Vegetation Cover destruction</th>
<th>a. During Construction any construction materials should be screened or covered to prevent offsite movement (primarily windblown soil) and the surplus material should be removed from site to an approved disposal site</th>
<th>a. turbidity level of Ruiru river at the site of the works</th>
<th>a. Water quality analysis report conducted downstream Ruiru river</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b. Stripping of vegetation should be done as minimal as possible to avoid making the ground bare and susceptible to erosion.</td>
<td>b. Area striped of vegetation</td>
<td>b. Records of trees planted.</td>
</tr>
<tr>
<td>4. Dust Control</td>
<td>a. During construction of the Trunk Sewer</td>
<td>a. quality of air</td>
<td>a. Records of Contractor</td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>
### Air Pollution

<table>
<thead>
<tr>
<th>dust and sand may generate leading to (reduced visibility for vehicles travelling along adjacent roads).</th>
<th>within the site peripherals</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Mitigatory measures such as wetting down, as well as the erection of shade netting screens to prevent offsite movement of dust may also be required.</td>
<td>b. no complaints from neighbours, workers and government officials from relevant institutions (NEMA, Public Health.)</td>
</tr>
<tr>
<td>c. The use of straw stabilisation or mulching of exposed soil should also be considered.</td>
<td>c. Service schedules of machinery on site.</td>
</tr>
<tr>
<td>d. Diesel exhaust emissions from heavy machinery on site (excavators, front end loaders and hauling trucks) must be controlled and minimised by regular checks and servicing of vehicles. Any construction vehicle found to be emitting excessive smoke should be stopped from the operations for some mechanical attention before it could continue</td>
<td>a. Records of complaints from stakeholders</td>
</tr>
<tr>
<td>e. All areas disturbed during construction of the Trunk Sewers must be re-vegetated</td>
<td>b. Records of complaints from stakeholders</td>
</tr>
</tbody>
</table>

### Storm Water Management and Control

<table>
<thead>
<tr>
<th>a. Proper drainage channels should be constructed within the construction site. The channels control runoff from flooding in the area</th>
<th>a. Minimum or no flooding in the area</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Records of works done specifically to address storm water on site</td>
<td>a. Records of works done specifically to address storm water on site</td>
</tr>
<tr>
<td>Contractor Supervising Consultant ECO</td>
<td>Contractor Supervising Consultant ECO</td>
</tr>
<tr>
<td>Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000</td>
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</tr>
</tbody>
</table>
### 6. Machinery Management

| b. All vehicles, trucks, equipments and general plant equipment, must be maintained in good condition that prevents leakage and possible contamination of soil or groundwater, pollution of air by exhausts, noise and vibration beyond required decibels less than 90 decibels | a. Machinery working efficiently and no breakdowns | Machinery servicing schedules | Contractor | Best management practices – cost within the contract bid price |

### 7. Emergency Procedures

<table>
<thead>
<tr>
<th>a. The Contractor shall submit Method Statements covering the procedures and response plan for the main activities, which could generate emergency situations through accidents or neglect of responsibilities. These situations include, but are not limited to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. Accidental fires</td>
</tr>
<tr>
<td>ii. Accidental leaks and spillages</td>
</tr>
<tr>
<td>iii. Vehicle and plant accidents</td>
</tr>
<tr>
<td>iv. Blasting (if required)</td>
</tr>
<tr>
<td>b. Approved method statements / emergency plan by the engineer in place</td>
</tr>
<tr>
<td>b. An evaluation of how the emergency situation (if)</td>
</tr>
</tbody>
</table>

<p>| Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000 |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td><strong>Health and Safety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>a.</strong> The Contractor shall comply with all standard and legally required health and safety regulations as promulgated under the Occupational Health and Safety Act 2007 and associated regulations</td>
<td><strong>a.</strong> PPE on site for employees&lt;br&gt;<strong>b.</strong> Availability of well equipped first aid kit&lt;br&gt;<strong>c.</strong> staff trained on OSH</td>
<td><strong>a.</strong> State/condition of PPE provided to staff&lt;br&gt;<strong>b.</strong> Fire equipment servicing</td>
</tr>
<tr>
<td><strong>b.</strong> The contractor must provide and maintain personal protective equipment and facilities to employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>c.</strong> Official training in the correct fit, use, care,</td>
<td></td>
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</tr>
<tr>
<td><strong>e.</strong> The Contractor shall ensure that his employees are aware of the procedure for dealing with spills and leaks. The Contractor shall also ensure that the necessary materials and equipment for dealing with the spills and leaks are available on site at all time</td>
<td><strong>c.</strong> Availability of well equipped first aid kits on site&lt;br&gt;<strong>a.</strong> staff trained and aware of emergency procedures in place example(oil spill procedure, fire procedure) <strong>b.</strong> emergency procedures clearly displayed on walls within the site</td>
<td><strong>c.</strong> Number of emergency procedure displayed</td>
</tr>
<tr>
<td><strong>a.</strong> The Contractor shall assemble and clearly list the relevant emergency telephone contact numbers for staff and brief staff on the required procedures.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Section</td>
<td>Description</td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
</tbody>
</table>
| **9. Surface and ground water** | a. Machineries should be operated and maintained according to manufacturers guidelines, this is to avoid oil, lubricants and fuel leaks that might pollute water resources in the area.  
   b. Records / plans of surface drainage among the plans of the project.  
   c. Status of Surface and underground drainage.  
   d. Ensure that excavated and stockpiled soil material is stored and bermed on the higher lying areas.  
   e. Vegetation clearance must be kept to a minimum to reduce the risk of soil erosion.  
   f. Adequate provision must be made for sanitation for the construction workers. Septic tanks on site are to be emptied regularly. |
| **10. Noise and Vibrations** | a. Construction and the use of construction machinery should be limited between 0600hr and 1800hr on weekdays.  
   b. Service log for the machineries.  
   c. Recorded Compliance of noise incidence from the stakeholder.  
   d. The contractor should use modern equipment, which produces the least noise. The use of noise shielding screens should be used and the operation of such machines must be limited between 0600hr and 1800hr on weekdays.  
   e. The contractor should use modern equipment, which produces the least noise. The use of noise shielding screens should be used and the operation of such machines must be limited between 0600hr and 1800hr on weekdays.  
   f. The contractor should use modern equipment, which produces the least noise. The use of noise shielding screens should be used and the operation of such machines must be limited between 0600hr and 1800hr on weekdays.  
   g. Lack of complains from the community.  
   h. Relevant permits available (blasting) |

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>Action</th>
</tr>
</thead>
</table>
| Contractor | a. Plant Machinery Working efficiently  
   b. Status of Surface drainage  
   c. Records / plans of surface drainage among the plans of the project  
   d. Ensure that excavated and stockpiled soil material is stored and bermed on the higher lying areas.  
   e. Vegetation clearance must be kept to a minimum to reduce the risk of soil erosion.  
   f. Adequate provision must be made for sanitation for the construction workers. Septic tanks on site are to be emptied regularly.  
   g. Lack of complains from the community.  
   h. Relevant permits available (blasting) |
| Supervising Consultant | a. Recorded Compliance of noise incidence from the stakeholder  
   b. Relevant permits available (blasting) |
| ECO | a. Status of first Aid kit on site |

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machinery restricted to when it is actually require

c. Construction activities must abide by the national Noise regulations recently gazetted by NEMA
d. Prior to blasting (if required), the contractor must inform the adjacent landowners and local administration and obtain relevant permits from Mines and Geology Department

11. Blasting and Drilling (if any)

a. In the event that blasting or rock drilling is required, the following recommendations will be implemented.
i. The contractor shall take all necessary precautions to prevent damage to special features and the general environment, which includes the minimisation of, and if required, removals of any fly rock.
ii. Environmental damage caused by blasting/drilling shall be repaired at the contractor’s expense to the satisfaction of the ECO and RE

b. No blasting may be done on Sundays. Careful sealing off of the site and surrounding area will be carried out to ensure that all personnel are removed from the site and its immediate surrounds.
c. Adequate warning must be provided prior to all blasting to all site staff and permits from mines and geology)

ers

a. Lack of complains from neighbour community
b. Blasting permits from Mines and Geology Department

a. Recorded Compliant of noise incidences from the stakeholde rs

Contractor, Supervising Consultant ECO

Best management practices – cost within the contract bid price

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neighbours. All-clear signals must also be clearly given

<table>
<thead>
<tr>
<th>Chapter 5: Environmental Impacts and Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. General: Crime, safety and security</td>
</tr>
<tr>
<td>a. Ensure that only suitably qualified personnel use construction vehicles</td>
</tr>
<tr>
<td>b. Ensure that the contact details of the police or security company and ambulance services are available on site</td>
</tr>
<tr>
<td>c. Limit access to the construction crew camp to construction workers through access control</td>
</tr>
<tr>
<td>d. Ensure that the handling of equipment and materials is supervised and adequately instructed</td>
</tr>
<tr>
<td>e. Vehicular traffic during construction activities must be limited to a maximum speed limit of 30 km/hr.</td>
</tr>
<tr>
<td>f. Site notices informing the public of the planned activities must be placed at visible locations a few days prior to any blasting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13. Tree/Vegetation removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The working strip required for the construction of the Trunk Sewer must be effectively monitored to prevent excessive vegetation removal</td>
</tr>
<tr>
<td>b. Construction activities should be limited to dry season should construction occur in the</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>d. Health and safety awareness among staff;</td>
<td></td>
</tr>
<tr>
<td>e. Frequency of incidents/accidents and fatalities./security reported cases</td>
<td></td>
</tr>
<tr>
<td>Recorded Compliant incidences of security from the stakeholders</td>
<td></td>
</tr>
<tr>
<td>Contractor Supervising Consultant ECO</td>
<td></td>
</tr>
<tr>
<td>Best management practices – cost within the contract bid price phase</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Phase</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Presence of good balance between fauna and flora</td>
<td></td>
</tr>
<tr>
<td>a. Site inspection on a monthly</td>
<td></td>
</tr>
<tr>
<td>a. Water quality analysis report conducted downstream</td>
<td></td>
</tr>
<tr>
<td>Contractor Supervising Consultant ECO</td>
<td></td>
</tr>
<tr>
<td>Best management practices – cost within the contract bid price phase</td>
<td></td>
</tr>
<tr>
<td>14. Excavations and soil stockpiling</td>
<td>a. Topsoil and subsoil must be placed on opposite sides of the trench and must be kept separate throughout construction and rehabilitation</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>b. Topsoil must not be stockpiled for an extensive period (&gt; 3 months). This is to prevent the redundancy of the existing seed bank as well as the alteration of the soil characteristics (permeability, bulk density etc.)</td>
<td></td>
</tr>
<tr>
<td>c. Erect signs and/or danger tape around the exposed excavations to warn the public of the inherent dangers.</td>
<td></td>
</tr>
<tr>
<td>d. Trucks removing excavated material can cause compaction of soil if new pathways are created. Vehicles should, therefore, use existing roads. If the creation of new roads</td>
<td></td>
</tr>
<tr>
<td><strong>rainy season, the erection of berms may be in areas which have been stripped. These bermed areas must be monitored frequently for signs of erosion</strong></td>
<td>basis and reporting in the log book.</td>
</tr>
<tr>
<td><strong>c. Vegetation to be retained during the after completion of excavations</strong></td>
<td></td>
</tr>
<tr>
<td><strong>d. The topsoil cleared must be retained. The topsoil contains most of the inorganic matter, decomposed organisms and nutrients, thus the removal of the topsoil constitutes a major loss in terms of ecosystem function</strong></td>
<td></td>
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</tbody>
</table>
### Chapter 5: Environmental Impacts and Mitigation Measures

<table>
<thead>
<tr>
<th></th>
<th>is unavoidable, these temporary roads should be ripped and re-vegetated after use</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.</td>
<td>Ensure that excavated and stockpiled soil material is stored and bermed on the higher lying areas of the site and not in any storm water run-off channels or any other areas where it is likely to cause erosion or where water would naturally accumulate</td>
</tr>
<tr>
<td>f.</td>
<td>The areas where excavated soil will be stockpiled must be bordered by berms to prevent soil loss caused by rain.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15. Destruction/protection of heritage resource (if any)</th>
<th>a. Reported cases of archaeological material excavated</th>
</tr>
</thead>
<tbody>
<tr>
<td>g. Should any archaeological artefacts be exposed during excavation, work on the area where the artefacts were found, shall cease immediately and the ECO shall be notified as soon as possible, the ECO shall then notify the National Museums of Kenya for further action</td>
<td></td>
</tr>
<tr>
<td>b. Sensitive environments and natural features within and/or close to a site will be designated as ‘no-go’ areas and will not be interfered with during decommissioning of the plant</td>
<td></td>
</tr>
<tr>
<td>c. Any taxa, especially those of conservation concern (as per the ecological report) exposed during the closure of the site should be captured for later release or translocation to adjacent suitable habitat</td>
<td></td>
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</tbody>
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<table>
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</thead>
<tbody>
<tr>
<td>a. Final aesthetic</td>
<td>Records of contractor Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000</td>
</tr>
</tbody>
</table>
# Environmental Impact Assessment Report
## Ruiru Sewerage System
### Athi Water Services Board

## Chapter 5: Environmental Impacts and Mitigation Measures

<table>
<thead>
<tr>
<th>visual</th>
<th>outside the width of the working area by clearly demarcating the working area</th>
<th>b. Remove spoil material from the area once the trench has been filled</th>
<th>c. Re-vegetate disturbed ground in the working area by seeding and spreading of vegetation that has been removed from the trench at the start of construction</th>
<th>condition of the site</th>
<th>beautification initiatives undertaken</th>
<th>Supervising Consultant ECO</th>
<th>General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Demobilisation</td>
<td>d. The site is to be cleared of all construction materials, including litter prior to hand over</td>
<td>b. Fences, barriers and demarcations associated with the construction phase must be removed from the site</td>
<td>c. The site must be fully rehabilitated and stabilised (for example, through revegetation)</td>
<td>a. Site conditions after completion of civil works</td>
<td>Final inspection report and handing over snag list</td>
<td>contractor Supervising Consultant ECO, AWSB MoNMP RJWSCO</td>
<td>Preliminary and General Item of the Bills of Quantity should have ITEM – Environmental Compliance KES 5,000,000</td>
</tr>
<tr>
<td></td>
<td>d. A meeting must be held on site between the Engineer, ECO and the Contractor to approve all remediation activities and ensure that the site has been restored to a condition approved by the Engineer</td>
<td>e. Rehabilitation Activities of Environmental Cases indentified must continue throughout the defect liability period</td>
<td></td>
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Athi Water Services Board.
Matrix 5-3 Operational Environmental Management

<table>
<thead>
<tr>
<th>Activity / Issue</th>
<th>Action required</th>
<th>Performance Indicators //</th>
<th>Monitoring Indicator</th>
<th>Responsibility</th>
<th>Provisional Budget</th>
</tr>
</thead>
</table>
| Project overall management during operation of the plant | a. Identify environmental issues that need mitigation during project operation.  
b. Identify occupational health and safety issues related to operation of the landfill  
c. Develop management plans and procedures needed to address the environmental concerns  
d. Set environmental performance targets and adhere to them  
e. Programme for performance Improvement especially on Environmental matters | a. Project environmental technical economic and social sustainability.  
b. Implement a monitoring and evaluation schedule  
c. Provide regular Monitoring and Evaluation reports including Environmental Audit Reports as required | a. Project operation manual to include best project management including post EIA requirement (initial Environmental Audit after 1 year of operation followed by annual self audits by RJWASCO. | RJWASCO | To be established at operation phase and included in the operation of the system |
### Chapter 5: Environmental Impacts and Mitigation Measures

<table>
<thead>
<tr>
<th>Environmental Impact</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>f. Set management roles and responsibilities for staff operating the facility</td>
<td>under EMCA 1999.</td>
</tr>
<tr>
<td>g. Monitor and evaluate the performance against set targets</td>
<td></td>
</tr>
<tr>
<td>h. Set a budget for environmental management; and restorations</td>
<td></td>
</tr>
<tr>
<td>i. Schedule for revising and updating the EMP.</td>
<td></td>
</tr>
<tr>
<td>j. Initiate sensitization programmes on best practices on solid waste management right from the source, sorting, transportation and disposal</td>
<td></td>
</tr>
<tr>
<td>k. Conducting an initial audit in the first year of operation of the facility</td>
<td></td>
</tr>
<tr>
<td>l. Pollution of river by unsatisfactory treated waste water</td>
<td>a. Regular inspection of the system to ensure performance is maintained at high levels</td>
</tr>
<tr>
<td>a. Blockages should be detected and promptly replaced</td>
<td></td>
</tr>
<tr>
<td>b. Regular monitoring and sampling of the waste water at influent and effluent points as well as in the receiving water bodies</td>
<td>a. Water quality results of the adjacent water resources</td>
</tr>
<tr>
<td>b. Blockages should be detected and promptly replaced</td>
<td>a. Operation efficiency of the system</td>
</tr>
<tr>
<td>c. Regular monitoring and sampling of the waste water at influent and effluent points as well as in the receiving water bodies</td>
<td>c. Repaired / corrected blockages and leaks</td>
</tr>
<tr>
<td>a. Daily, weekly, Monthly and quarterly influent and effluent quality analysis of to ascertain level of compliance to NEMA guidelines</td>
<td>b. Records of blockages and leaks repaired</td>
</tr>
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</tr>
<tr>
<td>a. Regular inspection of the system to ensure performance is maintained at high levels</td>
<td></td>
</tr>
<tr>
<td>b. Blockages should be detected and promptly replaced</td>
<td></td>
</tr>
<tr>
<td>c. Repaired / corrected blockages and leaks</td>
<td></td>
</tr>
<tr>
<td>a. Daily, weekly, Monthly and quarterly influent and effluent quality analysis of to ascertain level of compliance to NEMA guidelines</td>
<td></td>
</tr>
<tr>
<td>b. Records of blockages and leaks repaired</td>
<td></td>
</tr>
<tr>
<td>c. Repaired / corrected blockages and leaks</td>
<td></td>
</tr>
<tr>
<td>a. Water quality results of the adjacent water resources</td>
<td></td>
</tr>
</tbody>
</table>
### Methane / Hydrogen Sulphide and other gaseous management during Operation of the Sewer system

- a. Tapping of Methane gas by covering the anaerobic ponds in case of oxidation of ponds
- b. In case of trickling filters all sludge should be directed to sludge digester for generation of gas
- c. Hydrogen Sulphide gas is responsible for foul smell that is often associated with WWTW
- d. The gases should be cleaned with appropriate technology and used to generate electricity needed at the WWTW
- e. Otherwise, the other alternative could be to clean the gases and flare them to reduce them to CO₂ and H₂O (not recommended because its a waste of potential energy)

### Risks of Birds nuisance scavenging in the area especially at inlet works at WWTW

- d. The inlet works should be enclosed in a building to avoid exposure to birds
- e. Daily Burying of the wastes in appropriate solid Waste disposal section covering with soil, this reduces the tonnage of wastes on site and exposing the wastes to scavenging birds
### 18. Risks of wildlife and rodents attractions to the site

| a. The Plant if not properly fenced could attract wildlife like hyenas, Hippos, Crocodile, wild dogs and | a. proper fence in place around the plant | Operation manual and facility book records of initiatives undertaken to maintain hygiene status to required levels including fencing of the facility |
| Proper fencing of the Plant to keep off wildlife is recommended | b. Hygiene standards of the plant / facility | , RJWASCO |
| c. Maintaining high standards of hygiene at the site throughout the operation phase of the facility | | Budget included in the routine operation of the facility |
| d. Constant consultations with KWS in event that wildlife is spotted in the area | | |

### Occupational health and safety

| a. Liaise with the Directorate of Occupational Health and Safety Department to provide for appropriate training and regular updating of worker skill on occupational health and safety matters; | a. Health and safety awareness among staff; | a. Records of staff operating the facility trained / certificates |
| b. Provide appropriate personal protective equipment (PPE) to workers and any visitors; | b. Frequency of incidents/accidents and fatalities. | b. Records of incidences of injuries to staff and other personnel including visitors to the facility |
| c. Provide for First Aid facilities for field and localised staff as per the Occupational Safety and Health Act,2007; | c. Presence of proper adequate PPE at the facility | c. Conduct a safety audit as required by OSHA 2007 and file report with Directorate |
| d. Develop and implement a detailed and site specific Emergency Response Plans. | | |
19. Aesthetic/visual of the facility
   a. The facility should be properly kept by trimming the grasses, flower gardens and collecting any litters within the sites
   b. Reinstatement of sites to original status or better after any repair / service works

<p>| | | |</p>
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</thead>
<tbody>
<tr>
<td>a.</td>
<td>The facility should be properly kept by trimming the grasses, flower gardens and collecting any litters within the sites</td>
<td>e. Site conditions during implementation and completion of civil works</td>
</tr>
<tr>
<td>b.</td>
<td>Reinstatement of sites to original status or better after any repair / service works</td>
<td>Facility notes / records on greening initiatives</td>
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<td></td>
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<td>RJWA SCO</td>
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<td></td>
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<td>Best Practices</td>
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</tbody>
</table>
## 5.4 Decommissioning Flow Chart

Decommissioning of the plant is anticipated to be after 20 years design life of the sewer system from 2011.

During decommissioning, the following steps should be considered in order to undertake the procedure in a structured manner.

<table>
<thead>
<tr>
<th>Step</th>
<th>Activity</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Initiation Development of an Objective Worksheet and checklist incorporating references, legal and policies</td>
<td>Proponent then</td>
</tr>
<tr>
<td>2</td>
<td>Prepare and Award Contract Prepare a road map for decommissioning design Conduct design review to validate elements of the design and ensure design features are incorporated in the decommissioning design. Public consultations</td>
<td>Proponent then</td>
</tr>
<tr>
<td>3</td>
<td>Prepare and Award Contract Prepare a contract that incorporates validated project information and award to a contractor as per the Procurement rules.</td>
<td>Proponent then</td>
</tr>
<tr>
<td>4</td>
<td>Prepare and Award Contract Implement design elements and criteria on the Project in accordance with specifications and drawings. Inspect during decommissioning and at Project completion to ensure that all design elements are implemented according to design specifications.</td>
<td>Contractor, Proponent</td>
</tr>
<tr>
<td>5</td>
<td>Non-Conformance, Corrective/Preventive Action Determine root cause Propose corrective measures Propose future preventive measures.</td>
<td>All responsible</td>
</tr>
</tbody>
</table>
CHAPTER SIX
PUBLIC CONSULTATION

6.1 Introduction
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 Methodology
Public participation was mainly achieved through direct interviews, observations and questionnaire administration. The following is a detailed discussion of the public consultation methodology used by the EIA team.

6.2.1 Direct Interviews and Stakeholders Meetings
Public consultations with the neighbours were conducted through direct interviews, and questionnaire administration. Direct interviews were used to get responses from various stakeholders, among them the Managing Director, RUJWASCO, Commercial Manager, RUJWASCO, Technical Manager, Sewerage, RUJWASCO. Their comments were sought by engaging them in discussions about the proposed project and other related issues. We take this opportunity to thank the above officers for finding time from their busy schedules to provide our environmental officers with valuable information.

Public consultations with the stakeholders were conducted through direct interviews, and questionnaires in 2009, with further consultation conducted in April 2012 and June 2012 through leaders forum for the project organized by the Physical Planner for Ruiru District and Chaired by the District Commissioner.

Various stakeholders among them the; Public Health Officer, Town Clerk, Worship the Mayor, Juja Member of Parliament Managing Director, RUJWASCO, Commercial Manager, RUJWASCO, Technical Manager, Sewerage, RUJWASCO and the general public were contacted. Public consultation was done with the following aims:
- To inform the local people about the proposed project and its objectives
- To confirm availability of Land for the proposed site Githunguri/Block 3/ Plot Number 2297
- 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 would wish the perceived impacts to be addressed.

6.2.2 Questionnaire administration

Stakeholder comment sheets were prepared and administered to the neighbours of the proposed project.

6.3 Stakeholders comments

During field visits, various stakeholders were contacted in a bid to get their views about the proposed project. While the local people had no major problem with the proposed development, the quarry workers who depend on the proposed Waste Stabilization Pond site for quarrying activities felt that the project will affect their livelihood. The project neighbours contacted also felt that local people should be given first priority in employment. The members of Ruiru River WRUA had no major issues with the project. They however felt that wastewater should not be discharged into the Ruiru River, but should be used for irrigation. They advocated for the building of a reservoir so that the water is not taken back into the River.

The following is a summary of the issues raised by the Ruiru Stakeholders:

- The design plan should go through WRMA to enable them make an informed decision about the proposed project.
- The problem of Nairobi where the upstream of Nairobi River is completely polluted should not be repeated in Ruiru. It is the dilution effect of Ruiru and Ndaragwa Rivers that is making Athi river waters clean.
- Pollution prevention should be combined with waste water treatment so that industries are not allowed to discharge contaminated water directly into sewers.
- A reservoir should be built so that wastewater is not taken back into the River
- The plan should recognize the future population of the area so that the system is not overwhelmed
- The effluent from the industries should be monitored by RUJWASCO
- The final part (Reservoir) can be provided by the WRUA if the government does not have the resources.

- The land was originally 250 acres and there is a feeling that this land has been grabbed. The project requires a big piece of land.

- Overall, the people support the project as the region is growing fast but the sewer infrastructure is development inadequate and unavailable.

### 6.4 Leaders meetings

- Leaders consultative meeting was held in April 2012 hosted by District commissioner Ruiru district to inform leaders in the district about the planned project and gather views to be in cooperated in the EIA study, representation ranged from NEMA officials, Physical Planners, Town clerk, local leaders, Public Health officials, District Water Officer, Managing director, Ruiru Juja Water and Sewerage Company.

- Leaders consultative meeting was held in July 2012 at the District Commissioners offices Ruiru to agenda was land for the proposed project, representation was NEMA officials, Physical Planners, Town clerk, local leaders, Public Health officials, District Water Officer, Managing director, Mayor for Ruiru Town and area member of parliament, the leaders agreed to solve issues related to the land parcel for the project and communicate to AWSB.

- Stakeholder questioners have been widely distributed in the area to gather local residents views regarding the project, findings from the questionnaires were be analyzed and in cooperated in the EIA for the proposed project. Appendixes to the report are sampled filled questionnaires and minutes of the leaders meetings.

- August 2012 engaging of quarry workers and land parcel owners along the trunk line during preparation of valuation roll for the RAP.

- September 2012; disclosure of the finding of the consultative forums and EMP in the widely read Newspapers, Kenya gazette and Ruiru District offices for the public to give their comments.

- Compilation of across board views of all stakeholders and in cooperation in the Environmental and Social Impact Assessment study report and issuance to NEMA for Environment License.

- Finalization of Resettlement Action Plan report for the land parcels to be affected along the trunk lines and quarry workers breaking stone in the proposed land parcel for the project.

Other people contacted had various comments that are annexed to appendix 1 of this project report.
6.4 Interpretation of questionnaires administered

The project was unanimously endorsed by the respondents who largely see it as a community uplifting project. The questionnaires captured the following; Water and sanitation, Health, Solid waste management, Sewer situation in Ruiru Town and overall respondents recommendation.

6.4.1 Water and sanitation

Residents use water provided by stand pipe in dwelling and stand pipe in dwelling at 37.5% and tankers at 25%. The rest, depend on stand pipe in yard and public taps (at 12.5% each) with none depending on river, spring or dam as per the chart below.

The residents largely use septic tanks and piped sewer system. 70% of the respondents use septic tanks while only 20% use piped sewer system. The chart below summarises the detail.
Relevance
From the interpretation it is clear that a large percentage of Ruiru Population depend on septic tanks for sewerage disposal which is a health hazard when it fills up, during rainy season and expensive to the individual due to regular emptying cost which is KES 5,000 for $8m^{3}$ a flat owner could empty at least twice in three months. Construction of Ruiru Sewerage System will be of great benefits to the area residents both sanitation and cost of sanitation.

### 6.4.2 Health
Diseases largely suffered by the residents of Ruiru are malaria. Diarrhea and other unspecified diseases are (in part) what they also suffer from. The chart below summarizes the details.
Key
1 - Malaria  2 – Diarrhoea  3 - Stomach  4 - Eye infection
5 - Respiratory  6 - STI/HIV & AIDS  7 - Preg child birth  8 - Anemia
9 - Cholera  10 - Typhoid  11 - Other

Relevance
The bar graph indicates that the most common diseases suffered by residents of Ruiru are Diarrhoea and Stomach complications, an indication of poor sanitation in the area as the sewer infrastructure is in poor condition leading to contamination of water bodies around the area.

6.4.3 Solid Waste Management
From the responses, the largely generated solid waste was kitchen waste standing at 50%. The rest was paper and plastic both at 25% each.
Key
1-plastic 2-paper 3-metal 4-kitchen waste 5-effluent
6-hospital 7-hazardous 8-agricultural 9-other

Solid Waste disposal
The chart below represents the methods of waste disposal methods. The methods of disposal are largely two as the respondents indicated. Half (50%) of the respondents burnt the waste while the rest disposed through bin/bag collector.

![Bar chart showing waste disposal methods]

3-bin/bag collector (50%) 1-Burn (50%)

Key
1-burn
2-open
3-bin/bag collector
4-CCN
5-private
6-youth groups
7-other

6.4.4 Sewer Situation in Ruiru Town
Ruiru town has no proper and structured waste water disposal system. As indicated by the responses below 100% of the respondents thought the town lacks a proper disposal system.

The residents thought that the waste water drained into septic tanks (75%) other unspecified areas (25%) as well as rivers (25%).
On the issue of bursts and overflows, 50% of the respondents agreed that the town is affected by regular bursts and overflows while the rest disagreed.

![Chart showing responses to whether Ruiru is affected by regular bursts and overflows.]

**Key:**
- 1 - Yes
- 2 - No

![Chart showing the areas affected if Ruiru is affected by regular bursts and overflows.]

**Key:**
- 1 - Town
- 2 - Estates
- 3 - Other

1 50%
2 12.50%
3 37.50%
If sewers were a health hazard, 62.5% of the respondents thought it was, another 25% thought it was not while the rest remained unresponsive on the issue.

Almost all respondents found the effects of sewers to be nauseating smell (62.5%) while the rest remained unresponsive on the issue.
Where does raw sewer flow to incase it bursts?

1-River  2-People
CHAPTER SEVEN
CONCLUSION AND RECOMMENDATIONS

- The design should ensure comprehensive waste water treatment to allowable limits by NEMA, KEBS and WHO standards and the World Bank Environmental Health and Safety Guidelines, before releasing into the river,
- Involvement of all relevant stakeholders is proposed throughout the process to ensure project acceptability.
- Proper measures should be taken into account to ensure the adequate compensation of persons depending on the quarry as a source of livelihood according to OP 4.12 on Involuntary Resettlement.
- All construction waste will be properly disposed off in a timely manner, the excavated material wherever possible will be used as raw material for a range of activities, such as road repair or construction, and for use as building material e.g stones
- Provisional Budget of Kenya Shilling 5,000,000 should be included in the bidding documents for implementation of mitigation measures of potential Negative environmental impacts indentified in the report.

Ruiru County Council, NEMA and District Public Health Office should ensure that all industries located in Ruiru have an effluent pre-treatment system

The overall objective of constructing Ruiru Sewerage infrastructure is a Social Uplifting Project (SUP) according to NEMA Kenya Categorization and therefore recommended for implementation provided the mitigation measures indentified in the study for the potential negative impacts are properly addressed as well as form part of conditions of the Environment Licence.
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