KENYA VISION 2030

NATIONAL YOUTH SERVICE

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED NYS MAVOLONI DAM

CLIENT: NATIONAL YOUTH SERVICE (NYS)

REPORT TYPE: ENVIRONMENTAL IMPACT ASSESSMENT

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NEMA Reg. No.: 9491

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Date 22/1/2024

Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

The NYS Mavoloni Field Unit dam is located in Kithimani Sub - county, Machakos County. It is located in farm owned by the Government of Kenya and the tittle deed is registered to the NYS. The land size is approximately 949.74 acres. The farm is located between Goliba and Kithimani towns which is approximately 80km to the Northeast of Nairobi along the Thika - Garissa Road (A3).

The project aims at providing water for domestic, livestock and irrigation uses.

Agricultural activities include production of kale, onions, mangoes, oranges, and maize as well as livestock production mainly poultry, pisciculture, cattle, sheep and goats. The farm is also tasked with the responsibility of producing more than one million tree seedlings for planting in arid and semi - arid areas.

The project area lies within the Yatta Plateau which is underlain by Precambrian basement rock system consisting of biotite gneisses. The Yatta Plateau is bounded to the west by the Athi Trench and the Tiva Plateau to the east. The major soils in Yatta sub-county are a combination of Ferric Luvisols, Lithisols and Rhodic Ferralsols. The dominant rock in the study area is granite. Other less extensive members include pelitic schists and gneisses. A large portion of the area to the east comprising of Kanzalu range comprise of undifferentiated Basement System.

The Yatta Canal is the main water resource and the only single water supply for irrigation and domestic uses within the semi-arid area of Yatta Constituency in Machakos County. An alternative water source is therefore necessary.

Considering known site conditions as well as the availability of construction materials within the vicinity of the dam reservoir area, an earth - fill dam with a clay core and 12.5 m high was determined as the best alternative for the site.

The identified impacts have been categorized as upstream and downstream impacts with mitigation measures identified for the negative impacts.

Since there is no need for resettlement, the need for alternative sources of water, taking into account that all negative impacts can be mitigated against it is concluded that the implementation of the project with full implementation of the Environmental Management Plan will not result in the degradation of the environment.

1) INTRODUCTION

i. The Proponent: National Youth Service (NYS)

The Act of Parliament, (Cap 208), established the National Youth Service (NYS), in September 1964.NYS was established as part of the transition process of the Nation of Kenya from a Colony to a National State. Notably, NYS was initially established to support and resettle young Kenyans who had been disadvantaged due to the struggle for independence. NYS was further charged with the responsibility of training young men and women to serve the nation and the deployment of service members in tasks of national importance and service to the nation.

Since its inception, the NYS has been domiciled in eight different Ministries creating nomadic enculturation in its governance. Between 1964 and 1979, NYS was under the Ministry of Labor and later in the office of the President from 1979-1982. In 1982-1983, NYS was placed under the Ministry of Regional Development and then moved back to the office of the President for twenty years. Following Government re-organization in 2003, NYS was placed under the Ministry of Home Affairs for three years, and then later moved to the newly created Ministry of Youth Affairs and Sports in 2006. In the 2013 Government re-organization, NYS was again placed under the Ministry of Devolution and Planning, and in the Ministry of Public Service Youth and Gender in November 2015.

ii. Project Area

The project area lies in Machakos County in the former Yatta district. Yatta borders Masinga to the north east, Ndithini to the north west and Katangi to the southeast. Yatta covers a total area of 531 km2. Yatta has five wards, which are Matuu, Ndalani, Kithimani,Ikomba and katangi.

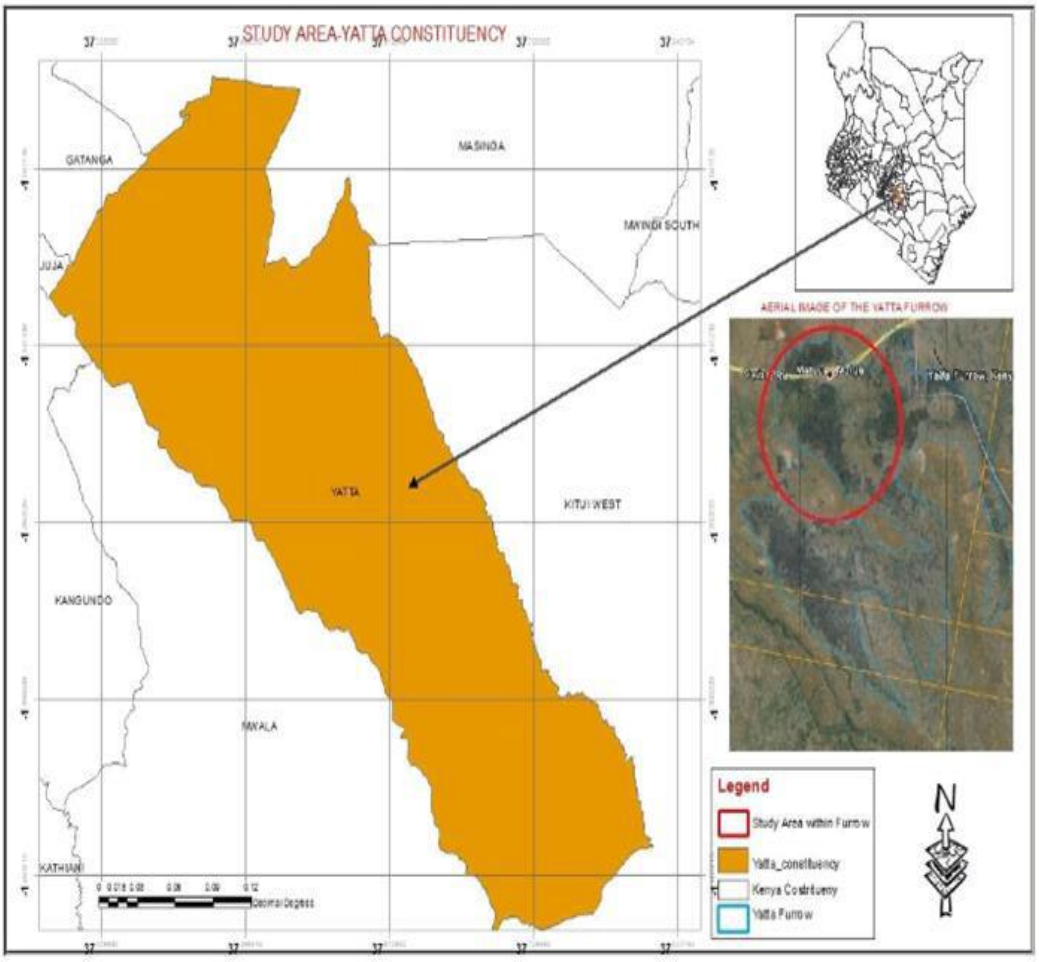


Figure 1: Yatta Constituency

The NYS Mavoloni farm is located between Goliba and Kithimani towns which is approximately 80km to the Northeast of Nairobi along the Thika-Garissa Road (A3). The project is within Mavoloni farm which is owned by NYS , the site bearing about 1°06'54.9"S 37°25'43.2"E at an altitude of 1190m above sea level. The farm is located within Yatta Sub-county of Machakos County.

Figure 2: Mavoloni project Area

2) PROJECT DESCRIPTION

i. Purpose of the project

The purpose of the project is to provide water for domestic, livestock and irrigation uses.

The farm is more than 900 acres which is used for both livestock and agricultural activities. The agricultural activities include vegetables, maize, beans fruits like mangoes and currently tree nurseries have been established for the farm to provide trees for planting in the arid and semi- arid areas. The activities listed are limited by the water availability. The farming activities are undertaken by NYS servicemen and women who are housed in the same compound in form of Barracks.

Farming activities in the farm are limited by the availability of the water available and the farm has relied on water from Yatta canal to water the crops when there is less or no rainfall. Further as stated above the farm is tasked with the responsibility of producing more than one million tree seedlings for planting in the arid and semi-arid regions. The limitation of the activities of the farm is the availability of water to undertake its various activities. The dam will therefore complement water flowing from the Yatta canal during the dry period.

ii. Site description

In the uphill of the dam the soft soil is as deep as 1.7 meters, in the areas next to the stream the soft soils are deep and 20m from the stream groundwater was found at a depth of 1.8 meters in one of the pits while about 5m from the stream groundwater was struck at less than 300mm. About 10 meters from both sides of the stream the groundwater is less than 1.0 metres from the surface.

Figure 3: Mavoloni test pits

iii. Design of the dam

The dam has been designed as an earth dam as the site has sufficient red coffee soils to be used for construction and the borrow site is within the reservoir area.

The dam will have the following features.

- Core trench formed on a hard rock to avoid settlement,
- Toe drain and sand filter to prevent piping,
- Slope of 1:2.5 d/s and 1:3 u/s for slope stability,
- An offtake pipe of 100mm diameter anchored on 20/25 anchor blocks has been provided,

- Wearing coarse on the embankment crest of 300mm
- A spillway to drain flood water which is lined with riprap stones.

Parameters of the dam

The dam is classified as medium risk

Embankment fill 78,278.94m^3

Volume 265,001.89 m^3

Height 12.50m

Spillway width 15m

Reservoir capacity 265,001.89m^3

Spillway length 18

3) STAKEHOLDER ANALYSIS

Stakeholder analysis is a technique used to identify and assess the importance of key people, groups of people, or institutions that may significantly influence the success of an activity or implementation of a project. For purposes of this study, stakeholders were identified as any group of people or institutions that will benefit from or impact the proposed NYS Mavoloni dam Project.

A sound understanding of the activities linked with the project was undertaken to begin the stakeholder analysis. This was done by reviewing existing project documents. With the help of these documents list of stakeholders was identified. To gather data, stakeholder consultations were undertaken through stakeholder visits with the key stakeholder groups. For this purpose, stakeholder visits were organized to undertake interviews and focus group discussions as it is believed this method would facilitate the collection of a more reliable data set for the study. The gathered data was then analyzed, and the findings were reported in this section of the report.

Table 1: Stakeholder analysis

No.	Stakeholder	Photos	Responsibility
1	NYS Mavoloni Field Unit		comply with dam safety standards that reflect a duty of care to communities down stream.
2	Kenya National Administration		Co-ordination of National Government functions, programmes, and projects.
3	Yatta Water & Sanitation Company		Provision of drinking water and sewerage services

4	NYS Mavoloni Unit Service men & women		• Express their concerns about the proposed dam construction. • Acquiring the necessary skills in dam construction activities
5	Local community		• provide valuable input to the proponent. • Express their concerns about the proposed dam construction.
6	Water Resources Authority		Allocation of water rights and monitoring use
7	Farmers Representative		Express their concerns about the proposed dam construction.
9	National Environment		Enforcement of environmental laws

	Management Authority		and environmental audits
12	Ministry of Water & sanitation and Irrigation		external partners to support project implementation
13	National Water Harvesting & Storage Authority		external partners to support project implementation

All the stakeholders gave their opinions in regard to the proposed project and they unanimously agreed to have the project implemented, the weighted benefits of the project were the major push by all the stakeholders to have the project implemented

4) PROJECT ALTERNATIVES

The project alternatives that will be discussed in this section include: the no project option, the construction of dam in an alternative site, making use of other water sources.

i. No project option

This option seeks to maintain the status quo. There will be no dam project hence avoiding all its advantages as well as any disadvantages that may be associated with it.

The National Youth Service, Mavoloni field unit stands in need of water for use in increasing the acreage under agriculture. In addition to the crops grown, there are also animals, horticultural crops as well as tree seedlings. These cannot be left to be watered from rainwater only since the rain patterns are erratic.

The Yatta area in which Mavoloni field unit is located is generally semi – arid and does not receive enough rainfall in a year. In addition the unit is set to receive an increase in the number of service men and women under their care. There will be a definite increase in demand for water for the service men and women, more food production to cater for their dietary needs as well as animals to produce milk and other products. The net effect is almost a tripling of the amount of water required compared to current consumption levels.

There is no single source of water that can be used to provide the amounts needed. It is therefore either the project is constructed or a severe shortage of water hits the camp in a few years' time. To avoid inconveniences in the future therefore, a no project option is not feasible.

ii. Alternative site for the project

The surveying and engineering teams considered several sites where the proposed project could be undertaken. Some of the residents had suggested a site along Thika River just adjacent to the NYS Mavoloni Field Unit main Offices.

This site has other disadvantages as an alternative due to the fact that it is not possible to abstract enough water to feed the dam from the river and leave enough amounts for downstream users as well as the environmental flow.

Other sites have therefore to be made use of since to avoid environmental problems as well as high cost of pumping the water to feed to the other areas.

iii. Making use of other water sources

The other water sources available for use in the project area include groundwater and rainwater harvesting.

The present water demand for the Mavoloni field unit is about 1500cubic metres/day. To satisfy this demand and also have surplus water to use in increasing the production capacity as well as hosting more people enormous rainwater harvesting structures have to be put up. With the current unpredictable weather, it will not be a given that the structures so constructed will receive rainwater at predictable intervals or on a fixed period of the year. This makes water treatment and distribution plans based on such a project unreliable.

Groundwater exploitation at such a high rate would be disastrous for the tapped groundwater aquifers. The rate of groundwater recharge cannot march the abstraction rates necessary to sustain water supplies that satisfy this demand.

This would inevitably lead to groundwater depletion with all its attendant consequences. This alternative would therefore only be feasible when combined with other alternatives such as the construction of the proposed project

5) DESCRIPTION OF THE PROJECT ENVIRONMENT

i. Machakos County

Machakos County is strategically located as it borders seven counties. To the north it is bordered by Embu, Muranga and Kiambu Counties, to the west Nairobi and Kajiado counties, to the south Makueni County and to the East Kitui County.

The County covers an area of 6208.2 Km² with Machakos covering 925.2 Km², Kangundo covers 177.2 Km², Kathiani covering 207.1 Km², Athi River covers 843.2 Km², Yatta covering 1,057.3 Km², Masinga covering 1,402.8 Km², Matungulu covering 577.5 Km² and Mwala covering 1,017.9 Km².

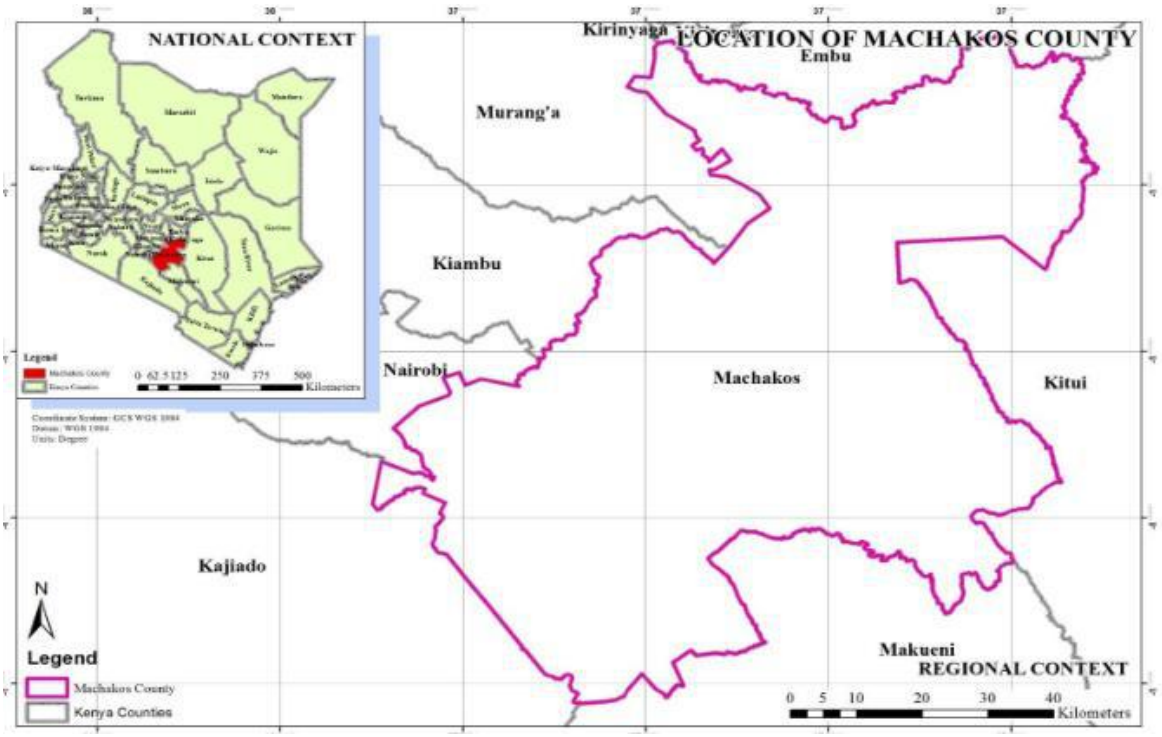


Figure 4: Machakos County Location. Source: Machakos County Spatial Database.

ii. Administrative Units

The total land mass of Machakos County is divided into eight sub-counties/constituencies, namely; Mavoko, Kathiani, Machakos, Matungulu, Yatta, Masinga, Mwala, and Kangundo as shown in Table 2.1 below. The populatin for Machakos County is 1,421,932, the male population is 710,707 and female 711,191and average households size is 3.5 (KNBS 2019) persons.

Table 2: Machakos County population

Sub-County/ Constituency	Area (Km^2)	(2009 Census)		2019 Census	
		Popn	Den (Km^2)	Popn	Den (Km^2)
Machakos	**925.2**	**199,211**	**215**	**170,606**	**243**
Kangundo	177.2	94,367	532	97,917	600
Kathiani	207.1	104,217	503	111,890	568
Mwala	843.2	163,032	160	181,896	181
Yatta	1,057.3	147,579	140	172,583	157
Masinga	1,402.8	125,940	90	148,522	101
Matungulu	577.5	124,736	216	161,557	244
Mavoko	1,017.9	139,502	165	157,288	187

Population of Machakos Sub Counties

iii. Topography

The terrain of the project area is undulating with a general fall from Goliba towards Kithimani towns at an elevation of 1190m above sea level. The project area lies within the Yatta Plateau which starts from the western side of the Mavoloni farm and runs in the eastern direction .It is well drained towards Thika river which forms the Northern boundary of the farm.

iv. Hydrology

iv.1. River Network

The catchment area is within Tana River Basin and has a dendritic drainage pattern (see figure below). The dam's main water resource will be the catchment

area upstream of the dam axis. The site is within a stream with its water source being springs which are about 300m upstream of the dam site. The stream flows in a North Easterly direction to join Thika River which also flows in the same direction towards Masinga Dam to join Tana River which then flows all the way to Tana Delta eventually draining into the Indian Ocean.

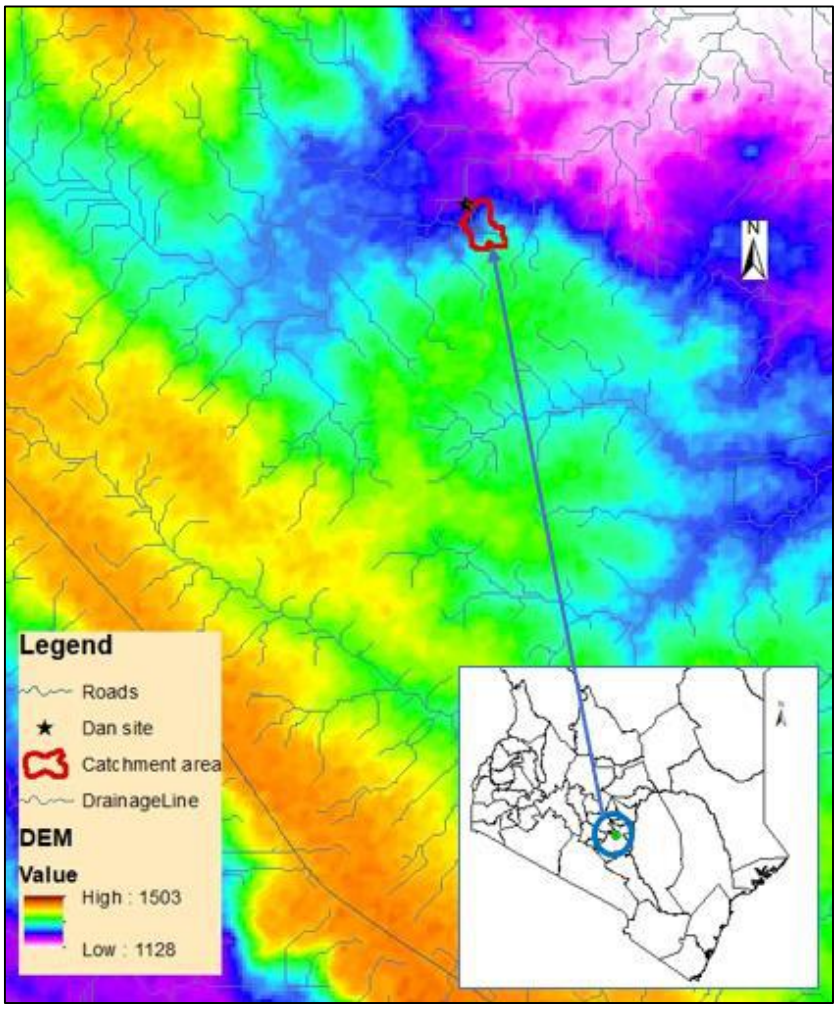


Figure 5:Mavoloni NYS Dam Catchment Area

iv.2. Terrain Characteristics

The catchment area was delineated from SRTM DEM in ArcMap GIS platform. The SRTM DEM data used has been enhanced to fill areas of missing data (Void Filled) to provide more complete digital elevation data with a resolution of 1 arc-second (~ 30 meters) for global coverage. The data is a regularly spaced grid of elevation points with embedded geographic information downloaded as a Georeferenced

Tagged Image File Format (GeoTIFF) file. The voids are filled using interpolation algorithms in conjunction with other sources of elevation data. The DEM specifications are shown in Table 3 (Source: USGS, 2018).

Table 3: SRTM DEM product specifications. (Source: USGS 2018*)*

Projection	Geographic
Horizontal Datum	WGS84
Vertical Datum	EGM96 (Earth Gravitational Model 1996)
Vertical Units	Meters
Spatial Resolution	1 arc-second for global coverage (~30 meters)
Raster Size	1-degree tiles
C-band Wavelength	5.6 cm

Catchment terrain processing to obtain catchment characteristics was done using ArcHydro in ArcMap GIS platform. From the analysis of the SRTM DEM, the catchment area of the proposed dam was found to be about 179 Km2 with the highest and lowest altitude at about 3838 masl and 1986 masl respectively. The catchment has a general average slope of 4.9% as observed from analysis of the longest flow path (37,820 M). The results of the analysis are shown in Table 4 and in, Figures 4 and 5.

Table 4: Terrain Characteristics

Catchment area	82706 m^2 ~ 0.083 Km^2
Maximum elevation	1250 masl
Minimum elevation	1199 masl

Longest flowpath	581 m
Average Slope of longest flowpath	8.7%

iv.3. Climate

The Mavoloni NYS is proposed dam catchment is in a semi-arid area characterized by a hot and dry climate for most parts of the year. The rainfall portrays a bimodal pattern distributed in two rainy seasons. The first season 'long rains' occur in March, April and May (MAM season), while the second season 'short rains', occur in October, November and December (OND season). The rainfall pattern is influenced by Inter-Tropical Convergence Zone which controls the Monsoon winds. The rainfall is unevenly distributed within the rainy seasons and shows significant annual and seasonal variability. The amount of annual rainfall ranges between 500 mm – 600 mm, with marked temporal variations.

iv.4. Water Resources

The dam site is within a small stream which is fed by a spring upstream. The main source of water around the catchment area is tertiary canal from the larger Yatta Canal. The canal conveys water to Kithimani, Ndalani and Matuu locations where it is used for domestic, irrigation and livestock purposes. It is also the source of water for Matuu Water Supply and recharges flow into several streams along its way.

iv.5. Runoff Yield

The annual runoff yield was estimated using modified version of the Rational Formula given by the formula:

$$Q = CiA$$

where:

A = the area of the catchment (m^2)

C = runoff coefficient for drainage area (for this area it is about 0.3).

i = annual average rainfall (m)

Q = Runoff yield (m^3)

Q = 0.3*0.6m*82,706m^2 =15,787m^3

From the analysis results, the dam catchment area is not sufficient to fill the proposed dam. An alternative

iv.6. Flow Measurements

In situ measurements of the flow in the tertiary canal near the dam site and also the flow from the spring feeding the stream in where the dam is to be located were done using the float method and the results were as follows:

1. Flow in the tertiary canal = 0.342m^3/s
2. Flow from the spring = 0.0269m^3/s

iv.7. Climatic Conditions

The area is in agro-climatic zone IV which is classified as semi-arid land. The mean temperature ranges from 170 at night to 240 during the day, the rainfall is bimodal with long rain commencing end of March to May (about 400mm) and short rains from the end of October to December (500mm).

The evaporation in the Yatta district is on average approximately 1,800 mm/year and evaporation rate for the Yatta reservoir area is determined as 0.17 – 0.27 m3 /s. The reservoir is near the Mavoloni dam.

v. Ecological Environment

There is no Wildlife, bird sanctuaries or conservation areas within the project site. There are no rare, endangered, or endemic species recorded. The ecology of the project area is not very rich in diversity or high in endemism and is typical of semi-arid/dry grassland.

vi. Ecology and nature Conservation

This area is a highly suitable habitat for a wide diversity of fauna some of which attract tremendous conservation interest. The state of wildlife is stable unless when there is wildfires and animal migration. Some of the species found in the area include; Cape buffalo, black and white Columbus, Skye's monkey, baboon, eland, zebra, spotted hyenas etc.

There exists protected areas which help in better conservation of the existing ecosystem. These protected areas include; public parks, national parks and reserves and ultimately forests.

The proposed project will be on land that is owned by NYS. Most of it is under shrubs. A number of plant and tree species were observed in these patches. These include Carex pellita (Woolly Sedge), Gymnosporia senegalensis, Acacia tortillis, Lantana camara and Castor plant among others. However, none of the plant or tree species are endemic to the area, endangered or rare. They are found downstream and upstream of the Thika river ecosystem. As such, they are not accorded any special protection under conservation laws of Kenya or international environmental agreements.

vii. Fauna and Flora

There exist plants along the project site; however, there are no plants of conservation importance, due to the dry nature of the area, only tufts of grass and shrubs are present on the ground.

No animals were observed at the proposed project site probably due to the dry nature of activities on the ground.

Figure 6: Vegetation within the project site

viii. Geology and Soils

The project area lies within the Yatta Plateau which is underlain by Precambrian basement rock system consisting of biotite gneisses. The Yatta Plateau is bounded to the west by the Athi Trench and the Tiva Plateau to the east. the major soils in Yatta sub-county are a combination of Ferric Luvisols, Lithisols and Rhodic Ferralsols.

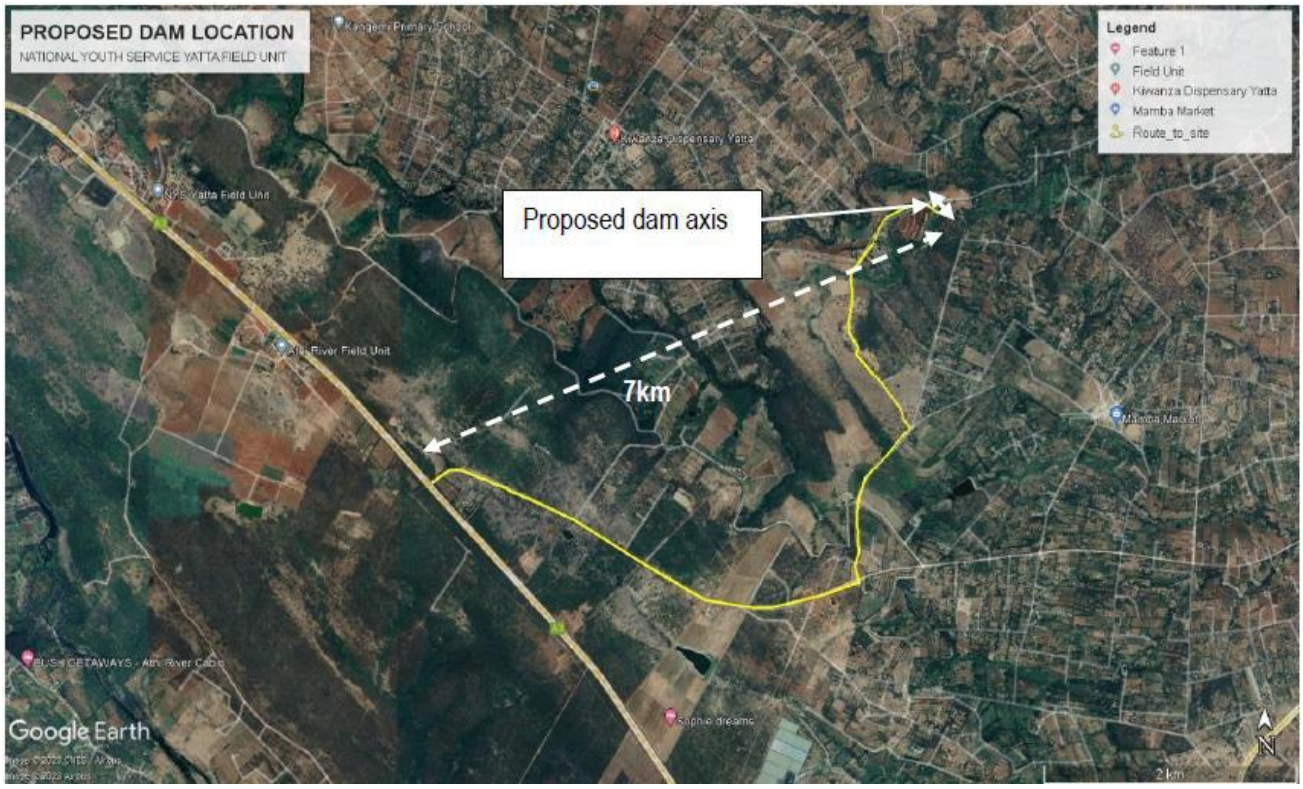


Figure 7: Dam axis

viii.1. Physiography

The investigated site is generally flat and lies at an average altitude of **1312m** amsl east of Yatta plateau. Two main physiographic features are recognized for the general area viz:- the NW-SE trending Yatta plateau and the adjoining rolling topography dissected by SE trending ephemeral channels draining into both Tana and Athi rivers. The topography is occasionally broken by ranges, hills and inselbergs. The wider topography gently slopes towards the SW and belongs to the Low Foreland Plateau Physiographic Unit interposed between the Duruma Wajir Low Belt and Eastern Highlands (Groundwater Master Plan-1992).

viii.2. Geological Setting

The investigated site lies on Basement System rocks. In the two sections below a discussion on the geology in a regional context is followed by a more detailed assessment of the geology in the investigated area. The area geology is described in ***"Geology of The North Machakos-Thika Area" By W.A. Fairburn-1963.*** The report describes an area of some **2700 sq. km.** straddling Machakos and Kiambu Counties. It is bounded by longitudes **370 00'** and **370 30'E** and latitudes **10 30'** and **10 30' S.**

Regional Geology

The regional geology of the area consists of Basement System rocks forming the a greater part to the east of the area while to the west , lavas, pyroclastics

and sediments of tertiary age are exposed. In general, the rocks in the area can be divided into four main groups:-
(4) Recent:- Soils and alluvial deposits
(3) Pleistocene:- Sediments
(2) Tertiary:- Volcanics and sediments
(1) Archean:- Basement System.

The Basement System rocks resulted from intense regional metamorphism of initial sediments of various compositions and intrusives resulting into schists, gneisses, granitoid gneisses, amphibolites, marbles and quartzites. Metasomatic processes resulted into migmatites and granitic gneisses. Repeated rejuvenation and erosion resulted into two recognizable erosion bevels:- end-Cretaceous and sub-Miocene (after renewed uplift). The formation of the Rift Valley during Tertiary times resulted into outpouring of Kapiti phonolite and a huge mass pyroclastics

The sequence of events occurring throughout the geological history of the general project area is as summarized herebelow:
(1) Deposition of sediments of the Basement System.
(2) Basic intrusions.
(3) Compression and folding of Basement System with metamorphism and granitization.
(4) Injection of granite with pegmatite and quartz veins.
(5) Periods of uplift and erosion.
(6) Formation end-Cretaceous peneplain.
(7) Uplift and rejuvenation.
(8) Formation of the sub-Miocene peneplain.
(9) Emplacement of Tertiary volcanics and deposition of lake beds.
(10) Pleistocene deposits .
(11) Formation of Recent deposits.

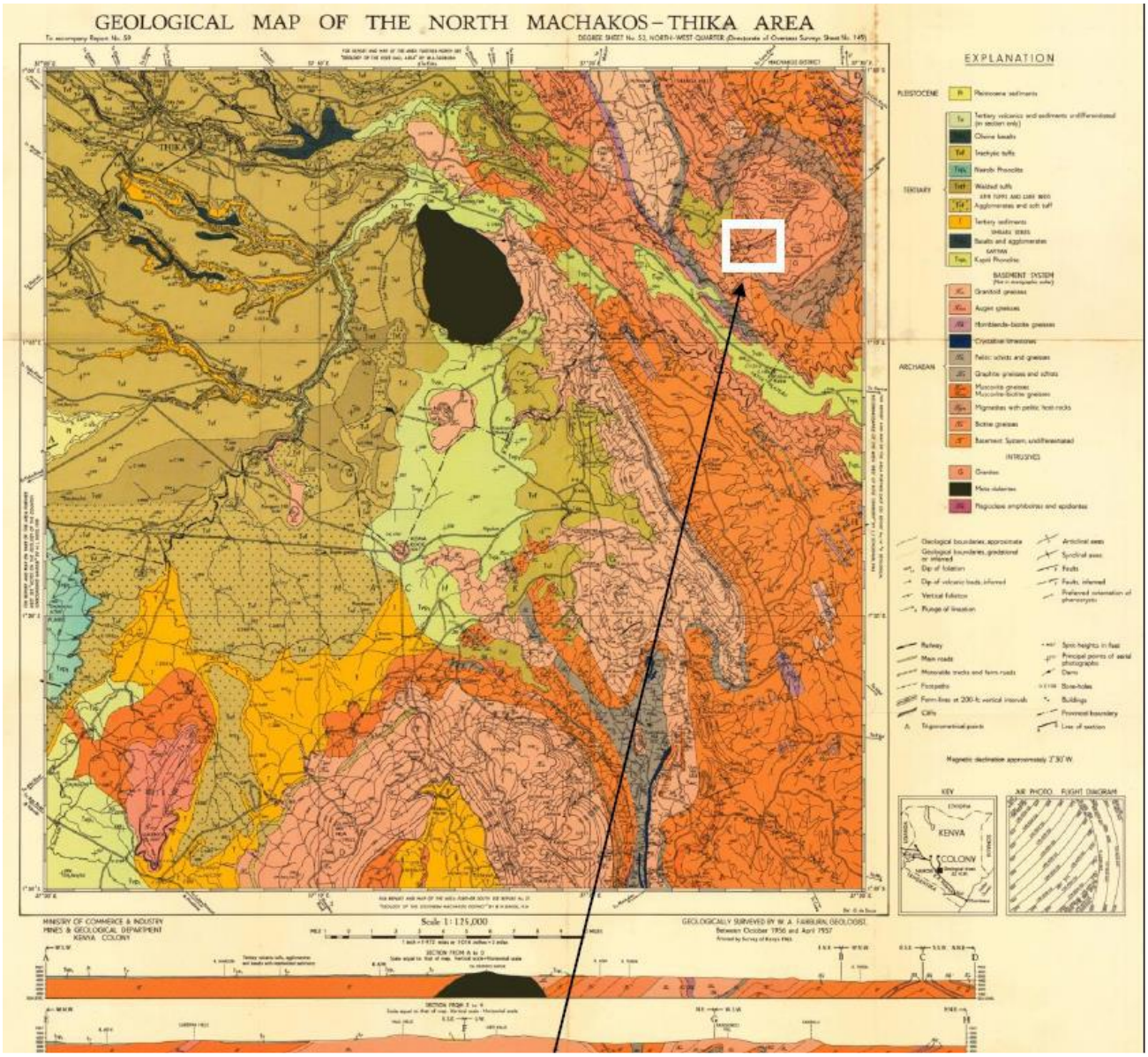


Figure 8: Geological map extract of the study area'

Geology of the Investigated Area

The dominant rock in the study area is granite. Other less extensive members include pelitic schists and gneisses. A large portion of the area to the east comprising of Kanzalu range comprise of undifferentiated Basement System. On outcrop scale, the following rock types were observed in the field:-

(1) Granite
(2) Quarzo-feldspathic gneiss
(3) Biotite gneiss

Sandy alluvial deposits occur along the river course

Granites

These rocks are rather homogenous un-bedded occurring in large blocks with exfoliation surfaces. In the study area their outline controls the directional trends of the surrounding rocks. Their origin is attributed to alkali metasomatism of preexisting rocks resulting into rocks of granitic character.

Figure 9: Granite outcrop

Biotite gneiss

The exposure for this rock is poor and the available outcrops are highly weathered

Figure 10: Biotite gneiss

Quarzo-feldspathic gneiss

Quarzo-feldspathic gneiss observed in the study area occurs on the right abutment and manifests as typical feldspar weathering with feldspar material rich residual soils. Intercalated in gneiss are pegmatites which occur in narrow bands.

Figure 11: Quarzo - feldspathic gneiss

Structural Geology
Structural features observed at outcrop level consist of mostly joints and fractures. Strike direction is between north and north-west while dips are to the

dominantly to the west and vary between 200 and 400. Foliations are prominent in schistose rocks and absent in granitized rocks. ***The river on which the dam will be located actually follows the contact between granite intrusion and biotite gneisses.***

viii.3. Geophysical Investigation Methods

A great variety of geophysical methods are available to assist in the assessment of geological subsurface conditions. In the present survey the geo-electrical and magneto-telluric techniques were used. Investigations of the electrical resistance at the project area included the use of geophysical techniques to probe the sub-surface. The main emphasis of the fieldwork undertaken was to determine the electrical resistance of the underground rock to locate the weathered zones, fault lines and other weak points that need to be appropriately treated with other external materials to enhance water retention in the dam.

This information was principally obtained in the field by means of signal averaging system (SAS) earth resistivity equipment model **No SSR-MP-ATS** and **PQWT-S500** EM equipment capable of probing upto 500m depth.

Resistivity Method

The VES and HEP measurements were carried out to probe the condition of the sub-surface. The VES investigates the resistance and resistivity layering below the site of measurement while the HEP gives the lateral resistance variation at a particular depth below the ground surface. This technique is described below.

Basic Principles

The resistivity of earth materials can be studied by measuring the electrical potential distribution produced at the earth's surface by injection of low frequency electric current. Two fundamental considerations are the basis of the theory behind galvanic resistivity methods viz:-

(1) Ohm's law :

$E = \rho i$

Where: **E** = Potential gradient (**Volts per meter**)

i = Current density (Am-2)

ρ = Resistivity of the earth medium(Ω-m)

(2) The divergence condition for the current flux into the ground:

$\Delta \times i = 0$

It follows from above that the potential function **V** for a single point source at a distance of **r** meters on the earth's surface is given by:

(i) $Vr = \rho I/2\Pi r$ (Volts)

In hydro geological field surveys using galvanic Resistivity methods the quantities measured are current **I**, flowing between two electrodes **A** & **B** and potential difference **ΔV** between two measuring points **M & N.** The following relationship applies to various electrodes configurations.

(ii) $\rho = K \times \Delta V/IAB$ (Ω-m)

Where K is defined as the geometrical factor derived from electrode configuration adopted. The most common field arrays are the Schlumberger and Wenner configurations. Data obtained is normally subjected to modelling analysis using a digital computer. This is combined with data from existing boreholes to come up with a more realistic interpretation and recommendations.

Magnetotelluric Method

The magnetotelluric **(MT)** method is a passive surface geophysical technique that uses the earth's natural electromagnetic fields to investigate the resistivity structure of the subsurface. The **MT** method allows us to probe the crust from depths of tens of meters to depths of tens of kilometers (*Vozoff, 1991*).

The Earth's natural electromagnetic fields that are measured include the magnetic and electric field due to world-wide lightning activity at frequencies of **10,000 Hz** to **1 Hz** and geomagnetic micro-pulsations at frequencies of **1 Hz** to **0.0001 Hz.** The natural electric and magnetic fields propagate vertically in the earth because the very large resistivity contrast between the air and the earth causes a vertical refraction of both fields transmitted into the earth *(Vozoff, 1972).* The method can determine resistivity variations at different depths because the different frequency fields propagate to different depths *(Vozoff, 1972).*

The **PQWT** instrument is an automated data-acquisition and processing system, in which the natural electric and magnetic fields are recorded in two orthogonal, horizontal directions (the vertical magnetic field is sometimes recorded as well). The recorded time-series signals are used to derive earth tensor apparent resistivities and phases. This is achieved by first converting them to complex cross-spectra using **FFT (fast-Fourier-transform)** techniques. Least-squares, cross-spectral analysis (Bendat and Piersol, 1971) is used to solve for a tensor-transfer function that relates the observed electric fields to the magnetic fields under the assumption that the Earth consists of a two-input, two-output, linear system with the magnetic fields as input and the electric fields as output (Rodriguez and others, 1996). Prior to their conversion to apparent resistivity and phase, the tensor is normally rotated into principal directions that usually correspond to the direction of maximum and minimum apparent resistivity.

For a two-dimensional (2-D) Earth, the **MT** fields can be de-coupled into transverse electric **(TE)** and transverse magnetic **(TM)** modes; 2-D modeling is generally done to fit both modes. When the geology satisfies the 2-D assumption, the **MT** data for the **TE** mode is assumed to represent the situation when the electric field is along the geologic strike, and the data for the **TM** mode is assumed to represent the situation when the electric field is across strike. The **MT** method is well suited for studying complicated geological environments because the electric and magnetic relations are sensitive to vertical and horizontal variations in resistivity. The method is capable of establishing whether the electromagnetic fields are responding to subsurface rock bodies of effectively 1-, 2-, or 3-dimensions.

The propagation and magnitude of the **EM-field** is subject to **Maxwell's equations**, especially relating the AC impendance to frequency, magnetic and electric field components:
(1) **ρs = Ex/5fH** where;
ρs: AC impendance
f: Frequency
H: Magnetic field component

Ex: Electric field component

When the **EM** field interacts with ground medium, the depth of penetration depends upon the attenuation caused by the skin effect given by:
(2) **δ=503.3ρF**
Following from (2) above, lower frequencies mean higher penetration and the vice versa.
The basic **PQWT** instrument measures the electric field component on the earth's surface by means of a pair of electrodes for a single channel instrument. This field is as a result of a sheet of direct current flowing through conductive layers of rocks. Two conditions apply here:
(i) The total current through the geological formation is conserved hence the current density is inversely proportional to the thickness of the conductive formation
(ii) The electric field measured at the surface will be proportional to the resistivity of the conductive geological formation and inversely proportional to its thickness.

The **MT** equipment takes measurements in multi-frequency mode depending upon the depth of penetration. The values recorded are in (millivolts) **mV per meter (electric field strength**) since the magnetic component is assumed to be constant. The instrument is invaluable in picking out the anomalous zones.

Figure 12: Geophysical profile

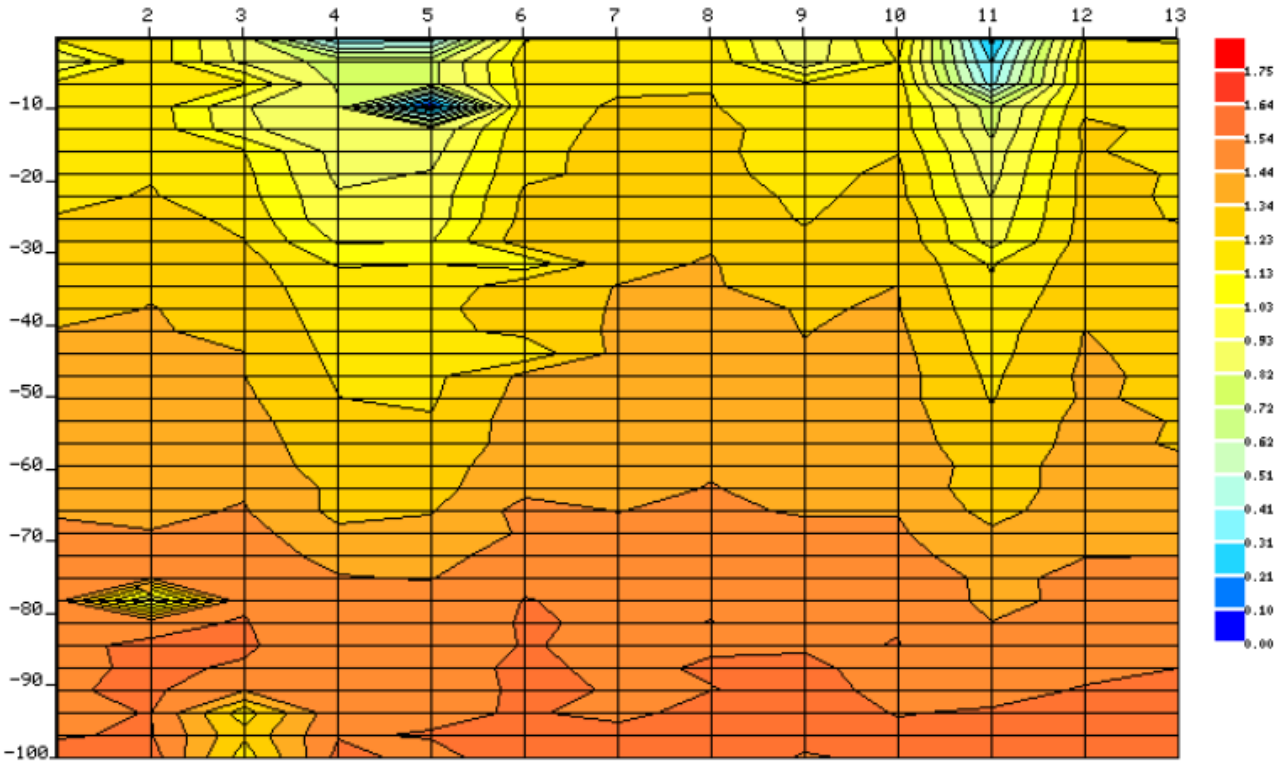


Figure 13: Profile 1

Profile-1:-

This profile was ran for a distance of 60m from the left bank top beacon. Since this is an area of lower hydrostatic pressures, the station interval was set at **5m** for a resolution of about **2.5m**. No fault-lines, fracture zones, shear zones detected. The rock is relatively massive except for compositional and rock character variations in space which manifest as blue hued zones.

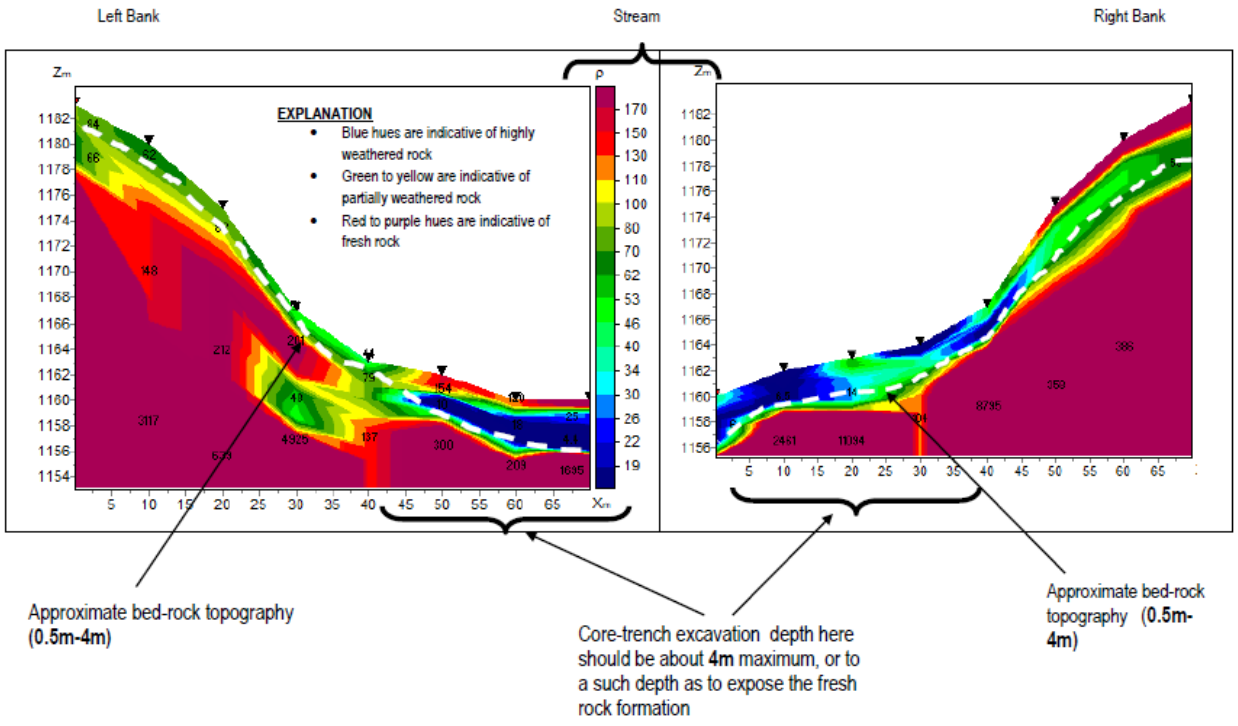


Figure 14: Interpreted geo-electric section along the dam axis facing downstream

The soil in the study area is also suitable for a variety of crops and vegetables and irrigated farming is widely practiced in the area, with irrigation water drawn mainly from the Yatta Canal.

ix. Land and Land Use

The land has aesthetic, cultural, and traditional values and is a vital factor of production in the economy. Land in the County is broadly used for Forest, Government Reserves, Townships, Game Reserves, Agriculture, Ranches, Industrialization, mining and livestock keeping. The absence of a national land use policy has led to the proliferation of informal settlements, inadequate infrastructure services, congestion environmental degradation, unplanned urban centers, pressure on agricultural land, and conflicts. Below is a map showing the land use.

Out of the 6,028 Km2 covered by the County, approximately 3,720.2 Km2 is arable land while approximately 2,436 Km2 is nonarable land and approximately 124 Km2 is under water mass. Masinga Sub County has the highest water mass since it is the home of Masinga dam and the Seven Folks dam.

According to the available data, the proportion of land with title deeds stands at 28.5per cent with the most affected area without title deeds issued being Athi River, Machakos and Kathiani. The impact of the lack of title deeds in these areas has result- ed in the reduced investments despite the investment potentials vested in these areas.

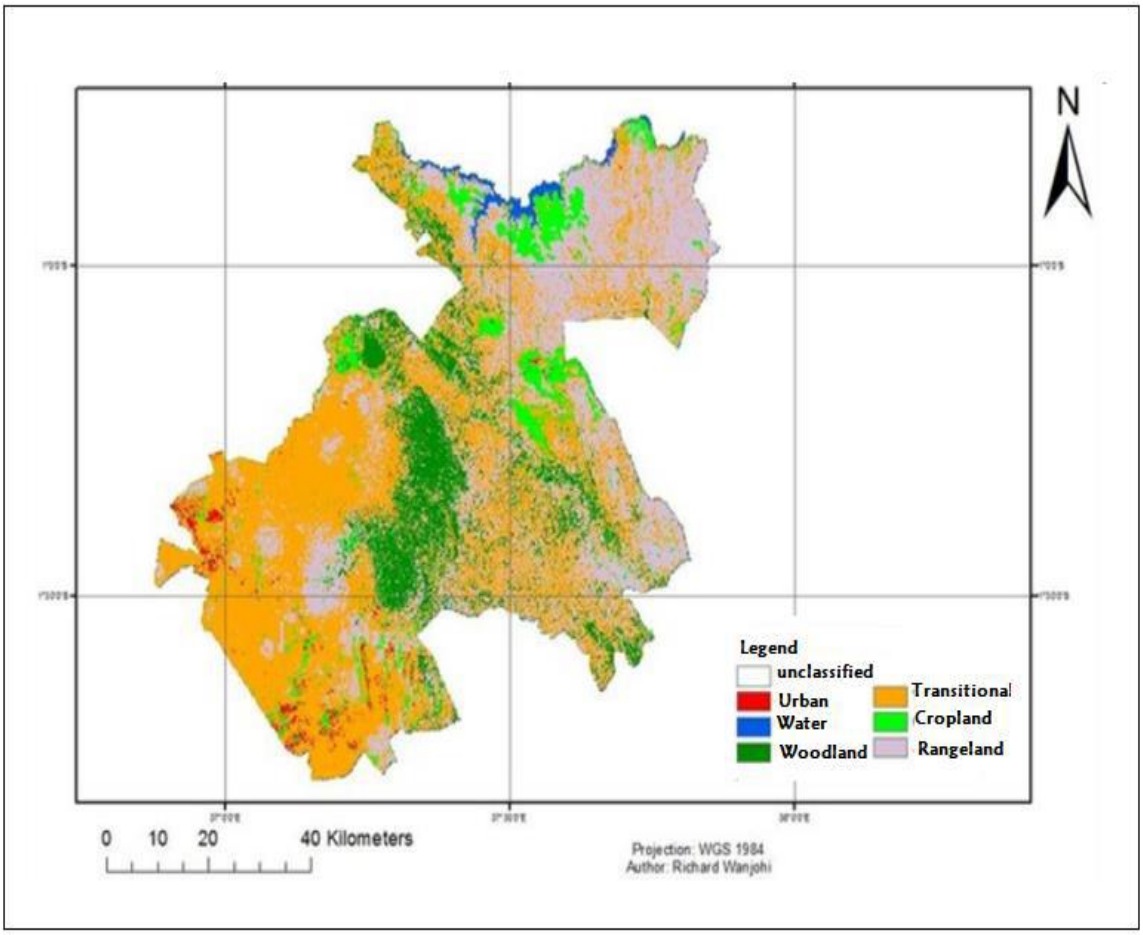


Figure 15: Machakos County land use

Much of the land within the project area is arable but due to the poor or total lack of rains, much of it remains underutilized, the only alternative the land owners have for agricultural use is the canal water.

The majority of the people along the project site depend on agriculture for their livelihood. Farm holdings range from small to large company and cooperative farms with a variety of food and cash crops, and livestock.

In NYS Mavoloni farm agriculture activities include kale, onions, mangoes, oranges, and maize farming. There is also poultry, pisciculture, and livestock farming within the farm. The farm is also tasked with the responsibility of

producing more than one million tree seedlings for planting in arid and semi-arid areas.

Figure 16: Maize farming in NYS Mavoloni farm

Figure 17: Banana farming in NYS Mavoloni farm

Figure 18: Grape farming within NYS Mavoloni

Figure 19: Mango Plantation in NYS Mavoloni farm

The farm relies on water from the Yatta canal whose source is the Thika River. The water shortage in the Yatta canal is so acute at certain times of the year thus hampering the activities in the farm

Figure 20: Furrow water for irrigation within NYS Mavoloni farm

x. Water Resources

The Yatta Canal is the main water resource and the only single water supply for irrigation and domestic uses within the semi-arid area of Yatta Constituency in Machakos County.

Yatta Canal was designed by the British colonists and constructed an earth canal in 1953 by our forefathers who were arrested when they were fighting for independence and was commissioned in 1959 with the purpose of conveying water from the Thika River to serve the North Yatta area of Matuu and the south Yatta area of Kitui. It is the source of livelihood for the people of Yatta Sub County. Indeed, the canal supports over 110,000 people and 35,000 livestock and generates 662 million shillings from the sale of farm produce and other commercial activities annually. The Canal is 60 km long from the intake of Thika River to the terminal point, an existing stream. There are 27 canal bridges and aqueducts to allow the canal to cross the valleys and stormwater to flow across it. It conveys water to Kithimani, Ndalani and Matuu towns and their environs where it is used for domestic, irrigation, and livestock water purposes. The canal commands more than 400km2 of irrigable land and water demand in such an area would be more than 10m3 /s compared to the current maximum abstraction of 1.13m3 /s of water transferred due to the current state of repair. From the irrigable area commanded by the canal and other demands (domestic and livestock) the demand is very high and it is unlikely to be satisfied by this one canal. The Canal is also the source of water for Matuu town under management of Yatta Water and Sanitation Company and recharges flow into other several streams along its way. The first major rehabilitation of the canal was done by the

National Youth Service at a cost of 500 million Kenya shillings in 1996 and the second was desilting in 2012 through Kazi kwa Vijana initiative at a cost of 8 million shillings. There have been other several desilting that have been done recently through Machakos county government and the local CDF.

In order to carry out its farming activities the Mavoloni farm relies on water from Yatta canal which originates from the Thika River. The recharge of the river is normally low during the dry period and further affected by abstraction upstream mainly being water for domestic and agricultural use. It is, therefore, necessary for NYS to re-strategize how to undertake farming activities during the dry period. The Mavoloni farm has an area of 949.74 acres and has the potential to carry out major agricultural activities.

Figure 21: Yatta canal intake at Thika River

xi. Infrastructure

The project areas are well endowed with both social and supportive infrastructural services, this include roads, social places like schools, health facilities, shopping centres etc. The Thika – Garissa tarmac road crosses the upper part of the project area near Kithimani and through Matuu Town respectively. The other towns and trading centres in the project area are traversed by gravel roads and most are supplied with. In all the towns and centres including NYS farms, no centralized sewerage disposal system is in place. Emphasis is onsite waste water disposal systems.

xii. Markets and Urban Centers

The main urban centers in the County are Machakos, Kangundo-Tala, Athi River, Kathiani Masii, and Matuu, however, the major urban centers are Machakos and Athi River. Other trading centers include Mlolongo, Kyumbi, Mwala, Mbiuni, Kaewa, Mitaboni and Kithimani among others. For purposes of categorizing markets, the County Finance Act has identified seven (7) urban centers and twenty-three (23) peri-urban

xiii. Housing: Types, Building Materials, Structure Quality and Distribution

Houses in the County are both permanent and semi-permanent. 59.2 per cent of all the homes have brick/block walls, 23.9 per cent stone walled and 12.3 per cent mud / wood walls. Other houses have 1.5 per cent, 2.7 per cent wood wall and corrugated walls respectively. The highest number of houses has earth floor which accounts for 62.4 per cent, others have cement floors accounting for 46.6 per cent. Only 0.4 per cent of the housing have floor tiles. The main roofing materials in the County is corru- gated iron sheets which represents 82 per cent of the total houses. Other houses are roofed using grass, tiles, concrete and asbestos sheets which accounts for 14.5 per cent, 1 per cent, 1.2 per cent and 0.5 per cent respectively.

xiv. Morbidity: Five Most Common Diseases in Order of Prevalence

The most prevalent disease is malaria which accounts for 40 percent of the total cases reported. Respiratory complications account for as high as 24 percent. Other diseases are flu accounting for 15.9 percent stomachache and Diarrhea accounting for 5.2 percent and 3.1 percent respectively

6) POLICY LEGAL AND INSTUTIONAL FRAMEWORK

i. Overview

Policy and legislative developments have recently been directed at redefining the role of the state with separation of policy and regulation. Policy formulation is largely reserved for the state while implementation of the developed policies is left to private sector and/or statutory bodies. At the same time, there has also been movement to redefine the role of the state vis-à-vis the individual and/or community groups. The constitution and policies such as the National Land Policy have considerably strengthened the community rights. It has also enshrined the right to clean water as a human right. This is critically important as developments such as this proposed project has the ability to supply clean drinking water to people and hence enable the enjoyment of the right to clean water. But the project has the ability to create social conflicts if some of the components are not handled properly. This implies a need to engage the affected communities from the earliest stages of project planning.

ii. Policy Provisions

Constitution of Kenya

Article 42 of the Bill of Rights of the Kenyan Constitution provides that 'every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures. Part 2 of Chapter 5 of the constitution is dedicated to Environment and Natural Resources. Article 69 in Part 2 provides for among others sustainable utilization and exploitation of natural resources, public participation on matters affecting the environment, establishes environmental assessments and monitoring systems.

Article 43(1) enshrines the right to clean water. It states:

Every person has the right;

I. to the highest attainable standard of health, which includes the right to health care services, including reproductive health care;

II. to accessible and adequate housing, and to reasonable standards of sanitation;

III. to be free from hunger, and to have adequate food of acceptable quality;

IV. to clean and safe water in adequate quantities;

V. to social security; and

VI. to education.

Further, Article 70 states that if a person alleges that a right to a clean and healthy environment recognized and protected under Article 42 has been, is being or is likely to be, denied, violated, infringed or threatened, the person may apply to a court of law for redress.

The NYS Mavoloni Field Unit dam will increase the amount of water in storage thus serving to enhance the enjoyment of rights highlighted in the Bill of Rights.

The Kenya Vision 2030

Vision 2030 is Kenya's development programme beginning from 2008 to 2030. It has the objective of transforming Kenya into a newly industrialized, middle - income country, with the ability to provide high quality of life to all its citizens by 2030. The Vision was formulated through a stakeholder consultative process that was participatory and all – inclusive. The vision has its base on three pillars;

1) The Economic Pillar

The economic pillar is aimed at improving the prosperity of all Kenyans through well designed economic development programmes that cover all the Kenyan regions. It targets an average Gross Domestic Product (GDP) growth rate of 10% per annum. To achieve this target, policies will be implemented to ensure the prevalence of macro - economic stability. Other issues such as a low savings to GDP ratio will be addressed by encouraging increased foreign investments in Kenya and overseas development assistance (ODA). The informal sector which also employs about 75% of the Country's workforce will be supported. The support will be to aid the sector improve productivity and increase incomes.

The specific activities under this pillar include: Marketing tourism and improving mining, increasing value in agriculture and manufacturing for the regional market.

2) The Social Pillar

This pillar is aimed at building a just and cohesive society with social equity in a clean and secure environment. Under this pillar, Kenyans with disabilities as well as marginalized communities will be given special consideration. This pillar lays

more emphasis on: Education & training, the health systems and maternal health, water and sanitation, environment, housing and urbanization, gender, youth and vulnerable groups, equity and poverty elimination and reconciliation.

3) The Political Pillar

This pillar aims at realizing a democratic political system founded on issue-based politics that respects the rule of law, and protects the rights and freedoms of every individual. The objective is to transform Kenya into a state in which equality is entrenched, irrespective of one's race, ethnicity, religion, gender, or socioeconomic status. This will encourage the harnessing of the diversity of the people, values, traditions, and aspirations for the benefit of all citizens. It aims at transforming the governance system to one that is result – oriented, stable, predictable and whose performance is based on measurable outcomes. The specific activities are aimed at improving: rule of law, electoral & political processes, democracy and public service delivery, transparency and accountability, security, peace building and conflict management.

The NYS Mavoloni Field Unit dam will lead to improvement of health and sanitation through increased supply of potable water its construction therefore should be encouraged as a way to achieving the Vision 2030 targets as well as water related MDGs.

National Policy on Water Resources Management and Development

The overarching objective of the National Water Resources Management Strategy (NWRMS) is to eradicate poverty through the provision of potable water for human consumption and water for productive use. It proposed reforms whose main purpose was to separate water resources management and development from water services delivery. The Ministry responsible for water would mainly focus on policy formulation, implementation and monitoring. It would then leave the detailed regulation to a number of parastatal bodies who report to boards that represent different stakeholders' interests. It was hoped that the provision of water services, by water service providers, both from the private and Non – Governmental actors, would be market driven. The NWRMS spells out how water resources of Kenya shall be managed, protected, used, developed conserved and controlled. It also prescribes the principles, objectives, procedures and institutional arrangements for the conservation and control of water resources including: Classifying water resources, determining the requirements of the

reserve for each water resource and identifying areas designated as protected and groundwater conservation areas.

It also calls for development of appropriate sanitation systems to protect people's health and water resources from pollution. Economic activities, therefore, should be accompanied by corresponding waste management systems to handle liquid effluents and other wastes emanating there from that should also include appropriate measures to ensure environmental resources and people's health in the immediate neighbourhood are not negatively impacted by the effluent.

The National Policy on Water Resources Management and Development was established with an objective to preserve, conserve and protect available water resources and allocate it in a sustainable rational and economic way. It also desires to supply water of good quality and in quantities sufficient enough to meet the various water needs while ensuring safe disposal of wastewater and environmental protection. The policy focuses on streamlining provision of water for domestic use, agriculture, livestock development and industrial utilization with a view to realizing the objectives of the Millennium Development Goals (MDGs) as well as Vision 2030. To achieve these goals, water supply (through increased household connections and developing other sources) and improved sanitation is required in addition to interventions in capacity building and institutional reforms.

All components of the proposed project will therefore have to be implemented in such a way that the objectives of this policy are fulfilled. The harnessing of water to supply the filling of NYS Mavoloni Field Unit dam, will have to take place without affecting either the downstream users or the environmental flows of the river.

National Policy on Environment

The National Environment Policy aims to provide a holistic framework to guide the Management of the environment and natural resources in Kenya. It further ensures that the linkage between the environment and poverty reduction is integrated in all government processes and institutions in order to facilitate and realize sustainable development at all levels. This is done in the context of green economy, enhancing social inclusion, improving human welfare and creating opportunities for employment and maintaining the healthy functioning of ecosystems.

The Policy also proposes to:

- Strengthen legal and institutional framework for good governance

- Integrate environmental management with economic growth, poverty reduction and improving livelihoods
- Improve research and capacity development
- Promote new environmental management tools
- Promote collaboration and cooperation and partnerships in environmental management,
- Promote domestication, co - ordination and maximization of benefits from Strategic Multilateral Environment Agreements.

The Policy also recognizes challenges posed by climate change. It therefore discusses intended climate change - related policy actions, which include;

- Developing a comprehensive climate change policy
- Strengthening capacity for national and country level institutions for climate resilience and low carbon development
- Developing and implementing awareness and capacities for implementing the climate change action plan
- Strengthening and enhancing an early warning and response system for disaster risk reduction
- Strengthening research capacity
- Developing a climate financing mechanism
- Establishing a national carbon trading platform
- Promoting public and community participation in mitigation and adaptation measures.

The policy discusses the multiplicity of environmental degradation issues and challenges facing the country. It notes that environmental degradation is driven by; inappropriate technology, unsustainable consumption and production patterns, increased incidences of poverty and climate change.

Urban environmental degradation occurs mainly through lack of appropriate waste management and sanitation systems. Whereas, industry and transport - related pollution, adversely impact on human health, well – being, as well as air, water, and soil quality. Another major set of challenges is recognized as arising from emerging global environmental concerns such as stratospheric ozone

depletion and biodiversity loss.

The Policy therefore, proposes a broad range of measures and actions as a response to the identified environmental challenges. It goes further to identify the various vulnerable ecosystems proposing measures to mainstream sound environmental management practices in all sectors of society.

The NYS Mavoloni Field Unit project will have to be implemented with full implementation of a well laid out Environmental Management Plan (EMP). The project will therefore not lead to any notable environmental degradation before, during and after implementation.

The Agricultural Policy

In Kenya the agricultural policy revolves around key areas of policy concern including increasing agricultural productivity, especially for small-holder farmers, emphasis on irrigation, encouraging diversification into non - traditional agricultural commodities, enhancing food security, encouraging private sector led development and ensuring environmental sustainability.

The policy notes that droughts and floods have increased in frequency and intensity in the past three decades resulting in high crop failure and livestock deaths. Increased land degradation has decreased land resilience thereby exacerbating the effects of drought and floods leading to famine which has taken its toll on human and animal lives.

Involvement of women in small - scale agriculture (with over 75% of the labour force) is appreciated as an important factor towards improvement of agricultural performance. However, despite their contributions women still face a number of hindrances especially limited access to productive resources like land ownership, inputs, extension services and marketing services.

Environmental degradation and rising poverty is of major concern for agricultural development. The continued scarcity of productive land and increasing poverty levels has led to an increase in agricultural practices that conflict with the environment particularly in the rural areas. Pressure on high potential areas is pushing people to migrate into ASAL lands where they practice inappropriate farming practices leading to environmental degradation and thereby creating a vicious cycle of environmental degradation and poverty.

The NYS Mavoloni Field Unit Dam will in the long – term help improve the food security situation by providing water for crop irrigation and animals which in turn give milk, meat, hide and manure for improving soil fertility.

The Land Policy

Environmental management principles proposed in the land policy include the restoration of the environmental integrity. The government shall therefore introduce incentives and encourage use of technology and scientific methods for soil conservation. Fragile ecosystems shall be managed and protected by developing a comprehensive land use policy bearing in mind the needs of the surrounding communities.

Zoning of catchment areas to protect them from further degradation and establishing participatory mechanisms for sustainable management of fragile ecosystems will also be done. It will also develop procedures for co - management and rehabilitation of forest resources while recognizing traditional management systems and sharing of benefits with contiguous communities and individuals. All the national parks, game reserves, islands, front row beaches and other areas hosting fragile biodiversity are declared as fragile ecosystems.

The sustainable management of land based natural resources depends largely on the governance system that defines the relationships between people, and between people and resources. To achieve an integrated approach to management of land based natural resources, all policies, regulations and laws dealing with these resources shall be harmonized with the framework established by the Environmental Management and Coordination Act (EMCA), 1999.

The NYS Mavoloni Field Unit dam is to be constructed inside the land under the NYS compound. There however, will be prepared a plan on the catchment management which will guide so that the water is not contaminated whilst in the dam.

The National Biodiversity Strategy

The overall objective of the National Biodiversity Strategy and Action Plan (NBSAP) is to address the national and international undertakings elaborated in Article 6 of the Convention on Biological Diversity (CBD). It is a national framework of action to ensure that the present rate of biodiversity loss is reversed and the present levels of biological resources are maintained at sustainable levels for posterity. The general objectives of the strategy are to conserve Kenya's biodiversity to sustainably use its components, to fairly and equitably share the benefits arising from the utilization of biological resources among the stakeholders, and to enhance technical and scientific cooperation nationally and

internationally, including the exchange of information in support of biological conservation.

The NBSAP promotes the creation of a healthy environment providing abundant biodiversity resources. It encourages the conservation of Kenya's biodiversity and sustainable use of all its components. It especially recognizes that forests in Kenya are under threat. It therefore puts forward recommendations to reverse this trend and protect forests. It specifically proposes stopping further forest land excision and instead support communities and private land - owners to initiate and implement forest rehabilitation programmes. In order that forests are not treated as being of zero economic value, the ecosystem services provided by forests will instead be assigned a corresponding economic value. The ecosystem services include:

Watershed protection, influence on climate, cultural and aesthetic value, actual genetic value and the value of the rich biodiversity both flora and fauna found in a forest. It also encourages the use of forest resources for ecotourism, and drawing up of management plans for each forest area.

The NYS Mavoloni Field unit will have a tree planting component to increase tree cover in conjunction with Kenya Forest Service (KFS).

iii. International Policy Framework

Kenya is a signatory as well as a party to various international conventions, treaties and protocols relating to the environment and aimed at achieving sustainable development. According to the Registrar of International Treaties and other Agreements in Environment (UNEP 1999), there are 216 treaties, 29 of which are of interest to Kenya. The country is a signatory to 16 such agreements, which range from use of oil, protection of natural resources and protection of the atmosphere.

Protection of Natural Resources

There are 12 agreements of significance to Kenya under this category which the country has signed and ratified. This section reviews a number of policies that are triggered or met by the proposed project.

Convention on Biological Diversity

This global convention was held to foster conservation and sustainable use of biological resources, to preserve their diversity for posterity. Kenya is a signatory to this convention, having ratified it in 1994. The provisions of this Convention have since been integrated in the laws of Kenya, climaxed by the development of the Kenya National Biodiversity Strategy and Action Plan in 2000 by the Ministry of Environment and Natural Resources.

The project proponent will endeavor to implement this project giving due regard to especially those species that are of conservation concern.

The Ramsar Convention

This is the Convention on Wetlands of International Importance. It was held in Ramsar, in 1971 and came into force in 1975, hence the name Ramsar Convention. The aim of this convention was to raise to global context the value of wetlands in our ecosystem and encourage partner states to develop instruments for conservation and management of wetlands. Kenya ratified the convention in June 1990. The convention defines “Wise use of wetlands” as "the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development". "Wise use" therefore has at its heart the conservation and sustainable use of wetlands and their resources, for the benefit of humankind.

Any wetland in the range of this project site will be protected and studies conducted to ensure that it will not be negatively affected by the implementation of this dam project.

African Convention on the Conservation of Nature and Natural Resources

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

The objective of this convention was to encourage conservation, utilization and development of soil, water, flora and fauna for the present and future welfare of mankind, from an economic, nutritional, scientific, educational, cultural and aesthetic point of view.

The States that are signatories to this convention undertake to adopt the measures necessary to ensure the conservation, utilization and development of soil, water, floral and faunal resources in accordance with scientific principles and with due regard to the best interests of the people (art. II). They agree to take effective measures to conserve and improve the soil and to control erosion and land use (art. IV). Furthermore, they are to establish policies to conserve, utilize and develop water resources, prevent pollution and control water use (art. V). Parties also undertake to protect flora and ensure its best utilization, the management of forests and control of burning, land clearance and overgrazing (art. VI). They are to conserve faunal resources and use them wisely, manage populations and habitats, control hunting, capture and fishing, and prohibit the use of poisons, explosives and automatic weapons in hunting (art. VII). Protected species in list A enjoy full total protection, while those in list B may be taken only with authorization (art. VIII). Traffic in trophies is to be tightly controlled, to prevent trade in illegally killed and obtained trophies (art. IX). Conservation areas are to be established and maintained (art. X), while customary rights are to be reconciled with the Convention (art. XI). Conservation education is to be undertaken at all levels (art. XIII) and conservation and ecological factors are to be considered in development plans (art. XIV). Parties undertake to cooperate wherever necessary in implementing the Convention (art. XVI). The Organization of African Unity (now the African Union) is mandated to carry out the function of Secretariat to the Convention.

In cases where the impounded water may cause damage or soil erosion, the project implementers will put in place appropriate measures. The welfare of all species both floral and faunal will be taken into consideration before project implementation.

Kyoto Protocol to the United Nations Framework Convention on Climate Change

The Kyoto Protocol requires signatories to the United Nations Framework Convention on Climate Change to reduce their greenhouse emissions levels to 5% below 1990 levels by the year 2012. The Protocol came into force on 16th February 2005, after it received the prerequisite signatures. However, there are some major countries who are not signatories to the Protocol.

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

The primary purpose of the convention is to establish methods to minimize global warming and in particular the emission of the greenhouse gases. The United Nations Framework Convention on Climate Change (UNFCCC) defines "climate

change" as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."

It was adopted on 9th May 1992 United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro. It came into force on 21st March 1994. It established a Secretariat headquartered in Bonn. The Convention has been ratified by 189 states. Kenya ratified the Convention on 30th August 1994. It constitutes the foundational climate agreement that has provided the platform for most subsequent international climate agreements. The UNFCCC, for example, birthed both the Kyoto Protocol and Paris Agreement. The treaty called for ongoing scientific research and regular meetings, negotiations, and future policy agreements designed to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. The treaty called for ongoing scientific research and regular meetings, negotiations, and future policy agreements designed to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner

Objectives: To regulate levels of greenhouse gas concentration in the atmosphere, so as to avoid the occurrence of climate change on a level that would impede sustainable economic development, or compromise initiatives in food production.

The following section provides a brief summary of its provisions: (a) Definitions of the basic terminology of the Convention, such as "climate change", "climate system", "emissions", "greenhouse gases", "reservoir", "sink", "source" (art. 1);

(a) Principles to guide the Parties in their pursuit of the Convention's objectives

(b) (art. 3). The Parties are to protect the climate system for present and future generations. Developing countries should be accorded appropriate assistance to enable them to fulfil the terms of the Convention. The Parties should work in cooperation, so as to obtain maximum benefit from initiatives in the control of the climate systems;

(c) Commitments assumed under the Convention (art. 49. Parties are to prepare national inventories on greenhouse gas emissions, and on actions taken to remove them; formulate and implement programmes for the control of climate change; undertake cooperation in technology for the control of change in the climate system; incorporate suitable policies for the control of climate change in national plans; undertake education and

training policies that will enhance public awareness in relation to climate change. The developed country Parties (and other Parties listed in annex I) commit themselves to take special measures to limit their anthropogenic emissions of greenhouse gases, and to enhance the capacity of their sinks and reservoirs for the stabilization of such gases. The developed country Parties (and other Parties listed in annex II) undertake to accord financial support to developing country Parties, enable the latter to comply with the terms of the Convention;

(d) Cooperation by Parties in the establishment and promotion of networks and programmes of research into and systematic observation of climate change (art. 5);

(e) Establishment of a Conference of Parties, to be the supreme body of the Convention and to oversee the implementation of the Convention (arts. 7,8,9 and 10);

(f) Establishment of a financial mechanism, to provide resources on a grant or concessional basis, for the fulfilment of the objectives of the Convention (art. 11);

(g) Procedure for the settlement of disputes (art. 14).

United Nations Convention to Combat Desertification (UNCCD)

This is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long - term strategies supported by international cooperation and partnership arrangements. Desertification is a type of land degradation in drylands in which biological productivity is lost due to natural processes or induced by human activities whereby fertile areas become increasingly arid.

The Convention, the only one, that stems from a direct recommendation of the Rio Conference's Agenda 21, was adopted in Paris, France, on 17 June 1994 and entered into force in December 1996. It is the only internationally legally binding framework set up to address the problem of desertification. The Convention is based on the principles of participation, partnership and decentralization. These are the backbone of good governance and sustainable development. It has 197 parties.

The convention requires parties to take climate change considerations into account in their relevant social, economic and environmental policies and actions.

The permanent Secretariat of the UNCCD was established during the first Conference of the parties (COP 1) held in Rome in 1997. It has been located in Bonn, Germany, since January 1999. The functions of the secretariat are to make arrangements for sessions of the Conference of the Parties (COP) and its subsidiary bodies established under the Convention, and to provide them with services as required. One key task of the secretariat is to compile and transmit reports submitted to it.

This project will be used for irrigation to increase production as well as in increasing the tree cover in the Mavoloni NYS field unit.

The World Commission on Environment and Development

The UN's World Commission for Environment and Development, chaired by former Norwegian Prime Minister Gro Harlem Brundtland and thus referred to as the Brundtland Commission, published the report "Our Common Future," also known as the "Brundtland Report," in 1987. Influenced by the 1980 "World Conservation Strategy" of the International Union for Conservation of Nature (IUCN) the report defined the principle of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The publication of the report is considered a milestone in triggering international awareness and discourse on the importance of global sustainable development.

The commission focuses on the environmental aspects related to development and requires all development projects to be sustainable economically, socially and environmentally.

The project proponent is committed to implementing this project with the full participation of the local community and to do what is necessary to make it sustainable.

World Bank policy OP 4.01 Environmental Assessment

World Bank requires environmental assessment for projects proposed for the Bank financing to help ensure that they are environmentally sound and sustainable, and thus improve on decision making. Projects are screened and assigned categories (A, B, C or FI) depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

Environmental assessment evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation

by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts. It includes the process of mitigating and managing adverse environmental impacts throughout project implementation.

The Bank favour's preventive measures over mitigatory or compensatory measures, whenever feasible. During project implementation any adverse effects will be identified and mitigated against or seek to do things in a way that avoids the negative impacts altogether, when possible.

World Bank policy OP 4.04 Natural Habitats

The World Bank recognizes that conservation of natural habitats, is essential for long-term sustainable development. The Bank therefore supports the protection, maintenance, and rehabilitation of natural habitats and their functions in its economic and sector work, project financing, and policy dialogue. The Bank supports, and expects borrowers to apply, a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development. The Bank's economic and sector work includes identification of:

(a) natural habitat issues and special needs for natural habitat conservation, including the degree of threat to identified natural habitats (particularly critical natural habitats), and

(b) measures for protecting such areas in the context of the country's development strategy. As appropriate, Country Assistance Strategies and projects incorporate findings from such economic and sector work.

The project proponent will endeavor to replant elsewhere indigenous trees cut down to make way for the dam as well as other species that may be affected.

World Bank Operational Policy 4:37 Safety of Dams

Dam safety is a procedure that provides for surveillance, inspection, operation and maintenance of the specified dam for prevention of dam failure related disasters and to provide for institutional mechanisms to ensure their safe functioning and for matters connected therewith or incidental thereto.

The safe operation of dams has significant social, economic, and environmental relevance. The world Bank OP on Safety of Dams require that experienced and competent professionals design and supervise construction, and that the

borrower adopts and implements dam safety measures through the project cycle. The policy also applies to existing dams where they influence the performance of a project. In this case, a dam safety assessment should be carried out and necessary additional dam safety measures implemented. OP 4.37 recommends, where appropriate, that Bank staff discuss with the borrowers any measures necessary to strengthen the institutional, legislative, and regulatory frameworks for dam safety programs in those countries. This OP provides guidelines to ensure safety at Bank financed projects. The safety measures require appropriate plans for:

- Construction supervision and quality assurance;
- Instrumentation plan;
- Operation and Maintenance (O&M) plan; and
- Emergency preparedness plan.

Dam safety is a critical consideration during the design of this dam as well as inspections will be carried out during construction to ensure that standards are adhered to. A

Vienna Convention for the Protection of the Ozone Layer

Intergovernmental negotiations for an international agreement to phase out ozone depleting substances concluded in March 1985 with the adoption of the Vienna Convention for the Protection of the Ozone Layer. This Convention encourages inter - governmental cooperation on research, systematic observation of the ozone layer, monitoring of Chlorofluorocarbons (CFCs) production, and the exchange of information.

The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in September 1987, and was intended to allow the revision of phase out schedules on the basis of periodic scientific and technological assessments. The Protocol was adjusted to accelerate the phase out schedules. It has since been amended to introduce other kinds of control measures and to add new controlled substances to the list. Kenya signed the Montreal Protocol in February 1988 and has ratified the Protocol and its four amendments, namely; London (1990), Copenhagen (1992), Montreal (1997), and Beijing (1999).

Stockholm Convention on Persistent Organic Pollutants

The text of the Stockholm Convention was adopted by the Conference of the Plenipotentiaries (Stockholm, 22 May 2001) and entered into force on 17 May 2004. The text was subsequently amended by the Conference of the Parties at its fourth meeting (Geneva, 4 - 8 May 2009), fifth meeting (Geneva, 25 - 29 April 2011), sixth meeting (Geneva, 28 April - 10 May 2013), seventh meeting (Geneva, 4 - 15 May 2015), its eighth meeting (Geneva, 24 April - 5 May 2017) and at its ninth meeting (Geneva, 29 April – 10 May).

The 2019 revised text of the Convention includes the amendments adopted by the ninth meeting of the Conference of the Parties to Annexes A and C, to list dicofol and Perfluorooctanoic acid (PFOA), its salts and PFOA-related compounds in Annex A to the Convention; and to amend the listing in Annex B to the Convention of perfluorooctane sulfonic acid (PFOS), its salts and perfluorooctane sulfonyl fluoride (PFOSF).

The Stockholm Convention is a global treaty that aims to protect human health and the environment from the effects of persistent organic pollutants (POPs). The Convention entered into force on May 17, 2004.

What are some characteristics of POPs?

- They are toxic
- They have the potential to accumulate in unhealthy quantities in humans and animals
- They are stable and thus resistant to natural breakdown
- They can be transported over long distances through the atmosphere and oceans

POPs have been shown to adversely affect human health and the environment. They have been linked to cancer, damage to the nervous system, reproductive disorders, and weakening of the immune system.

How does the Stockholm Convention Work?

The Stockholm Convention, which currently regulates 29 POPs, requires parties to adopt a range of control measures to reduce and, where feasible, eliminate the release of POPs. For intentionally produced POPs, parties must prohibit or restrict their production and use, subject to certain exemptions such as the

continued use of DDT. The Stockholm Convention also requires parties to restrict trade in such substances. For unintentionally produced POPs, the Stockholm Convention requires countries to develop national action plans to address releases and to apply "Best Available Techniques" to control them. The Stockholm Convention also aims to ensure the sound management of stockpiles and wastes that contain POPs.

Basel Convention on Hazardous Waste

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal was adopted on 22 March 1989 by the Conference of Plenipotentiaries in Basel, Switzerland, in response to a public outcry following the discovery, in the 1980s, in Africa and other parts of the developing world of deposits of toxic wastes imported from abroad.

The objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as "hazardous wastes" based on their origin and/or composition and their characteristics, as well as two types of wastes defined as "other wastes" - household waste and incinerator ash.

It was necessitated by the tightening of environmental regulations in the industrialized world in the 1970s and 1980s leading to an escalation of disposal costs. This in turn led some operators to seek cheap disposal options for hazardous wastes in Eastern Europe and the developing world. The Basel Convention sought to combat the "toxic trade". The Convention entered into force in 1992.

Aims and provisions

The provisions of the Convention center around the following principal aims:

- the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;

- the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and

a regulatory system applying to cases where transboundary movements are permissible.

The first aim is addressed through a number of general provisions requiring States to observe the fundamental principles of environmentally sound waste management (article 4). A number of prohibitions are designed to attain the second aim: hazardous wastes may not be exported to Antarctica, to a State not party to the Basel Convention, or to a party having banned the import of hazardous wastes (article 4). Parties may, however, enter into bilateral or multilateral agreements on hazardous waste management with other parties or with non - parties, provided that such agreements are "no less environmentally sound" than the Basel Convention (article 11). In all cases where transboundary movement is not, in principle, prohibited, it may take place only if it represents an environmentally sound solution.

The regulatory system is based on the concept of prior informed consent, it requires that, before an export may take place, the authorities of the State of export notify the authorities of the prospective States of import and transit, providing them with detailed information on the intended movement. The movement may only proceed if and when all States concerned have given their written consent (articles 6 and 7).

The Convention also provides for the establishment of regional or sub-regional centres for training and technology transfers on the management of hazardous wastes and other wastes and the minimization of their generation.

Rotterdam Convention

The text of the Rotterdam Convention was adopted on 10 September 1998 by a Conference of Plenipotentiaries in Rotterdam, the Netherlands. The Convention entered into force on 24 February 2004.

The objectives of the Convention are:

- to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm;

- to contribute to the environmentally sound use of those hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties.

The Convention creates legally binding obligations for the implementation of the Prior Informed Consent (PIC) procedure. It built on the voluntary PIC procedure, initiated by UNEP and FAO in 1989 and ceased on 24 February 2006.

Major Provisions:

The Convention covers pesticides and industrial chemicals that have been banned or severely restricted for health or environmental reasons by Parties and which have been notified by Parties for inclusion in the PIC procedure. One notification from each of two specified regions triggers consideration of addition of a chemical to Annex III of the Convention. Severely hazardous pesticide formulations that present a risk under conditions of use in developing countries or countries with economies in transition may also be proposed for inclusion in Annex III.

Once a chemical is included in Annex III, a "decision guidance document" (DGD) containing information concerning the chemical and the regulatory decisions to ban or severely restrict the chemical for health or environmental reasons, is circulated to all Parties.

Parties have nine months to prepare a response concerning the future import of the chemical. The response can consist of either a final decision (to allow import of the chemical, not to allow import, or to allow import subject to specified conditions) or an interim response. Decisions by an importing country must be trade neutral (that is, decisions must apply equally to domestic production for domestic use as well as to imports from any source).

The import decisions are circulated and exporting country Parties are obligated under the Convention to take appropriate measure to ensure that exporters within its jurisdiction comply with the decisions.

The Convention promotes the exchange of information on a very broad range of chemicals. It does so through:

- the requirement for a Party to inform other Parties of each national ban or severe restriction of a chemical;

- the possibility for Party which is a developing country or a country in transition to inform other Parties that it is experiencing problems caused by a severely hazardous pesticide formulation under conditions of use in its territory;

- the requirement for a Party that plans to export a chemical that is banned or severely restricted for use within its territory, to inform the importing Party that such export will take place, before the first shipment and annually thereafter;

- the requirement for an exporting Party, when exporting chemicals that are to be used for occupational purposes, to ensure that an up-to-date safety data sheet is sent to the importer; and

- labeling requirements for exports of chemicals included in the PIC procedure, as well as for other chemicals that are banned or severely restricted in the exporting country.

iv. Legal Framework

Application of national statutes and regulations on environmental conservation suggest that the project proponents will have a legal duty and social responsibility to ensure the proposed dam development is carried out without compromising the status of the natural resources in the area as well as the social and cultural settings.

The key national laws that govern the management of environmental resources in the country have been briefly discussed in the sections that follow. It is noteworthy that wherever any of the laws contradict each other, the Environmental Management and Co-ordination Act 1999 (Environmental Management and Coordination (Amendment) Act 2015) prevails.

The Environment Management and Co-ordination Act, 1999

The Environmental Management and Coordination Act (EMCA) 1999 being the principal law shall be read alongside the Environmental Management and Coordination (Amendment) Act 2015. The latter provides amendments to the Principal Act on section-by-section basis.

Part II of the Environment Management and Coordination Act, 1999 states that every person in Kenya is entitled to a clean and healthy environment in accordance with the Constitution and relevant laws and has the duty to safeguard and enhance the environment. Section 3 of the Act also states that every person shall cooperate with the State Organs to protect and conserve the environment

and ensure sustainable development and use of natural resources. To partly ensure this is achieved, Part VI under Section 58 of the Act directs that any proponent for any project to undertake and submit to NEMA an Integrated Environment Impact Assessment (unless exempted by NEMA), who in turn may issue a license as appropriate.

Section 9 of the Act provides for voluntary environment conservation practices through natural resources conservancies, easements, leases, payments for ecosystem services and other instruments. Guidelines in this regard are to be formulated through relevant Agency collaborations. This will be partly achieved through sustainable land use practices that are in conformity with conservation measures as emphasized under Section 51 of the Act. This includes sustainable land use methods, selection and management of sensitive areas including buffer zones and catchments, control of alien species and encouraging traditional conservation knowledge integration among others.

Section 57 of the Acts provides that all policies, plans, and programmes undergo Strategic Environment Assessment (SEA) following guidelines issued by NEMA. On specific projects, Part VII of the Act requires preparation of Integrated Environment and Social Impact Assessment as enhanced under Section 58 and sub-section 6. Proponents shall prepare and submit impact reports to the Authority unless they have been exempted. Under EMCA, 1999, a set of specific regulations have been developed to address management and compliance in special aspects of the environment.

EMCA Regulations

Water Quality Management Regulations, 2006 (Legal Notice No. 120)

These regulations were drawn under section 147 of the Environmental Management and Coordination Act 1999. In accordance with the regulations, every person shall refrain from acts that could directly or indirectly cause immediate or subsequent water pollution and no one should throw or cause to flow into water resources any materials such as to contaminate the water. The regulation also provides for protection of springs, streams, and other water sources from pollution.

The project proponent will endeavor to safeguard water from pollution at all stages of this project life cycle.

Waste Management Regulations, 2006 (Legal Notice No. 121)

The regulations are formed under sections 92 and 147 of the Environmental Management and Coordination Act, 1999. Under the regulations, a waste generator is defined as any person whose activities produces waste while waste management is the administration or operation used in handling, packaging, treatment, conditioning, storage, and disposal of waste. The regulations require a waste generator to collect, segregate and dispose each category of waste in such a manner as provided by relevant authorities. Regarding transportation, licensed persons shall operate transportation vehicles approved by NEMA and will collect waste from designated areas and deliver to designated disposal sites.

It is observed that the Regulations are limited on standards for general wastes management giving more weight on hazardous wastes. The project activities will release oils and grease residuals from machinery and vehicle maintenance. Oils and grease are considered hazardous waste whose treatment and handling guidelines under these Regulations are illustrated under the 3rd Schedule of the Regulations.

The project proponent will observe the requirements under this regulation.

Noise and Excessive Vibration Pollution Control Regulations, 2009

Part II section 3(I) of these Regulations states that: no person shall make or cause to be made any loud, unreasonable, unnecessary, or unusual noise which annoys, disturbs, injures, or endangers the comfort, repose, health or safety of others and the environment. Section 3(2) deals with determining whether noise is loud, unreasonable, unnecessary, or unusual. Part II Section 4 also states that: except as otherwise provided in these Regulations, no person shall (a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations which exceed 0.5cm per second beyond any source property boundary or 30m from any moving source.

The second schedule defines maximum noise levels emitted from construction areas to facilities including health centers, educational institutions, homes for the aged and the aged, residential areas and commercial centers. The recommended levels are 60dBA by day and 35dBA by night. Other areas outside public locations are allowed to emit noise levels of up to 75dBA during the day and about 65dBA during the night. Quarrying activities within the proximity of silent zones and commercial areas are allowed to emit noise levels of up to 109dBA and 114dBA respectively.

Workers at the site will be provided with earmuffs and other protective clothing and all non – essential work will be stopped during night-time.

Air Quality Regulations

Under the general prohibitions (Part II), section 5 states that no person shall act in a way that directly or indirectly causes immediate or subsequent air pollution. Among the prohibitions are priority air pollutants (as listed under schedule 2 of the regulations) that include general pollutants, mobile sources, and greenhouse gases. Odors are also prohibited under section 9 of the regulations (offensive emissions). Emissions into controlled areas such as schools, hospitals, residential areas and populated urban centers are also prohibited.

Part VII on occupational air quality limits in section 29 states that an occupier of premises shall ensure that exposure of indoor air pollutants does not exceed the limits stipulated under the Factories and Other Places of Work rules or under any other law. Other sources that are recognized under sections 32 and 33 are those arising from construction equipment and materials as well as particulate matter from demolitions of structures and buildings as well as stockpiled dry materials. Sources of air pollutants from the construction works will include traffic in and out of the site emitting dust, rock crushing at quarry sites, batching plants, power generators and earth works at site among others.

All dusty roads will be watered during the day and regular maintenance of cars as well as machines taking care to avoid oil spillages and other contaminants.

Biodiversity Regulations

Part II of Regulations, section 4 states that no person shall engage in any activity that may have adverse impacts on ecosystems, lead to introduction of exotic species or lead to unsustainable use of natural resources without an EIA license. The regulation puts in place measures to control and regulate access and utilization of biological diversity that include among others banning and restricting access to threatened species for regeneration purposes. It also provides for protection of land, sea, lake or river declared to be a protected natural environmental system in accordance to section 54 of EMCA, 1999.

The proponent will consult the relevant agencies before causing to be introduced any species foreign to the project area. There are, however, no plans to exploit the biodiversity found in the project area.

The Water Act 2016

Section 22 of the Act allows the Water Resources Authority the responsibility to take any lawful action that will protect established water catchment and the water resources thereof. Section 36 of the Act outlines requirements to be met for abstraction and use of water while Section 40 provides procedures for obtaining a water abstraction permit. It also includes undertaking Environment Impact Assessment study for the target abstraction point as well as appropriate consultations with the relevant stakeholders in accordance with the environmental impact assessment as is required by the Environmental Management and Coordination Act, 1999. Part of the water abstraction conditions are listed under Section 43 of the Act while groundwater abstraction is guided by the Fourth Schedule of the Act.

The Act provides for the identification and protection of vulnerable water resources (catchment areas) for surface water with the responsibilities placed on Basin Water Resources Committees as established under Section 26 of the Act. Water Resources Users Associations (WRUAs) are constituted at the sub-basin levels being community-based initiatives for collaborative management of water resources and conflict resolutions (Section 29. Water Resources Authority supports these initiatives through the formation of Sub-Catchments Management Plans (SCAMPs).

The project proponent will consult WRA and obtain the necessary permits and licenses.

Water Rules

One of the outcomes of the water sector reforms has been improved regulatory framework for water resource management and use. In addition to the Water Act 2002, the main document outlining the regulations is the Water Resource Management Rules 2007. The rules set out the procedures for obtaining water use permits and the conditions placed on permit holders. Sections 54 to 69 of the Water Resources Management Rules 2007 impose certain statutory requirements on dam owners and users in regard.

Other sections within the rules imply that WRA can impose water quality sampling requirements from the water sources and impacts to the hydrology, water chemistry and river morphology downstream the basin. Section 16 of the Water Rules requires approval from the Water Resources Authority (WRA) for a variety of activities that affect the water resources, including the storage of water in dams and pans. Approval by WRA is conferred through a Water Permit. A permit is valid for five years and must be renewed.

Section 104 of the Water Resource Management Rules requires certain water permit holders to pay water use charges. The intention of the water use charges was to raise revenue for water resource management activities, raise revenue for catchment conservation activities, improve efficiency of water resource abstraction and provide a system of data collection on water resource usage.

Potential sources of water pollutants at the project will include discharges from camp sites, washrooms and toilets, car wash platforms, workshops, areas of earthworks and materials piles, spills from batching areas and parking areas. The Contractor will abide by the provisions of the Fourth Schedule of the Rules.

The project camp site will be provided with the required sanitation facilities and waste management facilities.

6.4.1. The Public Health Act (Cap. 242)

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

The project proponent will endeavor to always maintain cleanliness in all places and as well as taking the necessary measures to prevent infestation by disease causing vermin.

The Forest Act

The Forest Act No. 7 of 2005 consolidates all forests under the act and prescribes heavy penalties for damage to forests and trees. Charcoal burning in a forest or farmlands without a license or permit is an offence. Section 52(1) deals with felling, cutting, burning, injuring, or removing of any forest products. It sets heavy penalties for damaging trees. This assists farmers in maximizing benefits from growing trees. Section 40(1) of the act sets to ensure that the forest areas under her management are maintained for biodiversity, cultural or recreational use. In addition, it protects the concession area from destruction and encroachment by other persons.

Section 41(1) says that all indigenous forests and woodlands shall be managed on a sustainable basis for purposes of, Conservation of water, soil and biodiversity, River line and shoreline protection. Cultural use and heritage.

Recreation and tourism, Sustainable production of wood and non-wood products, Carbon sequestration and other environmental services Education and research purpose and habitat for wildlife in terrestrial forests and fisheries in mangrove forests. The Act puts emphasis on the need to strengthen community-based institutions by creation of Community Forest Associations, which gives the public a greater participatory role to the community in the forest conservation.

For this project site no forests either private or public are to be affected.

The Agriculture Act

Part IV no. 48 states that if the Minister considers it necessary or expedient so to do for the purposes of the conservation of the soil of, or the prevention of the adverse effects of soil erosion on, any land, he may, with the concurrence of the Central Agricultural Board, make rules to ensure the preservation of the environment. These rules may include:

(i) Breaking or clearing of land for the purpose of cultivation is prohibited.
(ii) Control, regulation or prohibition of grazing or watering animals.
(iii) With this prohibiting rule, the clearing or destruction of vegetation is done if deemed necessary by the minister for the preservation of soil and its fertility.

Part IV no. 48(b) state the act requires the regulating or controlling of:

(i) The afforestation or reforestation of the land,
(ii) The protection of slopes, catchment areas or other areas.
(iii) Rules made under section 48 may provide for the seizure and forfeiture of any stock pastured in contravention of a land preservation order.

The appropriate soil conservation measures will be instituted, and restoration carried out in all affected areas.

Pest Products Control Act

CAP 346 of the act says that no pest control product shall be sold without a label which has been approved by the board. Each label shall:

(i) Show name of pest control product and a description of its form and name of its active ingredients.
(ii) The class designation of the pest control product in capital letters and shall be classified as the first schedule.
(iii) Information detailing the nature and degree of hazard identified by appropriate precautionary symbol.
(iv) Information identifying any significant hazards in respect to handling, storage, display, and disposal of the pest control product with information that

will include instructions respecting procedures to alleviate hazards and when required by the board, instructions respecting decontamination procedures and disposal of the pest control product and the empty package.

Pest control product is to be used only in accordance with the directions on the label. It is an offence under the pest control products act to use or store a pest control product under unsafe conditions.

Any pest control products to be used will be in the safe custody of a responsible officer.

Physical Planning Act (Cap. 286)

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

There is no change of use issues for this project but any approvals necessary will be sought before project commencement.

The Penal Code Cap. 63

Section 191 of the Penal Code states that any person or institution that voluntarily corrupts or foils water for public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence. Section 192 of the same act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons/institution in dwellings or business premises in the neighborhood or those passing along public way, commits an offence.

The project proponent will take all care to leave all elements of the environment better than they were before project implementation.

Occupational Safety and Health Act. 2007

Before any premises are occupied, or used a certificate of registration must be obtained from the Director of Occupational Safety and Health Services. The Act provides for the health, safety, and welfare for employees at workplaces. General requirements of this Act vests obligations on occupiers (Part II) to ensure the safety, health and welfare at work of persons employed and to prevent occupational accidents, any situation potentially hazardous shall be rectified when detected. Section 44 of the Act requires contractors to register with the Directorate of Occupational Safety and Health Services before commencement of works on site.

Competent persons shall oversee site safety and appropriate arrangements be made to ensure that safety and health committees are formed as provided for in Section 9 of OSHA and Section 4 of the Factories and Other Places of Work (Safety and Health Committees) Rules. All employees are expected to be made aware of their obligations to comply with provisions of the Act through appropriate trainings organized by the contractors. Appropriate personal protective equipment shall be provided by the contractors to all employees to protect them from hazards associated with their work. These should include highly reflective jackets, helmets, dust masks, earmuffs, safety harnesses when working at heights, and protective clothing.

Section 55 specifies requirements for compliance with provisions of Machinery Safety. In construction sites of the proposed magnitude and nature, strict protocols need to be put in place to ensure all plants and equipment conforms to these requirements. These include earth moving equipment, chains, hoists, and lifting equipment including tower cranes. This equipment shall be maintained in accordance with provisions of the subsidiary legislation.

Special care shall be taken by the contractor to ensure transport safety including maintenance of fleet and control of speeds so as not to foul the air with dust. Excessive dust may have dire consequences to aviation space and therefore must be checked through regular water sprinkling of routes used by trucks, or by application of appropriate hydroscopic materials on earth roads. In addition, the contractor must carefully select routes to be followed during movement of construction materials. All drivers must have the requisite training and competence to operate stationary and mobile equipment, and appropriate procedures developed by the contractor must be always observed. These may include loading and unloading procedures.

The project proponent will appoint the required Safety and health officer.

The HIV and AIDS Prevention and Control Act

This Act commenced in March of 2009. It is an Act of Parliament to provide measures for the prevention, management and control of HIV and AIDS, to provide for the protection and promotion of public health and for the appropriate treatment, counselling, support, and care of persons infected or at risk of HIV and AIDS infection, and for connected purposes. Part 11, Section 7 requires HIV and AIDs education in the workplace. The government is expected to ensure provision of basic information and instruction on HIV and AIDs prevention and control to; Employees of all Government ministries, Departments, authorities, and other agencies; and Employees of private and informal sectors. The information on HIV/AIDs is expected to be treated with confidentiality at the workplace and positive attitudes shown towards infected employees and workers. Provisions of this Act forms part of the bidding document and the Contractor will comply by utilizing resources set aside in the BoQ.

There will be deliberate efforts to sensitize all project stakeholders on AIDS and other sexually transmitted diseases.

The Workmen Compensation Act Cap 236

Part II Section 5 of the Act instruct that personal injuries arising out of employment to a workman the employer shall be liable to pay compensation unless it is proved that the injuries are because of willful misconduct of the workman. Section 6 and 7 of the Act outlines payment of compensation to a workman or his/her dependents in the event of permanent injuries or death while at the place of work. Section 10 guides on the calculation of the compensation for the workman. Section 14 and 15 is a guide on reporting procedures for accidents and provision of medical examination and treatment to the workmen.

Worker welfare will be taken into consideration during project implementation.

Work Injury Benefits Act, 2007

Part II of the Act requires Employers to obtain and maintain insurance policy for their employees while Part III Section 10 provides for compensation of employees who get involved in accidents resulting in disablement or death and is entitled to benefits unless it is a result of misconduct of the employee. Under Section 34, in the event of death arising from the occupational accident, the compensation shall be paid to the dependents of the employee. Part VII section 45 requires that an employer provide and maintain appliance and services for rendering first aid to his employees. Section 48 instructs that an Employer shall defray any expenses reasonably incurred by an employee because of an accident arising out of and during the employer's employment.

The project proponent will endeavor to create a safe working environment to forestall the occurrence of accidents or any other situation likely to trigger the provisions of this act.

7) PUBLIC PARTICIPATION

Public participation is all about involving, informing and consulting the public in planning, management and other decision making activities before project commencement. This process aims at ensuring that due consideration is given to public values, concerns and preferences when decisions are finally made.

Public involvement is a requirement in Environmental Impact Assessment (EIA) systems, and is recognized as a fundamental element of the process. The range of stakeholders involved in an EIA typically includes the local communities, the proponent, government agencies, NGOs and academics. Public participation should influence and inform the decision-making process.

Public consultation in this project was carried out in order to:

(a) Seek views, concerns and opinions of people in the area concerning the project.

(b) Inform the local people, leaders and other stakeholders about the proposed project and its objectives.

(c) Seek from the locals and other stakeholders any positive or negative impacts the project may have on them and the environment.

The approaches that were made use of during public consultation included:

- Direct observation and Photography: - This was useful in especially capturing the real situation on the ground that was relevant to the study.

- Structured questionnaires: - This were used to collect information from community members, the local administration and other key stakeholders.

- Interviews: - These were simple one on one discussions or consultation meetings with relevant stakeholders.

The views collected were analysed and made use of in proposing suitable impact mitigation measures and coming up with the ESIA ToRs.

Some of the views included:

- Some of the community members in the area adjacent to the dam may not get to use the water.
- Whether people downstream would still continue getting water after dam construction?

- Good for Government to consider putting up another project in Yatta for use by the area residents.
- How soon the project construction would commence?
- Would locals benefit from employment opportunities?
- Could the project's fine details and designs be shared with the public?
- Most of the rivers in the area are seasonal and dry up during drought
- What happens to infrastructure in the way of the proposed project

8) ENVIRONMENTAL IMPACTS

The following are the impacts identified that may be associated with the proposed project:

I. The up - stream Impacts:-

a) Displacement of small animals, insects and predators

When a dam is constructed the stored water sips into spaces that were habited by small animals and insects. Termite mounds and hills cannot thrive under water. Termite nests are designed subterranean (underground), epigeal (close to the ground) or arboreal (living in trees). They are complex in geometry and material composition. Some of the materials include: chopped - up, pre - digested plant matter mixed with inorganic components. The colony within engineers favourable living conditions by controlling the mound's microclimate.

Termites are known to not swim in abundant water but drown. The dam also messes up the living conditions and food available for the termites.

Other small animals like rats, moles can also not survive in the area and would have to move.

Mitigation:

Create a reserve area around the dam to serve as a riparian area which could house the displaced insects, small animals and predators to a certain extent. It would also serve as a buffer to help prevent contamination of water by anthropogenic activities.

b) Loss of forests and flora

Trees are cut to make room for construction of the dam. The plant cover is also removed in the area which will be inundated by the water. Once the reservoir is full it can also result in the introduction of new plant species including water hyacinth and various types of reeds.

This may result in introduction of a multiplicity of organisms that are foreign to the area.

Mitigation:

Planting of trees that are indigenous to the area around the reservoir at a safe distance from the water. The control of water weeds and invasive species has also to be done regularly.

c) Siltation and sedimentation of reservoirs

Sediment transport is the general term used for transport of materials like silt, sand, gravel, boulders, in rivers and streams. The transported material is called the sediment load. The total sediment is volume of sediment particles in motion per unit time. This includes the sediment transported by bed load motion and by suspensions as well as the wash load. Siltation is the accumulation of silt (fine particles of sand, mud, and other materials) in the reservoir. It is also known that any water containing silt is turbid in nature and

hence require treatment before usage. Water flowing in streams or rivers has the ability to scour channel bed, to carry particles and to deposit materials. This phenomenon of sediment transport can affect substantially the design of reservoirs. Many cases have been recorded where reservoir siltation rendered water storage structures useless in less than 25 years.

Mitigation

Constructing a check dam before the main dam, sediment barriers, controlling erosion or scraping the dam bed periodically.

d) Reservoir induced seismicity causing earthquakes

Seismicity is the frequency of occurrence of earthquakes. They occur when the strength of a mass of rock, or frictional resistance between adjacent bodies of rock, is exceeded by stresses. A fault is a fracture where rock bodies have moved relative to each other. If a fault is oriented so as to be susceptible to slipping, and is near a critical state of stress, an increase in pore fluid pressure in the surrounding rock can reduce the friction holding the fault in place, thus potentially triggering an earthquake. Injection of fluid into the subsurface may cause such an increase in pore pressure, reducing friction, allowing fault movement possibly inducing earthquakes. Other factors affecting whether injected fluids will induce seismicity, include the distance between a fault and an injection well, permeability of the strata surrounding the fault, and the volume and rate of injection.

Mitigation

Carrying geophysical investigations to determine the presence of major fault lines that may predispose the area to seismicity. For cases where

faults are detected grouting will be carried out to reduce the instances of major fluid injections to the underground.

e) Microclimatic change

Dams substantially affect their places and close vicinity from economic, sociocultural and ecological aspects. Impacts of dams can be positive or negative. Especially, big dams storing more than 3 million m^3 water.

They also have been found to affect the climate at local level. These studies show that humidity rates increases in close proximity to large dams as well as decrease in annual temperature differences. They do not however, increase precipitation.

The moderate increase in humidity levels is therefore more of an advantage to plant and animal life and requires no mitigation.

f) Lose of agricultural/grazing land

Dams occupy space on land. This may have been used for production of food or grazing animals that produce benefits for their owners. Before dam construction therefore studies to determine the economic value of the loss as compared to the economic value of the benefits of the dam have to be conducted.

For the proposed Mavoloni Field Unit dam, the increase in economic benefits from the dam outweigh the losses. The dam will result in an increase in irrigated land that is greater in size compared to the space the dam occupies.

g) Availability of water for irrigation and other uses

A constructed dam acts as a reservoir for water that can be accessed during the dry period as well as the year round for purposes of irrigation. The accumulated water stores energy also which may be used to supply the water to areas lower in altitude as compared to the dam site. It also makes planning for activities possible due to a fixed amount of water available which may be deployed when required provided the amounts do not exceed the dammed amount.

h) Control of floods

Global warming is expected to increase flood risk by altering the distribution, variability, and intensity of precipitation events. While global estimates of populations exposed to river flooding vary widely across studies, a general increase in flooding events is predicted. By regulating water flow, dams generally alter the frequency, duration, and timing of annual flooding events. To

mitigate against floods, understanding the role of dams in climate impact studies has become increasingly important (Boulange et al., 2021).

i) Store of water for use during the dry periods

A dam is a structure built across a river or stream to hold back water. People have used different materials to build dams over the years. Ancient dam builders used natural materials such as rocks or clay. Modern - day dams are often built using concrete. Manmade dams create artificial lakes called reservoirs. Reservoirs can be used to store water for farming, industry, and household use. They also can be used for fishing, boating, and other leisure activities. Establishing nature gardens or other well maintained artificial gardens also helps in improving the aesthetics of the area around the dam. Dams are used in helping prevent flooding as well. https://education.nationalgeographic.org/resource/dams/

j) Marginal recharge of the underground aquifer

A recharge check dam is a barrier that is placed across a river or water channel to slow its movement, enabling seepage and groundwater recharge. Groundwater is an important source of water supply in semi - arid regions. It is protected from high evaporation rates that affect surface water bodies. To increase the sustainable yield of a groundwater body, induced groundwater recharge is of strategic importance. Due to climate change effects, managed aquifer recharge systems could be more effective than increasing surface reservoir capacities (Open-File Report, 1961)

II. The downstream impacts:-

a) Water logging and salinity due to over irrigation

Proper irrigation practices are crucial in maintaining adequate soil moisture in the crop root zone for healthy plant growth and optimum yield. Due to availability of water stored in dams some areas may experience over – irrigation.

The impact of excess water on crop growth and yield is influenced by crop type, soil characteristics, duration of excess water or flooding, initial soil water and nitrogen status, crop stage, soil and air temperature, as well as

other factors. Over - irrigation results in nitrogen leaching and runoff. Research has shown that excess water can increase weed pressure and create an environment favorable to diseases. The following are the effects of over – irrigation:

• Disturbs the oxygen balance of the root zone, drowns roots, reduces plant water uptake, and thus stresses plants.

• Reduces the exchange of air (oxygen) between the soil and atmosphere, and causes reductions in root growth (especially in the upper soil layers) and less transport of water and nutrients through the roots to the upper parts of the plant.

• Increases microbial growth which can cause the formation of sulfides and butyric acid that are toxic to plants.

• Increases the potential for root diseases.

• Causes a decrease in soil temperature, thus reducing root growth creating a shallow root structure.

• Leaches nutrients and pesticides from the root zone to groundwater.

• Negatively impacts yield.

• Wastes water and energy resources (Irmak & Rathje, n.d.)

Mitigation

The following practices will mitigate against over – irrigation:

- Charge for all water use including raw water pumped from any reservoir for use in irrigation.
- Sensitizing water users and farmers on the principles of integrated water resources management.
- Community ownership of dam projects to act as deterrent against resource misuse.

b) Reduced water flow and silt deposition in river

Water flowing in streams or rivers has the ability to scour channel bed, to carry particles and to deposit materials this is called silt deposition. Silt deposition is caused by transport of materials by rivers or streams. Sediment transport is the transport of materials like silt, sand, gravel, boulders, etc in rivers and streams. The transported material is called the

sediment load. This includes the sediment transported by bed load motion and by suspensions as well as the wash load. Siltation is the accumulation of silt (fine particles of sand, mud, and other materials) in the reservoir. It is also known that any water containing silt is turbid in nature and hence require treatment before usage.

It also plays a role in the design of reservoirs. If not properly treated siltation may substantially reduce the productive life of dams (Mama & Okafor, n.d.).

Mitigation

- Watershed management to reduce silt load in the dammed river or stream
- Make use of silt traps upstream of the dam
- Removing sediment or de - siltation of dams

c) Outbreak of vector - borne diseases like malaria

By and large dams have improved the quality of human life by providing drinking water and by promoting economic growth through irrigation of agricultural crops, production of hydroelectric power and flood control. However, there are concerns about vector borne diseases, such as malaria, schistosomiasis, filariasis, onchocerciasis, and dracunculosis. Research has shown that the microdams in Ethiopia create favourable conditions for the transmission of Schistosoma mansoni, hookworm and trichuris. In one study, a seven - fold increase in the incidence of malaria among children living close to small dams in the Tigray region of northern Ethiopia was reported, compared with children in villages distant from the dams (BMJ).

Mitigation

- Surveillance to record cases of disease outbreaks and their severity (indicator based as well as event based)
- Preparation of procedures for communication of disease outbreaks
- Vector control practices such as introduction of species that feed on mosquito larvae

d) Ambient noise and Vibration levels

Ambient noise level is also called background noise level, reference sound level, or room noise level. It is the background sound pressure level at a given location, specified as a reference level to study a new intrusive sound source (Oguntunde et al., 2019).

The Igembe dam is set in an area that is predominantly rural and therefore devoid of significant noise sources. A significant increase in noise and vibration levels is therefore disruptive. A noise level is considered disruptive if:

It exposes human beings to noise levels exceeding those set in the applicable noise standards;

- It exposes human beings to excessive ground borne vibrations or noise
- It results in a periodic or temporary increase in ambient noise levels substantially above the levels that existed before the project commencement; and
- It results in a permanent substantial increase in noise levels in the project vicinity above those that existed in the area before project commencement.

- The following are the proposed mitigation measures:
- The contractor should endeavor to use equipment and machines fitted with noise abatement devices as much as possible;
- Idle machines and vehicles to be turned off and
- Avoid unnecessary hooting and honking;
- Provide workers at the site with ear muffs;
- Provide a register for complaint registration to allow any affected persons file a report
- Avoid working at night.

e) Air Quality

Air pollution is among the most common forms of pollution nowadays which also has an impact on climate change. It impacts on public and individual health leading to increasing mortality and morbidity. There are many pollutants that are major contributing factors to diseased humans, they include: Particulate Matter (PM), particles of variable but very small diameter, penetrate the respiratory system via inhalation, causing respiratory and cardiovascular diseases, reproductive and central nervous system dysfunctions, and cancer. Ozone in the stratosphere plays a protective role against ultraviolet irradiation but it is also harmful when in high concentrations at ground level, also affecting the respiratory and cardiovascular system. Other pollutants include: Nitrogen Oxide, Sulfur Dioxide, Volatile Organic Compounds (VOCs), Dioxins, and Polycyclic Aromatic Hydrocarbons (PAHs) (Manisalidis et al., 2020).

Air quality is mainly impacted upon by the generation of dust. The project area has some roads which have not been upgraded to the bitumen standard. Vehicle and machine movement in the area together with site activities including excavation works and vegetation clearing may result in air quality deterioration.

The proposed Mitigation measures include;

- The workers working at the site have to be provided with Personal Protective Equipment to avoid negative effects on their health;
- The equipment and machinery used have to be regularly maintained and serviced to reduce emissions;
- Sprinkling water on dusty roads that are made use of regularly;
- Prior planning of transportation and vehicle movement to ensure vehicle and machine movements are kept to the minimum.

f) Occupational Health and Safety

Construction works exposes workers to certain risks associated with working with machines and increases possibilities of accidents. Other risks may be as a result of failure to provide protective clothing, sanitation facilities on site and potable water.

The following are the proposed mitigation measures:

- The contractor to develop and implement an on – site Health and Safety Rules and Regulations manual;
- Provision of Personal Protective Equipment to all workers and site visitors at least for the duration of the site visit;
- Enforce adherence to safety procedures on all workers;
- Provide access to first aid kits and qualified first aid personnel on site;
- Provision of sanitary facilities and clean drinking water; and
- Preparation of a site - specific Occupational Health and Safety Management Plan along with an Emergency Preparedness and Response Plan.

g) Possibility of contracting Covid - 19

Corona viruses are a large family of disease causing pathogens. They are known to cause a wide range of diseases including the common cold, Severe acute respiratory syndrome and the Middle East respiratory syndrome.

Covid – 19 is a novel Corona Virus that has not previously been identified in humans. Once it affects a human being it produces varied symptoms such as Coughing, Fever, exhaustion, Nausea, breathing difficulties among others.

The following are the mitigation measures:

- Social distancing
- Wearing masks
- Avoiding large gatherings of people especially during public participation meetings
- Sanitizing hands and pens used during public participation meetings
- Limiting all meetings to one hour duration

h) Waste Generation

Construction activities generate wastes over the construction period. The wastes generated include; Felled trees, shrubs, packaging materials, plastics, material rejects such as damaged blocks, and wastewater.

The construction camp also produces sewerage and wash water.

The following are the proposed mitigation measure:

- Organic wastes especially from the camp to be composted on site;
- Felled trees and shrubs may be collected by locals for use as firewood;
- Pit latrines to be dug for the workers residing in the construction camp; and
- Plastic waste may be recycled or delivered to an appropriate waste reduction facility.
- The wastewater generated from the resident workers should be disposed in a septic tank with a soak pit. The septic tank should be constructed in such a way that it does not malfunction and contaminate groundwater.

9) ESIA METHODOLOGY

The impact assessment methodology to be used in the ensuing Environmental and Social Impact Assessment report will provide a basis to characterise the potential environmental and social impacts of the Project. Such activities as routine and non-routine Project Activities or events required for the Construction and Pre-Commissioning, Operational, or Decommissioning Phases of the Project will be considered.

Particular importance will be attached to the identification of impacts, mitigation measures and eventual development of the Environmental and Social Management & Monitoring Plan (ESMMP)

Also called an Environmental Action Plan or corrective action plan, the ESMMP will define resources, roles and responsibilities required to manage biodiversity impacts and implement mitigation measures. It forms a link between the ESIA report and the Social and Environmental Management System. The central elements of the developed ESMMP will include a description of the activities planned to mitigate impacts, a time line and identification of resources to ensure the ESMMP can be delivered.

The ESMMP will also define monitoring requirements to determine whether mitigation was carried out as it should have been. Although monitoring is often overlooked since it occurs once the project has been approved and is underway, it is important for providing evidence whether the proponent has achieved compliance and allowing for additional necessary remedial measures to be put in place.

10) ENVIRONMENTAL MANAGAMENT PLAN

Table 5: Environmental Management Plan

Level	Impact	Proposed Mitigation	Responsibility	Cost (Kes)
Up - stream				
	Displacement of small animals, insects and predators	• Creating a vegetated area around or near the dam to provide shelter	Contractor Proponent	100,000
	Loss of forests and flora	• Planting of trees that are indigenous to the area around the reservoir in consultation with KFS	Contractor	120,000

	Siltation and sedimentation of reservoirs	• Constructing a check dam before the main dam • Scraping the dam bed periodically • Controlling erosion in the catchment	Contractor and Proponent	250,000
		-		
	Reservoir induced seismicity causing earthquakes	• geophysical investigations • Grouting	Contractor and proponent	200,000
Down - stream				
	Water logging and salinity due to over irrigation	• Charge for water use • Sensitization of farmers	Contractor and Proponent	25,000
	Reduced water flow and silt deposition in river	• Watershed management • Silt traps • de - siltation	Proponent WRA	250,000

	Outbreak of vector - borne diseases	• Vector control	Proponent	20,000
General	Noise Emission	• Water dusty roads when significant movement is expected.	Contractor	100,000
	Dust emission	• Keep vehicle and machine movement to the minimum on dusty roads and site • Service vehicles and machinery regularly. • Avoid working at night	Contractor	30,000
	Possibility of Covid – 19 infections	• Use of sanitisers • Social distancing	Contractor and Proponent	20,000

	Waste Generation	• Place waste baskets at strategic places on site • Waste reduction and re – use	Contractor	20,000
	Air quality	• Provide protective equipment • Water dusty roads • Service and maintain machines	Contractor	200,000
		•		
General	Occupational health and safety	• On site safety regulations manual • Provide first aid kits and qualified personnel • Provision of sanitary facilities on site		50,000

11) CONCLUSIONS AND RECOMMENDATIONS

From the report content the following conclusions have been arrived at:

1. The need for water cannot be satisfied from the alternative sources available
2. There are no negative impacts that cannot be mitigated against
3. The alternative sites to the current one are either not suitable geographically or geological setting
4. The impacts can also be classified as positive or negative, however mitigation measures have been proposed for all negative impacts
5. The construction of the dam will support the increase in number sof service men/women as well as the corresponding increase in production of food and animal products to feed them

It is therefore recommended that the NYS Mavoloni dam be constructed with full implementation of the Environmental Management Plan with constant monitoring during and after construction to identify issues that need addressing.

12) BIBLIOGRAPHY

(i) Boulange, J., Hanasaki, N., Yamazaki, D., & Pokhrel, Y. (2021). Role of dams in reducing global flood exposure under climate change. *Nature Communications*, *12*(1), 417. https://doi.org/10.1038/s41467-020-20704-0

(ii) Djuma, H., Bruggeman, A., Camera, C., Eliades, M., & Kostarelos, K. (2017). The Impact of a Check Dam on Groundwater Recharge and Sedimentation in an Ephemeral Stream. *Water*, *9*(10), 813. https://doi.org/10.3390/w9100813

(iii) Irmak, S., & Rathje, W. R. (n.d.). *Plant Growth and Yield as*

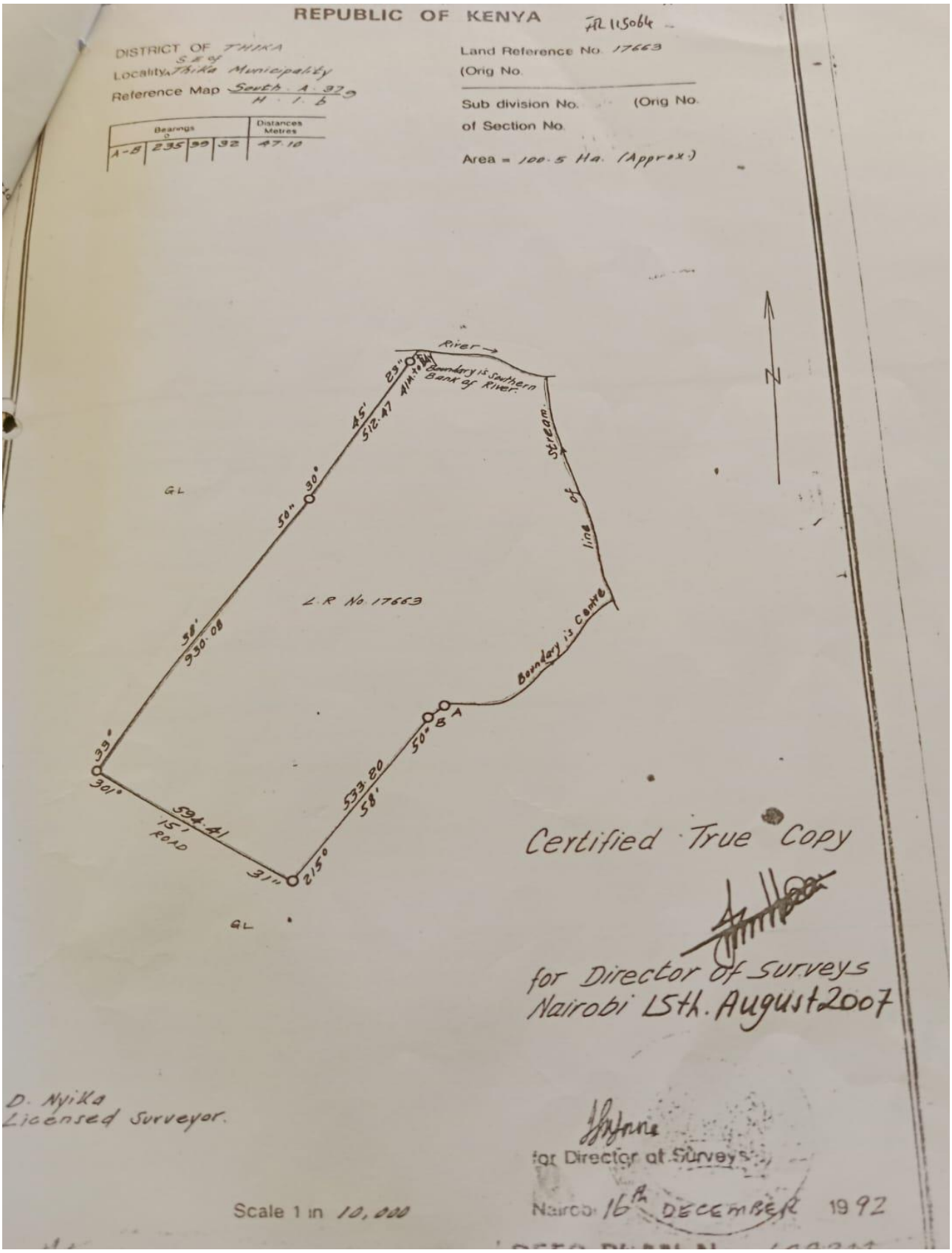
Affected by Wet Soil Conditions Due to Flooding or Over-Irrigation.

(iv) Mama, C. N., & Okafor, F. O. (n.d.). SILTATION IN RESERVOIRS. *Nigerian Journal of Technology*, *30*(1).

(v)*Open-File Report* (Open-File Report). (1961). [Open-File Report].

13) **APPENDICES**

1. Land Ownership



REPUBLIC OF KENYA

NEW GRANT

DISTRICT OF THIKA

Locality S.E of THIKA Municipality

Reference Map Survey A 37 H 1 6 5

Land Reference No 9434

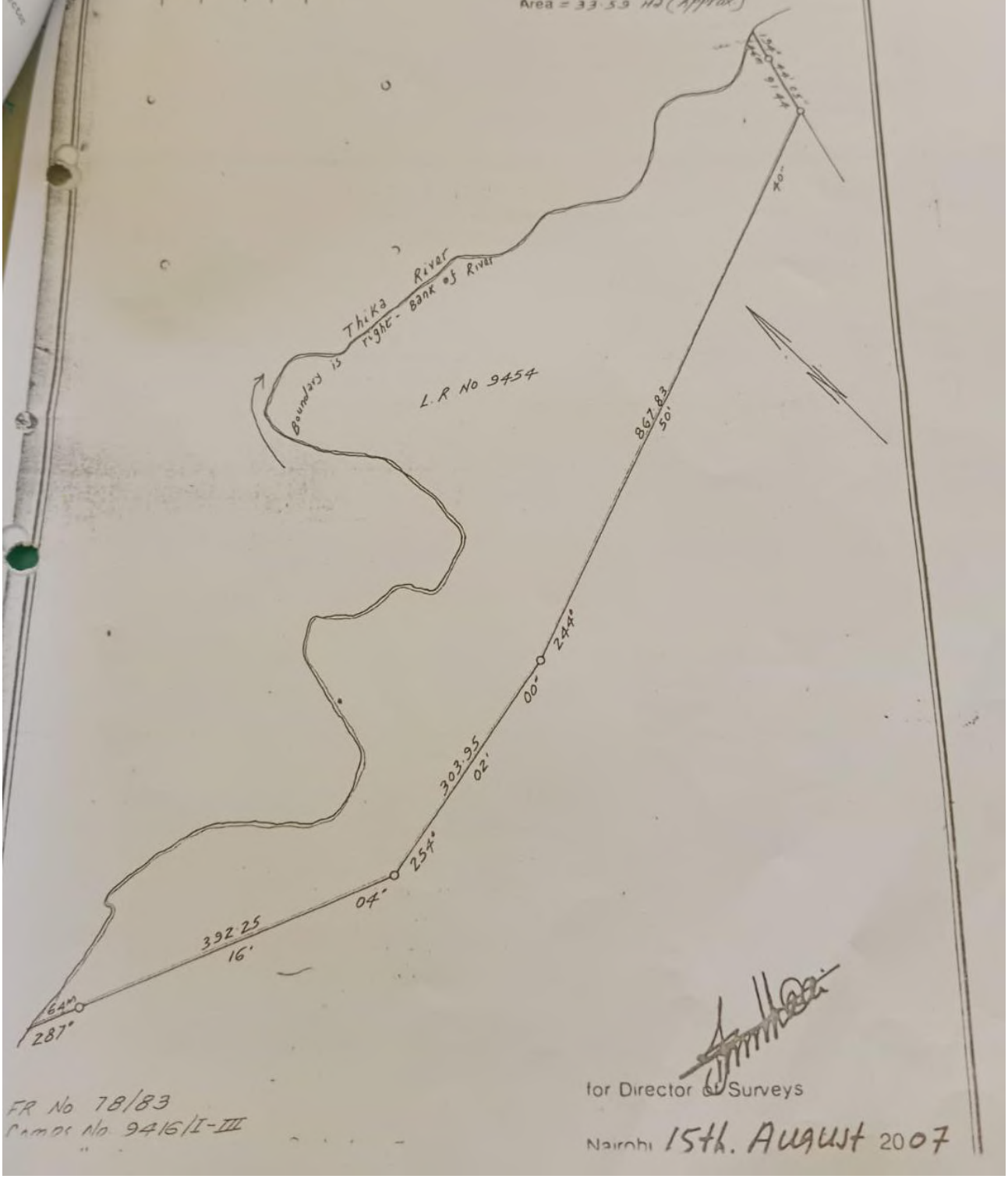
(Orig No

Sub division No (Orig No

of Section No

Area = 33.53 Ha (Approx)

Bearings °	Distances Metres



for Director of Surveys

Nairobi 15th. August 2007

FR No 78/83

Camos No 9416/I-III

NEW GRANT
IR. 113330

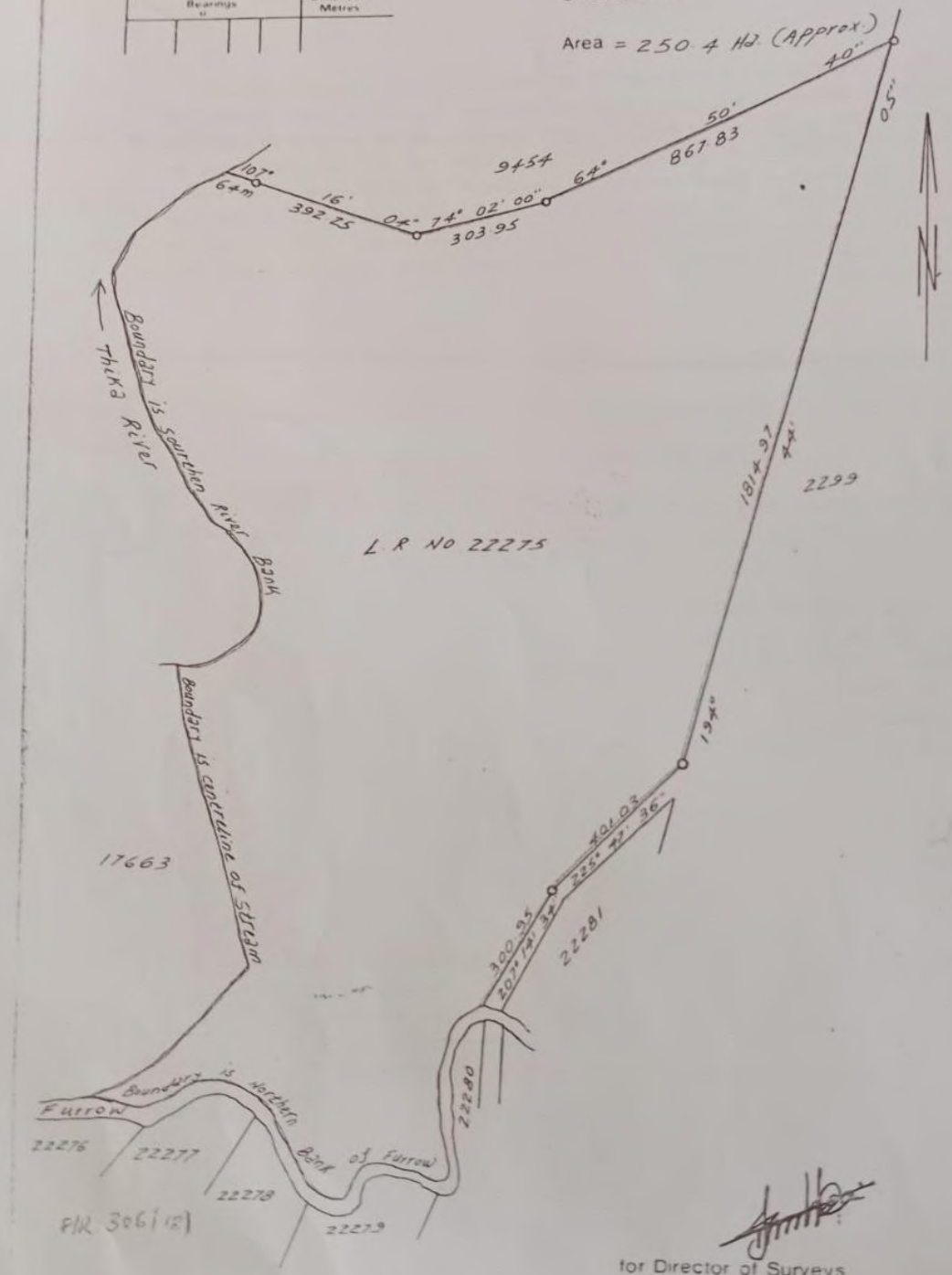
REPUBLIC OF KENYA

DISTRICT OF MACHAKOS
Locality S.E. of Thika Municipality
Reference Map South A 37 / H. 1. b 9

Land Reference No. 22275
(Orig No
Sub division No. (Orig No
of Section No.

Area = 250.4 Ha. (Approx.)

Bearings ° ' "	Distances Metres
107° 64m	
16'	392.25
04° 74° 02' 00"	303.95
64°	867.83
50'	
40"	
05"	
194°	1814.37
44'	
225° 42' 36"	401.03
207° 14' 32"	300.35



for Director of Surveys

Scale 1 in 10000

Nairobi 7th. March 2007

DEED PLAN No. 274639

2. Minutes

MINUTES OF ESIA PUBLIC PARTICIPATION EXERCISE – MAVOLONI NYS DAM HELD AT MAVOLONI NYS UNIT ON 1st NOVEMBER 2023 FROM 09:30HRS

PRESENT

A list of the participants is attached as an annexure to these minutes.

MINUTE 1 – MAVOLONI-NYS/ESIA/ 01/1/11/2023 - PRELIMINARIES

The meeting was called to order at 9:30am with a word of prayer from one of the locals.

MINUTE 2 – MAVOLONI-NYS/ESIA/ 02/1/11/2023 - INTRODUCTION

An introduction of participants was done comprising of area Chief, members of the local community, NWHSA and NYS staff.

MINUTE 3 – MAVOLONI-NYS/ESIA/ 03/1/11/2023 - COMMUNICATION FROM AREA CHIEF xxxx

The area Chief extended a warm welcome to the visitors from NWHSA and thanked and management of Mavoloni NYS Unit for organizing the public participation meeting. The chief thanked the local community for taking their time from their busy schedules to attend the meeting.

The stakeholders were informed that NWHSA had requested a meeting with them and that it is a requirement that public participation must be undertaken before commencement of government projects.

MINUTE 4 – MAVOLONI-NYS/ESIA/ 04/1/11/2023 - COMMUNICATION FROM MAVOLONI NYS UNIT COMMANDING OFFICER MADDAM xxxx

The Commanding Officer welcomed NWHSA team and the local community to the Unit compound. She emphasized on the need for the continued mutual relationship between the community and NYS staff, servicemen and servicewomen.

MINUTE 5 – MAVOLONI-NYS/ESIA/ 05/1/11/2023 - COMMUNICATION FROM NWHSA ENVIRONMENT LEAD EXPERT – GEORGE MACHARIA

The Environment lead expert explained the purpose of the meeting was to collect views from the local community regarding the proposed Mavoloni NYS dam. He emphasized that importance of public participation as a forum for the project proponent (NYS) to explain the objectives of the project and for the community to give their views and concerns about the proposed project. He explained that it is a requirement under Environmental Management and Coordination Act 2009 and Constitution of Kenya 2010.

MINUTE 6: MAVOLONI-NYS/ESIA/ 06/1/11/2023 – QUESTION AND ANSWER SESSION

The following issues were raised by the local community. The responses of NYS and NWHSA team also shown in the table below:

No	Name	Issues	Response
1	Community	• Will the dam affect the flow of the furrow serving both NYS and the local community?	• The project will impact positively on the flow of the furrow. NYS will have the dam as the main source of water hence reduce their water demand from the furrow. This means more flow will be available for other users downstream of the furrow.
2	Community	• Will the dam affect the community water pipeline passing through NYS grounds?	• The pipeline is outside the dam site and dam reservoir area and hence it will not be affected. • Due care will be undertaken to avoid any damage to the pipeline during construction. Incase of accidental damage, repairs will urgently be undertaken by NYS at no cost to the community.
3	Community	• Will the dam affect the seepage flow from NYS grounds and flowing through the dam site which is used by the communities and especially by Mamba villagers doing farming?	• During construction the flow will be affected. However NYS will ensure that the period of disturbance to the flow is minimized as much as it is practically possible. • The dam is expected to stabilize the flow throughout the year once completed.
4	Community	• Will the water be shared to the local community?	• The main objective of the dam is to supply water for NYS farms. • NYS will install water draw points for the community.
5	Community	• NYS to initiate Community Social Responsibility projects to benefit the community hosting NYS.	• Mavoloni NYS Unit will communicate these two requests to the Director General (DG) and will also

		• NYS to give slots of employment to local youths	communicate the feedback from the DG.

MINUTE 7: MAVOLONI-NYS/ESIA/ 07/1/11/2023 – QUESTINNAIRE

The participants were taken through the questionnaire and explained what each of the questions meant by Jonathan Mwania, a hydrologist from NWHSA. The filled questionnaires are herein attached with the minutes.

MINUTE 8: MAVOLONI-NYS/ESIA/ 08/1/11/2023 – VOTES OF THANKS

Mr. Macharia on behalf of NWHSA thanked members of the community for making time to attend the meeting. The Mavoloni NYS Commanding Officer Maddam xxxx also thanked the community and reminded those in attendance that they were ambassadors and should inform their neighbors about the project. The chief also addressed the community for coming and made some official government announcements.

There being no other business to transact the meeting ended at 11.45 pm with a word of prayer.

CERTIFIED BY:

NYS REPRESENTATIVE

Name: NATWARI WEKESA BEN **Signature**..... **Date** 01/11/2023

CHIEF

Name: COSMUS M KALOKI **Signature**..... **Date** 01/11/2023

3. Public participation lists

KENYA VISION 2030

NATIONAL YOUTH SERVICE

Mavoloni NYS Dam Project Public Participation Exercise Attendance Register				
No.	NAME	PHONE No.	ID/P.No.	SIGNATURE
1.	BRENDAH KHANALA	0743471102	41380555	
2.	MEDIATRINE KHAVETSA	0711713719	40945904	
3.	NARWA OTALO	0111746052	39506377	
4.	RUTH WANJIRU	0746729550	41201098	
5.	EUNICE WAMBUI	0745105213	37856744	
6.	ELIZABETH BAHATI	0741477669	39956024	
7.	DOREEN CHEBET	0729081616	40708581	
8	ROSE OOKO	0114579242	38356911	
9	VERA AWUOR	0726692013	37133498	
10	EVARLINE MWAMBERE	0707490178	40916096	
11	IMMACULATE NANDWA	0796036100	36599233	
12	EMMANUELA LEMUSI	0795162099	40553571	
13	BRANICE KARGHA	0796143163	37692959	
14	Anna Nzioki	0746413238	38116805	
15	Dorcas Wanjiku	0701690598	41278591	
16	DORCAS WAIRIMU	0759073949	40531306	
17	NANCY NGUGI	0745196180	38479556	
18	ANNJOY KAGWIRIA	0794138983	39628701	
19	Lucy KARANJA	0742660580	41271208	
20.	CHEROTICH CARREN	0715795555	40337763	
21	Roselyn malibe	0704881481	40340490	
22.	Talary Bella	0795180750	40982079	

KENYA VISION 2030

NATIONAL YOUTH SERVICE

Mavoloni NYS Dam Project Public Participation Exercise Attendance Register				
No.	NAME	PHONE No.	ID/P.No.	SIGNATURE
1.	Philip Mutunga	0702337491	39882033	[signature]
2	Bravin Wanjala	0794685683	40285474	[signature]
3	Jackson Kasina	0702749139	39003613	[signature]
4	Denis Kimani	0702384246	35318919	[signature]
5	Mark Ochieng	0113359159	37873134	[signature]
6.	Oscar Justin	0712101597	41443919	[signature]
7.	Stephen Mwangi	0792627367	39080097	[signature]
8.	Victor Lukhanga	0113721895	39772259	[signature]
9.	Cornelius Yano	0790240451	41080156	[signature]
10.	Samuel Mureithi	0742802539	39295207	[signature]
11.	Okwale Nyendo	0754278149	36794704	[signature]
12.	Brian Oseko	0711390219	39851935	[signature]
13	Chrispin Boke	0798611087	40986606	[signature]
14	Martin Mwikhali	0766056209	37649606	[signature]
15	James Mbatia	0757987160	35382731	[signature]
16	Alex Karani	0797238395	41327633	[signature]

KENYA VISION 2030

NATIONAL YOUTH SERVICE

Mavoloni NYS Dam Project Public Participation Exercise Attendance Register				
No.	NAME	PHONE No.	ID/P.No.	SIGNATURE
1	DAVID G NJOROGE	0708888865	1071872	
2	Jeremiah Kyeva	0727836131	22625730	
3	STEPHEN MUNENE	0723075024	22593765	
4	MOSES MUNENGE	0793675327	1301338	
5	ISAACH MACHARIA	0710129692	16647276	
6	FRANCIS MUTUA	0715153761	23883970	
7	Charles Mutuku	0714823650	20056653	
8	ELIJAH Gathungu	0716473085	20056034	
9	Patrick Musyoka	0726138567	23628213	
10	PETER NGURU	0729719431	22793496	
11	Noah Nzioka	0748046690	11726085	
12	Martin Maina	0727944383	10891220	
13	GEORGE NTHENGE	0707706591	10514548	
14	SIMON NJOROGE	0719739735	13832739	
15	Jelem Kanja	0713273741	11038208	
16	AITHAN KAMANGARA	0700397367	0455164	
17	FRANCIS MWANGI	0700814620	7054880	
18	Paul Njoroge Itega	0720862689	7191438	
19	JOSEPH KILO	0718217381	1668106	
	SIMON Njoroge	0728745186	22777739	

KENYA VISION 2030

NATIONAL YOUTH SERVICE

Mavoloni NYS Dam Project Public Participation Exercise Attendance Register				
No.	NAME	PHONE No.	ID/P.No.	SIGNATURE
1	FRIMILA MUSA	0719284117	39594992	
2	Zipporah Kerubo	0701229062	41329772	
3	GERTRUDE JEPKOSGEI	0743551471	41377274	
4.	JEDIDHA JEMUTAI	0793524714	40562578	
5	MELVIN Matete	0708695696	40195041	
6.	REHEMA JUMA	0740782355	39332115	
7	JOAN MUSIMEI	0115280630	40189400	
8	MERCAH JEPYEGON	0746622754	39775422	
9	FAITH NDUATI	0741108557	41334242	
10	Venacyline Makokha	0758844536	40002931	
11	Janet Mokaya	0115849764	41248298	
12.	Mercy Kendi	0700075120	39961204	
13	JOKE KIBEI	0723044883	35226766	
14	Glorias Chepkoech	0714255627	39527895	
15	Maurine Otieno	0703334007	40667396	
16	IRENE MUMBUA	0700225569	39446613	
17	EUPHLASIO OUMA	0113162541	39429189	
18	CONSOLATA KAWERA	0799493503	44356249	
19	NANCY NEKESA	0702750115	41088498	
20	CAROLINE ODHIAMBO	0768148179	22235	
21	MOURINE ALIMA	0748672975	38325911	
22	LYDIA CHARLES	0794260475	41017228	

4. Questionnaires

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name. Mavoloni Dam
2) Respondent's Name. Lindah Mafula Mobile: 0790280594
3) County. Machakos
4) Location. Mamba
5) Designation/job.....
6) Gender of the Respondent
   i. i) Male ✓ii) Female

7) Is the project necessary? Yes ☑ No □ . If not give reasons
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8) If Yes explain the project significance or importance
.....
It will help for irrigation
It will help for storage of water
It will help for farming during dry season
Help for fishing
.....
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.....

9) What are the expected socio – economic effects both positive and negative?

Canal

Others.

Specify.....

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ✓ ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No ✓

If Yes explain Briefly

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No ✓

If yes explain

.....

17) Signature of the Respondent.....

Date.....

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name. MAVOLONI NYS DAM
2) Respondent's Name. HELLEN NASHIMIYU Mobile: 0745601531
3) County. MACHAKOS
4) Location. MAMBA
5) Designation/job. SERVICE WOMAN
6) Gender of the Respondent
   i. i) Male ii) Female ✓

7) Is the project necessary? Yes ☑ No ☐ . If not give reasons

8) If Yes explain the project significance or importance

To commence with the project is useful to increase average underground irrigation
savers in Agriculture
Acts as storage of water to help retain underground water
stores water in seasons of drought

9) What are the expected socio – economic effects both positive and negative?

Canal

Others.

Specify.....

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No

If Yes explain Briefly

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No

If yes explain

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17) Signature of the Respondent.....

Date 31st August 2023.....

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name. NYS Mavoloni dam
2) Respondent's Name. Jane Wanjiru Mobile: 0741845856
3) County. Machakos
4) Location. Mamba
5) Designation/job
6) Gender of the Respondent
   i. i) Male ii) Female ✓

7) Is the project necessary? Yes ☑ No □ . If not give reasons

8) If Yes explain the project significance or importance
- Water for irrigation is provided
- Increase economy for people more to the area due to the production of water

9) What are the expected socio – economic effects both positive and negative?

Canal

Others.

Specify.....

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ✓ ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No ✓

If Yes explain Briefly

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No ✓

If yes explain

.....

17) Signature of the Respondent.....

Date.....

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name... NYS ... MAVOLONI ... DAM .....
2) Respondent's Name... MERCY ... MWENDE ..... Mobile: ... 0701058084
3) County..... MACHAKOS .....
4) Location..... MAMBA .....
5) Designation/job..... SERVICE ... WOMAN .....
6) Gender of the Respondent
   i. i) Male ii) Female ✓

7) Is the project necessary? Yes ☑ No □ . If not give reasons
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8) If Yes explain the project significance or importance
① Helps ... in ... Aquaculture .....
② Is a ... storage ... of ... water .....
3. It also ... helps ... in ... agriculture ... and ... irrigation of ... plants .....
4. It ... also ... helps ... to ... reduce ... drought ... to ... attain ... food ... security .....
.....
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.....

9) What are the expected socio – economic effects both positive and negative?

Canal ✓

Others.

Specify……canal……

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ✓ ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No ✓

If Yes explain Briefly

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No ✓

If yes explain

……No……

17) Signature of the Respondent……

Date……..

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name..VERONICAH NEHEMIAH NYS MAVOLONI PAM.....
2) Respondent's Name..VERONICAH NEHEMIAH...Mobile: 0791411037.....
3) County..MACHAKOS.....
4) Location..MAMBA.....
5) Designation/job.....
6) Gender of the Respondent
   i. i) Male ii) Female ✓

7) Is the project necessary? Yes □ No □ . If not give reasons
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8) If Yes explain the project significance or importance
Helps in irrigation.....
.....
Helps in fish farming.....
.....
Helps in water storage.....
.....
Prevents flooding.....
.....
.....

9) What are the expected socio – economic effects both positive and negative?

Canal

Others.

Specify.....

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No

If Yes explain Briefly

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No

If yes explain

.....

17) Signature of the Respondent.....

Date. 31/08/2023.....

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name..NYS MAVOLONI DAM.....
2) Respondent's Name IAN COLLINS ORWAKA Mobile: 0707614331
3) County..MACHAKOS.....
4) Location..MAMBA.....
5) Designation/job.....
6) Gender of the Respondent
   i. i) Male ii) Female

7) Is the project necessary? Yes ☐ No ☐ . If not give reasons
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8) If Yes explain the project significance or importance
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The project is significant because it will help in irrigation process.....
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9) What are the expected socio – economic effects both positive and negative?

✓Canal

Others.

Specify.....

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No

If Yes explain Briefly

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No

If yes explain

.....

17) Signature of the Respondent.....

Date.....

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name.....DAM CONSTRUCTION NYS MAVOLONI DAM.....
2) Respondent's Name..ERICK MARIITA.....Mobile: 0720255251
3) County.....MACHAKOS.....
4) Location.....KITHIMANI (MAMBA).....
5) Designation/job....CIVIL SERVANT.....
6) Gender of the Respondent
   i. i) Male ii) Female

7) Is the project necessary? Yes ☑ No ☐ . If not give reasons
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8) If Yes explain the project significance or importance
- It will serve the farming projects within the Community
- Domestic use.
- For livestock purpose.
- Help when setting target
- Increase area of fish farming
- Modification of micro environment
- Act as storage of waters.

9) What are the expected socio – economic effects both positive and negative?

Serve in domestic purpose e.g
- Cooking, Bathing, Mentain cleanes
- Place for Sports and leisure activits
- Fishing activities

10) Expected environmental effects positive and/or negative?
- Increase of tree Plantation
- Provide Water for animals
- Irrigation
- Aquatic home
- Breeding Ground for Mosquitoes
- Prevent flooding

11) What is the main source of income for your household?
✓ Agriculture
Formal Employment
Self Employed
Other..
Specify?..

12) What is your Age Group?
18 – 30 years
30 – 40 years
✓ 40 – 50 years
50 – 60 years
60 – 70 years
Above 70 years

13) What are the main sources of water for your household?
✓ River or stream
Borehole or groundwater
Harvested Rainwater

Canal

Others.

Specify.....

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No

If Yes explain Briefly

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No

If yes explain

.....

17) Signature of the Respondent.....

Date...31/08/23.....

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name..... NYS MAVOLONI DAM .....
2) Respondent's Name.. BERNARD MEYA ..Mobile: 0723689270
3) County..... MACHAKOS .....
4) Location..... MAMBA .....
5) Designation/job... CIVIL SERVANT (NYS) C.I. .....
6) Gender of the Respondent
   i. i) Male ✓ ii) Female

7) Is the project necessary? Yes ☑ No ☐ . If not give reasons
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8) If Yes explain the project significance or importance
   - It will enhance and improve farming through irrigation
   - It will help us in fish farming
   - Modification of the Environment
   - having purified water for human and livestock Consumption
   .....
   .....

9) What are the expected socio – economic effects both positive and negative?

- It will increase production of farm inputs
- It will improve Economy in the area because people will indulge in Saling of farm produce.
- It will improve the Society by Employment.
- It will improve in Aquatic uses having fish ponds.
- It will add mosquito breeding

10) Expected environmental effects positive and/or negative?

- It will increase mosquito breeding
- It will reduce over flooding

11) What is the main source of income for your household?

Agriculture
Formal Employment ✓
Self Employed
Other.....
Specify?.....

12) What is your Age Group?

18 – 30 years
30 – 40 years
40 – 50 years
50 – 60 years ✓
60 – 70 years
Above 70 years

13) What are the main sources of water for your household?

River or stream ✓
Borehole or groundwater
Harvested Rainwater

Canal

Others.

Specify.....

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ✓ ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No ✓

If Yes explain Briefly

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No ✓

If yes explain

.....

17) Signature of the Respondent.....

Date 31/08/2023

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name..NYS MAVOLONI DAM.....
2) Respondent's Name..FAUSTINE OSOTSI..Mobile: ..0726812047
3) County..TRANS NZOIA.....
4) Location..KINYORO.....
5) Designation/job...SERVICE MAN.....
6) Gender of the Respondent
   i. i) Male ✓ ii) Female

7) Is the project necessary? Yes ☑ No □ . If not give reasons
   .....
   It.....
   .....
   .....
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8) If Yes explain the project significance or importance
   .....
   It will help us in getting enough water for irrigation.....
   .....
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9) What are the expected socio – economic effects both positive and negative?

Canal

Others.

Specify.....

14) Are you aware of the Mavoloni NYS dam project?

i) Yes ii) No

15) Are there areas or features that have cultural significance within the proposed dam site?

i) Yes ii) No

If Yes explain Briefly

.....

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16) Are there any plant species (flora) or animal or insect species (fauna) that are either threatened or require special protection?

i) Yes ii) No

If yes explain

.....

17) Signature of the Respondent.....

Date 31st 8 2023

KENYA VISION 2030

NATIONAL YOUTH SERVICE

QUESTIONNAIRE FOR THE PROPOSED MAVOLONI NYS DAM

1) Project Name..... DAM CONSTRUCTION - NYS MAVOLONI
2) Respondent's Name..... JUDY MUUNDA ..... Mobile: 0725334649
3) County..... MACHAKOS
4) Location..... KITHIMANI
5) Designation/job.....
6) Gender of the Respondent
   i. i) Male ii) Female ✓

7) Is the project necessary? Yes ☑ No □ . If not give reasons
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8) If Yes explain the project significance or importance
- The dam will be of useful in irrigation. NYS Mavoloni being a farm unit, farming will be easy and also the community will benefit equally by in food production.
- We will achieve Vision 2030 - Food security.
- We shall store water during drought.
- Production of all food stuff e.g. fish
- Mavloni will also be green.

9) What are the expected socio – economic effects both positive and negative?

- Social Economic
- Help get enough water
- Increase in food production - Benefit us by selling and getting income.
- Attract visitors who would want to bench back with us and by so we shall get income.
-

10) Expected environmental effects positive and/or negative?
=> ~~Attracts~~ animals -
=> Help in planting more trees and irrigate food products
=> provides us to grow aquatic animals

11) What is the main source of income for your household?
Agriculture ✓
Formal Employment
Self Employed
Other.....
Specify?.....

12) What is your Age Group?
18 – 30 years
30 – 40 years ✓
40 – 50 years
50 – 60 years
60 – 70 years
Above 70 years

13) What are the main sources of water for your household?
River or stream ✓
Borehole or groundwater
Harvested Rainwater ✓

5. Public participation letter

KENYA VISION 2030

Telegrams: "VIJANA", Yatta
Telephone: 020 2060294
Fax: 020 2060290
Website: www devolutionandplanning.go.ke
Email: nysyatta@kenya.go.ke
When replying please quote
Ref: **YTA/ADM/1/3 VOL 11(153)**

NATIONAL YOUTH SERVICE
Yatta Field Station
P. O. Box 16
KITHIMANI

28th AUGUST, 2023

The Deputy County Commissioner,
Lower Yatta Sub-County,
MACHAKOS.

Dear Sir/Madam,

RE: PUBLIC PARTICIPATION MEETINGS FOR NYS DAMS ESIA

The National Youth Service (NYS) intends to construct dams in the parcels of land in their possession for their own use to ease the running of their training camps and staff quarters.

This is to inform you of the intention to hold public participation meetings as part of the Environment and Social Impact Assessment (ESIA) exercise as per the requirements of The Environmental Management and Coordination Act (EMCA), 1999. The public meetings will be conducted by a team from NYS and National Water Harvesting & Storage Authority (NWHSA), will be conducting the said public participation meetings.

The purpose of this letter is to inform you about the public meetings. The team will inform you of the exact date and venue of the meetings in good time. The management of NYS is committed to safeguarding against Corona virus infections. Therefore, all the meetings will fully adhere to the set Government regulations.

We thank you for your continued support and look forward to the successful completion of the exercise.

Yours faithfully,

NYAKANG'O KENNEDY

Kennedy Nyakang'o,HSC
SDD/COMMANDING OFFICER

ANCENT M. KIMATU
ASSISTANT CHIEF
KAKUMINI SUB - LOCATION
PHONE 0718 854 956
DATE 31/8/23 SIGN

ASSISTANT CHIEF
KITUU SUB LOC
DATE 31/8/23

6. Lead Expert's licence

FORM 7 (r.15(2))

nema
mazingira yetu | uhai wetu | wajibu wetu

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY(NEMA)

THE ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION ACT

ENVIRONMENTAL IMPACT ASSESSMENT/AUDIT (EIA/EA) PRACTICING LICENSE

License No : NEMA/EIA/ERPL/18807

Application Reference No: NEMA/EIA/EL/24785

M/S **George Macharia**
(individual or firm) of address
P.O. Box 30173 - 00100 NAIROBI

is licensed to practice in the capacity of a (Lead Expert/Associate Expert/Firm of Experts) **Lead Expert**
General

registration number **9491**

in accordance with the provision of the Environmental Management and Coordination Act Cap 387.

Issued Date: **2/2/2023**

Expiry Date: **12/31/2023**

Signature.....

(Seal)
Director General
The National Environment Management Authority

P.T.O.

ISO 9001:2015 Certified