PROPOSED STANDARD GAUGE RAILWAY PROJECT FROM NAIROBI SOUTH RAILWAY STATION-NAIVASHA INDUSTRIAL PARK-ENOOSUPUKIA, NAROK

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSME2NT (ESIA) STUDY

VOLUME I – MAIN REPORT

Submitted To:

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY – NEMA, KENYA
P.O. BOX 67839-00200 Nairobi, Popo Road off Mombasa Road, NAIROBI, KENYA

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PROPONENT	**Vision 2030 Government Flagship Project**
KENYA RAILWAYS right on track **KENYA RAILWAYS CORPORATION** P. O. Box 30121 - 00100, Off Haile Selassie Avenue, Nairobi, Kenya | Tel: 254-20-2210111 / 2215211 / 2210200 | Fax: 254-20-340049 / 221456 | Email: contact@krc.co.ke	KENYA VISION 2030 TOWARDS A GLOBALLY COMPETITIVE AND PROSPEROUS NATION HARAMBEE

October 2016

SUBMISSION OF DOCUMENTATION

I,…………………………………………………………………………**…**on behalf of the ESIA Team of Experts and **Habitat Planners& Environmental Consultants**submit the following Environmental and Social Impact Assessment (ESIA) Report for the proposed **Standard Gauge Railway Project** from **Nairobi South Railway Station-Naivasha Industrial Park-Enoosupukia, Narok County. I hereby confirm that** to my knowledge, all information contained in this report is an accurate and truthful representation of all findings as relating to the proposed project as per project information provided by the proponent and contractor to the ESIA consultants.

Signed in**NAIROBI** on this ……….**.** Day of **October2016.**

Signature and stamp : …………………………………………….

Designation : **LEAD ENVIRONMENTAL CONSULTANT AND TEAM LEADER**

SUBMISSION OF DOCUMENTATION

I,……………………………………………**…………………………………………………**,on behalf of **Kenya Railways Corporation (Proponent)** submit this Environmental and Social Impact Assessment (ESIA) Report for the proposed **Standard Gauge Railway Project** from **Nairobi South Railway Station-Naivasha Industrial Park -Enoosupukia, Narok County.** To my knowledge, all information contained in this report is an accurate and truthful representation of all findings as relating to the proposed project and as per the project description provided to the ESIA consultant.

Signed at **NAIROBI** on this………day of **October 2016**

Signature and stamp ……………………………………………………

Designation: **MANAGING DIRECTOR**

ESIA TEAM

Core ESIA Team

Name	Position	Tasks
1. **Professor John Kiringe** (PhD, M.Sc, B.Sc, Wildlife Ecology and Conservation Biology), Leicester University (UK) University of Nairobi	Wildlife Ecologist& Conservation Biologist	Wildlife and habitat impact specialist (**Team leader)**
2. **Dr. Francis Mwaura** PhD, M.Sc, B.Sc (Biogeography), University of Nairobi & McGill University (Canada)	Environmentalist	Environmental policiesand regulations, Environmental safeguards& lead documentalist
3. **James Ndungu**B,Sc Botany & Zoology (University of Nairobi), MA Environmental Planning & Management (University of Nairobi)	Environmentalist	Stakeholder engagementfacilitatio
4. **Philip Oguba Wandera**, MA (Environmental Economics, Moi University), PGD (Education), University of Nairobi, Dip (Business Management), Business Management Association, London United Kingdom, BA (Economics and Rural Economy, Makerere University)	Rural development	Project cost-benefit analysis & Stakeholder engagement
5. **Dr. Richard Mbithi Mulwa**, Ph.D Environmental Economics (JLU-Giessen, Germany) , Master of Economics (University of Nairobi), Bachelor Agricultural Economics (University of Nairobi)	Environmental Economist	Project cost-benefit-analysis
6. **Dr. Peter Ndiba, PhD (Environmental Engineering,** New Jersey Institute of Technology NJ, USA), M.Sc (Civil Engineering, University of Nairobi), M.Sc (Civil Engineering, University of Nairobi)	Civil Engineer/ Environmental Engineer	Project engineering design analysis
7. **Kivuti Karingi** MA (Environment) & MA Planning, B.Sc. (Geography & Atmospheric Science) University of Nairobi	Physical Planner/Environmentalist	Physical planning, logistics coordinator

ESIA Support Team

Name	Position	Tasks
1. **Tiffany Mwake** (B.Ed), University of Nairobi	Office Assistant	➢ Secretarial services ➢ Workshop secretariat ➢ Document preparation
2. Sharon Mwende (B.A) University of Nairobi	Office Assistant	➢ Secretarial services ➢ Workshop secretariat ➢ Taking minutes during community consultations
3. Lynne Koskei Obare (Bachelor of Urban & Regional Planning, University of Nairobi)	Field Assistant	➢ Background support

Other Participating Experts

Name	Position	Affiliation
1. Solomon Ouna	Engineer	Kenya Railways Corporation
2. Maxwell Mengich	Engineer	Kenya Railways Corporation
3. Erastus Chege	Surveyor	Kenya Railways Corporation
4. James Mwachidudu Chimera	Social Environmentalist	Kenya Railways Corporation
5. Darren Dai	Marketing Manager, Marketing Department	China Communications and Construction Company
6. Xue Haitao	Deputy Manager, Marketing Department	China Communications and Construction Company
7. Zeng Chao	Deputy Chief Engineer	China Communications and Construction Company
8. Bysen Li	Technical Assistant	China Communications and Construction Company

ACRONYMS

ASALs	Arid and semi-arid Lands
AU	African Union
BOK	Bomas of Kenya
BP	Bank Procedures
BRT	Bus Rapid Transit
CBD	Central Business District
CBD	Convention on Biological Diversity
CCCC	China Communications Construction Company Ltd
CIDP	County Integrated Development Plans
CITES	Convention on International Trade in Endangered Species
CO2	Carbon Dioxide
CO2-e	Carbon emission
CPP	Consultation and Public Participation
CRDS	Chinese Railway Design Standard
CRP	Compensation and Relocation Plan
CSR	Corporate Social Responsibility
CTC	Centralized Traffic Control
CUEA	Catholic University of East Africa
CWTL	Central Water Testing Laboratories
DAS	Directly affected stakeholders
DRSRS	Department of Resource Surveys and Remote Sensing
EA	Environmental Audit
EEZ	Exclusive Economic Zone
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Co-ordination Act
EMP	Environmental Management Plan
EMS	Environmental Management System
EPZA	Export Processing Zone Authority
ERS	Economic Recovery Strategy
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
FONNAP	Friends of Nairobi National Park
GDP	Gross Domestic Product
GIS	Geographic Information System
GOK	Government of Kenya
GPS	Global Positioning System
HGNP	Hell's Gate National Park
HIV	Human Immunodeficiency Virus
HQs	Headquarters
IAS	Indirectly Affected Stakeholders
IATA	International Air Transport Association
IBA	Important Bird Area
ICAO	International Civil Aviation Organization
ICD	Inland Container Depot
IFAW	International Fund for Animal Welfare
IFC	International Finance Corporation
ILO	International Labour Organization
ILRI	International Livestock Research Institute
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
JKIA	Jomo Kenyatta International Airport
KAA	Kenya Airports Authority
KAM	Kenya Association of Manufacturers
KARLO	Kenya Agricultural and Livestock Research Organization
KBS	Kenya Bureau of Standards

KCAA	Kenya Civil Aviation Authority
KDF	Kenya Defence Force
KEFRI	Kenya Forestry Research Institute
KEMFRI	Kenya Marine and Fisheries Research Institute
KenGen	Kenya Electricity Generating Company
KENHA	Kenya Highways Authority
KeRRA	Kenya Rural Roads Authority
KES	Kenya Shillings
KETRACO	Kenya Electricity Transmission Company Ltd.
KFS	Kenya Forest Service
KPA	Kenya Ports Authority
KPC	Kenya Pipeline Company
KPLC	Kenya Power and Lighting Company
KRC	Kenya Railways Corporation
KURA	Kenya Urban Roads Authority
KWS	Kenya Wildlife Service
KWSTI	Kenya Wildlife Training Institute
LCA	Life Cycle Approach
LRRT	Light Rail Rapid Transit
M& E	Monitoring and Evaluation
MEAs	Multilateral Environmental Agreements
MOF	Ministry of Finance
MOT	Ministry of Transport, Infrastructure, Housing and Urban Development
MOU	Memorandum of Understanding
MRTS	Mass Rapid Transit System
NCCRS	National Climate Change Response Strategy
NCTA	Northern Corridor Transit Agreement
NEAP	National Environment Action Plan
NEC	National Environmental Council
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
NIP	Naivasha Industrial Park
NIUPLAN	Integrated Urban Development Master Plan for the City of Nairobi
NLC	National Land Commission
NMCS	Nairobi Metropolitan Commuter Services
NMK	National Museums of Kenya
NMR	Nairobi Metropolitan Region
NNP	Nairobi National Park
NRM	Nairobi Railway Museum
NTSA	National Transport and Safety Authority
OP	Operational Policy
OSHA	Occupational Safety and Health Act
PCB	Polychlorinated biphenyls
PCM	Public Consultation Meetings
PCR	Physical Cultural Resources
PD	Public Disclosure
PEV	Post Election Violence
PM	Particulate matter
PPG (E)	Personal Protective Gear (Equipment)
PPM	Parts Per Million
PPP	Public Private Partnerships
PSV	Public Service Vehicle
PTC	Positive Train Control
PVC	Polyvinylchloride
RAP	Resettlement Action Plan
RSA	South Africa
RTI	Railway Training Institute
RVR	Rift Valley Railways
SEA	Strategic Environmental Assessment

SGR	Standard Gauge Railway
SHE	Safety, Health and Environment
SPM	Suspended Particulate Matter
STDs	Sexually Transmitted Diseases
SWM	Solid Waste Management
TDS	Total Dissolved Solids
TEU	Twenty-foot Equivalent Unit
TMIS	Transportation Information System
TOR	Terms of Reference
TSP	Total Suspended Particulates
UAE	United Arab Emirates
UK	United Kingdom
UN	United Nations
UNAIDS	United Nations and AIDS
USA	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VAT	Value Added Tax
VCT	Voluntary Counseling and Testing
WB	World Bank
WHO	World Health Organization
WRMA	Water Resources Management Authority
WRUA	Water Resource Users Association
WWF	World Wildlife Fund

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1. Background and Rationale of the Standard Gauge Railway(SGR) Project

The Government of Kenya through Kenya Railways Corporation (KRC) is currently undertaking construction of Phase 1 of the Mombasa-Nairobi-Kisumu-Malaba Standard Gauge Railway (SGR). This phase entails construction of the Mombasa-Nairobi SGR, which passes through eight (8) Counties: Mombasa, Kwale, Kilifi, Taita-Taveta, Makueni, Kajiado, Machakos and Nairobi. It passes through 31 urban centres/towns, and coversa total distance of 485.303km,with 33 yards/terminals. The length of section subgrade will be 427.377 km comprising of;98 large and medium bridges;969 culverts (2 culverts per kilometer);77 overpasses across roads (highways). The new railway line route generally runs parallel to the Mombasa-Nairobi Highway (A109) which is 482km long.

KRC is proposing to construct Phase 2A of the Mombasa-Nairobi-Kisumu-Malaba SGR. This phase is set to start fromNairobi South Station (DK0+00) and terminate at Enoosupukia in Narok County.The railway constructionwill be done by the China Communications Construction Company (CCCC) Ltd (the Contractor). In this regard,this Environmental and Social Impact Assessment (ESIA) work is one of the activities that the contractor has to facilitate on behalf of KRC (the Proponent). Phase 2B of the SGR covering Enoosupukia-Narok-Kisumu-Malaba railway line will undergo a separate ESIA at a later stage of the entire SGR project. Upon completion, the Mombasa-Nairobi-Kisumu-Malaba SGR will be the most important railway channel in Kenya, and will link the Port City of Mombasa to the rest of country’s interior and East Africa through the TerminalStation in Malaba. A feasibility study for the project was conducted in 2015 and recommended that the Phase 2A railway line will pass through five (5) counties, namely, Nairobi, Kajiado, Kiambu, Nakuru and Narok. It will have a total length of 120kmand 6 yards/terminals.

Upon completion, the Mombasa-Malaba railway (of which the Nairobi-Naivasha Industrial Park-Enoosupukia is part of) will be a trunk line for the proposed Eastern African SGR regional network in accordance with the East Africa Railways Master plan (2009). The aim of the master plan is the rejuvenation of the existing railways serving Tanzania, Kenya, Uganda and extending them initially to Rwanda and Burundi and eventually to South Sudan, Ethiopia and beyond. Prior to the construction of Phase 1 of the SGR, the existing metre/narrow gauge railway was and is still operational, with the Rift Valley Railways (RVR) being the concessionaire managing entity. The narrow gauge railway line was built in 1891 and was the only railway system in East Africa at that time. Over the years, as a result of aging due to usage and below ideal load capacity, the railway line is now considered to be grossly insufficient. Therefore, the six member states of the East African Community (EAC) and Ethiopia decided to construct more than 10 new railways in the region within 12 years in order to form a modern railway network to promote regional socio-economic growth. **Plate 1** shows the 750km Ethiopia-Djibouti SGR from Addis Ababa to the Port City of Djibouti which started operating in October 2016.

Plate 1: Ethiopia-Djibouti SGR train from Addis Ababa to the Port City of Djibouti

It's envisioned that the SGR railway network in Kenya will address cargo handling problems resulting from the large number of container freights that arrive at the Port of Mombasa by sea and which are thereafter transported by road to; Nairobi, Uganda, Rwanda, and Burundi, South Sudan and other destinations. In turn, this exerts huge pressure to Kenya's road system and increases cargo freight costs thereby impacting negatively on regional trade development. The existing rail system also has a number of negative environmental, economic and safety issues including high carbon emission, transport backlogs and frequent derailments. All these are serious setbacks to the overall socio-economic returns expected from it.

The SGR project is one of Kenya's Vision 2030 flagship projects that is expected to play an important role in strengthening cooperation among EAC member states, whilst integrating and promoting regional economic development. The freight flow of this line will mostly consist of bulk cargos including containers, coal, fuel oil and petroleum products, and cement transported from Mombasa Port and Nairobi to Malaba or further places, as well as a small amount of goods produced in local areas along the line. The line shall also meet the local passenger transport demands. The SGR is seen as an important measure for improving the country's transportation network, as well as a means of protecting the environment and reducing; road accidents, time taken to transport goods within and outside the country, and vehicular pressure on key highways and associated repair costs. The project is within the Kenya National Transport Policy – Moving a Working Nation (2009) whose vision for the railway sector isto provide efficient, reliable, safe and secure railway transport services that are integrated with national and regional railway, road, water, pipeline and air transport services for the transportation of goods and passengers on a sustainable and competitive basis".

The government policy in Kenya as well as regional and international policies on mega projects and programmes such as the SGR is to subject them to a vigorous Environmental and Social Impact assessment (ESIA) at the planning stages in order to ensure that any potential impacts on the environment are taken into consideration and mitigated during the detailed design, construction, operation and decommissioning stages.

The Environmental Management and Coordination Act 1999 (EMCA 1999, revision 2015, Cap 387) is recognized as the umbrella environmental legislation in Kenya. EMCA (1999) gives "teeth" and "muscle" for the National Environment Management Authority (NEMA) to spearhead pre-cautionary activities in order to ensure sustainable development in all sectors including transportation infrastructure through Environmental and Social Impact assessment (ESIA) for all the subjectable projects in order to protect all the valued and sensitive environments in the country. The ESIA is considered as a measure to ensure that development, which is an inevitable necessity in the country does not in any way undermine the objectives of environmental conservation. In other words, it is necessary to regulate development so that in the long-term, it doesn't destroy the environment from which the valued goods and services it requires are obtained. The assessment also ensures that unnecessary conflicts that may retard development in the country are prevented through adequate stakeholder consultations. It was on the basis of this obligatory requirement that theSGR project proponent (KRC), through the project contractor (CCCC) undertook this ESIA, which incorporatesall the various environmental concerns as required by law.

2. SGRPhase 2ARoute Option Analysis

SGR Phase 2A will involve construction of a railway line starting from the Nairobi South Station (DK0+00) and terminate in Enoosupukia area (DK120) in Narok County. The purpose of the ESIA route option analysis was to evaluate the environmental suitability of the first 50km stretch where 7 different options were proposed from the Nairobi terminalupto the Kamangu area in Kiambu County beyond which all the different routes converge and then proceed into the rift valley. **Figure 1** shows the proposed routes for the SGR-IIA in the first 50km within the Greater Nairobi Region including the Nairobi National Park.

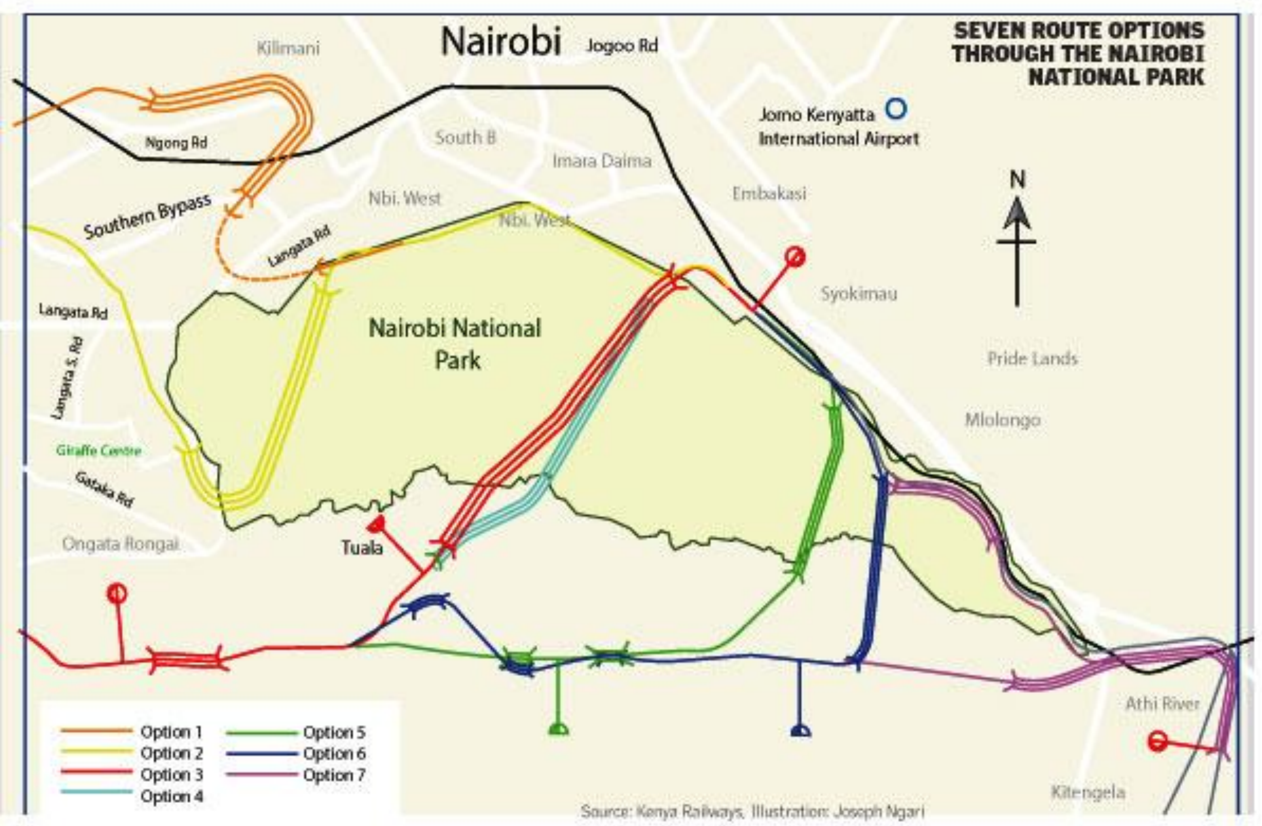


Figure 1: Spatial layout of the proposed SGR-IIA routes within Nairobi

Figure 1 shows that the SGR-IIA construction in the Nairobi section will inevitably cross over or pass along the edge of the world famous Nairobi National Park (NNP) in all the 7 route options within the Greater Nairobi Region. All the seven route options will affect the national park in one way or another. However, this will not be the first time that a railway line is passing through a national park. The world famous Tsavo National Park in Kenya has been intersected by the Kenya-Uganda international railway line throughout its history. The park has coexisted with the Mombasa-Kampala railway line for 68 years since its gazettement in 1948. This ground surface railway line stretches for many kilometres within the park. In the recent past, the Mombasa-Nairobi SGR Phase 1 has also crossed over the Tsavo National Park mostly through the use of a number of wildlife underpass super bridges.

The crossing of railway lines through conservation areas (National Parks, Nature Reserves, Wildlife Sanctuaries and World heritage Sites) is common in other parts of the world. Some of the other countries in the world which are characterized by a railway line through a protected area include the proposed railway project in Ethiopia where the line will run for 104 km through the Awash National Park. The other world famous national parks which are transversed by raillines include the Grand Canyon National Park in Arizona, the Great Smoky Mountains National Park in North Carolina, the Mojave National Reserve in California, the Glacier National Park in Montana, all in the USA. The Barron Gorge National Park in Queensland Australia which is a World Heritage Area is also transversed by the Kuranda Railway line.

i) Route Option 1: Nairobi South Station-Langata-Kibera-Dagoretti-Karen-Ngong-Kamangu (Orange Line in Figure 1)

This route would exit the Nairobi South Station (DK0+00) and run parallel to the Southern Bypass inside Nairobi National Park before entering an underground tunnel after the Carnivore Restaurant to the south of Langata Road near the Langata Army Barracks. It will then cross Langata Road still in the tunnel above the Langata Cemetery and take a sharp north-eastern turn to the south of the cemetery through Kibera and then turn north on an overpass bridge over the Kibera area and then cross the busy Ngong Road.From there, the railway line will maintain a western direction on an embankment to the north of Dagoretti Market and follow the oil pipeline corridor inside the Ngong Forest to the east of Karen, and proceed to a a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It thendrops into the rift valley through Ewaso Kedong (DK64+700), Mai-

Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County. The total distance for this route upto the Ngong tunnels is 41km. This route would encroach the Nairobi National Park (NNP) by about 8.5km including 5.4km of excavation and 3.1km of embankment. Due to the ragged terrain, the total length of bridges will be 28.21km and the total length of tunnels will be about 5km. The required land acquisition for this route is estimated at Ksh 120 million due to the high population density zones through which the SGR would pass. The estimated construction cost for this route is about $674 million. The route would have an additional annual operational cost of 2.12 million $ compared to other 6 proposed routes. Route option 1 has a higher social impact due to the level of public disturbance during the SGR construction as a result of the high number of key utility crossings (roads, power lines, narrow gauge railway). The operation phase will have a large number of SGR noise and vibration receptors.

ii) Route Option 2: Nairobi South Station-Langata- Nairobi National Park-Magadi Road-Bomas of Kenya-Karen-Ngong-Kamangu (Yellow line in Figure 1)

This route would exit the Nairobi South Station (DK0+00) and runs along the Southern Bypass inside Nairobi National Park. It will enter Nairobi National Park approximately 1.5 km after passing the Wilson Airport emergency gate near the Langata Barracks. The SGR would then pass over Nairobi National Park in asuper bridge or flyover(viaduct) through the eastern margin of the forested section in the north-western part of the park near the KWS Hqs. The viaduct is designed to allow for passage of wildlife, water flow and tourists. The line would pass between the "Director's Tree Corner" and Hyena Dam heading straight towards the Ivory Burning Site after which the alignment heads to Nangolomon Dam and then take a northern curve to go between the David Sheldrick Elephant Sanctuary and the KWS Central Workshop and workshop staff quarters. This route would exit the park near the Magadi Gate and cross Magadi Road after which it makes a sharp north-western and pass at the edge of Bomas of Kenya. It then passes through the Karen area to the left of the Southern Bypass and then take a western turn to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County.The total distance for this route upto the Ngong tunnels is 39.4km.This was initially the most viable route option recommended by the project feasibility study with an estimated construction cost is $615 million.This route option has a higher social impact due to the level of public disturbance during the SGR construction as a result of the high number of key utility crossings (roads, power lines, narrow gauge railway). The operation phase will have a large number of SGR noise and vibration receptors.

iii) Route Option 3: Nairobi South Station-Nairobi National Park–Tuala-Rongai-Nkoroi-Ngong–Kamangu (Red linein Figure 1)

This route would proceed from the Nairobi South Station (DK0+00) and run on embankment straight on in a north-east direction for approximately two (2) kilometres outside the northern edge of Nairobi National Park upto near the East Gate after which it would pass over the middle of the Nairobi National Park along a 7.2km viaduct or super flyover bridge consisting of precast T frame girders of an average height of 18m, along a 15m way-leave single track. The viaduct is designed to allow for passage of wildlife, water flow and tourists. The SGR will exit the park near the NNP's Maasai Gate near Tuala area,from here it would turn west past Tuala market centre and proceed to Ongata Rongai Town, then cross Magadi Road through the Adventist University of Africa. It then proceedsthrough Nkoroi area and crosses Ngong Road at Ebulbultown before heading to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County.The total distance for this route upto the Ngong tunnels is 36km. The estimated cost of construction for Option 3 will be about $523 million. The annual cost of operation will be lower compared to Options, 1 and 2.

iv) Route Option 4: Nairobi South Station-Nairobi National Park-Tuala-Rongai-Nkoroi-Ngong–Kamangu (Light blue linein Figure 1)

The alignment for this route starts from the western end of the Nairobi South Station (DK0+00) and runs on embarkment straight on in a north-east direction for approximately two (2) kilometres outside the NNP before making a bend in the south-western direction and entering the NNP near the East Gate. It will then crosses over Nairobi National Park through the savannah regionin an almost straight line along a 6km viaduct consisting of precast T frame girders of an average height of 18malong a 15m single track way-leave. The viaduct or superbridge flyover is designed to allow for passage of wildlife and also ensure that natural water flow in the park is not affected. It will also allow the undisturbed movement of tourists in the park. The precast T-frames will have a low structural height toprevent interference with aircraft landings at the Jomo Kenyatta International Airport and aircraft take-off from the Wilson Airport. The T-frames will be factory pre-built for direct installation on site and will also include appropriate acoustic noise-deflectors for low impact. The T-frame girders will be designed appropriately in order to blend with the surrounding natural environment to reduce visual intrusion and impact. The SGR construction base camp for the NNP section will be located outside the camp. The construction base camp will be located outside the camp. The construction work will require a one-side 5m service road along the 6m stretch. However, the construction work could be undertaken using the KAA emergency truck which is located close to the route option. The construction of the 6km viaduct over the park will be fast-tracked to take only about 18 months in three stages as follows in order to minimize the disturbance to wildlife movements:-

- 1st Stage – Northern side, 2.2km at the entry point near the East Gate
- 2nd Stage – Middle part, 2.1km from the 1st Stage
- 3rd Stage – Exit part, 1.7km at the exit point near the Maasai Gate

The SGR will exit the park near the NNP's Maasai Gate near Tuala area, from here it would turn west past Tuala market centre and proceed to Ongata Rongai Town, then cross Magadi Road through the Adventist University of Africa. It then proceeds through Nkoroi area and crosses Ngong Road at Ebulbul town beforeheading to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County.The total distance for this route upto the Ngong tunnels is 36.2km.This route is quite similar in terms of alignment to Option 3 but slightly shorter by 1.2km.The approximate construction costfor this route is about $523 million. The annual cost of operation will be lower compared to Options, 1 and 2.The implementation of the SGR project through Route Option 4 has factored in compensation to be given to KWS through an endowment fund.

v) Route Option 5:Nairobi South Station-Allpark area-Nairobi National Park-Tuala-Rongai-Ngong–Kamangu (Dark Green linein Figure 1)

This route would proceed from the Nairobi South Station (DK0+00) andthen turn back south towards Athi River town along the southern edge of the Nairobi National Park upto the Allparks area just before Mlolongo town after which it would enter the Nairobi National Park and pass over the southern section of the before exiting across the Mbagathi River near the Sheep and Goat Holding Area to the north of Athi River. This route option would pass through the Nairobi National Park along a 6.5km corridor on a 4.7km overhead bridgein the savanna area, 0.3km of embankment and 0.3km of excavation area along the south eastern edge of the park. After the Mbagathi River crossing, the SGR, will then turn west past the Ngurunga quarries towards Tuala and Ongata Rongai Towns, then cross Magadi Road through the Adventists University of Africa, and then proceed to Nkoroi to cross Ngong Road at Embulbul before heading to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County.The total distance for this route upto the Ngong tunnels is 41.5km.The construction cost for this route is nearly $611 million with an additional $3.55 million in annual operations compared to other proposed routes.

vi) Route Option 6: Nairobi South Station-Mlolongo-Nairobi National Park-Mbagathi-Tuala-Rongai-Nkoroi-Ngong–Kamangu (Dark Blue linein Figure 1)

This route starts at the Nairobi South Station (DK0+00) and turns back towards Athi River town passing along the south-eastern edge of Nairobi National Park upto Mlolongo after which it would enter and pass over the southern section of the park before exiting across Mbagathi River. This route option would pass through the Nairobi National Park along a total of 5.8km including 2.7km of excavation section and

0.1km embankment along the edge of the park and 2.1km overhead bridge over the savanna sectionof the park.
After the Mbagathi River crossing, the SGR will then turn west past the Ngurunga quarries towards Tuala and Ongata Rongai Towns then cross Magadi Road next to the Adventist University of Africa and then cut through Nkoroi tocross the Ngong Road at Embulbul before heading to the Ngong tunnel (DK32+320), then the Lusigetti tunnel (Dk46+490) and Kamangu tunnel (DK53+600).From there it proceeds north-west to Kamangu and then drops into the rift valley and head to the proposed Naivasha Industrial Park near Suswa after Mai Mahiu and then crosses B3 at Duka Moja to Enosupukia in Narok County. The route is quite similar in terms of alignment to option 5.The total distance for this route upto the Ngong tunnels is 43.85km.The estimated construction cost for the route is $635 million with an expected additional $3.55 million as annual operations cost compared to other proposed routes. Consequently, the annual cost of operation will be higher than Options 1-5.

vii) Route Option 7: Nairobi South Station-Nairobi National Park-Athi River–Rongai-Nkoroi-Ngong-Kamangu (Pink linein Figure 1)

This route would start at the Nairobi South Station (DK0+00) and then turn back towards Athi River on a parallel embankment line along the newly constructed Mombasa-Nairobi SGR Phase 1 at the south-eastern edge of Nairobi National Park where the SGR-I has already excised a section of the parkline upto the Athi River Station. From Athi River, the SGR will require the construction of a parallel superbridge heading west outside the southern edge of Nairobi National Park through the wildlife dispersal area within the Sheep and Goat Holding Grounds in Kajiado County.The SGR would then pass to the south of the Ngurunga quarries towards Tuala and Ongata Rongai Towns then cross Magadi Road next to the Adventists University of Africa and then cut through Nkoroi tocross the Ngong Road at Ebulbul before heading to the Ngong tunnel (DK32+320), then the Lusigetti tunnel (Dk46+490) and Kamangu tunnel (DK53+600).From there it proceeds north-west to Kamangu and then drops into the rift valley and head to the proposed Naivasha Industrial Park near Suswa after Mai Mahiu and then crosses B3 at Duka Moja to Enosupukia in Narok County.In this option,the SGR will encroach the Nairobi National Parkfor a total lengthof 10.6km along the south-eastern edge as it heads to Athi River which will hive about 100 acres. This will include 10km embankment and 3.4km of excavation. The super-bridge in the Athi River will be approximately 3.1km of overhead bridge.This route will affect the Athi River-Kitengela wildlife dispersal area for a about 10km. The dispersal area is a critical lifeline for the wildlife in Nairobi National Park.

The total distance for this route upto the Ngong tunnels is 64.3km.This option would require significant modification from the Syokimau terminus to allow re-routing of trains back to Athi River after reaching Nairobi from Mombasa. Further, it will require a parallel 2.5km super-bridge over the Athi River in addition to the one for SGR Phase I (Mombasa-Nairobi). The estimated cost of construction for this route option is approximately $832 million. An additional $12.34 million is needed annually for operations compared to other proposed routes. Consequently, the annual cost of operation will be higher than Options 1-6.This route option has a higher social impact due to the level of public disturbance during the SGR construction as a result of the high number of key utility crossings (roads, power lines, oil pipeline and narrow gauge railway). The operation phase will have a large number of SGR noise and vibration receptors especially in The Mlolongo area and Athi River town. The cumulative negative environmental impact for this SGR route in addition to the construction of the proposed Greater Southern Bypass will be disastrous to Nairobi National Park.

A compilation of the various aspects associated with the 7 SGR route options is summarized in **Table 1** and the elaborate comparative analysis provided in Section 3. The overall evaluation of the 7 (seven) number of route options showed that **Route Option 4** (**Nairobi South Station-Nairobi National Park-Tuala-Rongai-Nkoroi-Ngong–Kamangu-Mai Mahiu-Suswa-Enosupukia**) is the most suitable option followed by **Route Option 3**, while Route Options 7 and 1 are the least suitable in terms of environmental, social, engineering and economic analysis based on information both from the Project Proponent, Contractor and the ESIA findings. **Figure 2** shows the alignment of **Route Option 4**as the most suitable route for SGR-2A. This ESIA report is based on **Route Option 4** as the most suitable option in terms of minimum adverse environmental and social impacts. **Routes Option 7, 1** and **2** were found to have higher negative environmental and social impacts compared to all the other options and were therefore recommended for outright abandonment.

Table 1: Summary of the different aspects of the 7 SGR route options

SGR route	Project phase	Route distance (km)	Total bridge length (km)	Total construction cost upto Ngong tunnel (million $)	Operational cost upto Ngong Tunnel (Million US$)/ km/Year	Proposed SGR distance over the Naairobi NationalPark (km)	Loss of wildlife habitats in Nairobi National Park (Ha)
Option 1	Construction	41	9.64	664		8.5	34.8
	Operation	41			0.6705		0
Option 2	Construction	39.4	8.14	615		16.4	92.9
	Operation	39.4			0.6529		3.96
Option 3	Construction	36	8.55	523		7.2	98.8
	Operation	36			0.6127		3.96
Option 4	Construction	36.2	6.79	543		6	57.9
	Operation	36.2			0.6188		3.19
Option 5	Construction	41.5	6.69	611		6.5	126.0
	Operation	41.5			0.6991		2.20
Option 6	Construction	43.85	5.8	635		5.8	138.4
	Operation	43.85			0.7101		1.76
Option 7	Construction	64.3	15.2	832		10.6	205.3
	Operation	64.3			0.8073		0
Best Options	Construction	Route 3, 4	Route 6	Route 3 & 4		Route 5 & 6	Route 1 & 4
	Operation	Route 3, 4	Route 7		Route 3,4		Route 1 & 4
Worst options	Construction	Route 7		Route 7 & 1		Route 2 & 7	Route 7 & 6
	Operation	Route 7			Route 7		Route 7 & 6

Nairobi - Naivasha Standard Gauge Railway Project Schematic Plan

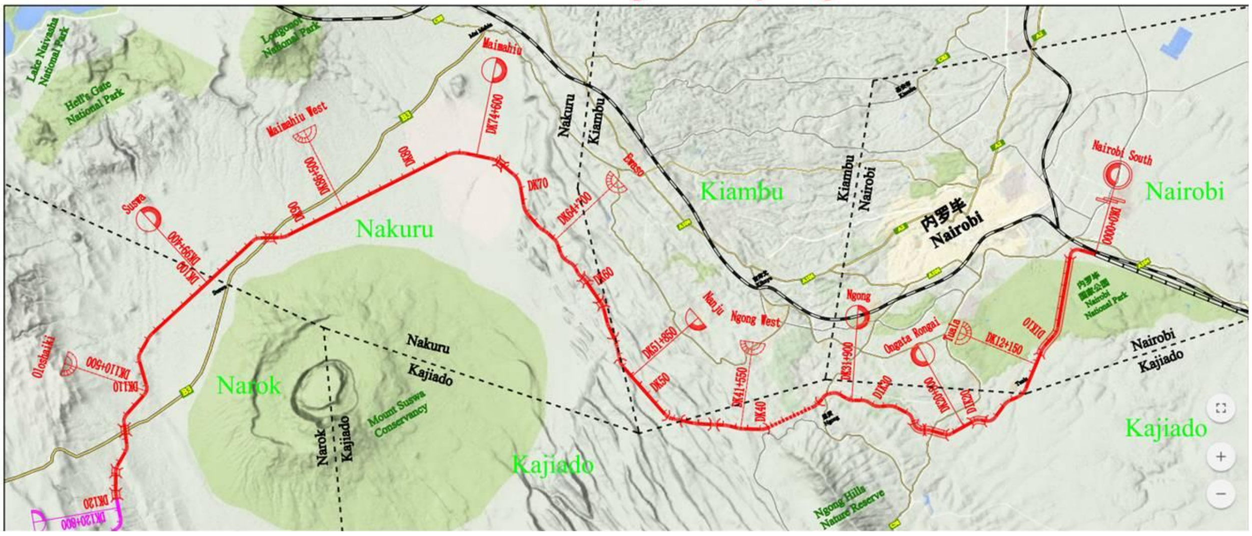


Figure 2: The alignment of most suitable routeoption for the SGR-2A (Option 4)

The proposed Nairobi South Railway Station–Naivasha Industrial Park-Enoosupukia, Narok County Standard Gauge Railway project will thereforestart from the NairobiSouth RailwayStation, which is the end terminous station for the Mombasa-Nairobi SGR, which is currently under construction. From here, the railway line extension will cross over the middle of Nairobi National Parkon an 18m high overhead bridge covering a distance of 6km long. It will then exit the park near the Maasai Gate and pass through Tuala area, then proceed to Ongata Rongai.It would then cross Magadi Road through the Adventist University of Africa and pass through Nkoroi area and cross the Ngong Road at Ebulbul before heading to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700) and Mai-Mahiu (DK74+600).The alignment will then cross the Mai Mahiu–Narok Road (B3) at DK83, which is about 7km to the north of Mt. Suswa before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400) through a 10km branch railway line to be constructed in the future. Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County.The proposed Nairobi South Railway Station - Naivasha Industrial Park-Enoosupukia, Narok County SGR alignment will encompass the first 120km(DK0-DK120) of what will eventually be the Mombasa-Nairobi-Narok – Malaba SGR.

3. Project Description

The proposed Nairobi South Railway Station -Naivasha Industrial Park (NIP) - Enoosupukia, Narok County SGR alignment will encompass the first 120km (DK0-DK120). The proponent proposes a total of twelve (12) new railway stations excluding the Nairobi South Station which is part of the existing NEMA approved Mombasa-Nairobi SGR Phase 1 project. There will be 6 District stations and 6 intermediateand crossing stations. This also excludes the proposed Nairagie station (CK123+800), which will be in the next phase of the Nairobi-Malaba SGR project. The distance between the stations ranges between 9.9-24.1km depending on the technical design requirements, geographical position, human settlements and local economic activities/ needs.

The main technical standards for the SGRrailway line are as summarized in **Table 2**.

Table 2: Main Technical Standards for the SGR Project

S/N	Items	Standards
1.	Design standard	Chinese Railway Design Standard (CRDS)
2.	Gauge	1435mm (standard gauge)
3.	Number of main lines	Single track railway
4.	Limiting gradient	12‰
5.	Minimum radius of curve	1200m (800m in difficult sections)
6.	Axle weight	25tonnes
7.	Load specification	Double stacked container
8.	Freight vehicle	DF8B
9.	Maximum speed of freight vehicle	80km/hr
10.	Passenger car	DF11
11.	Maximum speed of passenger car	120km/hr
12.	Type of traction	Diesel traction
13.	Tractive tonnage	4000tons
14.	Effective length of arrival-departure track	880m

The horizontal location of the line will mainly be controlled and influenced by the track connection stations, topography, geology, water resources, conservation areas, population density, utility crossings and other planning considerations along the line. The line will also intersect with some key and busy urban roads such as Magadi Road, Ngong Road as well as key highways such as the Mai-Mahiu-Narok-Bomet Road (B3). In terms of safety, the SGR is designed to be a National Class I railway. In areas where crossings for wildlife are required, designs will be made to fit the requirements of Kenya Wildlife Service (KWS) standards as well as other relevant international standards in order to control movement and crossing of wildlife especially rhinos, giraffes, zebras, and buffalo among others.

The SGR will include a total of 12 railway stations including 5 in Kajiado County, namely Tuala Station (DK12+150, Ongata Rongai Station (DK20+800), Ngong South Station (DK31+900) and Ngong West Station (DK41+550), 1 station in Kiambu County, namely Nanju Station (DK51+850) in Kamangu area, 2 stations in Nakuru County, namely Mai Mahiu Station (DK74+600) and Mai-Mahiu West Station (DK86+500), and 3 stations in Narok County, namely Suswa Station (DK99+400), Oloshaiki Station (DK110+500) and Enosupukia Station (DK110+500). Table 3 shows the railway characteristics.

The SGR subgrade design has taken account of the existing natural characteristics along the proposed alignment in terms of topography, weather features, ground motion parameters, geological structure, hydrogeology and future climate change issues. The main subgrade construction site types of the whole line will consist of embankment slope protection, cutting slope protection, soft soil subgrade, swelling soil subgrade, black cotton soil subgrade, and impervious embankment protection.

Other operational and support facilities for the SGR will include maintenance and assembly workshops, sheds for shunting locomotive, railway station staff living quarters, general office buildings, canteens, bathrooms and other sanitary facilities, water supply systems, sewage and waste oil treatment facilities. The communication system of the line shall be designed based on the principle of remote monitoring, and centralized maintenance and management. The communication network of the railway line shall consist of the transmission access system, telephone exchange system, dispatching communication system, mobile communication system and station yard communication system. A decentralized and autonomous Centralized Traffic Control (CTC) and information system, which will be based in Nairobi will adopt modern communication and computer technology. Two (2) 33kV distribution substations at Kamangu and Mai-Mahiu substations will additionally be set up for power supply for continuous power line.

Table 3: Proposed Railway Stations from DK0 – DK 120

No.	County	Station Name	Type of Station	Location (km)	Distance between the stations (km)
1.	Nairobi	Nairobi South	District Station	DK0+000	0.0
2.	Kajiado	Tuala	Intermediate Station	DK12=150	12.15
3.		Ongata Rongai	District Station	DK20+800	20.80
4.		Ngong	District Station	DK31+900	31.9
5.		Ngong West	Crossing Station	DK41+550	41.55
6.	Kiambu	Nanju	District Station	DK51+850	51.85
7.	Kajiado	Ewaso	Crossing Station	DK64+700	64.7
8.	Nakuru	Mai-Mahiu	District Station	DK74+600	74.6
9.		Mai Mahiu West	Intermediate Station	DK86+500	86.5
10.	Narok	Suswa	District Station	DK99+400	99.4
11.		Oloshaiki	Intermediate Station	DK110+500	110.5
12.		Enosupukia	Terminating Station	DK120+800	120.8

The design of the proposed Nairobi South Railway Station-Naivasha Industrial Park-Enoosupukia, Narok County Standard Gauge Railway (SGR) shall be executed according to a contract between the Kenya Government represented by the KRC and the contactor (CCCC). A separate participatory Resettlement Action Plan (RAP) will be developed and executed professionally before commencement of works to reduce conflicts and ensure project sustainability. In addition, this ESIA report has not considered the environmental impacts of campsites, quarries and crushing plants, batching plants, borrow pits, slipper factories and other material sites that will be constructed later prior to commencement of the construction works. These will be subjected to a separate ESIA process after they have identified.

4. Project Justification

The Nairobi-Malaba RailwaySGR is an important part of the Mombasa-Nairobi-Malaba-Kampala-Juba Railway System which is a trunk railway line in the East Africa region, and is the extension of the Mombasa-Nairobi SGR which is under construction. Works are currently underway for the initial phase of the railway, which is the Mombasa-Nairobi SGR, which is slated for completion in 2017. The proposed Nairobi South Railway Station–Naivasha Industrial Park-Enoosupukia, Narok County SGR (120km) will be the nexus between the Mombasa-Nairobi SGR and the Narok–Malaba SGR. This Project is a key skeleton line for the East African railway networks thatwill connect to South Sudan, Rwanda, Burundi and Congo to form amodern regional railway network.

The proposed project will greatly improve and strengthen the transport capacity of East Africa railway network. Due to the limited capacity of the existing narrowgauge railway line, passenger and freight volumes have been handledby highways and civil aviation, causing a greatnegative impact to the highway system of Kenya. Pressure on the existing supporting infrastructure has resulted in lagging behind of thecountry's economic developing.Further, the existing regional meter gauge railway network is unable to cope with the rapid increase in regional passenger and freight traffic demand. It's currently estimated that the regional highway transportation market share accounts for more than 90%of the total traffic volume. Insufficient traffic capacity, low efficiency and unsatisfactory service of the regional transportation system have been one of the critical bottleneckshindering Kenya's economic development, thus the need for the SGR network.

As a transportation corridor connecting the coastal, southern, western borders of Kenya, the SGRnetworkwill provide transportation services for exploitation of mineral resources,spur industrial development and improve the travelservices for local people and tourists in the region. The SGR project is also critical in promoting and sustaining regional economic growth and natural resources exploitation along the railway and its environs. It will be key in enhancing industrial and agricultural production whichare currently restricted by the existing old and dilapidatedrailway infrastructure. In addition, it will provide a reliableand superior traffic supportinfrastructure for rapid regional economic development,which will ultimately enhance societal livelihoods.

As previously stated, the SGR is one of Kenya's Vision 2030 flagship projects that will play an important role in strengthening cooperation among EAC member states and promote national and regional economic development. The construction of the SGR is of great significance to Kenya and the East Africa region. It will improve and enhance regional infrastructure development and transportation, whilst spurring numerous socio-economic development opportunities. Moreover, it is set to ease vehicular pressure offthe country's road network especially in the Northern Transport Corridor, thereby improving traffic management and interrelation among the main economic strongholds of Kenya. The SGR will also reinforce development and growth of infrastructure forthe tourism industry.

The construction of the SGR is necessary owing to itsnumerous potential benefits which will include the following;-

- Reduction of transportation cost in the country and East Africa region making Kenya an attractive investment destination and competitive in the region;
- Enhanced environmental protection through reduced carbon emission associated with large scale vehicular movement;
- Acceleration of industrialization through easier and cheaper transportation, and establishment of new industries to service the new railway;
- Increased annual GDP growth which is estimated to be at a minimum of 1.5% during the construction and operation phases;
- Positioning the Port of Mombasa as the transport and logistical entry port of choice for the region.
- Improving the competitive edge for the Port of Mombasa as part of the Northern Transport Corridorand is experiencing stiff competition by the Port of Dar es-Salaaam in the Central Transport Corridor and which will also be served by the proposed Port of Bagamoyo in Tanzania;
- Reduction in cargo load congestion at the Port of Mombasa through enhanced and more efficient transport system. This will bea more attractive and preferred port of choice coastal facility in the region;
- Reduction in wear and tear of Kenya roads and associated repair and maintenance costs;
- Reduction in road travel time between Mombasa, Nairobi and Malaba;
- Enhanced prospects for development of a free port and Export Processing Zones,and Industrial Parks along the railway line;
- Creation of employment and business opportunities during construction and operation phases. This includes both skilled and unskilled workers such as engineers, technicians and general labourers during construction. The railway project will also trigger creation of new employment opportunities in the service and hospitality industries (food, accommodation and leisure), as well as in other entrepreneur-related ventures;
- Creating demand and market for large quantities of local products such as;steel, cement, aggregates, electricity generation and electricity transmission pylons and cables, roofing materials, glass, sand, ballastamong others.;
- Reductionin the number of heavy trucks on the Mombasa-Nairobi-Malaba highway which will in turn make the road system safer and reduce accident incidences;
- Provision of a cheaper and safer alternative means of transport for tourists visitingvarious inland wildlife conservation areas (parks and reserves) thereby promoting the tourism sector;
- Promotion of easier economic exploitation of natural resources in the East Africa region.

5. Project Cost and Implementation Period

The total estimated cost for the project is **USD. 1,482,745,029.43 (KShs. 156, 518, 120,483.12),** whichexcludes the following expenses: land acquisition, demolition of various structures along the route, government VAT charges, duty and relevant taxes, financing loan interest and other expenses in need of Kenya government's entrustment. Taking into account the scale, standard, terrain and spatial distribution of all sections in the project, the total construction period is estimated to be less than 54 months.

6. Objectives and Scope for ESIA

Habitat Planners, a NEMA- registered firm of experts was appointed as a consultant to conduct the Environmental and Social Impact Assessment (ESIA) of the proposed SGR extension from Nairobi to Enoosupukia, Narok County. The scope of the assessment covered the project site and their environs, and the utilities proposed. The output of the said assessment is this ESIA study report which is expected to inform the National Environment Management Authority (NEMA) in their decision making on matters related with the issuance of an NEMA EIA licence to the proponent and contractor as stipulated by EMCA (1999, 2015 Review) Cap 387.

The consultant on behalf of the proponent and contractor conducted the ESIA study based on the followingbroad Terms of Reference (ToR): -

a) Undertaking a detailed baseline environmental assessment in the proposed SGR route,
b) Identifying the anticipated social and environmental impacts of the proposed SGR project and the scale of impacts,
c) Identifying and analyze alternatives to the proposed SGR project,
d) Proposing mitigation measures taken during and after implementation of the project,
e) Developing an Environmental Management Plan (EMP) with mechanisms for monitoring and evaluating compliance and environmental performance; which shall include the cost of mitigation measures and the time frame of implementing the measures.

7. ESIA Process Approach andMethodology

A comprehensive ESIA was undertaken because of the magnitude and complexity of the issues associated with the proposed railway project. The general steps followed during the assessment included:-

- Environment screening, during which the proposed standard gauge railway project was identified as among those requiring to be subjected to the ESIA process as stipulated under Schedule 2 of Kenya Gazette Supplement No.74 (Acts No. 5) EMCA amendment, 2015.
- Environmental scoping that provided the key environmental issues to be considered.
- Desktop studies and documentary review.
- Physical inspection and assessment of the railway track alignment from its starting point at Nairobi South Railway Station through Naivasha Industrial Park to the end point at Enoosupukia, Narok County.
- Analysis of project alternative options.
- In-house consultative meetings.
- Comprehensive baseline environmental assessment.
- Intensive stakeholder engagement and consultations.
- Comprehensive impact analysis.
- Impact mitigation planning.
- Environmental management planning
- Report writing

Key environmental issues and potential impacts

The key environmental issues and potential impacts of the proposed project are as highlighted below.Majority of the people whose opinion was considered duringthe ESIA consultations had no objection to implementation of the project. All those consulted agreed that there are potential positive gains and negative costs associated with the proposed SGR project.

a) Positive impacts

The proposed project will have numerous positive impacts as exhaustively discussed in **Subsection 6.1** of this report. These positive environmental and social impacts during the construction and operation phases include:-

- Generating employment opportunities for both skilled and semi-skilled workers resulting directly from the construction and maintenance of the SGR-line and from transport of passengers and freight.

- Creating one of the most important railway channel in Kenya, which will link the Port of Mombasa to the rest of Eastern Africa.
- Enhancing the transport system in the country and the East African Region thus helping propel Kenya to a middle-income country as envisioned in Vision 2030.
- Reducing congestion and enhance the volumes that will be handled at the port of Mombasa thus spurring intra-country and regional trade.
- Making transportation of people, goods and services cheaper, more efficient and safer. Projections are indicating that transport costs will reduce by up to 40%.
- Decongestion of Northern Transport Corridor by significantly reducing the number of most long-distance trucks which will also increase the level of road safety along the Nairobi- Nakuru-Eldoret-Kisumu road network.
- Increased business opportunities for small and medium -scale traders such as hotel and shop owners, food vendors, among others.
- Provision of alternative rapid transport for people.
- Creation of faster means of transport for bulk cargo from the ports.
- Decongestion at the Port of Mombasa and the Inland Container Depot.
- Reduced pressure on the road system.
- Reduced risk of accidents on the roads.
- Contribution of revenue to county, national and regional governments.
- Emergence andexpansion of new urban centres due to construction of industrial parks to be associated with the railway line.
- Reduction of HIV/AIDS prevalence along the Mombasa –Nairobi–Kisumu-Malaba Highway.
- Revitalization of large-scale agricultural production in rural areas along the new route and its environs.
- Development of other sectors of the economy especially mining and construction due to reduced goods transportation costs.
- Increased regional trade.

b) Key potential negative impacts and recommended mitigation strategies

The key potential negative impacts and proposed mitigation measures for the project are summarized in **Table 4**and **Table 5**below:-

Table 4: Summary of Negative Environmental and Social Impacts and Mitigation Measures in Nairobi National Park

Possible Impacts	Mitigation measures
Vegetation loss: The SGR construction through Route Option 4 will affect approximately 6.43ha of 4 key vegetation types along the 6km stretch including 2.06ha of open grasslannd, 3.35ha of open low shrub cover, 0.72ha of *Acacia drepanolobium* dwarf shrub grassland and 0.30ha of riverine vegetation	The contractor will ensure that vegetation disturbance along the SGR route is restricted as much as possible to the viaduct pillar sites
	The contractor will adopt an appropriate vegetation restoration plan, which will consider rehabilitation of affected areas. The vegetation restoration plan will be approved by KWS
Soil erosion: The SGR construction through Route Option 4 will affect the soil along a 6km narrow corridor from near the East Gate to near the Masaai Gate	The contractor will adopt an appropriate soil reinstatement plan, which will consider reinstatement of trampled areas (access roads), placement of the removed topsoil, sowing and improvement of soil characteristics. The soil reinstatement plan will be approved by KWS
Invasive species: The construction of the viaduct or super-brige flyover can introduce invasive species in the park	The contractor with the supervision of KWS will screen the construction equipment to avoid the spread of invasive species such as *Nicotiana glauca* seeds attached to road construction machinery
	Regular monitoring and control of emerging invasive species by KWS
Landscape impact: The project will have impact on the landscape due to landscape fragmentation which will	The Contractor should strive to ensure that the SGR corridor will blend as much as possible to the park environment through the use of suitable strategies which will be

appear to separate the area along the SGR corridor into two parts	approved by KWS
	The SGR train shall not turn on intense lights in the national park at night in order to reduce the impact on wildlife
Wildlife impacts: The SGR construction through Route Option 4 will affect the habitats of key species in the park including lion, Black rhino, zebra, wildebeest, Coke's hartebeest, Grant's gazelle, Thomson's gazelle, impala, buffalo, Maasai Giraffe and eland	A 6km viaduct or super-bridge flyover of an average of 18 m will be installed for the railway to pass over the park and allow free movement of wildlife in the underpasses
	The contractor will install fences to prevent animals from falling into the SGR viaduct pillar trenches whose design specifications and actual installations will be approved and supervised by KWS
	Construction activities shall be restricted the daytime (6am-6pm)
	The camping of people/workers in the national park must be avoided
	The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park
	KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities
Noise: Ambient noise quality in the project area is generally high (60-80dBA) due to the continuous over-flying of the SGR corridor by large aircraft on the landing approach to Jomo Kenyatta International Airport	The SGR line over the national park will be fitted with an acoustic noise barrier whose specifications will be approved by KWS to ensure that the noise do not increase significantly above the baseline levels
	The contractor in collaboration with KRC will ensure the installation of strict No Train Whistle Blowing signage before the railway enters into the park which will be a SGR whistle-forbidding section
Waste disposal: Construction debris and solid/liquid wastes generated along the SGR corridor in the park might deteriorate the environment in their immediate surroundings of disposal	The contractor will ensure that all construction waste must be carried away from site every day and with no dumping on site
	The railway operator will ensure that no waste is dumped in the park during train movements
Accidents: The most significant safety issues for any railway operation are derailments, train crash, train collisions, oil spills, chemical spills, fires and explosions (including sabotage/terrorism)	The Contractor will prepare a collaborative Environmental Risk and Emergency Response Plan by KRC and KWS to deal with any accidents which must be approved by KWS. This will include appropriate capacity (personnel and equipment) and a clear Command Centre to deal with any accidents
Invasive species: The SGR construction and operation activities have the potential of introducing invader species into the park which might be detrimental to the environment and biodiversity	The contractor, KWS and KRC will develop an invader species management framework and protocol to reduce the risk of introducing invasive species such as *Nicotiana glauca* and *Prosopis* seeds attached to construction machinery or trains

Table 5: Summary of Negative Environmental and Social Impacts and Mitigation Measures outside Nairobi National Park

Possible Impacts	**Mitigation measures**
Soil erosion	• Control earthworks • Install drainage structures properly • Ensure management of excavation activities • Landscaping of disturbed areas
Dust generation	• Spray stock piles of earth with water • Avoid pouring dust materials from elevated areas to ground • Cover all trucks hauling soil, sand, rocks and other loose materials

Possible Impacts	Mitigation measures
	• Provide dust screen where necessary
Increase in HIV/AIDs and STDs infection incidence during construction	• Provide VCT services among construction workers and surrounding community • Strengthen advocacy through awareness training in HIV/AIDS and other STDs
Land acquisition and involuntary resettlement/displacement of persons	• A Resettlement Action Plan (RAP) will be commissioned • Property valuation and compensation • Implement a public awareness programme
Vegetation disturbance, habitat alteration and fragmentation	• Landscape the sites by planting grass and trees in all disturbed areas • Avoid fragmentation or destruction of critical terrestrial and aquatic habitats. • Construction of bridges to span atrisk areas (e.g. wetlands) • Minimize the unnecessary clearing of vegetation during construction • Avoid construction activities during the animal breeding season and other sensitive seasons or times of day • Avoid the introduction of invasive species during reinstatement activities • Care for the existing and planted trees
Occupational health and safety hazards	• Regular maintenance of vegetation within railroad rights-of-way • Training workers in personal track safety procedures • Implement Noise and Vibration Control Regulations • Avoid exposure to diesel exhausts to both humans and wildlife • Rest periods at regular intervals and during night hours in accordance with international standards and good practices for work time • Implementation of rail operational safety procedures on: General rail operational safety, transport of dangerous goods, every crossings safety, pedestrian safety
Emissions to air and exhaust emissions	• Fuel-efficient and less pollution equipment shall be used where feasible • Consider the reduction and control of combustion source emissions • Consider the reduction and control of fugitive emissions • Engine idling time shall be minimized • Equipment shall be properly tuned and maintained
Soil and water resource contamination due to leaks and spills of fuel and oil	• Storage tanks and components should meet international standards • Storage tanks should have appropriate secondary containment • The spill retention area should be equipped with an oil/water separators • Fueling facilities should develop a spill prevention and control plan
Accidents involving wildlife & livestock	• Earth embankments • Fence railway corridor • Construct underpasses at strategic points • Establish water points across underpasses for animals • Avoid all level crossings
Disturbances to public utilities/ infrastructure	• Involvement and continuous consultation of key stakeholders at all stages of the project cycle • Compensation and re-locations • Use of an integrated approach in planning public utilities by sharing most transport corridors for roads, pipelines, water, sewerage, electricity lines
Disruption of livelihoods, loss of jobs and businesses for	• Employment of locals and considerations in job allocations especially for activities requiring unskilled labor

Possible Impacts	Mitigation measures
people depending on the long-distance road trucks	• Training in emerging job opportunities and requirements in the new railway system • Commissioning of other potential income generating activities along the rail line, e.g. revitalization of large-scale agricultural activities, mining, livestock farming, tourism, etc. • Truck owners to sell their long-distance trucks to other countries and also to be supported to shift to investment to private trains • Truck owners to shift to other areas that still require their services in the region
Wastewater Discharge	• Use of ultra-filtration to extend the life of washing solutions for aqueous parts or use of alternatives to water cleaning • Plumbing connection of floor drains, if any, in maintenance areas to the wastewater collection and treatment system • Prevention of discharge of industrial waste to septic systems, drain fields, dry wells, cesspools, pits, or separate storm drains or sewers • Pretreatment of effluents to reduce contaminant concentrations
Waste generation and disposal	• Passenger train operators and cleaning contractors to segregate waste in the trains • Instituting an integrated solid waste management program for Waste from passenger trains and terminals • Waste storage, collection, transportation and disposal as per Waste Management Regulations, 2006
Noise pollution and vibrations	• Implementation of noise reduction or prevention measures at the source • Sensitize workforce including drivers of construction vehicles • Install sound barriers for pile driving activity • Install portable barriers to shield compressors and other small stationary equipment where necessary • Regular maintenance of all equipment • Workers in the vicinity of high level noise to wear safety and protective gear
Hazardous materials	• Use of aqueous detergent cleaning solutions or steam cleaning, or use and recycling of aliphatic cleaning solvents • Use of water-based paints • Use of track mats to retain wayside grease and other contaminants • Avoiding use of new or replacement parts with asbestos containing materials

c) Other general recommended remedial actions

The following additional remedial actions are recommended:

- The contractor should adopt safe and acceptable construction and operation practices to ensure protection of animals, livestock, people and other environmental media.

- Implementation and Monitoring the EMP and NEMA EIA License conditions need to be done systematically to ensure that the basic goals of sustainable development are achieved.

- A Resettlement Action Plan (RAP) is recommended since some persons will be displaced to pave way for the railway line and its reserve. A compensation and relocation plan (CRP) should be prepared for the project affected persons who will be relocated as a result of the intervention. This should cover all costs of loss of shelter, trading and business facilities, assets, etc.

- The government should re-invest the revenue accrued from the railway project and other sources in rural, agricultural, mining and tourism development activities along the railway corridor in order to generate new jobs for affected communities and persons

- The government should encourageand support current truck owners to transfer their business and clients to the railway system.

d) Proposed environmental management plan (EMP)

An elaborate EMP is provided in this report for purposes of the proposedSGR project, and covers the entire project life cycle including the planning stage, construction, operation and decommissioning. It also includes a comprehensive environmental monitoring plan.

8. Conclusion and Recommendation

The existing railway system in Kenya is constrained in many ways including its operations. This has resulted in congestion of the Port of Mombasa Port and the Inland Container Depot (ICD) and the road system leading to;a) regular damage of the road network,b) high transportation and road maintenance costs, c)increased road accidents, and d) loss of regional trade opportunities. In this regard, implementation of the proposed SGR project will collectively address these problems and further spur numerous economicdevelopment opportunitiesand growth in the country and the East Africa region. The construction of the new railway will have positiveimpacts on the area lying on the transport corridor from Nairobi to Narok, and beyond.

The SGR will contribute positively in enhancing the transport system in the country and the East African Region at large, thus help propel Kenya to a middle-income country as envisioned in Vision 2030. It will influence all the three pillars of Vision 2030 both directly, indirectly and induce significant economic benefits. Economic estimates indicate that the SGR is expected to add up to 1.5 per cent to GDP.The SGR will reduce congestion at the Port of Mombasa and enhance the volume of cargo that will be handled at the port thus spurring intra-country and regional trade. It is predicted that upon the completion of the SGR project, the cargo handling capacity at the Port of Mombasa will almost double to 44 million tonnes/year in 2025; 55.6 million tonnes/year in 2030; and 67.46 million tonnes in 2040. This will help securing the port as a preferred facility in the East African region.The SGR project will also make transportation of people, goods and services cheaper, more efficient and safer with projections indicating that transport costs will reduce by up to 40%.

The ESIA findings showed that the project design is the most suitable for the area based on the current state of environment and the available technology. The overall benefits of the proposed development are far higher than the potential cost of the negative environmental changes which that likely to occur. The project will support the County Integrated Development Plans (CIDPs) for Nairobi, Kajiado, Kiambu, Nakuru and Narok Counties. The project will improve the socio-economic status of Nairobi County including the Nairobi Metropolitan Region (NMR). It will support the urban transportation strategy for the City of Nairobi as outlined in the Integrated Urban Development Master Plan for the City of Nairobi (NIUPLAN) by shifting most of the freight in the current narrow gauge trains to the SGR and dedicating the meter gauge track for urban passenger services. The SGR will also connect well with the Ongata Rongai and Ngong transport hubs for the proposed Nairobi Metropolitan Region (NMR) Mass Rapid Transit system (MRTS) including the Bus Rapid Transit (BRT) and Light Rail Rapid Transit (LRRT).

In view of the findings of the ESIA, the proposed project is considered as environmentally sound. In addition, the project proponent (KRC) is willing to guarantee that the potential adverse impacts whose mitigation strategies have been disclosed in this report and most of which have already been incorporated in the project design. On the basis of these findings, it is recommended that the proposed constructionof the SGR Phase 2A be approved based on **Route Option 4**as the most suitable route and the willingness by the proponent (KRC) to implement the proposed project in strict adherence to the Environmental and Social Management Plan (ESMP) and Environmental Monitoring Plan. The ESIA consultant hereby recommends that the National Environment Management Authority (NEMA) should issue the proponent with an EIA license as required by Kenya's environmental laws in order for the project to proceed.

1. INTRODUCTION

1.1: Background

The project information provided in this chapter is outlined as provided by the proponent and contractor through feasibility study report and consultations. The project proponent,Kenya Railways Corporation (KRC) is a State Corporation established in 1978 by an Act of Parliament (the Kenya Railways Corporation Act Cap 397) of the Laws of Kenya to provide a coordinated and integrated system of rail and inland waterways transport services and inland port facilities within Kenya. KRC is also regulated under the State Corporations Act (Cap 4860 which was amended through The Kenya Railways (Amendment) Act 2005 to make it possible for the Board of Directors to enter into Concession agreements or other forms of management for the provision of rail transport services. Following this amendment, KRC conceded railway operations to Rift Valley Railways Ltd (K) from November 1st 2006 for a period of 25 years for freight services and 5 years for passenger services (Kenya Railways Corporation, 2010). The railway network handed over to the Concessionaire comprised of 2,156 route kilometers of the metre gauge railway track.

The railway line runs across Kenya from the coast of Mombasa to Malaba with principal branches connecting Nakuru-Kisumu, Nairobi-Nanyuki, Kisumu-Butere, Eldoret-Kitale, Gilgil-Nyahururu, Voi-Moshi and Konza-Magadi. KRC has its headquarters in Nairobi with wide spread assets worth several Kenya shillings (KES) billions in major towns in the country.The existing railway linking Mombasa in Kenya and Kampala in Uganda has been the only railway in East Africa from the late 1800's. Over the years, as a result of significant track aging and outdated technology, this railway is in very poor physical condition. Therefore, the six member statesof the East African Community (EAC) (Kenya, Uganda, Rwanda, Burundi, South Sudan, and Tanzania)as well as Ethiopia have agreed to construct more than 10 new railways in this region in the next 12 years in order to providea modern railway network to promote regional economic growth. The proposed railway projects in the region include the following:

- Mombasa-Nairobi-Malaba-Kampala SGR and the Tororo-Juba SGR projectsto be completed in 2025.
- Kampala-Kasese & Kigali SGR to be completed in in 2030.

As part of this initiative, Kenya is currently undertaking construction of the Mombasa-Malaba SGR. The proposed SGR is one of Kenya's Vision 2030 flagship projects which will play an important role in strengthening cooperation among EAC member states and promote national and regional economic development. Further, it is part of the Northern Corridor Infrastructure Master Plan which was developed for the five Northern Corridor Transit Agreement (NCTA) member countries, namely Kenya, Uganda, Rwanda, Burundi and the Democratic Republic of Congo (DRC). According to the Master Plan, the capacity of the main railways in the Northern Transport Corridor in their present condition could be estimated at less than 5 million tons a year. With significant infrastructure investments, this could be increased to 15 million. The SGR is therefore considered as an important measure for improving Kenya's transportation network and a key strategy of saving the country's financial resources and protecting the environment due to large scale vehicular carbon emissions. Construction of the Mombasa-Nairobi portion of the SGR is currently ongoing and will be completed in 2017.

a) The proposed project

The proposed project is part of the Mombasa-Malaba SGR that runs between the Nairobi South Railway Station through Naivasha Industrial Park to Enoosupukia, Narok County. The project will be the nexus between the Mombasa-Nairobi SGR and the proposed Narok – Malaba SGR. Upon completion, the Mombasa-Malaba SGR will be the most important railway channel in Kenya, and will link the port city of Mombasa to the rest of East Africa through the terminating station at Malaba. The projected implementation duration for the project include the initial stage upto 2025, the short-term upto 2030 and the long-term upto 2040.

b) Project justification

The existing narrow gauge railway network which was built in 1891 is in a poor physical state, hasobsolete equipment andis highlyunreliable due to long turn round trips occasioned by outdated technology. The narrow gauge railway network has very basic manual engineering characteristics and geometrics with limiting axle loads, speed and train capacity. Therefore, a large amount of container freights that arrive in Port of Mombasa by sea have to be transferred by roadways to Uganda, Rwanda, Burundi, South Sudan and other destinations within the country. Statistics show the current transport expenses of import and export trade in East Africa accounts for 40% of total cargo costs. It is estimated that among the deferred import freights, 24% of them suffer from backward traffic infrastructure. The current railway which is operated by Rift Valley Railways (RVR) can only handle about 6% of the cargo from the Port of Mombasa (approximately 13 metric tons per year). The rest (94%) has to be hauled by road, which is unsustainable in the long run as the cargo volumes increase.This situation not only causes huge pressure on the Kenya's road system, but also increases the freight cost in time and money which has a negative impact on the development of regional trade.

Upon completion, the Mombasa-Malaba SGR (of which the Nairobi South Railway Station through Naivasha Industrial Park to Enoosupukia,Narok County SGR will be a part of)will be a trunk line for the planned Eastern African SGR regional network. The Kenyan Economic Survey of 2015 indicated that revenue earned from cargo transportation in the railway subsector grew by 13% from KShs 4.6 billion in 2013 to KShs 5.2 billion in 2014, but revenue earned from passenger traffic stream dropped by 23.2 per cent from KShs 211 million to KShs 162 million over the same period.Therefore, operations restructuring and infrastructure improvement of the sector is inevitable in order to realize increased revenue whilst improving and modernizing the existing railway system.

Development of the SGR will bring many benefits to Kenya including:-

- Reduction in cost of transportation in the country and the region making Kenya an attractive investment destination and competitive in the region;
- Protecting the environment through reduced carbon emission arising from vehicular movement;
- Acceleratedindustrialization through easier and cheaper transport and the establishment of new industries to service the new railway system;
- Increased annual GDP growth by a minimum of at least 1.5% during construction and subsequently during operation;
- Positioning the Port of Mombasa as the transport and logistical entry port of choice for the East African Region. The Port of Mombasa which is part of the Northern Transport Corridor is currently experiencing stiff competition from the Central Transport Corridor which is served from the Port of DaresSalaaam and in future will also be serviced through the proposed Port of Bagamoyo in Tanzania;
- Reduction in congestion at the Port of Mombasa, securing more efficiency and making it a more attractive and preferred coastal port facility in the region;
- Reduction in wear and tear on Kenya roads which increases the cost of repair and maintenance;
- Reductionin road travel time from Mombasa to Nairobi and vice versa;
- Enhanced freight security compared to road transport;
- Enhanced prospects for the development of a free port and Export Processing Zones and Industrial Parks along the railway line;
- Creation of employment opportunities during construction and operation phases. This includes unskilled workers, environmental, social/ community liaison, health and safety, engineers and technicians during construction who will to be available for local and regional railway development;
- Triggering and creation of new jobs in the service and hospitality industry (food, accommodation and leisure) and jobs in the self-employment sector;

- Creating demand and market for large quantities of local inputs such as; steel, cement, aggregates, electricity generation and electricity transmission pylons and cables, roofing materials, and glass.
- Reduce the number of heavy trucks on the road thereby reducing prevalence of accident which will ultimately make the roads safer to humans;
- Promote regional economic growth and resource exploitation in the East African region;
- Providing a cheaper and safer alternative means of transport for tourists to various inland wildlife parks, reserves and coastal parts of Kenya, hence promoting the tourism sector in the country;**Plate 1.1** shows passenger train in the Ethiopia-Djibouti SGR which became operational in October 2016.

Plate 1.1: Passenger train in the Ethiopia-Djibouti SGR

In conclusion, the proposed SGR Project is one of Kenya's Vision 2030 flagship projects which will play an important role in strengthening cooperation among EAC member states, and will promote national and regional economic development. It is an important measure for improving the Kenyan transportation network, and an important means to save resources and protect environment. Accordingly, the project is therefore anurgent necessity.

1.2: ESIAProcess and Scope of the Report

The Environmental Management and Coordination Act 1999 (EMCA 1999, revision 2015, Cap 387) is recognized as the umbrella environmental legislation in Kenya. EMCA (1999) gives "teeth" and "muscle" for the National Environment Management Authority (NEMA) to spearhead pre-cautionary activities in order to ensure sustainable development in all sectors including transportation infrastructure through Environmental and Social Impact assessment (ESIA) for all the subjectable projects in order to protect all the valued and sensitive environments in the country. The ESIA is considered as a measure to ensure that development, which is an inevitable necessity in the country does not in any way undermine the objectives of environmental conservation. In other words, it is necessary to regulate development so that in the long-term, it doesn't destroy the environment from which the valued goods and services it requires are obtained. The assessment also ensures that unnecessary conflicts that may retard development in the country are prevented through adequate stakeholder consultations. It was on the basis of this obligatory requirement that theSGR project proponent (KRC), through the project contractor (CCCC) undertook this ESIA, which incorporatesall the various environmental concerns as required by law.

Habitat Planners & Environmental Consultants which is registered by NEMA as a licenced firm (Certificate No. 0465) authorized to undertake environmental assessments and audits in Kenya including Strategic Environmental Assessment (SEA) and ESIAs was contracted by the CCCC in partnership with the KRC to undertake the ESIA for the Nairobi-Naivasha-Enosupukia SGR project in accordance with the national regulations and guidelines for ESIA in Kenya.The scope of the assessment covered the project site and their environs, and the utilities proposed. The output of the said assessment is this ESIA study report which is expected to inform the National Environment Management Authority (NEMA) in their decision making on matters related with the issuance of an NEMA EIA licence to the proponent and contractor as stipulated by EMCA (1999, 2015 Review) Cap 387.

The key objectives for the SGR-2A ESIA were as follows:

a) Establish whether the project infrastructure and operations are compatible with sustainable environmental planning and management in Kenya.
b) Establish whether the project complies with national and international environmental policy and legislative obligations.
c) Ensure the integration of environmental considerations into theproject.
d) Identification of key positive and negative environmental impacts associated with the project.
e) Identification of suitable mitigation strategies for any potential negative impacts of the project.
f) Strengthening the project implementation strategy through stakeholder consultations.
g) Assessing the environmentaland socio-economic suitability of the seven SGR route options in the Nairobi region including the Nairobi National Park in order to recommend the most environmentally suitable route.

The ESIA report is expected to provide information on the nature and extent of potential environmental and social impacts arising from the pre-construction, construction and operational phases of the project and their related activities. The purpose of this ESIA study was to determine the acceptability/suitability of the Nairobi South Station through Naivasha Industrial Park to Enoosupukia, Narok CountySGR in terms of any adverse environmental impacts that may arise, provide mitigation measures for the control of impacts that may arise during construction, operational and decommissioning of the proposed project.

The scope of the ESIA, therefore, covered:

a) Undertaking a detailed baseline environmental assessment in the proposed SGR route,
b) Identifying the anticipated social and environmental impacts of the proposed SGR project and the scale of impacts,
c) Identifying and analyze alternatives to the proposed SGR project,
d) Proposing mitigation measures taken during and after implementation of the project,
e) Developing acomprehensive Environmental Management Plan (EMP) with mechanisms for monitoring and evaluating compliance and environmental performance; which shall include the cost of mitigation measures and the time frame of implementing the measures.

1.3: ESIA Terms of Reference (ToR)

Habitat Planners which is a registered Firm of Experts was appointed as the consultant to conduct the ESIA of the proposed Nairobi South Railway Station-Naivasha Industrial Park-Enoosupukia SGR project. The scope of the assessment covered the proposed project alignment, surrounding environment and the utilities associated with the project. The output of this work is a comprehensive ESIA study report for the purposes of applying for an EIA licencefrom NEMA in order to embark on the construction work and subsequent train operations. The ESIA included the necessary specialist studies to determine the environmental and social impacts relating to the biophysical and socio-economic aspects and to determine the issues or concerns from the relevant authorities and interested and/or affected parties. The ESIA also recommendsappropriate mitigation measures for potential negative impacts while emphasizing the positive impacts.The appropriate measures to ensure sustainability of the proposed development with other social and economic activities in the railway line are provided as part of Environmental Management Plan.

The consultant on behalf of the proponent (KRC) and contractor (CCCC) conducted the ESIA assessment by analysing the project documents and consulting and thereafter describing the following as part of the Terms of Reference (ToR): -

- Proposed location of the project.
- The proposed standard gauge railway project.
- Project objectives.
- The national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.
- The technology, procedures and processes to be used, in the implementation of the project.
- The materials to be used in the construction and implementation of the project.
- The products, by-products and waste to be generated by the project.
- The environments that are likely to be affected by the SGR project.
- The environmental effects of the project including the social and cultural effects and the direct, indirect, cumulative, irreversible, short-term and long-term effects anticipated.
- Recommendationsfor environmentally sound and affordable waste management.
- Analysis of alternatives including project site, design and technologies.
- A comprehensive Environmental Management Plan (EMP) proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment, including the cost, timeframe and responsibility to implement the measures.
- Environmental monitoring plan for the prevention and management of the foreseeable accidents and hazardous activities in the cause of carrying out development activities.
- Measures to prevent health hazards and to ensure security in the working environment for the employees, local community and for the management in case of emergencies.
- Gaps in knowledge and uncertainties, which were encountered in compiling the information.
- Economic and social analysis of the project.
- Other matters as the National Environment Management Authority(NEMA) required.

1.4: ESIA Approach and Methodology

In order to comply with the Environmental (Impact Assessment and Audit) Regulations 2003, various environmental assessment activities were undertaken using different procedures, methodologies and tools. This was necessary in order to also comply with the NEMA approved Terms of Reference for the ESIA.

1.4.1: Approach

The ESIA was conducted through desktop studies, field work and intensive stakeholder consultations. Before the field work, reconnaissance was done to identify specific areas for subsequent site visits. These included areas where major operations and work components would take place during construction and operation of the proposed line. These areas were; the site for the Nairobi South Railway Station, proposed marshaling yards, Inland Container Deport (ICD), major stations, bridge location areas, the proposed Naivasha Industrial Park and flood prone zones. After making observations, expert judgment and conducting interviews, identified impacts were recorded for further evaluation. In some sections of this study, the existing railway operations and layout informed the study.

In addition, a review of the feasibility technical report, literature review on soils and geology and available maps was carried out. It also involved generation of project path maps and uploading of pre-selected sites geographic locations into GPS for use by the various teams for easier navigation to these sites prior to visiting the sites.

The general roadmap followed during the assessment were as follows.

- Environment screening, during which the proposed standard gauge railway project was identified as among those requiring to be subjected to the ESIA process as stipulated under Schedule 2 of Kenya Gazette Supplement No.74 (Acts No. 5) EMCA amendment, 2015.
- Environmental scoping that provided the key environmental issues to be considered.
- Desktop studies and documentary review.
- Physical inspection and assessment of the railway track alignment from its starting point at Nairobi South Railway Station through Naivasha Industrial Park to the end point at Enoosupukia, Narok County.
- Analysis of project alternative options.
- In-house consultative meetings.
- Comprehensive baseline environmental assessment.
- Intensive stakeholder engagement and consultations.
- Comprehensive impact analysis.
- Impact mitigation planning.
- Environmental management planning
- Report writing

1.4.2: Environmental Screening and Scoping

Environmental screening and scoping aimedsought to determine whether an ESIA was required and what level of assessment was necessary. This was done in reference to requirements of the EMCA, 1999, and specifically the second schedule of (EMCA (amendment) Act, 2015). Issues considered included the physical location, sensitive issues and nature of anticipated impacts.

1.4.3: Desktop Study

This included documentary review on the nature of the proposed activities, project documents, designs, policy and legislative framework as well as the environmental setting of the area among others. It also included discussions with managers and design engineers as well as interviews with SGR corridor neighbours (Directly affected stakeholders (DAS), Project Affected Stakeholders (PAS), Indirectly Affected stakeholders (IAS), general public, institutions and establishments) and other stakeholders.

1.4.4: Data Collection

First, the Consultant undertook environmental screening and scoping to avoid unnecessary data. The data collection was carried out through questionnaires/standard interview schedules, key stakeholders meetings, use of checklists, observations and photography, site visits and desktop environmental studies, where necessary in the manner specified in Part V (refer to Section 31-41) of the Environmental (Impact Assessment and Audit) Regulations, 2003. Data collections tools are appended to this report.

1.4.5: Site Assessment

Field visits were carried out for physical observations of physiography, geology and soil, water resources and vegetation, in order to gather information on them along the proposed line. In addition, noise, vibration and air quality characteristics were considered. Photographs at selected sites were taken for inclusion in this report to further emphasize these observations. Field visits meant for physical inspections of the site characteristics and the environmental status of the surrounding areas to determine the anticipated impacts were conducted. It also included further interviews with the SGR corridor neighbours (Directly affected stakeholders, general public, institutions and establishments), surrounding enterprises and key stakeholders.

The approach and methodologies adopted in various thematic areas for the SGR ESIA wereas highlighted below.

1.4.5.1:Wildlife assessment

Wildlife assessment was done using the available secondary data with ground trothing through rapid field appraisals using the road transect method. The assessment involved the identification and mapping of key types of valued ecosystems, identification of valued habitats, identification of valued species and identification of rare and endangered species. Special consideration was made to determine the existence of any Red list species in accordance with the IUCN list for Kenya.

1.4.5.2:Vegetation assessment

Rapid vegetation surveys were conducted in the proposed SGR construction routes with emphasis on woody vegetation (trees and shrubs). All the vegetation data was meant to shed light on the overall woody species composition in each site as well as species that were of any conservation concern based on the IUCN Red listfor Kenya.

1.4.5.3: Hydrology and drainage

The hydrology and drainage of the project/study area was initially evaluated using topographic maps for the area. The focus was mainly on the key streams, rivers, wetlands and groundwater aquifers within the proposed SGR route. This was coupled with an intensive analysis of existing literature. Thereafter, intensive ground truthing was done through drive, site inspection transects along the motorable tracks in the area.

1.4.5.4: Water quality

The water quality baselines were collected through sampling of water in boreholes, shallow wells, water pans, rivers and wetlands in various places within the project area. A rapid appraisal of the water quality status in any springs, streams, or rivers near the Kenya Railway audit sites was undertaken on site using the Hanna multi-parameter meter model HI 9828 (**Plate 1-1)**. The following attributes were measured on site; water pH, total dissolved solids (TDS), electrical conductivity, and oxidation reduction potential. The state of the aquatic environment werebe evaluated against the National Environment Management Authority (NEMA) and WHO standards.


Plate 1- 1: The Hanna multi-parameter portable water analyzer

1.4.5.5: Noiseenvironmental impact assessment

The pre-project air craft noise levels were measured in Nairobi National Park using a Benetech DigitalSoundLevelMeterModelNo. GM 1357 (**Plate 1-2**). The baseline ambient noise levels were undertaken in the Nairobi National Park area at two points; a) SGR entry into the NPP near East Gate (Aircraft exit from NPP airspace), b) SGR exit from the NPP near Masai Gate in Tuala (Aircraft entry into NPP airspace) and also within Nairobi National Park. The baseline ambient noise measurements were also taken at various points along the SGR route between Ongata Rongai (Kajiado County) and Enosupukia (Narok County).The Measurementswereinterpretedusing theEnvironmentalManagementand Coordination(Noise&Excessivevibration Pollution)Regulations2009,andNoiseRiskReductionRules,2007underthe OccupationalSafety and Health Act of 2007.

Plate 1- 2: The Benetech Digital Sound Level Meter Model No. GM 1357

1.4.6: Assessment of structural and engineering integrity

This included but not limited to; review of the suitability of the proposed geometric designs and related land uptake and accessibility to the adjoining properties, identification of the sources of construction material and review of the local geology, review of the proposed camps workshops and borrow sites, review of the proposed construction methodology and equipment to be used, review of the proposed erosion and slope protection measures and their suitability, review of the proposed traffic deviations and management, visual assessment of the existing road surface condition and geometric configuration and, any other issues of importance. There be achieved through reconnaissance field site visit and survey, review of the proposed design, visual impact assessment, collection and review of previous reports and documents on the project area.

1.4.7: Population, human settlements and economic analysis

The methodologies used included both secondary and primary sources of data gathering. The secondary analysis included a thorough review of the County Integrated Development Plans (2013-2017). The distribution of the affected households was determined from the route feasibility reports.The expected net returns per kilometerfrom each SGR route in Section DK00-DK50 was estimated by combining the expected gross returns (annual freight and passenger tariffs),thendeducting the annual freight and passenger costs for each route. From the resulting figure, the additional annual operations costs from each route was deducted. The formula for route mean net returns was expressed as:

$$MNR_i = \frac{1}{n}\left(\sum_{t=25}^{40} ([P_F.F - C_F.F + P_{PS}.PS - C_{PS}] - A_{OC})/RL\right)$$

Where MNR_i is the mean net returns for route i; P_F is the tariff price for freight; F is the freight in ton-km; C_F is the operation costs for transporting the freight; P_{PS} is the passenger tariff price; PS is the passenger numbers expressed in passenger-km; C_{PS} is the operational costs for transporting a passenger-km; while A_{OC} is the additional annual operational costs for each route. RL is the route length in km. Note that this is mean over a period of 15 year (2025 to 2040), thus n=15.

1.4.8: Stakeholder engagement and consultations

Stakeholder engagement and consultations were undertaken in order to determine and capture all the key areas of potential environmental impact, namely: a) physical environment, b) biological environment, c) social-cultural environment, d) economic issues, e) political issues, f) institutional issues, g) international implications, and h) any other issues. **Table 1-1** highlights the key issues considered in the ESIA.

Table 1- 1: A summary of the key issues considered in the stakeholder consultations

	Socioeconomic aspect	Description	Method of data collection
1	Population characteristics	▪ Present population, expected change ▪ Ethnic and racial diversity ▪ Influxes and outflows of Temporary residents ▪ Gender	▪ Document review using tools such as literature /maps, to extract relevant information ▪ Discussion with key individuals ▪ Listening to people
2	Community and institutional structures	▪ Voluntary associations ▪ Interest group activity ▪ Size and structure of local government ▪ Employment/income characteristics ▪ Employment equity of minority groups	▪ Document review using tools such as literature /maps, to extract relevant information ▪ Discussion with key individuals

		▪ Local/regional/national linkage ▪ Industrial/commercial diversity ▪ Presence of planning and zoning activity	▪ Transect walks ▪ Informal conversations
3	Political and social resources	▪ Distribution of power and authority ▪ Identifications of stakeholders ▪ Interested and affected stakeholders ▪ Leadership capability and characteristics	▪ Discussion with key individuals ▪ Informal conversations ▪ Observations
4	Individual and family changes	▪ Perceptions of risk, health, and safety ▪ Displacement/relocation concerns ▪ Trust in political and social institutions ▪ Residential stability ▪ Density of acquaintanceship ▪ Attitudes towards policy/project ▪ Family and friendship networks ▪ Concerns about social well-being	▪ Discussion with key individuals ▪ Informal conversations ▪ Brainstorming with people in anarea
5	Community resources	▪ Change in community infrastructure ▪ Land use patterns ▪ Effects on cultural, historical, and archaeological resource	▪ Discussion with key individuals ▪ Observation ▪ Informal conversations ▪ Brainstorming with people in the area

The principal objectives of the stakeholder consultations were to:-

a) Ensure understanding of the SGR project: an open, inclusive and transparent process of appropriate engagement and communication was undertaken to ensure that stakeholders were well informed about the proposed project. Information about the project was disclosed as comprehensive and as appropriate as possible.

b) Involve stakeholders in the assessment: Stakeholders were included the assessment of impacts and the generation of mitigation and management measures of the ESIA report. They also played an important role in providing local knowledge and information for the baseline to inform the impact assessment.

c) Build relationships: by supporting open dialogue, engagements that would help establish and maintain a productive relationship between the Kenya Railways Corporation and stakeholders.

d) Ensuring compliance: the process was designed to ensure compliance with both local regulatory requirements and international best practice

Reconnaissance missions were undertaken for the purpose of stakeholder mapping after which the information was used in the planning of stakeholder consultations through public meetings and institutional stakeholder consultations. The aim of the consultations was to:-

- Explain the aim and purpose of proposed SGR project,
- Explain the designs of the project
- Understand the stakeholder expectations
- Understand the stakeholder environmental and socio-economic concerns
- Understand the stakeholder strategies for mitigating the negative impacts

Considering the linear nature of the SGR project (120 km), the wide spectrum and large number of stakeholders and the need to have cost effective and valuable consultations, it is imperative to explain here how the stakeholder engagement process was undertaken.

The stakeholder identification was undertaken in a number of steps. The first step was stakeholder identification which the ESIA Team members undertook through a brainstorming process. To guide the team, the following considerations were made:

- Which people/groups/institutions or organizations would be affected by/ interested in/involved in the SGR development and operation? What is/would be their role?
- Who are the potential beneficiaries of the SGR?
- Who might be adversely impacted by SGR development and operation? Who would be constrained by SGR development and operation?
- Who may impact on the SGR development and operation? Who has the power to influence SGR development and operation?

Thereafter, a list of stakeholder's organizations was developed and grouped the local community, the county government, the government, civil society or NGOs and private sector.The second step was to analyse the list of stakeholders to better understand their relevance and the perspectives they offer, to understand their relationship to the issues and each other and, to prioritize based on their the relative usefulness for the ESIA engagement. A list of criteria used to analyse each stakeholder is as follows:

- *Contribution* (value): does the stakeholder have information counsel or expertise on the issue that could be helpful to the ESIA process?
- *Legitimacy*: how legitimate is the stakeholders claim for engagement?
- *Willingness to engage:* how willing is the stakeholder to engage?
- *Influence*: how much influence does the stakeholder have?
- *Necessity of involvement*: can the stakeholder derail or delegitimize the ESIA process if they were not included in the engagement?

The stakeholder mapping identified three key stakeholder clusters as shown in **Table 1-2**.

Table 1- 2: the key stakeholder clusters in the SGR-2A ESIA

Stakeholder groups	Criteria	Focus
Group A	Directly affected by SGR alignment	Land/property owners: Government land (Kenya Wildlife Service, Kenya Forest Service, Kenya Rural Roads Authority, Kenya Urban Roads Authority), private land (individuals, institutions and group ranches) and community land (pastoralists), Kenya Land Commission
	Directly involved in implementation of SGR	In implementation: Ministry of Transport and Infrastructure, Kenya Railways Corporation, China Communications and Construction Company
Group B	Directly affected by SGR	Residents of Tuala, Ongota Rongai, Embulbul, Nachu, Ewaso Kedong, Suswa and Duka Moja Kenya Civil Aviation Authority (KCAA), JKIA
	Directly interested parties	Cargo owners and handlers (industries and businesses) and prospective passengers; Kenya Tourist Board, Kenya Association of Tour Operators
Group C	Indirectly affected and directly interested parties	County government (Nairobi, Kajiado, Kiambu and Natok), local leaders, civil society organizations: NGOs, CBOs, faith based organizations, trade unions, etc, research and academic institutions
Group D	Indirectly affected and indirectly interested parties	The general public

1.5: Purpose of the ESIA Report

The CCCC has been contracted to construct the Nairobi South Railway Station–Naivasha Industrial Park-Enoosupukia SGR. As a requirement under the Environmental Management and Coordination Act (EMCA) of 1999 and EMCA (CaP 387) (Amendment Act) 2015, the proposed project must be evaluated for environmental compliance since the activities in the processing plant may be injurious to the environment, and where harmful impacts are detected, then mitigation against the same must be outlined. The undertaking of this ESIA study is therefore guided by the EMCA (**EIA and Audit**) Regulations, 2003.The primary objective of the ESIA study is to ensure that the key environmental and social issues associated with the project are identified early enough so that the necessary mitigation measures are noted and integrated in the final project design. This will reduce the potential for issues relating to environmental impacts and environmental compliance to cause problems or delays at a later stage in the project implementation phase. This ESIA study report is part of the ESIA implementation framework in Kenya and is expected to assist NEMA in decision making as shown in **Figure 1-1**.

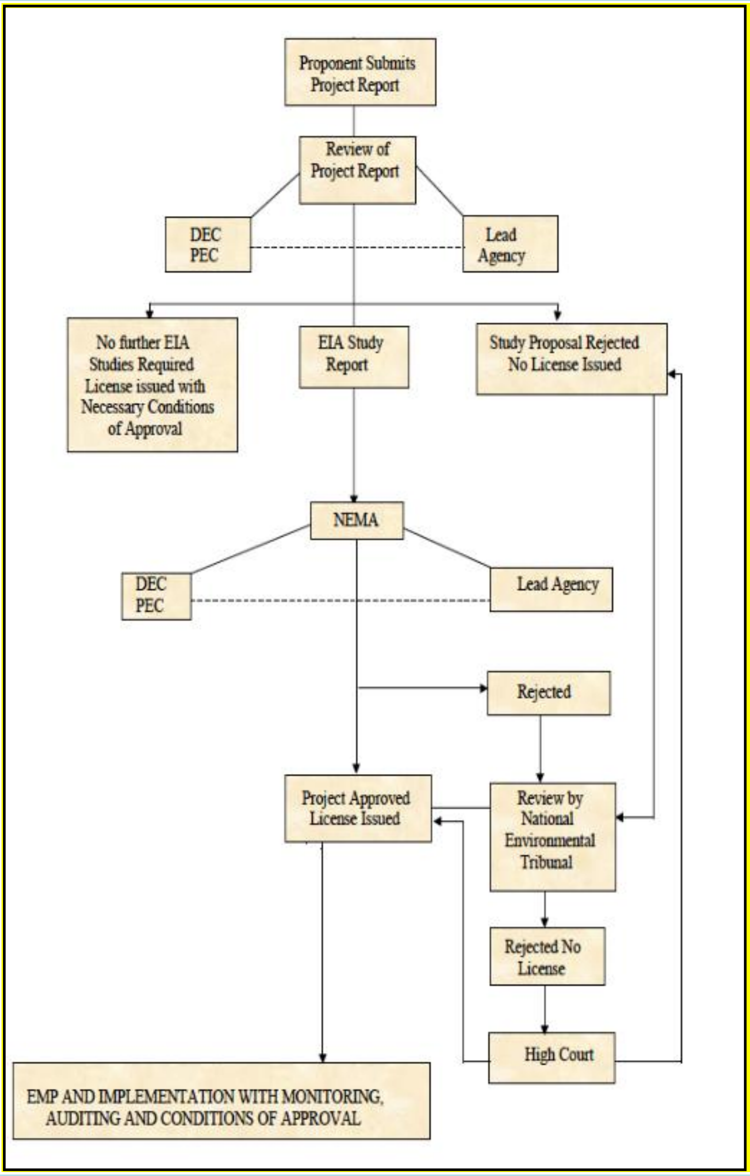


Figure 1- 1: The ESIA implementation in Kenya

2. PROJECT DESCRIPTION

2.1: General Project Information

This chapter is based on China Communications Construction Company Ltd (CCCC) feasibility study for the proposed study which was undertaken in 2015 (CCCC, 2015 Nairobi–Naivasha SGR Project Feasibility Report), as well as the Preliminary Project Designs provided by CCCC and consultations with CCCC and KRC technical experts. Based on this, the proposed Nairobi South Railway Station–Naivasha Industrial Park-Enoosupukia SGR)Project will be the nexus between the Mombasa -Nairobi SGR (currently under construction and expected to be completed by 2017), and the Narok - Malaba SGR (ESIA to be done at a later time.) Upon completion, the Mombasa-Malaba SGR will be the most important railway channel in Kenya, which will link the Port of Mombasa to the rest of Eastern Africa through the Terminal Station at Malaba.

The proposed Nairobi South Railway Station–Naivasha Industrial Park- Enoosupukia SGR alignment will encompass the first 120km (DK0-DK120) of what will eventually be the Mombasa–Malaba SGR. The proponent proposes a total of twelve (12) new railway stations in this section excluding the Nairobi South Station which is part of the NEMA approved Mombasa-Nairobi SGR Project. The specific details of the proposed railway project are provided below.

2.1.1: Stations and Yards

The Nairobi South Railway Station will have passenger and freight yards transversely arranged, such that it will be longitudinally alignedwith the Embakasi Inland Container Depot (ICD, **Figure 2-1**). The locomotive and rolling stock will be located to the left of the station, whilethe freight yard set to the right of the station. The distance between the stations ranges between 8.3-12.9Km depending on the technical design requirements, geographical position, human settlements and local economic activities/ needs.

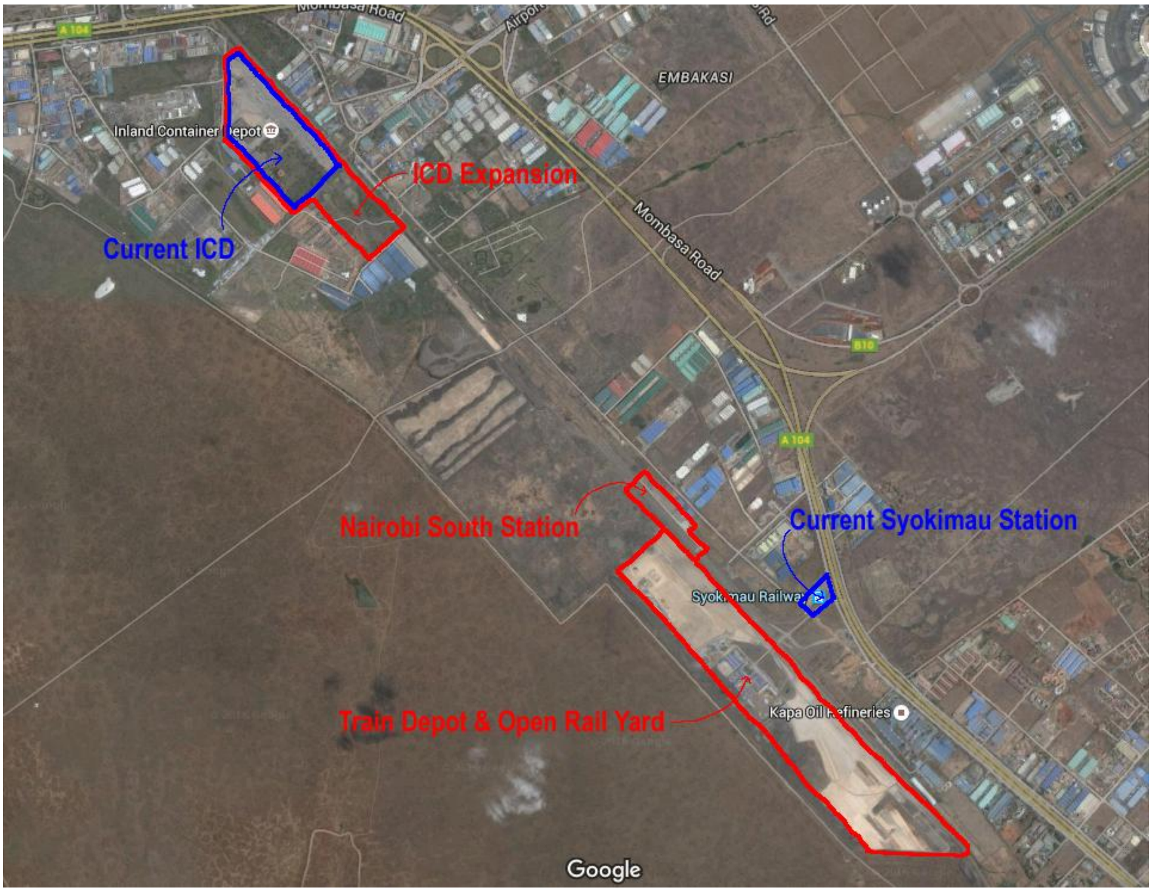


Figure 2- 1: Location of the Embakasi Internal Container Depot (ICD)

According to the CCCC, 2015, the Nairobi–Naivasha SGR Project Feasibility Report,the distribution of railway stations was based on the following principles:

- Satisfaction of long-term transport capacity and promotion of economic development along the line, facilitating the collection and distribution of ports, the railway transport organization and dispatch, as well as strengthening the competitiveness of the railway vis-a-vis various transportation modes.
- Consideration of terrain, geology, hydrological and railway operation conditions for station locations. The stations shall be set in sections with flat terrain to enable easy construction, maintenance of straight lines and good geology to ensure the convenience and safety of operations.
- Take into account the proportionality of section capacity and a reasonable distribution of the stations.
- Human distribution patterns and landuse activities along the SGR route.

Along the railway line, the main economic strongholds and areas with a large railway handling volume and use for passenger service are provided with intermediate stations.**Table 2-1** provides the details for the proposed railway stations while **Figure 2-2** shows a typical railway station in the SGR Phase 1 project.

Table 2- 1: Proposed Railway Stations from DK0 – DK 120

No.	County	Station Name	Type of Station	Location (km)	Distance between the stations (km)
1.	Nairobi	Nairobi South	District Station	DK0+000	0.0
2.		Tuala	Intermediate Station	DK12=150	12.15
3.		Ongata Rongai	District Station	DK20+800	20.80
4.		Ngong	District Station	DK31+900	31.9
5.	Kajiado	Ngong West	Crossing Station	DK41+550	41.55
6.	Kiambu	Nanju	District Station	DK51+850	51.85
7.	Kajiado	Ewaso	Crossing Station	DK64+700	64.7
8.	Nakuru	Mai-Mahiu	District Station	DK74+600	74.6
9.		Mai Mahiu West	Intermediate Station	DK86+500	86.5
10.	Narok	Suswa	District Station	DK99+400	99.4
11.		Oloshaiki	Intermediate Station	DK110+500	110.5
12.		Enosupukia	Terminating Station	DK120+800	120.8

2.1.2: Main design principle of stations and yards

a) Plane design: the stations shall be located on a straight line where feasible and will only be constructed on a curve under difficult conditions. The minimum curve radius shall not be less than the curve radius standard designed for main line.

b) Longitudinal section design: the station shall be located on flat ramp. The intermediate station can be set on the ramp with a slope no more than 1 ‰ under difficult conditions. The crossing station can be set on the ramp with a slope no more 6‰, but shall not be set continuously.

c) Type of stations: transversal layout is applied in general for new stations.

d) Receiving-departure track route*:* either directional route shall be designed for the stations along the whole line.

e) Type of starting signal*:* LED color light signal shall be used, with high signal for the main line and dwarf signal for the station track**(Figure 2-3).**

Figure 2- 2: A railway station in the SGR Phase I

Figure 2- 3: High signal in the SGR-I

f) Route for out-of-gauge freight train*:* the main line inside the station shall ensure the passage of the out-of-gauge freight train. An additional one route is provided for passage of the out-of-gauge freight trains in addition to the main line.

g) Connection of special siding*:* the safety siding should be arranged when depot siding, special siding and the third direction are connected with the main line and receiving-departure track within the station when there are no isolating equipment or parallel routes. But safety sidings shall not be provided when there are parallel routes; isolating turnouts and interlocking device are in stations.

h) Effective length of receiving-departure track*:* the effective length of receiving-departure track is 880m.

i) Passenger transport facilities:The crossing stations and the intermediate stations handling no passenger transport service are only provided with a traffic control platform of 50m×5m×0.3m. The intermediate stations handling passenger transport service are provided with one passenger platform of 450m ×6m ×0.5m.

j) Freight transport facilities:No freight transport facilities are provided for this section.

2.1.3: Design description of crossing station, intermediate stations or district stations

All the 12 stations will have unique designs as in the case for SGR Phase I. SGR-IIA will begin from the Nairobi South District Station which is built on the Mombasa-Nairobi Railway, with the passenger and freight yards transversely arranged, to be longitudinally arranged with the Inland Container Depot (**Figure 2-1**), with the locomotive and rolling stock at the left of the station and the freight yard set at the right of the station. **Figure 2-4** shows the schematic plan for the Nairobi South Station while **Figure 2-5** shows the overall site design.

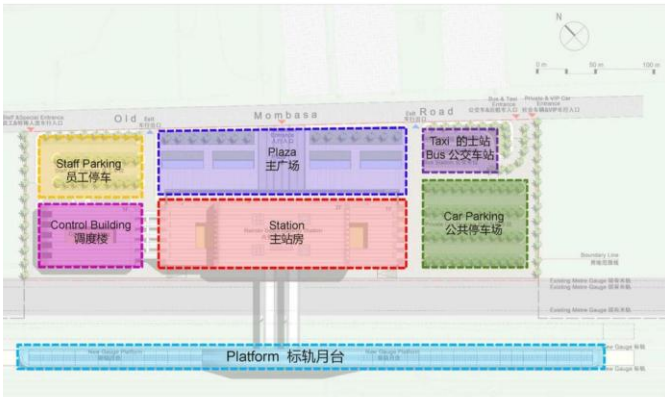


Figure 2- 4: Schematic plan for the Nairobi South Station

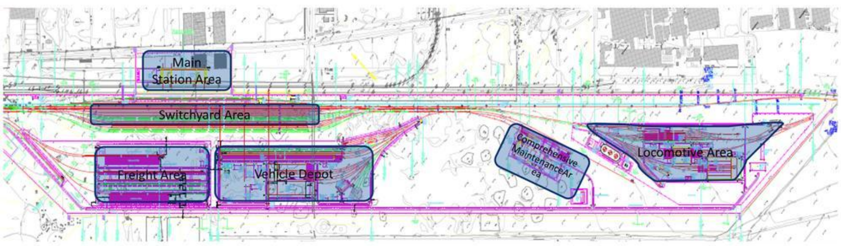


Figure 2- 5: The overall site plan for the Nairobi South Station

2.1.4: Reservation of special railway line for Naivasha Industrial Park

The proposed Naivasha Industrial Park is located in the northwest of Nairobi and between Hell's Gate National Park and and Mt. Longonot. This industrial park is planned to mainly promote power intensive investment in the proposed 1,300 acres Naivasha Industrial Park in Olkaria next to the geothermic power plants. It is likely to have a line distance of about 6-10 km from Suswa Station on the main line of Nairobi-Malaba Railway. While it is the policy of the government to develop this area, detailed plans for this industrial park are not yet done by the relevant National Government ministry in-charge of national industrial development. In the short term, the industrial park and SGR will be linked by roadway(CCCC, 2015).

2.1.4.1: Design of safety equipment

The catch sidings should be set at the downgrade station where gradient exceeds 6% in approaching direction within the braking distance beyond the home signal and under the circumstance that the special siding is connected with the intra-station main line or the receiving-departure track.

2.1.4.2: Standards for station track

***a) Rail**:* the jointed track of 50kg/m, 25m-long standard gauge is utilized for receiving-departure track, other station tracks and secondary station tracks.

***b) Sleeper**:* the new type II concrete sleepers and elastic rod type I fastenings are adopted for station track. 1520 sleepers are provided for the receiving-departure track every kilometer and 1440 sleepers are provided for other station tracks and secondary station tracks every kilometer.

***c) Track bed thickness**:* 40cm for the receiving-departure track; 25 cm for other station tracks; 20 cm for the secondary station track.

***d) Turnout**:* No. 12 single turnout is utilized for the turnouts on the main line (4249-4252 for dedicated line); No. 12 single turnout is utilized for the turnouts on the passenger train route; No. 9 single turnout is utilized for other turnouts.

2.1.4.3: Subgrade and drainage inside the station

a) Width of subgrade surface:The width from the center of station track to the subgrade edge: it shall not be less than 3m to the outermost track of the station, not be less than 4m to the outermost track of the station where the train inspection is conducted and not be less than 3.5m to the outermost ladder track and to the side of the draw-out track where the shunting operators often get on and off the train for operations. It shall not be less than 3.0m to the outermost track of the station and yard at the stations of other sections.

b) Subgrade bed:When the receiving-departure track and the main line are located on the same subgrade, the subgrade bed structure, the specifications of fillers and compacting criteria adopted for the receiving-departure track are the same as the standards adopted for the main line. The subgrade bed is 2.5m thick, consisting of 0.6m thick (Group A filler) for the base course and 1.9m thick (fillers of Group A and B) for the sub-base.

When the receiving-departure track and the main line are provided with drainage channels, platforms and other facilities, the receiving-departure track and the main line are separately provided. The subgrade bed structure, specifications of fillers and compacting criteria adopted for the receiving-departure track and the station track are designed based on the standard of Class II Railway Subgrade, with the total subgrade bed of 1.2m thick, consisting of 0.3m thick for the base course and 0.9m thick for the sub base. For the receiving-departure track, Group A filler shall be adopted for the base course and the fillers not conforming to requirements shall be improved; fillers of Groups A and B may be adopted for the sub base; or the soil improvement measures shall be taken. For other station tracks, fillers of Groups A and B are adopted for the base course; fillers of Groups A, B and C are adopted for the sub base or the soil improvement measures shall be taken.

c) Transverse slope of subgrade surface:The standard of the transverse subgrade slope of the receiving-departure track is the same as that of the main line. The top of the subgrade base course and the top and bottom of the sub base shall be provided with transverse drainage slopes with a gradient of 4% to both sides. For other station tracks, the gradient of transverse drainage slope for subgrade surface shall not be less than 2%.

d) Drainage:The longitudinal drainage channel shall be set between the receiving-departure tracks and the platform. The transverse drainage channel shall not pass through the main line. C20 precast or cast-in-place reinforced concrete is adopted for the drainage channel, below which a coarse sand bed course of 0.2m will be provided.The drainage channels in the station, yard and depot shall be provided with cover plates.The longitudinal drainage channel should be 0.4m wide for the bottom. When the depth is over 1.2m, the bottom shall be 0.6m wide and the gradient should not be less than 2%.**Plate 2-1** shows the drainage system used in SGR-I.

Plate 2- 1: Shows the drainage system used in SGR-I

2.1.5: Transport organization mode and operation management method

a) Transport organization mode:The line is an important part of the East African railway network. The freight flow of this line in the study years mainly consists of bulk cargos including containers, coal, fuel oil and petroleum products, agricultural goods and cement transported from the Port of Mombasa and Nairobi to Malaba or further places, as well as a small amount of goods produced in local areas along the line. The line shall also meet the local passenger transport demands; therefore, the transport organization mode of mixed passenger and freight traffic shall be adopted for this line.

b) Operation management method:The feasibility study conducted for theSGR project identified two operation management modes that can be adopted for this line in line with the current management capacity of national railways in Kenya, combining the design standards, construction conditions, infrastructure and equipment configuration, transportation characteristics and lessons learnt from international and Chinese railway operation management experience:

- **Mode I**: Establish new railway branch/department/ or other operational arrangements that shall be independently responsible for the construction and operation management of the line;

- **Mode II**: Kenya Railway Corporation (KRC) takes charge of the construction and operation management of the railway in a unified way.

h) **Advantages and disadvantages of Mode I**

*Advantages:*This mode is suitable for the line. The line is a new SGR, which differs from the existing meter-gauge railway. The new company once founded will establish its own operation management system, and make transportation arrangements independently, having independent power of decision-making, helping improve work efficiency and providing conditions for reform and innovation. Establishing a new company is conducive to fundraising, independent operation and financial management of the company, assets management and operation, financial accounting, fund raising, construction and loan settlement of the new company.

*Disadvantages:*Establishing a new company will increase management organizations, and require recruitment and training of new staff. New staff may lack experience resulting in low transport efficiency in the short term.

ii)**Advantages and disadvantages of Mode II**

Advantages: Kenya Railway Corporation (KRC) carries out unified management, which can avoid conflict of interest among different management organizations, facilitate train organization and operation, improve transport efficiency and reduce transport cost. Unified management by the existing railway administration can facilitate business coordination and KRC has production technicians who are familiar with the business, providing certain advantages for the successful operation of this line after completion.

Disadvantages: From the perspective of fundraising, it is difficult for KRC to undertake the tasks of fundraising, assets management, construction management and repayment of capital with interest for this railway.

2.1.6: Traffic flow characteristics and organization

The freight flow of this line in the study years mainly consists of bulk cargos including containers, coal, fuel oil and petroleum products, and cement transported from the Port of Mombasa and Nairobi to Malaba or further, as well as a small amount of goods produced in local areas along the line. The pass-through freight traffic volume dominates this line and the container transportation volume accounts for about 30% of the total freight volume.

a) Traffic flow

The line is dominated by the through-trains that depart from the port of Mombasa and pass through this line, and are supplemented by the district through-trains that depart from Nairobi South Station. Pick-up trains transport traffic flow along the line.

In the design of container transportation, double-deck container transportation has been adopted for this line just as in the Mombasa-Nairobi Railway. G70 new type tankers transport oil, C70 gondolas transport coal and ordinary vehicles transport steel and other goods. Calculation parameters of traffic flow are as shown in **Table 2-2** below:

Table 2- 2: Calculation Parameters of Traffic Flow

Vehicle Type	Special Flat Car for Double-deck Container	G70	C70	Average Index of Ordinary Vehicles
Average static load of freight car (t)	56	56	70	56.865
Average dead weight of freight car (t)	22	23.8	23.5	22.133
Average gross weight of freight car (t)	78	79.8	93.5	78.998
Average length of freight car (m)	19.466	13.446	13.976	13.914

2.1.7: Carrying capacity and transport capacity

The designed carrying capacity is checked and calculated according to the double-locomotive traction of 4000t of DF8B diesel locomotive with automatic inter-station block on single track. The carrying capacity is calculated by using the following main parameters: comprehensive maintenance time: 60min; removal coefficient of passenger trains: 1.3 for single track; removal coefficient of pick-up trains: 1.5 for single track; station headway: τ no—4min, τ yes—2min; additional time for train departure and stopping: train departure: 3min, train stopping: 1min; deducted time at district station: td—4min.

a) ***Required carrying capacity in the study years:***The required carrying capacity of the line is calculated according to the passenger and freight trains in the study years and the calculation parameters of carrying capacity, as shown in**Table 2-3**.

Table 2- 3: Required Carrying Capacity in Study Years

Item / Section	Initial Stage				Short Term				Long Term			
	Freight train	Pick-up train	Passenger train	Required capacity	Freight train	Pick-up train	Passenger train	Required capacity	Freight train	Pick-up train	Passenger train	Required capacity
Nairobi South - Nairagie North	9	1	3	17.28	13	1	3	22.08	17.5	1	5	30.6

Note: coefficient of reserved capacity: 20% for single track

The SGR will have a uniform design specification which will permit seamless operation across the borders. Each freight train will have a haulage capacity of 4,000 tonnes (216 TEUs) with a designed speed of speed of 80 kilometres per hour. Each passenger train will have a capacity of 1,096 passengers and with a designed speed of 120 kilometres per hour. It is expected that in the short term period (2025-2030); 10 Cargo trains and 2 passenger trains will operate per day. In the long term 14 Cargo trains and 2 passenger trains will operate per day. **Figure 2-6** shows the projected growth in annual freights (10^4 tons) and annual passenger numbers (10^3) from year 2025 to 2040.

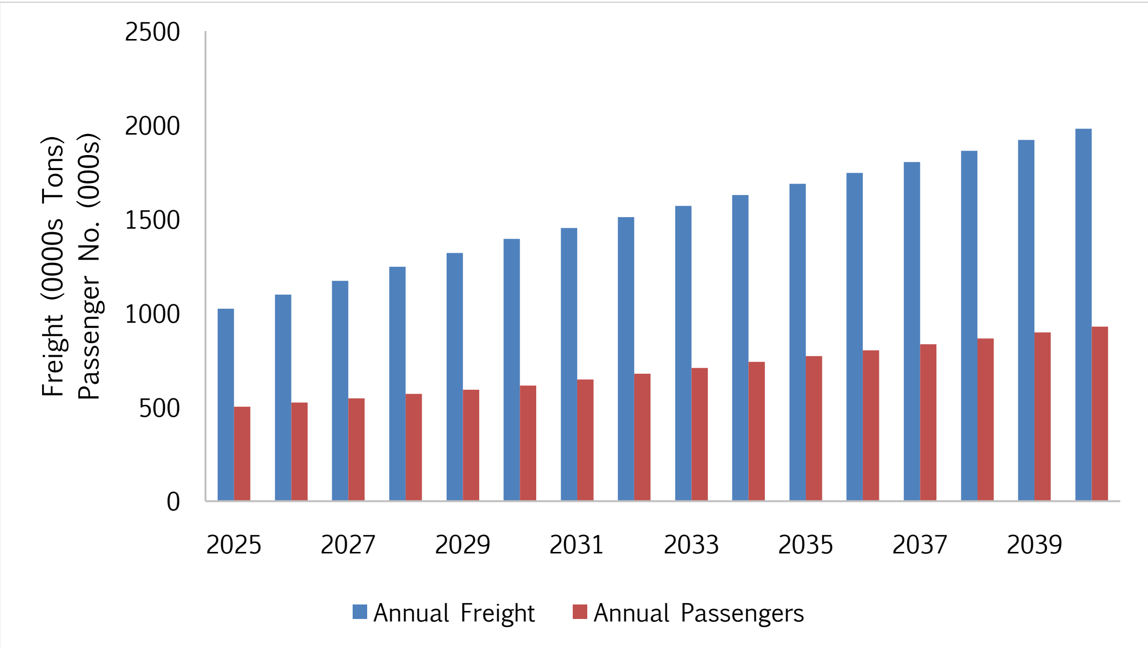


Figure 2- 6: The projected growth in annual freights (104 tons) and annual passenger numbers (103) from year 2025 to 2040

The freight tariff of the existing railways in Kenya is USD 0.07/ton-km for general freight and USD 0.085/ton-km for container freight, while the freight tariff of highways is USD 0.15-0.2/ton-km. The freight tariff of railways and that of highways differs a lot. With the consideration that this railway has higher grade than the existing railways, with high speed and short time for freight turnover, the freight tariff is determined based on the principle of high quality and low price. Therefore, in this design, the impact of freight tariff ranging from USD 0.08/ton-km to USD 0.13/ton-km

The passenger tariff of the existing railways in Kenya is USD 0.08/person-km for first-class seats, USD 0.05/person-km for second-class seats and USD 0.01/person-km for third-class seats. Considering that this railway has higher grade than the existing railways, its operation speed can reach 120km/h and the rolling stock with higher grade are provided on the railway, ensuring high comfort level, the average passenger tariff is designed as the average between that for second-class seats and that for third-class seats of the existing railways which is equivalent to USD 0.03/person-km.

b) Designed carrying capacity and transport capacity:The designed carrying capacity is checked and calculated according to the double-locomotive traction of 4000t of DF8B diesel locomotive with automatic inter-station block on single track. The designed carrying capacity and transport capacity in the study years are shown in **Table 2-4**.

Table 2- 4: Designed Carrying Capacity and Transport Capacity

Item **Section**	**Designed Carrying Capacity (Pairs)**			**Transport Capacity (10^4 t)**		
	Initial Stage	Short Term	Long Term	Initial Stage	Short Term	Long Term
Nairobi South-Nairagie North	23	23	37	1322.38	1322.38	2151

c) Adaptability of passenger and freight transport demand:Adaptability of the designed capacity to required capacity and of the designed transport capacity to predicted traffic volume in the study years is shown in**Table 2-5**.

Table 2- 5: Adaptability of Designed Capacity to Required Capacity

Study Year	**Study Section**	**Adaptability of Carrying Capacity (Pairs/Day)**			**Adaptability of Transport Capacity (10^4 t)**		
		Designed capacity	**Required capacity**	**Difference**	**Designed transport capacity**	**Predicted Traffic volume**	**Difference**
Short term	Nairobi South - Nairagie North	23	22.08	0.92	1322.38	1010	312.38
Long term	Nairobi South - Nairagie North	37	30.6	7	2151	1447	1018

As can be seen from the above table (**Table 2-5**), the designed carrying capacity of the line is greater than the required carrying capacity in the study years and the transport capacity of each section is greater than predicted traffic volume and has certain surplus in the short term and long term.

d) Measures to further improve transportation capacity:The SGR Railway is designed as single-track diesel traction, with a train traction mass of 4000t. If traffic volume continues to grow, the transportation capacity cannot meet the demand, so measures such as electrification transformation and adopting high-power locomotive traction are taken to further improve the transportation capacity, so as to meet the traffic volume growing demand.

2.2: Main Technical Standards

The Kenyan railway line is an important part of Eastern African railway network. The six countries of the Eastern African Community and Ethiopia planned to build more than 10 railway lines within the next 12 years in this region, which will form a modern railway network covering most countries in Eastern Africa.The main technical standards of proposed railways within the Eastern Africa Region are shown in**Table 2-6**. The main technical standards for the proposed Nairobi South Station–Naivasha Industrial Park–Enoosupukia-Narok railway are as summarized in**Table 2-6**.

The freight volume forecasted is 12,720,000 t/a in the short term (2023) and 21,640,000 t/a in long term (2028). The line will mainly provide the freight transport service and partial passenger transport service. The maximum designed operation speed is 120km/h. The common ballasted track (60kg/m) will be adopted for the line.

2.2.1: Gauge

Gauge represents the distance between two rails of a railway track (subject to the distance between the inner sides of rails).The standard gauge was determined to be 1435mm (4 feet and 8.5 inches) in 1937 by the International Union of Railways. Railways are divided into broad gauge, standard gauge and narrow gauge ones based on the gauge differences. Narrow gauge railways with a gauge of 1m or 1000mm are referred to as the meter-gauge railways.

The existing railway network in Kenya and Uganda adopted 1000mm narrow gauge, and the one in Sudan is the 1067mm narrow gauge. All the exisiting railways are old and have low carrying capacities and poor line conditions. Renovating the existing old lines to the modern level will be very expensive. In October 2004, Kenya, Uganda and Sudan proposed a plan of constructing high-speed railways using the standard gauge. The standard gauge was adopted in the construction of new railways in the region. This will also ensure a common standard for the future railway network. The standard gauge railways have a greater traction mass than the meter-gauge railway under a same ruling grade and a same cross and vertical section condition. The agreed option in the region is to adopt the standard gauge of 1435mm which is the type in the Mombasa-Nairobi SGR.

Table 2- 6: Main Technical Standards for the proposed Nairobi South Railway Station-Naivasha Industrial Park – Enoosupukia, Narok County Railway Project

#	Items	Standards
1.	Design standard	Chinese Railway Design Standard (CRDS)
2.	Gauge	1435mm (standard gauge)
3.	Number of main lines	Single track railway
4.	Limiting gradient	12‰
5.	Minimum radius of curve	1200m (800m in difficult sections)
6.	Axle weight	25t
7.	Load specification	Double stacked container
8.	Freight vehicle	DF8B
9.	Maximum speed of freight vehicle	80kM/h
10.	Passenger car	DF11
11.	Maximum speed of passenger car	120kM/h
12.	Type of traction	Diesel traction
13.	Tractive tonnage	4000t
14.	Effective length of arrival-departure track	880m

2.2.2: Railway classification

Railway classification is determined based on a comprehensive research for the significance, function as well as passenger and freight traffic volume of lines in a railway network.This line extends from east to west, starts from the Nairobi South Railway Station through the Naivasha Industrial Park and ends in Enoosupukia, Narok County. It connects with the Mombasa-Nairobi Railway (adopting the design standards for the National Railway Class I in China). It will become an important part of East African railway network, and is of great importance to improve the railway standards in Kenya, and the Eastern Africa region at large. It will increase the transport capacity of railway networks, ease the transport pressure of traffic systems in Kenya, accelerate communication between inland and coastal ports, and push social and economic development of areas along this line.

2.2.3: Running speed of passenger and freight trains

The proposedline isamixedpassengerand freightrailway witha railway classification of Class I.

Accordingto the standards for the NationalRailwayClassIinChina,thedesignrunningspeedshallnotbe lessthan120km/h.Therefore, themaximum runningspeedofthe passenger trainshallbe120km/h,andthemaximumrunningspeedof the freight trainshallbe80km/h.

2.2.4: Ruling grade

Rulinggrade notonly hasgreatimpactonrouteandlengthofthisline andstation distribution, butalsodirectly affects the transportcapacity,train operationsafety, engineeringcostandoperational cost.Itisclosely relatedto the naturalgrade along this line, transportdemands, traction and locomotive types,ruling grade ofadjacentlinesandfreighttraffic flow directions.

The SGR-2Alineconnects with the Mombasa-NairobiRailway, andwill serve as a trunk line for the EastAfricanmainlinerailway network.Thetraffic volumefrom Mombasa-NairobiRailwayoccupiesa largeproportioninthe trafficvolumeofthisline,soarulinggradeof12‰shallbeselectedto adapttothatofMombasa-NairobiRailway.

2.2.5: Axle load

Axleload represents thelocomotiveortrain weight born byeach wheelset.Itisthe mainbasisfordeterminingdesignloadstandards.At present, theaxle loadofrailwaysisnormally 21-25t.Consideringtypes, tractionmassandother conditionsoffreighttransportedbythisline, the proposed SGR willadoptan axleloadof25t.

2.2.6: Traction type

Thetractiontypeofrailwaysisnormally dieselorelectric power. Electriclocomotivesarecharacterizedbylargetractionforce,facilitatingacceleration, highcomputed velocity, large transport capacity, low pollutionandenergy saving;diesellocomotiveshave theadvantagesof less one-timeinvestmentand lowrequirementsonexternal supporting conditions, sousingdieseltractionmay effectively save investment,avoid investmentriskandeasefinancingpressure.

Thecurrent electricity powersupply in Kenya will not be able to meet the requirements on electric power traction within the study years; an electrification plan requires a large one-time investment,a higher external supporting conditioned higher investment in the initial term. Therefore, by comprehensively considering regional energy conditions and economic conditions,the diesel traction was adopted.

2.2.7: Locomotive type and traction mass

Therelationshipbetweenlocomotivetype,rulinggradeandtractionmassisshownin**Table 2-7**.

Table 2- 7: Analysis of Locomotive Type, Ruling Grade and Traction Mass

Limitingfactor		**Number of leading locomotive**	**Tractionmass(t)**				
			DF4	**DF4B**	**DF4D**	**DF8**	**DF8B**
Ruling grade	12%	Single	1960	2030	2220	1980	2190
		Double	3890	4020	4400	3920	4330

Note: Theabovevalues are thetractionmassof diesel locomotivesduringnormaloperation, andcorresponding deductionshallbeconsideredwhen operatingin high-altitude areas.The altitude of someareasalongthislineisover1000m otherareasareover1500m,andthehighestaltitude isover1600m.Therefore, diesellocomotivesshallbeprovidedwithnew-typessuperchargersto avoiddeductionintractionmass.

Fromtheperspectiveofmechanicalforce, witharulinggradeof12‰, the traction mass of diesel locomotives is normally 2000t for single-locomotiveand4000tfor doublelocomotive. Thetractionmassofdouble-locomotiveconsistingofDF4DandDF8Bisgreat.From theperspectiveof carryingcapacity,double locomotivewitha tractionmassof 4000t shall beadoptedtomaximizethecarryingcapacityofthisline.

2.3: Locomotive Facilities

The locomotive facility at the Nairobi South Station depot facility which is currently under construction is provided with three servicing temporary rest tracks for diesel locomotives (with the conditions for future 2 tracks provided). It is equipped with one 3 × 2000 m^3 oil depot, and operation and servicing equipment, dry sand equipment, equipment for oil unloading and delivery, grease distribution equipment as well as relevant auxiliary operation buildings. For the diesel locomotive, the depot is provided with 8 positions for minor auxiliary repair and 2 positions for medium repair. The major repair conditions for the diesel locomotive are provided.

2.3.1: Designed locomotive routings

Construction of the Mombasa-Malaba SGR is being designed and constructed in phases. The first phase that is currently underway is the Mombasa-Nairobi SGR, the second phase will is the Nairobi-Naivasha-Enoosupukia SGR (the subject of this ESIA) and the final phase is the Enoosupukia-Narok -Malaba SGR. Irrespective of the phased approach, the whole line shall be uniformly opened for service. Therefore, the locomotive routing is designed for the whole line.

a) Passenger locomotive routing: The diesel locomotive of the Nairobi South Locomotive Depot undertakes the shoulder-circuit locomotive routing from Malaba and Kisumu to Nairobi South.

b) Freight locomotive routing: The diesel locomotive (dual) of the Nairobi South Station Locomotive Depot undertakes the shoulder-circuit locomotive routing from Malaba and Kisumu to Nairobi South Station. The designed locomotive routing is shown in **Figure 2-7**.

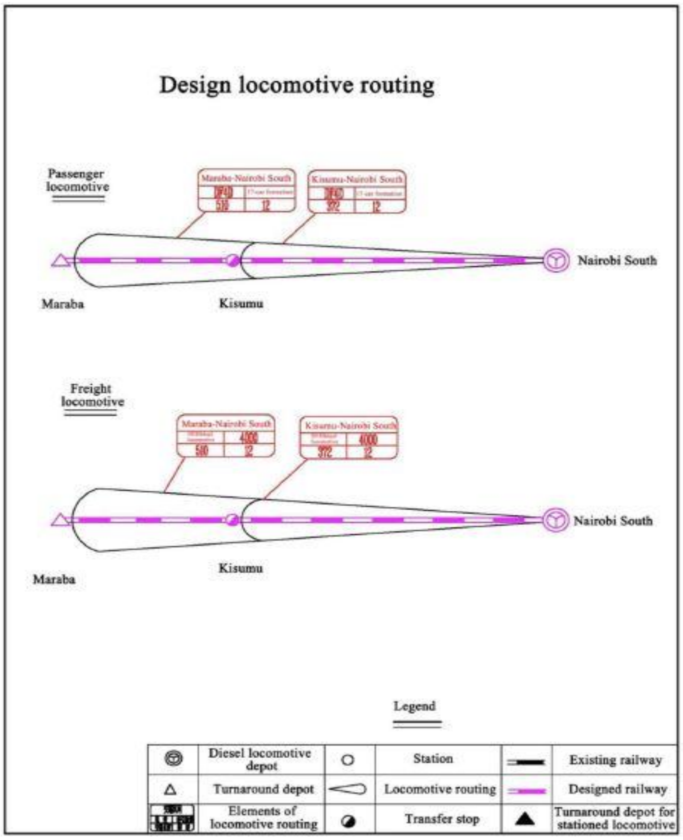


Figure 2- 7: Designed passenger and freight locomotive routing

2.4: Route and Track

The planned project is part of a regional railway network according to the East African Railway Master Plan. The Master Plan is a proposal for rejuvenating existing railways serving Tanzania, Kenya, Uganda and extending them initially to Rwanda and Burundi and eventually to South Sudan, Ethiopia and beyond. The SGR is a flagship project under the Kenya Vision 2030 development agenda. It will simplify transport operations across the borders and reduce travel costs, apart from benefiting the economies of Kenya and the neighbouring countries. **Figure 2-8** shows the existing and proposed railway network in the Eastern Africa region.

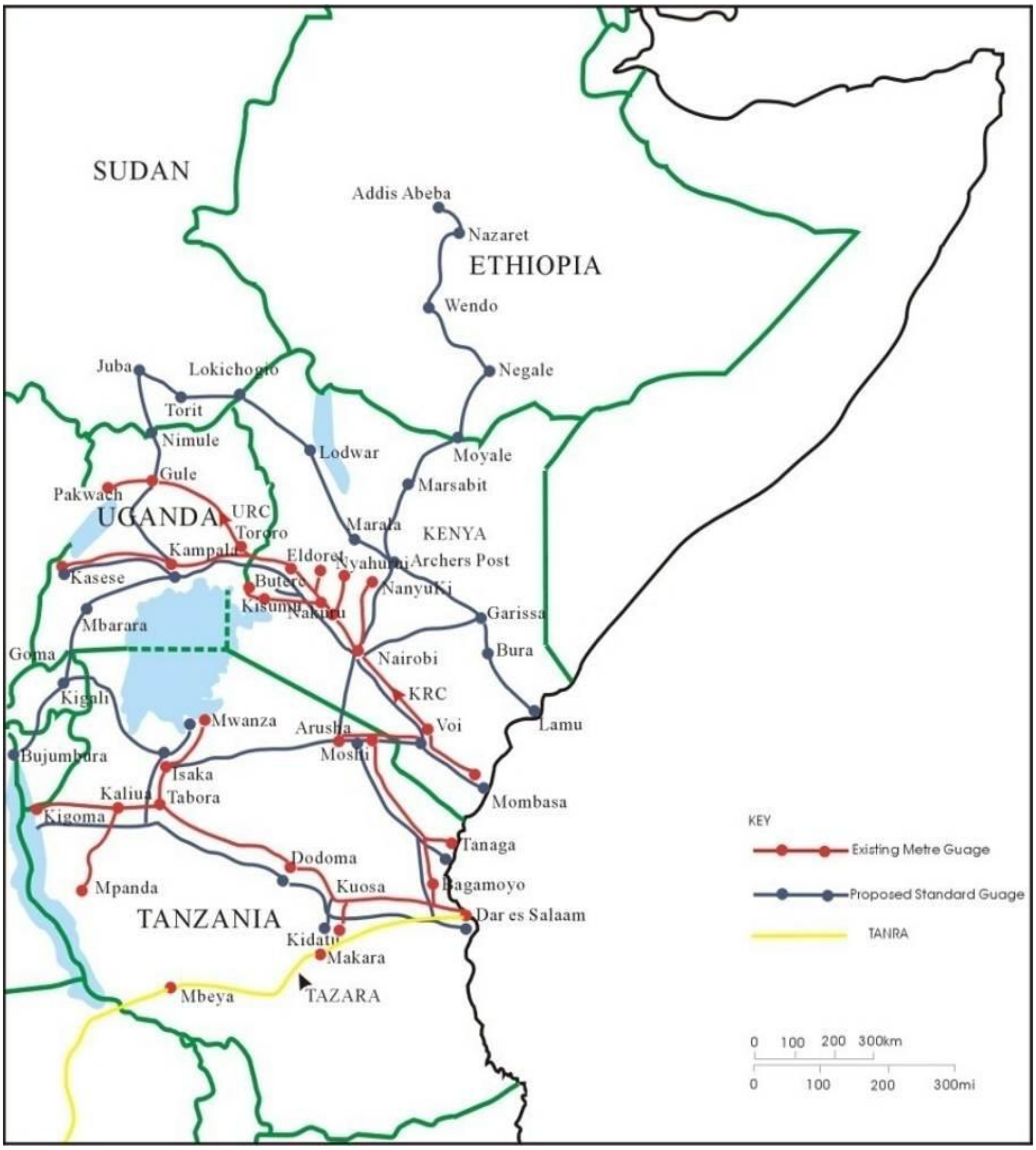


Figure 2- 8: Major railway networks planned in East Africa region

The proposed railway line passes through five (5) Counties: Nairobi, Kajiado, Kiambu, Nakuru and Narok Counties. It has a total length of 120km consisting of 5 yards/terminals. The proposed Nairobi South Railway Station–Naivasha Industrial Park-Enoosupukia, Narok County SGR project will start from the end point of the Nairobi South RailwayStation; this is the terminating station for the Mombasa-Nairobi SGR portion of the railway and is currently under construction as it is part of the Mombasa-Nairobi SGR project. DK0+00 is directly opposite the Nairobi South Railway Station which is under construction.

From here, the proposed line will proceed from the Nairobi South Station (DK0+00) and run on embarkment straight on in a north-east direction for approximately two (2) kilometres outside the NNP before making a bend in the south-western direction and entering the NNP near the East Gate. It will then crosses over Nairobi National Park through the savannah regionin an almost straight line along a 6km viaduct. The SGR will exit the park near the NNP's Maasai Gate near Tuala area, from here it would turn west past Tuala market centre and proceed to Ongata Rongai Town, then cross Magadi Road through the Adventist University of Africa. It then proceeds through Nkoroi area and crosses Ngong Road at Ebulbul town beforeheading to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County.The total distance for this route upto the Ngong tunnels is 36.2km. This route is quite similar in terms of alignment to Option 3 but slightly shorter by 1.2km.The approximate construction costfor this route is about $523 million. The annual cost of operation will be lower compared to Options, 1 and 2.The implementation of the SGR project through Route Option 4 has factored in compensation to be given to KWS through an endowment fund. In brief, the proposed Nairobi South Railway Station – Naivasha Industrial Park-Enoosupukia, Narok County SGR alignment will encompass the first 120km (i.e. DK0-DK120) of what will eventually be the Mombasa-Nairobi-Narok–Malaba SGR. Two other routing options had been considered with the Narok route considered as the most suitable alternatives. The other route options are Nairobi-Nakuru-Eldoret-Malaba and Nairobi-Nakuru-Kisumu-Malaba.

The proponent proposes a total of twelve (12) new railway stations which excludes the Nairobi South Station since is part of the NEMA approved Mombasa-Nairobi SGR Project. This also excludes the proposed Nairagie station (DK123+800), which will be in the next phase of the Nairobi-Malaba SGR project. There will be 6 district stations and 6 intermediate and crossing stations. The distance between the stations ranges between 8.3-12.9 km depending on the technical design requirements, geographical position, human settlements and local economic activities/needs.

The proposed line is a comprehensive transport corridor for passenger and freight transport services. Stations are distributed in accordance with the short-term and long-term freight volume forecast and with combination of natural conditions along the line, urban planning, railway operation condition and other comprehensive factors. Their design carrying capacities can meet the demand for transport capacities in short-term and long-term years accordingly. According to the tractive tonnage and type of locomotive for the line, the effective length of arrival-departure track of station is 880m in this design. The length of station site, intermediate station and passing station will be not less than 2500m, 1400m and 1300m, respectively. All stations will be set on a level track with some adjustments to maximum of 6% under very difficult situations.

The horizontal location of the line is mainly controlled and influenced by the track connection stations, topography of area, railway, highway, urban planning, special geology, water resource facilities and conservation areas along the line. Therefore, during the final route selection, relocation of a large number of residential houses along the line will be avoided at best; the unfavorable geology and water resource facilities along the line will be bypassed; and related planning, etc. will be combined, so as to reduce the construction difficulty as much as possible.

In terms of safety facilities, therailway line, l is designed to conform to a National Class I railway standards. According to the requirements of Chinese Regulations on Railway Transport Safety and Regulations on Railway Technical Operations, safety protection areas will be set along both sides of the Line. The safety zone along the railway line spreads outward from the toe of embankment slopes or the edge of the railway bridge, and is provided with a distance of no less than 8m in the urban areas, 10m in the residential areas, and 12m in the residential areas within rural areas, and 15m in other areas.

The safety zone along the railway line is provided with boundary posts. Route markings and signal signage of various types will be set. Separation nets will be set on both sides of bridges to arrest falling objects, and height limit frames and anti-collision overhead guards are planned on both ends of flyover crossings. In wildlife dispersal areas, the design will be modified to fit the requirements of Kenya Wildlife service (KWS) standards in order to allow the crossing of wild animals such asgiraffes and buffalos.

As for the track maintenance mechanism for the line, the principle of "repairing and maintenance separation" will be adopted. As for the line maintenance, the mechanized maintenance team within the track maintenance section and personnel will be responsible for carrying out the routine maintenance and temporary repairs in the work area and back up the line maintenance and 'first-aid' repair work. The comprehensive line maintenance will be carried out and routine inspection, constant maintenance and temporary repairing of route, bridges and other support facilities done by this team.

The track for the main line is the standard steel rail, which is 60kg/m and 25m long. In the main line, the new pre-stressed concrete sleepers with shoulders will be adopted,and laid in 1760/km. In addition, the Class I stone track bed is adopted for the entire line.

2.5: Subgrade

The subgrade for the 120km is 85.51 km in length, accounting for 71.25% of the total length of the whole railway line. Designed subgrade works have taken account of the existing natural characteristics along the line in terms of topography, weather features, ground motion parameters, geological structure and hydrogeology. The main subgrade construction site types of the whole line consist of embankment slope protection, cutting slope protection, soft soil subgrade, swelling soil subgrade, black cotton soil subgrade, and impervious embankment protection.**Figure 2-9** shows an artist impression of subgrade construction along the line.

Figure 2- 9: Artists impression of subgrade construction along the line

2.6: General Distribution of Tunnels along the SGR Line

The crossing of the SGR through the Great Rift Valley escarpment will require the use of bored tunnels, built using cut-and-cover methods that will involve reinforcements to ensure stability at all times. Tunnelclearance shallmeettherequirementsofthe*Clearancefor RailwayDouble StackedContainerTransport andLoading*for"Double-layercontainertransporttunnelconstructionclearanceof the People'sRepublicofChinaforrailways.Inthe preliminary stage, the supporttypessuchassprayingconcrete, anchorbar,steelbarmesh,steelframeandcombinedsupportthereofshall beadoptedaccordingtosurrounding geology and, ifnecessary,shall be supplemented byadvance supportmeasuressuch asanchor bolts and advancegroutingwithsmallducts forpre-reinforcement.**Table 2.8**shows the proposed distribution of tunnels, while**Plate 2-2** shows the tunnel in the Ethiopia-Djibouti SGR railway.

Table 2- 8: Proposed Location of Tunnels

Tunnel name	Entrance mileage	Exit mileage	Total length (m)
No.1 tunnel	DK34+826	DK39+333	4507
No.2 tunnel	DK43+455	DK43+920	465
No.3 tunnel	DK46+390	DK47+500	1110
No.4 tunnel	DK53+610	DK55+362	1752
Total length			**7834**

Plate 2- 2: SGR tunnel in the Ethiopia-Djibouti railway project

The whole line will have a total of 4 tunnels (with a total length of 7834m) and will constitute 4.18% of the total length of the line. For No. 1 tunnel, the entrance mileage is DK34+826, exit mileage is DK39+333,and the total length is 4507m. This tunnel is located on a straight section. The longitudinal slope is an 8.5‰ single face upslope. The section in which this tunnel is located, the seismic acceleration is 0.20g-0.40g and the basic intensity is VIII-IX degrees. Therefore, seismic fortifications measures shall be considered during tunnel design. The tunnel portal in high-intensity earthquake areas shall be subject to strict excavation height control of portal side and front slope.

Mechanical ventilation shall be provided in the tunnel longer than 2,000m along this line in accordance with the requirements of the Code for Design on Operating Ventilation of Railway Tunnel. Other tunnels would be ventilated by the piston airflow and natural airflow generated by the train passing through the tunnel.The tunnels will be provided with lighting equipment. According to the provisions of Technical Conditions for Lighting Facilities and Power Supply of Railway Tunnel (TB/T2275), the tunnel shall be provided with fixed lighting devices and rescue passageways, and emergency lighting facilities shall also be provided.

2.7: Bridge & Culvert

The best Chinese Bridge and Culvert codes and standards will be adopted. The distributions of bridges and culverts along the line are summarized in **Table 2-9**. The proposed main line has a total length of 120km,and will have 47 bridges: length of 28212.7 linear meters；23.51% of the total length of the line, and 255 culverts covering a total length of 5110 horizontal linear meters.**Figure 2-3**and **Plate 2-4**shows the structure of a SGR wildlife underpass bridge and culvert in the Phase I project.

Table 2- 9: Distribution List of Bridges and Culverts

Item	**Unit**	**Main Line**
		CK0+000-CK120+000
Super major bridge	Nr.-linear meter	9-14102.9
Major bridge	Nr.-linear meter	18-4892.6
Medium bridge	Nr.-linear meter	6-549.6
Culvert	Nr.-horizontal linearmeter	164-3247.8
Frame bridge	Nr./m^2(top)	7-884.8
Highway bridge	Nr./m^2(top)	7-2934

Plate 2- 3: Structure of a SGR underpass bridge in the Phase I project

Plate 2- 4: Structure of a culvert in the SGR Phase I project

2.8: Railway Stations/Yards

The proposed project will start from the Nairobi South Railway Station (DK0+00) and pass outside the northern edge of Nairobi National Park upto near the East Gate after which it would pass over the middle of Nairobi National Park for 6km before exiting the park near the Maasai gate and then headtowards Tuala market. In the park, the SGR line will run over an 18m high overhead bridge, and appropriate and effective mitigation measures will be put in place to minimize negative environmental impacts. From Tuala Station (DK12=150) it will head to Ongata Rongai Station (DK20+800) then cross Magadi Road next to the Adventists University of Africa and then to Ngong South Station (DK31+900) before crossing Ngong Road at Embulbul and heading to Ngong West Station (DK41+550). The SGR will then enter into a tunnel at the Ngong hills, after which the rail line will then proceed to Nanju Station (DK51+850) in Kamangu area. From the Nanju Station, the SGR will drop into the rift valley and pass at Ewaso Station (DK64+700) and then north to the Mai Mahiu Station (DK74+600), and then cross the Mai-Mahiu-Narok Road (B3) to the Mai-Mahiu West Station (DK86+500) and Suswa Station (DK99+400). From Suswa, the SGR will cross the Mai-Mahiu-Narok Road (B3) and proceed to Oloshaiki Station (DK110+500) before terminating at Enosupukia Station (DK120+800) in Narok County.

The proposed Standard Gauge Railway Project from Nairobi South Railway Station through Naivasha Industrial Park to Enoosupukia, Narok County will encompass the first 120km (DK0-DK120) of what will eventually be the Mombasa–Malaba SGR. This section (DK0-DK120) is set with 12stations in total, including the Nairobi South Stationthat is currentlyunder construction, and, 6 district and 6 intermediate stations crossing stations (**Table 2-10**).This also excludes the proposed Nairagie station (CK123+800), which will be in the next phase of the Nairobi-Malaba SGR project. The distance between the stations ranges between 8.3-12.3Km depending on the technical design requirements, geographical position, human settlements, and local economic activities/needs.

2.9: Embankment Slope Protection

When the general height (H) of embankment slope is less than 6m, the slope shall be protected with grass and provided with 0.5m wide and 0.1m thick concrete slab shoulder protectors on both sides and the inner slope shall be vertical, while the outer slope shall be of the same gradient as the embankments lope. When the general height (H) of embankment slope is not less than 6m, herringbone frameworks (with cut off trench) of M7.5 cement mortar rubbles shall be adopted for the slope surface at an interval of 3× 4m for slope protection, and grass shall be planted within the frame work for protection.When the height of embankment slope is over 5m, within the range of 3.0m horizontal widths on both side slopes of the embankment, one layer of two-ways tretchgeo-grid (TGSG30-30) shall be paved from the slope to the base course at an interval of 0.6m.**Plate 2-5** shows the embankment protection approach used in the SGR-I project.

Table 2- 10: Proposed Railway Stations

No.	County	Station Name	Type of Station	Location (km)	Distance between the stations (km)
1.	Nairobi	Nairobi South	District Station	DK00+000	0.0
2.	Kajiado	Tuala	Intermediate Station	DK12=150	12.15
3.		Ongata Rongai	District Station	DK20+800	20.80
4.		Ngong	District Station	DK31+900	31.9
5.		Ngong West	Crossing Station	DK41+550	41.55
6.	Kiambu	Nanju	District Station	DK51+850	51.85
7.	Kajiado	Ewaso	Crossing Station	DK64+700	64.7
8.	Nakuru	Mai-Mahiu	District Station	DK74+600	74.6
9.		Mai Mahiu West	Intermediate Station	DK86+500	86.5
10.	Narok	Suswa	District Station	DK99+400	99.4
11.		Oloshaiki	Intermediate Station	DK110+500	110.5
12.		Enosupukia	Terminating Station	DK120+800	120.8

Plate 2- 5: Embankment protection approach used in the SGR-I project

2.10: Rolling Stock

The rolling stock depot will be located on the southeast side of Nairobi South Station. Taking the maintenance and assembly workshop of rolling stock to be built as the center, other auxiliary buildings and facilities will be arranged around the workshop. The main facilities will include maintenance and assembly workshop and tank washing point, shed for shunting locomotive; wheel sets, deposit shed and air compressor workshop, living quarters, general office building, canteen, bathroom and other facilities. There will be a brake room, hook buffer cabin, bogie maintenance workshop, wheel axle depot, wheel lathe house, and wheel sets deposit sheds among others.

2.11: Water Supply, Sewage and Waste Oil Treatment Facilities

Within the new water supply points at each water supply station, one chlorine dioxide sterilization unit and one centralized control unit and two fire pumps will be provided. Within the new water supply point at each living water supply station, one ultraviolet radiation sterilization unit and one centralized control unit and two fire pumps will be arranged. The centralized monitoring system of water supply and drainage will be arranged at each station according to the station area control and conforming to the technical condition of basic process operations.

For sewage treatment facilities and discharge scheme, if there will be an existing sewer near a station, then sewage will be directed to a septic tank, treated by hair trapping well and the oil-bearing production wastewater treated by oil separator prior to release into the nearby sewer infrastructure.If there is no existing sewer line near a station, the sewage will be directed to a septic tank, treated ina hair trapping well and the oil-bearing production wastewater passed through an oil separator before being discharged into a SGR sewage treatment facility in a centralized manner. The effluent after treatment will be recycled for greening irrigation and the residual sludge will be collected by a licensed company.

At the living quarters, the domestic sewage will be directed to a septic tank, passed through a hair trapping well and the oil-bearing production wastewater passed through an by oil separator before being discharged into a separate treatment chamber. After treatment the resulting treated water will be recycled for greening irrigation and the residual sewage will be collected be licensed waste handlers.Coagulation and settling shall be performed when washing sewage of passenger cars. The sewage will be filtered and treated and then recycled for washing the external face of the passenger car, flushing the ground, greening among others. The oil-bearing sewage from the locomotive and rolling stock depots will receive air floatation and then flow into the drainage pipe of the station area.

a) Communication Network

The communication network is the foundation platform of communication and information to achieve the safe operation and high efficiency management of railway. It provides the safe, stable, reliable and flexible communication approaches for the dispatching and guiding system, freight system, information system among others, and satisfies the comprehensive business and development demands for voice, data, and imageamong others. The communication system of the line shall be designed based on the principle of remote monitoring and centralized maintenance and management.

The design of the communication network shall provide the complete system according to the actual transportation and production organization, and operation management demands of the line and the whole range and network demands of the communication network.The communication network of the line shall be made up of the transmission access system, telephone exchange system, dispatching communication system, mobile communication system and station yard communication system.

b) Signal system

This will be based on the railway construction concept of "people orientation, serving transport, system optimization and focusing on development", in order to realize railway management information, train operation dispatching command automation, as well as modern and efficient transport organization management pattern, train operation dispatching command adopts decentralized and autonomous Centralized Traffic Control (CTC) system (**Figure 2-10**).

CTC system which will be based in Nairobi will adopt modern communication technology, computer technology, network technology, and automatic monitoring technology comprehensively, based on the design philosophy of intelligent decentralized autonomy and employs the highly automatic dispatching command system centered on the control of train operation coordination plan. Its main functions will be as follows: to issue train operation plan and dispatching order through network, and realize manual and automatic adjustment of stage plan, real-time tracking of train operation, wireless train number calibration, automatic train reporting, train shift statistics, statistical analysis of train being on time and late, automatic drawing of actual train operation chart, automatic generation of train operation logs at station, train marshaling information management, shunting operation management, comprehensive maintenance management, manual and automatic planned selection sort of train and shunting route.

Artist's impression of the Railway Control Centre

Plate 2- 6: Artistic impression of the Centralized Traffic Control (CTC) centre

c) Information management system

The Railway Transportation Management Information System (TMIS) will be used which will be composed of:-

- Railway transportation management information system consists of railway transportation management center and station and depot.
- The freight billing, reporting, freight safety, existing car management, freight plan and other business terminals are set up in station and depot level.
- The station transacting relevant business shall be equipped with station client terminal and matching local area network equipment. Moreover, the interconnection with information center and uploading of management information will be achieved through the data network.

d) Electric power supply

The loads of stations along the SGR project will includes signal, communication, water supply, track maintenance point, locomotive turnaround depot, mechanical maintenance workshop, train inspection point, subdivision section for water supply, houses train-end operating point, water source well pump house, dispatching center, infrared journal temperature detection station, indoor and outdoor lighting. The other electric facilities and loads in the interval mainly are optical fiber repeater among others. The power supply scheme will consist of 33kV distribution substation and 33kV continuous power line.ThevoltageclassofthepowergridinKenyais33kVand11kV.Based ontheunreliable supply andinstabilityof thepowergrid, anew33kVdistributionstationand33kV powersupply throughlinewill beadopted.New33kV distribution substations will be installed in Kamangu(DK51+850) andMai-Mahiu(DK74+600) tosupply powerforthethroughline.Atthe stationswill be setwithadistributionsubstation, a station feeder supplies the first circuit of power supply of

Grade I loadandthesecond circuitofpowersupplyissuppliedwithpowerby a dieselgenerator. GradeII andIIIloadsatthestationsaresuppliedwithpowerby stationfeeder.

Atthe stationswithoutadistributionsubstation,thefirstcircuitof powersupplyofGradeIloadwill be obtained fromthethroughlinesandthesecond circuitofpowersupplyfrom thedieselgenerator.GradeIIandIII loadsatthestationsaresuppliedwithpowerfromthrough lines.Thesectionloadateachstationissuppliedwithpowerbythrough lines.

e) House building

Accordingtothetechnologicalrequirements,theoperationbuildings aredesignedtoreflectthedesignconceptof"peopleoriented", under existing operation conditions, toimprove the operationand office conditions, improve thelivingenvironmentandadoptthemanner of centralizedlayoutdominatedby storiedhousesasfaras possible.Atthe premise ofmeetingthe operation requirements, stationbuildings are designedtobecomprehensive stationbuildingsas faraspossible,soasto save landandinvestment.Thetotalbuildingareafor the0-120km operationandauxiliary operation buildingsistotally38,877m^{2}andthebuildingareaper kilometerofmain trackis324m^2.Configuration ofproductionbuildingsis carriedoutinaccordance withprocessrequirementsofupstreamdisciplineandStandardforDesign of Railway Buildings. Auxiliary living buildings are allocated in combinationwith project characteristics and inreferencetoStandardfor Designof Railway Buildings.Necessary buildingssuchascanteens, bathrooms,bachelor quarters, activity roomsareincluded inthe SGRdesign. The standard for bachelorquarter,bathroom andactivityroom is 17m^2/person, and the standardforcanteenis3m^2/person.A police post of500m^{2}maytemporarilybeprovided atKamanguStation(DK51+850).

f) Environmental quality design principles

For the railway project, the spoil yard shall be selected reasonably, for convenience of future rehabilitation and utilization after the project. The side slopes of the subgrade portal shall be protected by vegetation or necessary protective measures. When the railway must pass an area with soft foundation, fault or other special geological conditions, the safety of the project shall be guaranteed and corresponding protective measures shall be adopted for environmental and geological problems caused by the project.

The railway alignment shall be carried in combination with local planning and shall make a detour from the buildings sensitive to noise and vibration, and the buffer area shall be fully utilized for noise reduction and damping effect. Wastewater and slurry produced during the construction shall be treated in temporary sedimentation tank and then drained. In case it is permitted by actual situation, the wastewater and slurry should be recycled as much as possible. After being treated up to the standard, such wastewater and slurry should be used for watering the roads to restrain flying dust in the process of construction. Oily wastewater from the railway should be treated continuously. Wastewater from truck rinsing shall be treated by corresponding measures according to water quantity and quality, to meet the drainage standards specified in the Environmental (Water Quality) Regulations, 2006.

After the railway lineis operational, productive and domestic wastewater will be drained from the facilities in stations and depots, and main pollutants include oil, SS, BOD, and COD, among others. During construction, oil removal, sedimentation and floatation treatment shall be adopted for oily productive wastewater, while domestic water shall be used for greening or irrigation of agricultural land after fecal sewage has been treated in septic tanks, oxidation ponds and so on.Refuse in the stockyard should be piled in the designated areas and protected appropriatelyto avoid environmental pollution. Solid waste during the construction period and domestic refuse produced by contractors shall be stockpiled and collected by the respective County waste management departments or by licensedwaste collectors. During operation, solid wastes from all stations and depots, and common productive and domestic refuses shall be collected by specific refuse carrying vehicles and handed over for integrative treatment by the department concerned. Abandoned components and parts and cut metal scraps will recovered for recycling purposes. During the equipment lectotype, electricity-saving and energy-saving equipment will be preferred for the purpose of energy conservation.

2.12 Estimated Project Investment Cost

The estimated project cost is **USD1,482,745,029.43 (Kshs.156, 518,120,483.12).**The estimated total amount excludes the following expenses: -

- Land acquisition demolition cost and relevant expense;
- VAT, Duty and other relevant Taxes;
- Financing, loan interest and relevant expense;
- Other expenses in need of Kenya government's entrustment.

2.13 Land Utilization

The KRC and the contractor (CCCC) have agreed in principle that the design land use and farmland supplement as well as reclamation methods will be the guideline. This design shall be executed according to feasibility study opinion (CCCC, 2015). The land ownership in Kenya is divided into three forms: state-owned, community land trust and private (namely individuals or organizations possess land through lease or title). Railway route selection and land use design will strictly be observed by protecting arable land as much as possible, and adhere to the principle of land use in a legal, scientific, reasonable and economical way. The acquisition will be phased out during the project construction period. The design land use will be divided into permanent land use (acquired land) and temporary land use.The main line of Nairobi South railway station–Naivasha Industrial Park-Enoosupukia will have a total length of 120km. The areas along this route are mainly characterized by rangeland environment, scattered forests, agricultural areas, pastoral areas and urban built-up zones. This route is going to require permanent land (acquired land) and also temporary land use including temporary works, road diversion, borrow pit and spoil yard, among others.

2.14 Material Sites and other Associated Facilities

This ESIA has been conducted for construction activities that will take place along the SGR corridor, construction of infrastructure such as bridges, tunnels, as well as the various stations. Once the Nairobi South railway station-Naivasha Industrial Park-Enoosupukia SGR ESIA is approved by NEMA, and prior to commencement of construction, there will be additional ESIA's that will be conducted for associated facilities such as campsites for the contractor and construction workers, boreholes, concrete batching plants, crusher sites, explosives magazines; on material sites such as quarries, borrow pits and sand harvesting sites; and for spoil dumping sites.All pre-requisite permits for thematerial sites and other associated facilities will be obtained prior to construction. Below is a brief description of the associated facilities and material sites that will requireseparate ESIA's to be conducted before project commencement.

2.14.1 Campsites

The proposed project will require construction of campsites/yard for the ongoing construction of the Nairobi South railway station–Naivasha Industrial Park-Enoosupukia SGRProject. The various site camps will comprise of some or all of the following; Inspector room, Main site offices, Dormitory area, Material Stores, Engineering laboratories, Generator room, Main workshop and offices, Diesel pump station, Security (Administration Police) houses, Dust yard, Aggregate yards, Steel bar yard, Cement stores, Borehole, Parking and sanitary facilities once completed. The scope of the ESIA assessment of the campsites will include pre-construction, construction, operation and decommissioning phases.

2.14.2 Concrete batching plants

A concrete plant, also known as a batch or batching plant is a device that combines various ingredients to form concrete. Some of these inputs include sand, water, aggregate (rocks, gravel, etc.), fly ash, potash, and cement. There are two types of concrete plants: *ready mix* plants and *central mix* plants. Due to the large amounts of concrete required by the Nairobi South railway station-Naivasha Industrial Park-Enoosupukia SGR Project,batching plants will be constructed.These will have a variety of parts and accessories, including but not limited to: mixers (either *tilt-up* or *horizontal* or in some cases both), cement batchers, aggregate batchers, conveyors, radial stackers, aggregate bins, cement bins, heaters, chillers, cement silos, batch plant controls, and dust collectors (to minimize environmental pollution).

2.14.3 Slippers factory

The construction will involve putting up of a site camp withan Inspector room,Main site offices, Dormitory area, Material Stores,Engineering laboratories, Generator room, Main workshop and offices, Diesel pump station, Batching plant, Security (Administration Police) houses, Dust yard, Aggregate yards, Steel bar yard, Cement stores, Borehole Parking and sanitary facilities once completed. The area will be delineated using iron sheet boundary wall and most structures will be made of concrete floors, Styrofoam or stone walls and iron sheet roof, cased steel windows frames and a mixture of casement windows and timber. Simple roofing techniques on timber trusses, concrete foundations for all blocks, raised concrete tanks and overhead plastic water tanks. Drainage and service roads will be constructed to and within the campsite. The materials to be used are locally available so as to blend with the natural environment.

2.14.4 Explosives magazines

Provision of storage facilities for explosive magazines and accessories will be required for the SGR project. The magazines shall be properly designed and located to comply with all applicable laws, rules and regulations. Emphasis will be placed on proper storage to prevent unauthorized access to explosive materials and reduce their deterioration. All explosive materials, including blasting agents, detonators, detonating cord, boosters, blasting caps, and electric and nonelectric detonators will be stored in the magazines.

In some cases the explosives will bekept in safe stores to be constructed adjacent to the material sites where they will be utilized whereas in others they will be transported to sites elsewhere when needed. The explosives will be utilized to extract rock materials from licensed quarry sites to be used in constructing the SGR and in some cases the explosives will also be used to facilitate rock extraction in rocky areas where the railway line and other structures are to be constructed.

2.14.5 Quarries

Quarries are excavations or pits, usually open to the air, from which building stone, slate, or the like, is obtained by cutting, blasting, etc. For the South railway station–Naivasha Industrial Park-Enoosupukia SGR Project the contractor will lease land in various appropriate areas for quarry sites, storage yards and crushing plants for extraction of rocks to be crushed to various aggregates for use in project construction activities. This will involve the extraction of the underlying rock by blasting, then transporting them using conveyor belts and trucks to the crusher plants to be installed on site to grind the extracted material to small-standardized sizes of various sizes to be used for construction of the Standard Gauge Railway Project. Rock extraction shall be done by the use of explosives and mechanical equipment such as excavators. *The proponent will abide by the provisions of EMCA, 1999 which requires that quarry sites undergo an EIA before they become operational.*

2.14.6 Borrow pits

In construction and civil engineering, a borrow pit, is an area where material (usually soil, gravel or sand) has been dug for use at another location. For the SGR, soil will be excavated to fill embankments, gravel to be used for making concrete, murram extracted to construct access ways to material sites.Earth material borrowing is done in three common ways: manually using simple hand tools like chisel and mallet, andmechanized using stone cutting machine bulldozers, wheel loaders and other machineries. Mechanized extraction shall be preferred for the SGR project as it is efficient and produces materials in large scale, covering large and expansive areas, within a short time, and last but not least the chemical means; this is by use of explosive materials. Both the mechanized and the chemical methods, have a pronounced environmental impact as they leave behind large excavations, after mass movement of materials. They usually accelerate land degradation and erosion especially after the soil has been set loose. Vegetation is also affected as well as human settlements. Moreover, earth borrowing activities usually alter the biophysical and social environments of the mining areas. Control measures and procedures are thus required to limit its impacts to acceptable levels; these will be adequately addressed in the respective ESIA's.

2.14.7 Sand harvesting sites

Sand and gravel mining refers to the actual process of removal of sand or gravel from a place of occurrence. The increase in demand for sand and gravel for construction purposes has placed immense pressure on the environment where these resources occur. Miners employ different methods of extraction along river channels and their flood plains. Using environmental impact assessment guidelines and NEMA National Sand Harvesting guidelines 2007, Environmental Management Plans (EMPs) will be designed when ESIA's for the sand harvesting sites that will service the Nairobi South Station–Naivasha Industrial Park-Enoosupukia SGR Project are conducted. In some cases the contractor may opt to obtain sand from companies that conduct sand harvesting and in such cases they will ensure that the suppliers have EIA Licenses and all other pertinent documentation.

3. ANALYSIS OF THE ALTERNATIVE ROUTES

3.1: Introduction

Various routes have been proposed as possible SGR-IIA corridor alternative routes. These corridor routes were selected based on the criteria described in the feasibility report and ESIA fieldwork analysis. The objective of this analysis is to establish the most suitable route for the proposed Nairobi-Naivasha-Narok SGR project particularly in the first 50km after the Nairobi South Station. This section is characterized by high population density areas, important public utilities and the world famous Nairobi National Park all of which must be approached in an environmentally convenient and sustainable way. The initial screening at feasibility level ruled out routing along the existing metre gauge corridor due to the current gradient specifications for SGR. At the same time, the metre gauge corridor is expected to continue operating under the current operational long-term arrangement with Rift Valley Railways Ltd (RVR).

3.2: Analysis of the Option of Retaining/Refurbishing the Existing One-meter Railway Line

One alternative to the proposed SGR-IIA line is to retain the operations of the existing railway line as it is.The existing narrow gauge railway network which was built in 1891 and is currently about 125 years old. It is in poor condition due to aged infrastructure (**Plate 3-1**). The infrastructure is also highly unreliable and has long turn round trips due to outdated technology including basic manual engineering characteristics and geometrics, limiting axle loads, slow speed and low train capacity. Therefore, the large amounts of container freights that arrive in Port of Mombasa by sea have to be transferred by roadway to Uganda, Rwanda, Burundi, the DRC, South Sudan and other destinations within the country. This situation not only causes huge pressure on the Kenyan road system, but also increases the freight cost, as well as having a negative impact on the development of regional trade.

Plate 3- 1: The 1891 rail line in Kenya

This pressure has led to high road maintenance costs, loss of foreign exchange through importation of the rail tracks repair materials, and increased environmental pollution through high carbon emission (CO_2-e) which is bad for global climate change mitigation. If this option is selected, the number of livestock, wildlife and human deaths through road accidents will remain high, which is a big loss to the economy. This option is therefore not preferable. A different SGR line is therefore more acceptable than the retention of the proposed railway line. Accordingly, the use of the existing line option is therefore dismissed.

A second alternative to the proposed railway line is to refurbish the existing railway line. Due to the terrain through which the existing railway passes, it is not possible to:a) attain high speeds of trains which are currently desirable, b) lower the cost of doing business by industry, c) attract more local and foreign tourists, and d) increase volume of goods (eg livestock and agricultural produce) transported. The existing railway line can only transport limited tonnage and continue to increase the cost of goods which is not sustainable in the long run. The existing railway line and its support infrastructure is old and has a low carrying capacities and poor line conditions, so renovation will be quite expensive.

The Kenyan Economic Survey of 2015 highlights indicated that revenue earned from cargo transportation from the railway subsector grew by 13% from KShs 4.6 billion in 2013 to KShs 5.2 billion in 2014 but, the revenue earned from passenger traffic stream dropped by 23.2% from KShs 211 million to KShs 162 million over the same period. Therefore, operations restructuring and infrastructure improvement of the sector is inevitable in order to realize increased revenue. Upon completion, the Mombasa-Malaba SGR (of which the Nairobi South Railway Station through Naivasha Industrial Park to Enoosupukia will be a part of) will be a trunk line for the planned Eastern African SGR regional network that will enhance transportation in Kenya and the EAC. Kenya, Uganda and Sudan adopted the plan of constructing high-speed railways using the standard gauge in October, 2004 and the SGR project is part of that plan.**Figure 3-1** shows the proposed modern SGR network in East Africa.

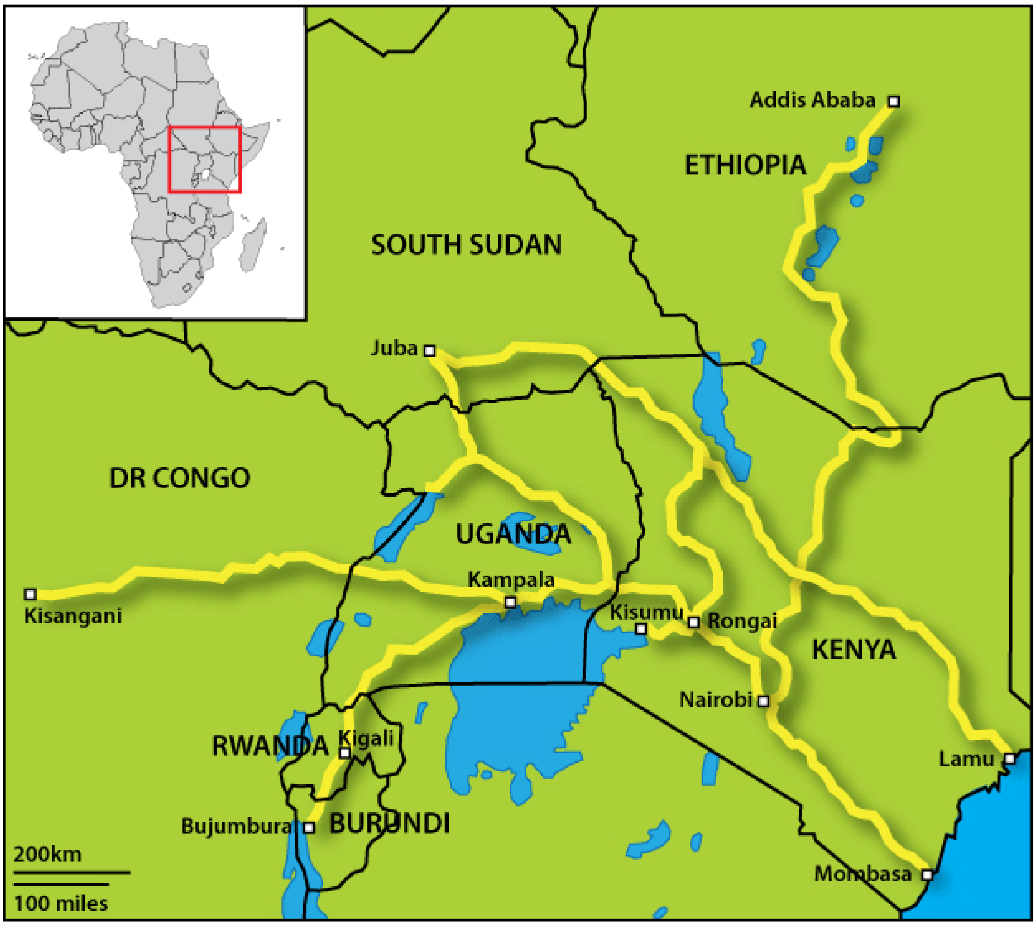


Figure 3- 1: A general outlook of the proposed Eastern African SGR network

The proposed SGR project is one of Kenya's Vision 2030 flagship projects that will play an important role in strengthening cooperation among the regional nations of Eastern Africa including the EAC member states and will therefore stimulate greater regional economic development. The project is an important intervention for improving the Kenyan transportation network. The project is significant in terms of saving valued natural resources and protecting the environment especially from the challenge of global warming because it will reduce the carbon emission (CO_2.e) footprint by introducing a modern and more efficient railway system. Therefore, the proposed railway line is a better option than retaining or refurbishing the old railway line. Standard gauge railways have a greater traction mass than the meter-gauge railway under the same ruling grade and same cross and vertical section conditions.

3.3: Option of Upgrading the Existing Road Network instead of SGR

Another alternative option for the proposed SGR project would be to upgrade the existing road networks by construction of super-highways. The cost of upgrading the road network will be very high and uneconomical considering the first leg of the Mombasa-Malaba SGR is currently under construction and the envisioned Mombasa-Malaba SGR would be rendered defunct if Phase IIA (Nairobi South Railway Station–Naivasha Industrial Park-Enoosupukia), is not undertaken.

The existing road network is heavily used by trucks, which is associated with many accidents leading to loss of human life, livestock and wildlife. The road transport of cargo and passengers is also associated with significant loss of time. Therefore this option is dismissed in favour of the proposed new railway line. Completion of the proposed railway will lead to decongestion of the highway and ensure fewer accidents. Although this option is dismissed for the SGR-IIA project, it should be considered in the long run forpassenger services and local supply of goods and services in the region. However, it will uneconomical for transportation of goods because of high fuel and road maintenance costs. At the same time, the road network option will also continue increasing the levels of CO_2-e in a global warming world especially due to the high number of trucks and buses on the roadways (**Plate 3-2**). This problem can be reduced through the SGR option.

Plate 3- 2: Heavy duty long distance trucks a Kenyan road

3.4: General Analysis Major Passage Options for Nairobi-Malaba Railway

Nairobi-Malaba Railway is an integral part of East Africa Railway Network. The East African Railways Master Plan (2009) indicates that after many years of decline, the railway sector and associated rail marine services have the potential to play an important role in the future development of the East African Community (EAC), not only for long distance freight and bulk transport, but also for urban transport in major cities, and for medium distance inter-city passenger transport. After the completion of SGR line, the freight flow from the Port of Mombasa is expected to eventually move more easily to Uganda, Tanzania, Rwanda, Burundi, South Sudan, and Sudan DRC Congo. The SGR flow in Kenya is expected to be dominated by the pass-through traffic volume and supplemented by the local traffic volume mainly from the growing number of manufacturing industries in the Nairobi Metropolitan Region (NMR). The traffic volumes for the three passages are basically the same through the economic analysis (CCCC, 2015).

Three railway passage options were considered for Nairobi-Malaba SGR project during the feasibility study (CCCC, 2015). These options were based on the; a) important economic stronghold factors including the planned Industrial Park to the southwest of Naivasha and

Kisumu, b) topographic and geological conditions of the area in eastern branch of Great Rift Valley through which the line must pass, c) current route of the existing metre gauge railway, and d) currentdistribution of major economic hubs between Nairobi and Malaba. The three route options for the Nairobi-Malaba SGR project are as follows and as shown in **Figure 3-2**:

a) Nairobi-Nakuru-Eldoret-Malaba option (**North Route Option**)
b) Nairobi-Nakuru-Kisumu-Malaba option (**Middle Route Option**)
c) Nairobi-Naivasha-Narok -Kisumu-Malaba option (**South Route Option**)

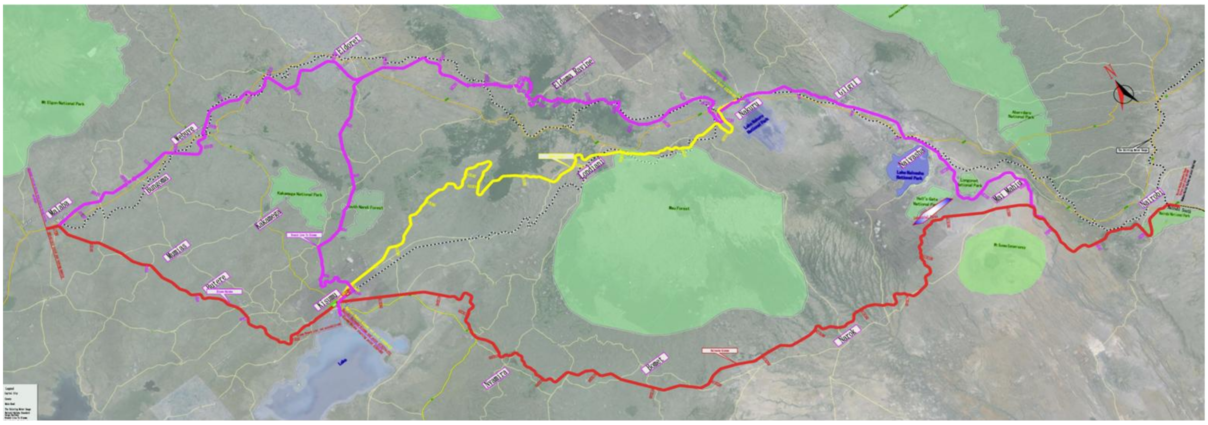


Figure 3- 2: Map of the three passage options* for Nairobi-Malaba Standard-gauge Railway (CCCC 2015) **- Note: the red represents south route option, the purplish red represents north route option and the yellow represents middle route option**

3.4.1: Nairobi-Nakuru-Eldoret-Malaba Option (North Route Option)

This SGR passage option runs northwest from Nairobi and passes through Naivasha, Nakuru and Eldoret and then bends to west to cross through Webuye, Bungoma and finally reach the Malaba border between Kenya and Uganda. This line would be connected to Kisumu due to the economic importance of the city. The combined scheme of the Nairobi-Nakuru-Eldoret-Malaba (505.2km) plus the branch scheme for the Eldoret-Kisumu connection (133.2km) would mean a total length of 638.2km for this option and makes it one of the most expensive options for investment by the Kenya Government. While this scheme option almost covers the main cities and towns to the northwest of Kenya which would greatly improve the transport services, the overlap in this option of the SGR with the existing meter-gauge railway would cause waste of national traffic resources because the government is also planning future refurbishment of the existing meter-gauge railway to improve its long term efficiency.

Terrain analysis for this option shows that the topographically complex areas for this route are mainly located in the Nairobi-Naivasha and Nakuru-Eldoret sections. Both areas are mainly located on the east and western wings of the Rift Valley, with a great variation in topography and a sharp increase or decrease in elevation. At the same time, the ground elevation within 20km at local areas of the Nakuru-Eldoret section increases from 2000m to 2500m. The longitudinal slope of ground is 20‰-30‰ and the line extends mostly during climbing and descending making one of the least preferred routes.

3.4.2: Nairobi-Nakuru-Kisumu-Malaba Option (Middle Route Option)

This SGR passage option runs northwest from Nairobi and passes through Naivasha, Nakuru, Londiani, Kericho and Kisumu, and then turns northwards to pass through Butere, Mumias and Malaba at the Kenya-Uganda border with a total length of 525.2km. According to the terrain analysis, the topographically complex areas for the middle route option are mainly located in Nairobi-Naivasha and Nakuru-Kisumu sections. The elevation of the route in Nakuru-Kisumu section rises rapidly from 1,950m at Nakuru to 2,500m at Londiani, and then to 1,200m at Kisumu. According to the existing meter gauge railway, the average longitudinal gradient of the existing meter gauge is 20‰-30‰ and the line mainly extends in plane. The line needs to overcome a great height difference and thus the project is very arduous from the engineering perspective.

According to the investment analysis, the bridge and tunnel ratio for the middle route option is the highest among the three options and the investment is the greatest because of the complexity in terrain and topography. The middle route option (Nairobi-Nakuru-Kisumu-Malaba) is therefore the most difficult to construct because it has a 36% ratio of bridges and tunnels. The line length and investment for this option is greater than that of the southern route option (CCCC, 2015). The line also lacks economic advantage compared with the north and south route options, since its economic service scope is narrow.

3.4.3: Nairobi-Naivasha-Narok-Kisumu-Malaba Option (South Route Option)

This SGR passage option runs northwest from Nairobi upto the Ewaso Kedong area in the eastern Rift Valley and then turns west and passes south west side of Mt. Longonot and north of Mt Suswa where it will have a connection to the proposed Naivasha Industrial Park at Suswa. From here it passes through Duka Moja and Enosupukia in Narok County and the crossed through Seyabei, Narok, Bomet, Sotik, Sondu and Ahero and Kisumu. It then turns north and crosses Butere and Mumias before arriving at the border town of Malaba. The line is 495.4km in length, hence the most cost effective to construct and most preferred by the Kenya Government to open the south region. According to the terrain analysis for this route option, the topographically complex area is mainly located in Nairobi-Naivasha section. The col on the west wing of the rift valley selected in this option has the minimum elevation of about 2,100m among the three options, with a relatively flat terrain. Meanwhile, the line of this option passes through the rift valley in the shortest distance which is compliant with the design principle of passing through adverse geological sections with the shortest distance. **Figure 3-3** shows two other options which were considered for the South Option in the section between Dagoretti and Naivasha in terms of whether to use the Uplands Option or the Kamangu Option. From the feasibility analysis, the Kamangu Option was selected due to a number of advantages including less land acquisition, less impact to agricultural farms, shorter length, less interference from existing railway line and less cost of investment (CCCC, 2015).

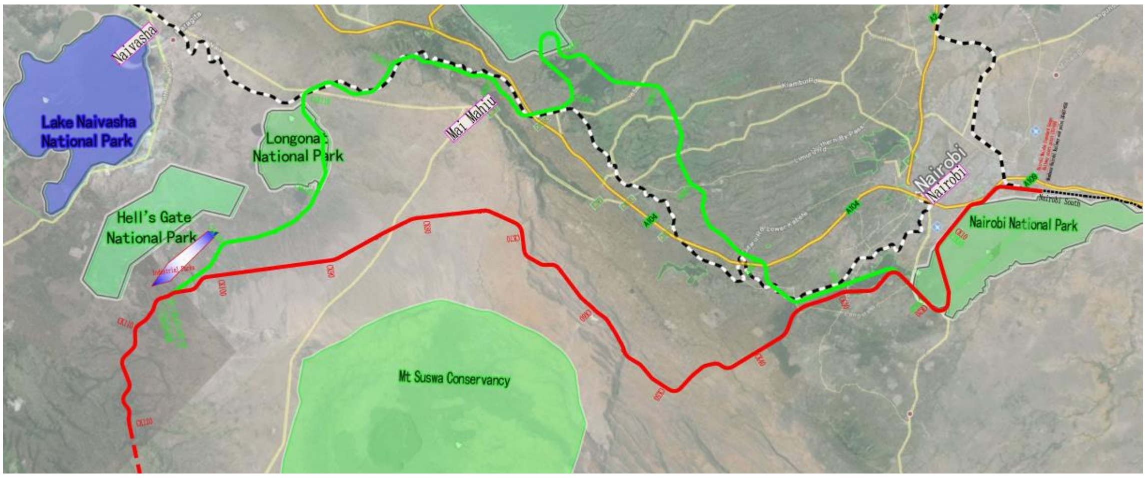


Figure 3- 3: Comparison of Kamangu and Uplands Options* (CCCC, 2015) - ***Note: the red represents Kamangu col option and the green represents Uplands col option**

The south route takes a different route from the existing meter-gauge railway which runs from Nairobi through Nakuru, Eldoret and several towns along the northern rail corridor. This line is approximately 125 years old. Taking the existing railway as an urban and regional growth factor, the line has greatly influenced the growth of several towns and economic strongholds along the line. It is expected that the route passage for the South Route Option will connect a number of additional major towns including Ongata Rongai, Ngong, Mai-Mahiu, Narok, Bomet and Kisumu, and will therefore introduce a second major traffic corridor in addition to the existing meter-gauge railway to the north. This will greatly promote the economic development of southwest Kenya by forming a new economic corridor. Meanwhile, the combined transportation of railway and the Lake Victoria harbour in Kisumu will greatly promote the economic development of Kisumu and its surrounding areas. The south option also re-connects with the existing metre gauge line in Kisumu.

According to the investment analysis, as the SGR line through the south route option turns southwest and bypasses the highland on the west wing of the rift valley, the construction challenges are greatly reduced with the ratio of bridge and tunnel at 28% while the investment amount is the minimum among the three passage options.

The south route option was therefore considered for the apparent advantage compared with the other two options based on the above comprehensive route analysis in terms of; a) economic investment, b) construction challenges and engineering considerations, and c) expanded urban and regional connectivity among other factors. Consequently, the south route option (Nairobi-Naivasha Industrial Park-Narok-Bomet-Kisumu-Malaba) is the most recommendable for the Government of Kenya for SGR construction and operation in a more cost-effective way. Consequently, the above justification based on the information available from the feasibility study, the ESIA report for the SGR-IIA project covering the first 120km is based on the South Route Option (Nairobi South Railway Station-Naivasha Industrial Park-Enoosupukia Narok). The exit of the South Route Option from SGR Phase 1 will inevitably have to pass within the world famous Nairobi National Park, thereby creating a major design challenge in terms of determining the most sustainable route with minimum negative impact on wildlife and tourism.

3.5: SGR-IIA and Nairobi National Park (NNP)

The SGR-IIA construction in the Nairobi section will inevitably cross over or pass along the edge of the the world famous Nairobi National Park (NNP). All the seven route options will affect the national park in one way or another. Nairobi National Park (117km^2) is one of the oldest national parks in Kenya gazette in 1946 and the only metropolitan national park in the world and ranks fifth in respect to visitation and income generation within the national park network in the country (**Plate 3-3**). However, the crossing of railway lines through conservation areas (National Parks, Nature Reserves, Wildlife Sanctuaries and World heritage Sites) is common in other parts of the world. The world famous Tsavo National Park in Kenya has, for example, been intersected by an international railway line throughout its history. The park has coexisted with the Mombasa-Kampala railway line for 68 years since its gazettement in 1948. This ground surface railway line stretches for many kilometres within the park. In the recent past, the Standard Gauge Railway has also crossed over the Tsavo National Park mostly through wildlife underpass super bridges.

Plate 3- 3: Nairobi National Park – The national park in a capital city

Some of the other countries in the world which are characterized by a railway line through a protected area include the proposed railway project where the line will run for 104 km through the Awash National Park in Ethiopia, the Grand Canyon National Park, Great Smoky Mountains National Park, Mojave National Reserve and the Glacier National Park all the USA. The Barron Gorge National Park in Queensland Australia is also crossed by the Kuranda Railway.**Table 3-1** and **Plate 3-4** show some of the other areas in the world where railways operate in the national parks.

Table 3- 1: Countries around the world with railway in national parks

Country	Park	Railway line	Total distance (km)	Benefits
1. USA	Grand Canyon National Park, Arizona* - UNESCO World Heritage Site	Grand Canyon Railway (Diesel & electric trains), Constructed in 1901	8	Brings nearly 200,000 visitors per year to the park. One of the most popular national parks in the world with about 4.2 visitors per year
2. USA	Great Smoky Mountains National Park, North Carolina*	Great Smoky Mountains Railway (narrow gauge 2 tunnels and 25 bridges)	85	Brings nearly 10 million visitors per year to the park
3. USA	Mojave National Reserve*	Union Pacific Railway	-	-
4. USA	Glacier National Park, Montana	Great Northern Railway	-	-
5. Australia	Barron Gorge National Park, Queensland – Wet Tropics World Heritage Area	Kuranda Railway	34	-

* Butler, W.B. (2007): Railroads in the National Parks, Colorado

a) Grand Canyon Railway, Grand Canyon National Park, Arizona, USA

b) Southern Railway in the Great Smoky Mountains National Park, North Carolina, USA

c) Union Pacific Railway in Mojave National Reserve

d) Great Northern Railway in the Glacier National Park, Montana

e) Kuranda Railway in the Barron Gorge National Park, Queensland, Australia

Plate 3- 4: World railway lines through conservation areas

3.6: Analysis of the SGR-IIA Alternative Routes upto DK50

A total of 7 different route options were identified for the SGR-2A in the first 50km from the Nairobi South Station which is the terminus for SGR-I (Mombasa-Nairobi). The 7 options were identified in order to deal with a number of challenging issues facing the construction of the SGR through the Nairobi region including passage near or through; a) Nairobi National Park, b) wildlife movements to and from Nairobi National Park, c) forest reserves in the Nairobi region, d) difficult and challenging terrain, e) high population density areas, f) public and private institutions, among others.

The 7 route options for the SGR-2A in the first 50km from the Nairobi South Station based on vigorous feasibility studies are as follows as shown in **Figure 3-4**:

1. **Route Option 1** - Nairobi South Station-Langata-Kibera-Dagoretti-Ngong-Kamangu Route (**Orange Line**)
2. **Route Option 2** – Nairobi South Station-Langata- NPP-Magadi Road-Bomas of Kenya-Karen-Ngong-Kamangu Route (**Yellow line**)
3. **Route Option 3** - Nairobi South Station-NNP–Tuala-Rongai-Nkoroi-Ngong–Kamangu Route (**Red line**)
4. **Route Option 4** - Nairobi South Station-NNP-Tuala-Rongai-Nkoroi-Ngong–Kamangu Route (**Light blue line**)
5. **Route Option 5** - Nairobi South Station-Allpack area-NNP-Allparks-Tuala-Rongai-Ngong–Kamangu Route (**Dark Green line**)
6. **Route Option 6** - Nairobi South Station-Mlolongo-NNP-Mbagathi-Tuala-Rongai-Ngong–Kamangu Route (**Dark Blue line**)
7. **Route Option 7** - Nairobi South Station- Athi River–Rongai-Ngong- Kamangu (**Pink line**)

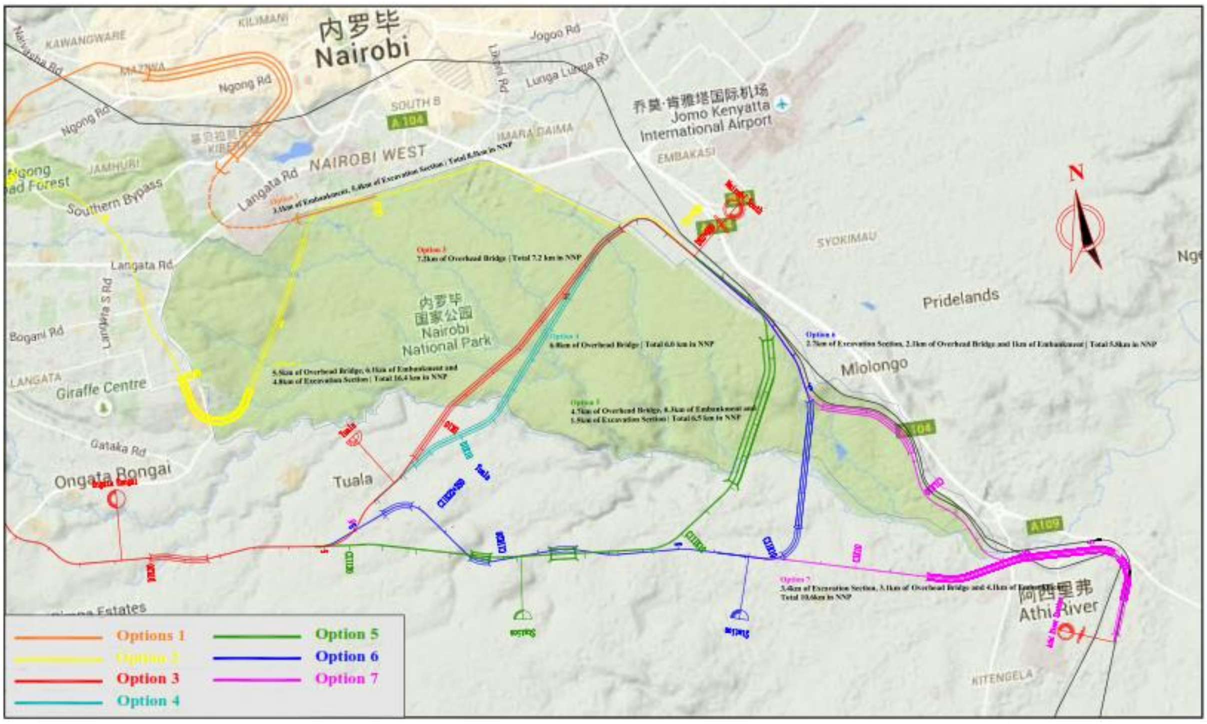


Figure 3- 4: Route options for the first 50km of the Nairobi-Naivasha-Enosupukia SGR

3.6.1: Nairobi South Railway Station: The on-going construction of the Nairobi South Railway Station is part of the Mombasa-Nairobi SGR Phase I and was therefore not part of this ESIA process. The current planning of the railway network of SGR at the Nairobi South Railway Station is that, the SGR is divided into the section to serve the Nairobi Hub, extension to Malaba and Uganda in the west and a provision for extension to Ethiopia in the north. The new Nairobi South Station is built along the Mombasa-Nairobi SGR, with the passenger and freight yards transversely arranged, to be longitudinally arranged with the Embakasi Inland Container Depot, with the locomotive and rolling stock depots on the left at the opposite side to the station and the freight yard set on the right at the opposite side to the station. The station is designed to have a receiving-departure yard, shunting yard, freight yard, locomotive depot, and rolling stock depot (CCCC, 2015).

3.6.2: Route option 1 – Nairobi South Station-Langata-Kibera-Dagoretti-Karen-Ngong-Kamangu (Orange Linein Figure 3-4)

This route would exit the Nairobi South Station (DK0+00) and run parallel to the Southern Bypass inside Nairobi National Park before entering an underground tunnel after the Carnivore Restaurant to the south of Langata Road near the Langata Army Barracks. It will then cross Langata Road still in the tunnel above the Langata Cemetery and take a sharp north-eastern turn to the south of the cemetery through Kibera and then turn north on an overpass bridge over the Kibera area and then cross the busy Ngong Road. From there, the railway line will maintain a western direction on an embankment to the north of Dagoretti Market and follow the oil pipeline corridor inside the Ngong Forest to the east of Karen, and proceed to a a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County. The total distance for this route upto the Ngong tunnels is 41km. This route would encroach the Nairobi National Park (NNP) by about 8.5km including 5.4km of excavation and 3.1km of embankment. Due to the ragged terrain, the total length of bridges will be 28.21km and the total length of tunnels will be about 5km. The required land acquisition for this route is estimated at Ksh 120 million due to the high population density zones through which the SGR would pass. The estimated construction cost for this route is about $674 million. The route would have an additional annual operational cost of 2.12 million $ compared to other 6 proposed routes. Route option 1 has a higher social impact due to the level of public disturbance during the SGR construction as a result of the high number of key utility crossings (roads, power lines, narrow gauge railway). The operation phase will have a large number of SGR noise and vibration receptors.

The route would be associated with the following key impacts:-

a) Socio-economic and cultural impacts
   - The SGR will cross through very high urban population density areas leading to high displacement and land acquisition costs (**Plate 3-5**).
   - The option might disturb a sensitive graveyards and burial site.
   - Noise, vibration and visual impact due to the overpass bridges in high populated areas.

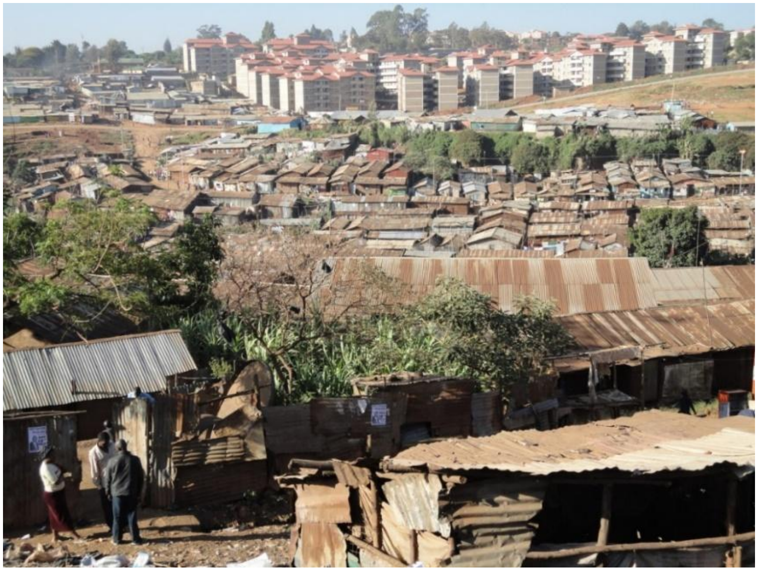


Plate 3- 5: Kibera slums

b) Security impacts
   - The SGR will operate 300m from the Langata military barracks.

c) Ecological impacts
   - The construction of the SGR will lead to additional encroachment into the NNP leading along the Southern Bypass.

3.6.3: Route Option 2 – Nairobi South Station-Langata Road-NPP-Magadi Road-Bomas of Kenya-Karen-Ngong-Kamangu (Yellow linein Figure 3-4)

This route would exit the Nairobi South Station (DK0+00) and runs along the Southern Bypass inside Nairobi National Park. It will enter Nairobi National Park approximately 1.5 km after passing the Wilson Airport emergency gate near the Langata Barracks. The SGR would then pass over Nairobi National Park in asuper bridge or flyover(viaduct) through the eastern margin of the forested section in the north-western part of the park near the KWS Hqs. The viaduct is designed to allow for passage of wildlife, water flow and tourists. The line would pass between the "Director's Tree Corner" and Hyena Dam heading straight towards the Ivory Burning Site after which the alignment heads to Nangolomon Dam and then take a northern curve to go between the David Sheldrick Elephant Sanctuary and the KWS Central Workshop and workshop staff quarters. This route would exit the park near the Magadi Gate and cross Magadi Road after which it makes a sharp north-western and pass at the edge of Bomas of Kenya. It then passes through the Karen area to the left of the Southern Bypass and then take a western turn to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County. The total distance for this route upto the Ngong tunnels is 39.4km.This was initially the most viable route option recommended by the project feasibility study with an estimated construction cost is $615 million.This route option has a higher social impact due to the level of public disturbance during the SGR construction as a result of the high number of key utility crossings (roads, power lines, narrow gauge railway). The operation phase will have a large number of SGR noise and vibration receptors. **Figure 3-5** shows the combined map of Route options 1 and 2.

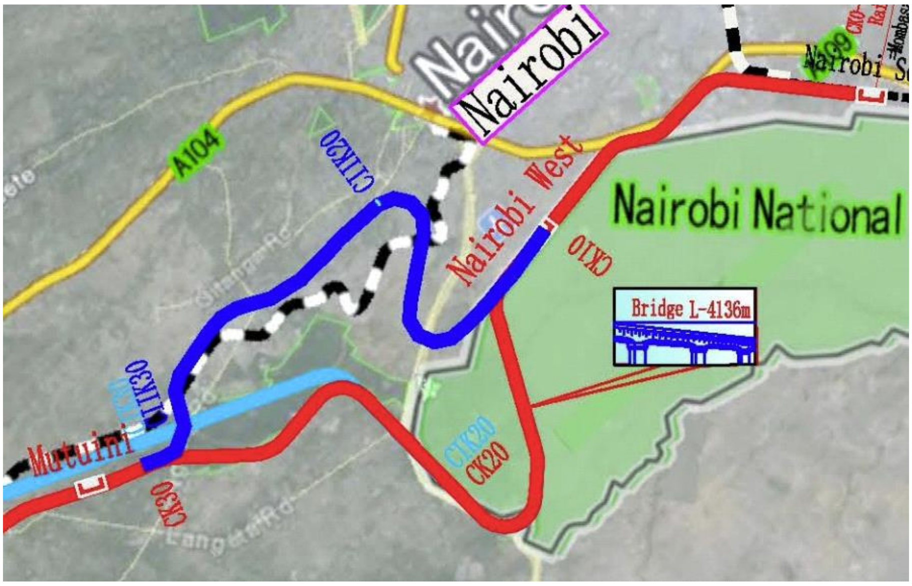


Figure 3- 5: A map of route options 1 and 2

The route would be associated with the following key impacts:-

a) Ecological impacts
   - Irreversible negative impacts to the NNP by encroaching the park by about 16.4 km including 6.1 km of embankment and 4.8 km of excavation area and 5.5 km of overhead bridge in sensitive forest environment.
   - Total loss of unique forest glades habitat used by a diverse of wildlife.
   - The SGR might affect the Nagolomon Dam (one of the oldest dam in the park and a major source of water to wildlife).
   - Clearance of a 50m Green Belt which stretches from the Wilson Airport to Athi River area.
   - Noise, vibration and artificial night light for the sensitive David Sheldrick Elephant & Rhino Sanctuary which is also a major tourism site (**Plate 3-6**).


Plate 3- 6: David Sheldrick Elephant & Rhino Sanctuary in NNP

b) Socio-economic impacts
   - Significant displacement cost due to high land value along the route such as the Bomas of Kenya area and Karen.

c) Institutional impacts
   - The SGR project is likely to disturb a number of key public and private institutions such as the following:
     - KWS Central Workshop and Staff Quarters
     - Multimedia University
     - Banda School
     - Brooke House School
     - Bomas of Kenya and the proposed Bomas International Convention
     - Galleria Shopping Centre

d) National heritage impacts
   - The SGR might affect the Ivory Burning Site (**Plate 3-7**).


Plate 3- 7: Ivory burning site in NNP

e) Visual impact on NNP tourists
   - The5.5km of overhead bridge will introduce a major visual footprint by the overpass near the NNP Main Entrance which could serious affect the " First Impression" to the visitors

3.6.4:Route Option 3 - Nairobi South Station-NNP–Tuala-Rongai-Nkoroi-Ngong–Kamangu (Red linein Figure 3-4)

This route would proceed from the Nairobi South Station (DK0+00) and run on embankment straight on in a north-east direction for approximately two (2) kilometres outside the northern edge of Nairobi National Park upto near the East Gate after which it would pass over the middle of the Nairobi National Park along a 7.2km viaduct or super flyover bridge consisting of precast T frame girders of an average height of 18m, along a 15m way-leave single track. The viaduct is designed to allow for passage of wildlife, water flow and tourists. The SGR will exit the park near the NNP's Maasai Gate near Tuala area,from here it would turn west past Tuala market centre and proceed to Ongata Rongai Town, then cross Magadi Road through the Adventist University of Africa. It then proceeds through Nkoroi area and crosses Ngong Road at Ebulbul town before heading to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County. The total distance for this route upto the Ngong tunnels is 36km. The estimated cost of construction for Option 3 will be about $523 million. The annual cost of operation will be lower compared to Options, 1 and 2.

The route would be associated with the following negative impacts on the park environment:-

a) Disturbance of park environment during the installation of about T-frame pillars along the 7.2 km long corridor. Each pillar will involve an excavation area of 4X4 m.
b) Noise and vibration during the construction and operation stages.
c) Risk of introduction of invasive species during construction and operation stages.
d) Negative visual impact on park tourism.
e) Solid waste disposal during the construction phase and also by train passengers during the operation stage.

3.6.5: Route Option 4 - Nairobi South Station-NNP-Tuala-Rongai-Nkoroi-Ngong–Kamangu (Light blue linein Figure 3-4)

The alignment for this route starts from the western end of the Nairobi South Station (DK0+00) and runs on embarkment straight on in a north-east direction for approximately two (2) kilometres outside the NNP before making a bend in the south-western direction and entering the NNP near the East Gate. It will then crosses over Nairobi National Park through the savannah region in an almost straight line along a 6km viaduct consisting of precast T frame girders of an average height of 18m along a 15m single track way-leave. The viaduct or super bridge flyover is designed to allow for passage of wildlife and also ensure that natural water flow in the park is not affected. It will also allow the undisturbed movement of tourists in the park. The precast T-frames will have a low structural height to prevent interference with aircraft landings at the Jomo Kenyatta International Airport and aircraft take-off from the Wilson Airport. The T-frames will be factory pre-built for direct installation on site and will also include appropriate acoustic noise-deflectors for low impact. The T-frame girders will be designed appropriately in order to blend with the surrounding natural environment to reduce visual intrusion and impact.**Figure 3-6** provides an artist impression of the viaduct through the NNP. The precast T-frames will have a low structural height to prevent interference with aircraft landings at the Jomo Kenyatta International Airport. T-frames will be factory pre-built with precise quality control and will also include a noise-deflector. Such sound-proof barrier can reduce noise by over 4-6 dBA. The T frame structure and span will be the same shape and size, and appearance and color may be enhanced to blend with the surrounding natural environment to reduce visual intrusion and impact. **Plate 3-8** shows a panoramic view of the state of environment along Route Option 4. **Plate 3-8** provides an artistic impression of the transparent noise deflectors along the viaduct or wildlife flyover while **Figure 3-7** shows the precast T-Frame girder design to be used in the NNP viaduct while.

Plate 3-8: Panoramic view of the site environment in Route 4 with Tuala area in the background

Figure 3- 6: Design impression of the viaduct super-bridge through NNP

The SGR construction base camp for the NNP section will be located outside the camp. The construction base camp will be located outside the camp. The construction work will require a one-side 5m service road along the 6m stretch. However, the construction work could be undertaken using the KAA emergency truck which is located close to the route option. The construction of the 6km viaduct over the park will be fast-tracked to take about 18 months in three stages as follows in order to minimize the disturbance to wildlife movements:-

- 1st Stage – Northern side, 2.2km at the entry point near the East Gate
- 2nd Stage – Middle part, 2.1km from the 1st Stage
- 3rd Stage – Exit part, 1.7km at the exit point near the Maasai Gate

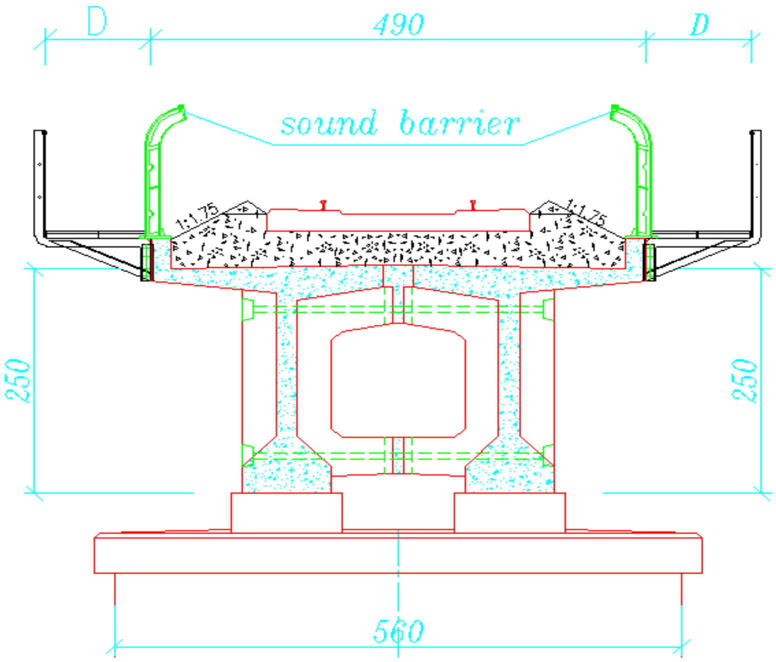


Figure 3- 7: Design for the precast T-Frame girder and noise deflector

Plate 3- 8: Artistic impression of the noise deflector in the NNP viaduct

Protective fencing around the T-frame pillar foundations will be installed only in the section under construction with the other two sections being open for wildlife movement. The entire fencing will be removed once construction is completed. KWS rangers will be engaged during construction in order to ensure additional wildlife safety and security. The SGR will exit the park after crossing Mbagathi River near the NNP's Maasai Gate near Tuala area. **Figure 3.9** shows the topographic profile of the SGR route through Nairobi National Park.

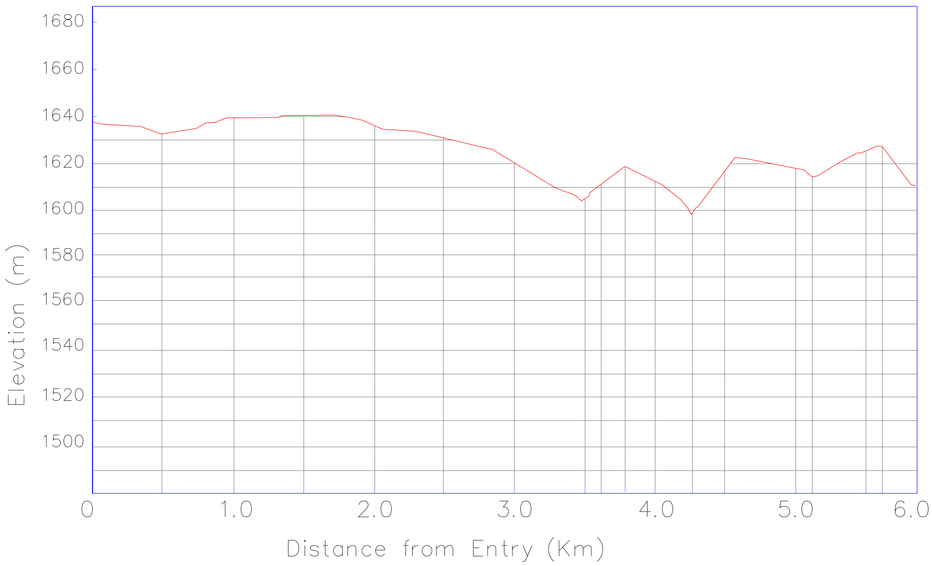


Figure 3-9: Topographic profile of SGR Route 4 through Nairobi National Park

From from Nairobi National Park, the SGR will turn west past Tuala market centre and proceed to Ongata Rongai Town, then cross Magadi Road through the Adventist University of Africa. It then proceeds through Nkoroi area and crosses Ngong Road at Ebulbul town beforeheading to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County.The total distance for this route upto the Ngong tunnels is 36.2km. This route is quite similar in terms of alignment to Option 3 but slightly shorter by 1.2km.The approximate construction costfor this route is about $523 million. The annual cost of operation will be lower compared to Options, 1 and 2.The implementation of the SGR project through Route Option 4 has factored in compensation to be given to KWS through an endowment fund.

Some of the advantages of this option include:-

a) It has avoids the total excision of the southern park edge environment along the Southern By-pass which will occur if Options 1 or 2 are adopted.
b) It has a shorter intrusion length over the park compared to Option 3.
c) It avoids the high density residential and commercial areas affected in Options 1 and 2 which will reduce the cost of land acquisition and resettlement.
d) It avoids the high number of public and private institutions to be affected by Option 2.
e) It avoids the disturbance of the rare forest environment in the NNP to be affected by Option 2.
f) The SGR will disturb a less ecologically sensitive section of Nairobi National Park compared to Options 5, 6 & 2.

The route would be associated with the following negative impacts on the park environment:-

a) Disturbance of park environment during the installation of about 187 T-frame pillars along the 6km long corridor. Each pillar will have aground surface footprint of 4X4 m or 16 square metres which translates to 2,992m^2. This is equivalent to about 0.003km^2 or 0.74 acres.
b) Noise and vibration during the construction and operation stages.
c) Risk of introduction of invasive species during construction and operation stages.
d) Negative visual impact on park tourism.
e) Solid waste disposal during the construction phase and also by train passengers during the operation stage.

3.6.5: RouteOption 5: Nairobi South Station-Allpark-NNP-Mbagathi-Tuala-Rongai-Nkoroi-Ngong–Kamangu Route (Dark Green line in Figure 3-4)

This route would proceed from the Nairobi South Station (DK0+00) and then turn back south towards Athi River town along the southern edge of the Nairobi National Park upto the Allparks area just before Mlolongo town after which it would enter the Nairobi National Park and pass over the southern section of the before exiting across the Mbagathi River near the Sheep and Goat Holding Area to the north of Athi River. This route option would pass through the Nairobi National Park along a 6.5km corridor on a 4.7km overhead bridgein the savanna area, 0.3km of embankment and 0.3km of excavation area along the south eastern edge of the park. After the Mbagathi River crossing, the SGR, will then turn west past the Ngurunga quarries towards Tuala and Ongata Rongai Towns, then cross Magadi Road through the Adventists University of Africa, and then proceed to Nkoroi to cross Ngong Road at Embulbul before heading to a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). It then drops into the rift valley through Ewaso Kedong (DK64+700), Mai-Mahiu (DK74+600) before connecting with the proposed Naivasha Industrial Park at Suswa (DK99+400). Thereafter, the SGR will cross through Oloshaiki (DK110+500) near Duka Moja and terminate at Enosupukia (DK120+800) in Narok County. The total distance for this route upto the Ngong tunnels is 41.5km. The construction cost for this route is nearly $611 million with an additional $3.55 million in annual operations compared to other proposed routes.

Some of the advantages of this option include:-

a) It has a shorter intrusion length over the Nairobi National Park compared to Options 2 and 3.
b) It avoids the high density residential and commercial areas affected in Options 1 and 2 which will reduce the cost of land acquisition and resettlement.
c) It avoids the high number of public and private institutions to be affected by Option 2.
d) It avoids the disturbance of the rare forest environment in the NNP to be affected by Option 2.

The route would be associated with the following negative impacts on the park environment:-

a) Disturbance of park environment during the installation of T-frame pillars along the 6.5km long corridor.
b) Disturbance of a more sensitive section of in the southern part of Nairobi National Park compared to route options 2, 3, & 4.
c) Noise and vibration during the construction and operation stages.
d) Risk of introduction of invasive species during construction and operation stages.
e) Negative visual impact on park tourism.
f) Solid waste disposal during the construction phase and also by train passengers during the operation stage.

3.6.5: RouteOption 6: Nairobi South Station-Mlolongo-NNP-Mbagathi-Tuala-Rongai-Ngong–Kamangu Route (Dark Blue line in Figure 3-4)

This route starts at the Nairobi South Station (DK0+00) and turns back towards Athi River town passing along the south-eastern edge of Nairobi National Park upto Mlolongo after which it would enter and pass over the southern section of the park before exiting across Mbagathi River. This route option would pass through the Nairobi National Park along a total of 5.8km including 2.7km of excavation section and 0.1km embankment along the edge of the park and 2.1km overhead bridge over the savanna sectionof the park.

After the Mbagathi River crossing, the SGR will then turn west past the Ngurunga quarries towards Tuala and Ongata Rongai Towns then cross Magadi Road next to the Adventist University of Africa and then cut through Nkoroi tocross the Ngong Road at Embulbul before heading to the Ngong tunnel (DK32+320), then the Lusigetti tunnel (Dk46+490) and Kamangu tunnel (DK53+600).From there it proceeds north-west to Kamangu and then drops into the rift valley and head to the proposed Naivasha Industrial Park near Suswa after Mai Mahiu and then crosses B3 at Duka Moja to Enosupukia in Narok County. The route is quite similar in terms of alignment to option 5.The total distance for this route upto the Ngong tunnels is 43.85km.The estimated construction cost for the route is $635 million with an expected additional $3.55

million as annual operations cost compared to other proposed routes. Consequently, the annual cost of operation will be higher than Options 1-5.

Some of the advantages of this option include:-

a) It has a shorter intrusion length over the Nairobi National Park compared to Options 2, 3, 4 & 5.
b) It avoids the high density residential and commercial areas affected in Options 1 and 2 which will reduce the cost of land acquisition and resettlement.
c) It avoids the high number of public and private institutions to be affected by Option 2.
d) It avoids the disturbance of the rare forest environment in the NNP to be affected by Option 2.

The route would be associated with the following negative impacts on the park environment:-

a) Disturbance of park environment during the installation of about 187 T-frame pillars along the 5.8km long corridor.
b) Disturbance of a more sensitive section of in the southern part of Nairobi National Park compared to route options 2, 3, & 4.
c) Noise and vibration during the construction and operation stages.
d) Risk of introduction of invasive species during construction and operation stages.
e) Negative visual impact on NNP's wildlife-basedtourism.
f) Solid waste disposal during the construction phase and also by train passengers during the operation stage.

3.6.5: RouteOption 7: Nairobi South Station- Athi River–Rongai-Ngong- Kamangu (Pink line in Figure 3-4)

This route would start at the Nairobi South Station (DK0+00) and then turn back towards Athi River on a parallel embankment line along the newly constructed Mombasa-Nairobi SGR Phase 1 at the south-eastern edge of Nairobi National Park where the SGR-I has already excised a section of the park line upto the Athi River Station. From Athi River, the SGR will require the construction of a parallel super bridge heading west outside the southern edge of Nairobi National Park through the wildlife dispersal area within the Sheep and Goat Holding Grounds in Kajiado County.The SGR would then pass to the south of the Ngurunga quarries towards Tuala and Ongata Rongai Towns then cross Magadi Road next to the Adventists University of Africa and then cut through Nkoroi tocross the Ngong Road at Ebulbul before heading to the Ngong tunnel (DK32+320), then the Lusigetti tunnel (Dk46+490) and Kamangu tunnel (DK53+600).From there it proceeds north-west to Kamangu and then drops into the rift valley and head to the proposed Naivasha Industrial Park near Suswa after Mai Mahiu and then crosses B3 at Duka Moja to Enosupukia in Narok County.In this option,the SGR will encroach the Nairobi National Parkfor a total length of 10.6km along the south-eastern edge as it heads to Athi River which will hive about 100 acres. This will include 10km embankment and 3.4km of excavation. The super-bridge in the Athi River will be approximately 3.1km of overhead bridge.This route will affect the Athi River-Kitengela wildlife dispersal area for a about 10km. The dispersal area is a critical lifeline for the wildlife in Nairobi National Park. **Figure 3-8** shows the routing for Option 7

The total distance for this route upto the Ngong tunnels is 64.3km. This option would require significant modification from the Syokimau terminus to allow re-routing of trains back to Athi River after reaching Nairobi from Mombasa. Further, it will require a parallel 2.5km super-bridge over the Athi River in addition to the one for SGR Phase I (Mombasa-Nairobi). The estimated cost of construction for this route option is approximately \$832 million. An additional \$12.34 million is needed annually for operations compared to other proposed routes. Consequently, the annual cost of operation will be higher than Options 1-6. This route option has a higher social impact due to the level of public disturbance during the SGR construction as a result of the high number of key utility crossings (roads, power lines, oil pipeline and narrow gauge railway). The operation phase will have a large number of SGR noise and vibration receptors especially in The Mlolongo area and Athi River town. The cumulative negative environmental impact for this SGR route in addition to the construction of the proposed Greater Southern Bypass will be disastrous to Nairobi National Park.

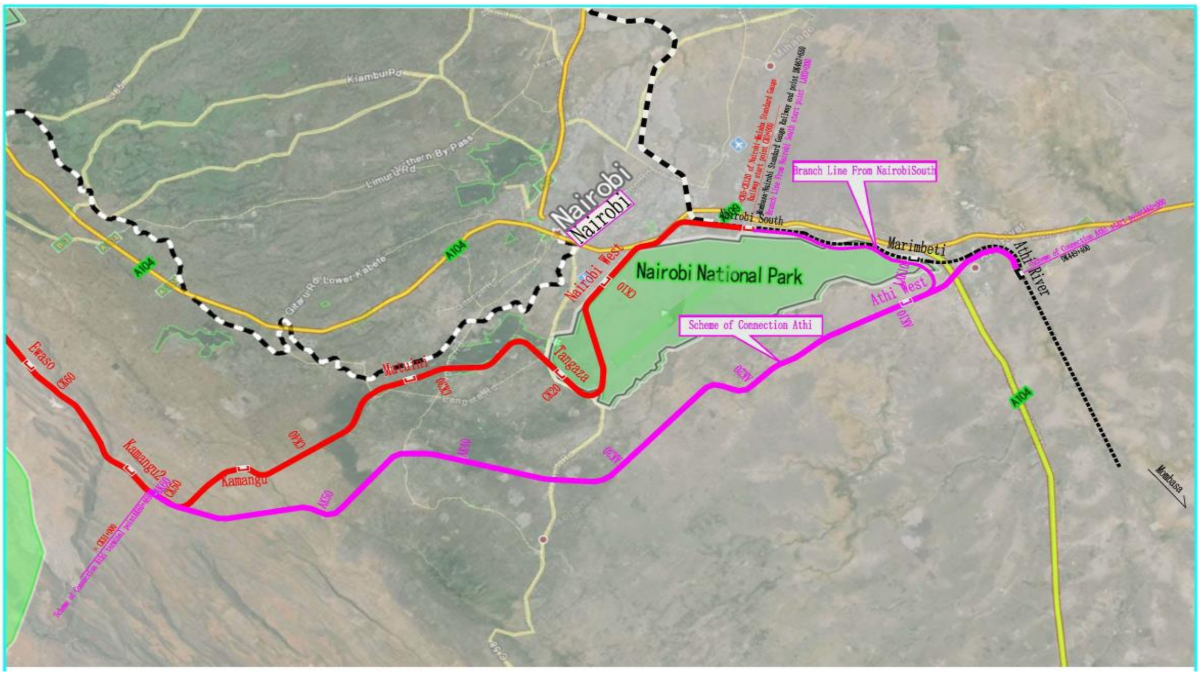


Figure 3- 8: Map of Route option 7

Some of the advantages of this option include:-

a) Avoiding the passing over Nairobi National Park.
b) Avoiding the high density residential and commercial areas affected in Options 1 and 2 which will reduce the cost of land acquisition and resettlement.
c) Avoiding the high number of public and private institutions to be affected by Option 2.
d) Reducing the traffic flow at Nairobi South Station by direct routing of Mombasa-Malaba cargo.

The main construction challenges to be encountered if the route is adopted will include the following:-

a) Installation of double tracks to the marshalling yard.
b) The south throat of Nairobi South Station and the layout of Athi River Station will need to be reconstructed or modified for Mombasa-Nairobi Railway which will involve:-
    - Construction of an assistant line passing along the edge of the national park,
    - Removing approximately 700m of tracks,
    - Laying 1900m of new tracks,
    - Removing 2 sets of turnouts,
    - Laying 9 sets of new turnouts, and
    - Finishing 40,000 m^3 of earth works.
c) Train movements from Mombasa to Malaba, or the rolling stock will require major re-organization in the Nairobi South Station that is under construction to allow the turn back to Athi River Station as well as the turn towards south of Tuala market. These two turns will introduce high difficulties of operation if re-organization does not take place now in order to avoid reducing the level of transportation efficiency of the in the Nairobi South Station.
d) Both Nairobi South Station and Athi River Station will have to be re-planned and realigned, since the initial design of Athi station was not designed as a connection station. This will require longer length of the railroad and bridges.
e) The Athi River steel plant will be affected because single railway will enlarge to 3 line railway (Mombasa to Nairobi, Mainline of Nairobi to Malaba, and assistant line).
f) The existing meter-gauge will have to be realigned because of the close distance to the proposed SGR lines.
g) The disconnect between Route Option 7 and the Embakasi Inland Container Depot (ICD) will continue congesting Mombasa road between Athi River and Nairobi because of the use of trucks to ferry some of the cargo from the Athi River Station.

h) Since the alignment of the proposed Southern Bypass is less flexible in comparison to the SGR which has 7 options, it is environmentally preferable to re-route the SGR away from the critical NNP support environment to the south of the park by picking on one of the other 6 route options.

i) The implementation of the Nairobi-Naivasha-Enosupukia SGR project through Option 7 will impact significantly on the movement of wildlife in and out of the NNP. The affected wildlife corridors which will be affected have already been mapped by the Department of Resource Surveys and Remote Sensing (DRSS) in conjunction with KWS and should be preserved in order to enable the wildlife move freely as they have traditionally done. The construction of the SGR through Route Option 7 is likely to have negative impacts on existing wildlife corridors thereby violating the key environmental goal of Vision 2030 of "Securing the Wildlife Corridors and Migratory Routes"

j) The implementation of the Nairobi-Naivasha-Enosupukia SGR project through Option 7 will negatively affect the Proposed Pastoralism and Wildlife Conservation Master Plan for Isinya-Kitengela 2006-2026 which is championed by Kenya Wildlife Service and partners including the Kitengela-Ilparakuo Land Owners Association.

The route will have a large number of negative ecological impacts including the following:-

a) The Nairobi South Station-Athi River return track will excise the south-eastern edge of Nairobi National Park and hive off an additional 100 acres in addition to the present land take by the Mombasa-Nairobi SGR which has already encroached the NNP by about 200 acres of the South Eastern sector of the park.

b) The additional excision of park land in the south-eastern part of the NNP through the construction of the SGR return line from the NSS to Athi River will increase the level of habitat transformation because this area has already been transformed by KPL oil pipeline and the KETRACO high voltage power lines. This will further increase the human footprint on wildlife and the park.

c) The initial section of the Athi River-Tuala outside the south-eastern part of Nairobi National Park will cut through cross through the Kitengela Wildlife Dispersal Area within the Sheep and Goats Holding Grounds near Athi River for distance of about 10km along the park boundary (**Figure 3-9**). This will affect a wide range of wildlife species. A wide range of species were sighted in the area during the baseline environmental assessment (wildebeest, Maasai giraffe, impala, Grant's and Thomson's gazelles, common zebra, Kongoni, Maasai ostrich, eland and olive baboon).

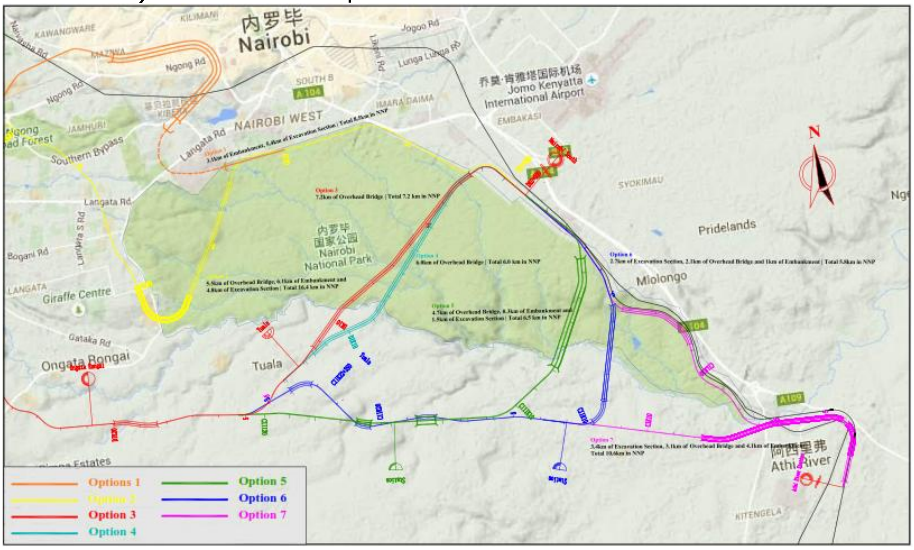
Figure 3- 9: Kitengela dispersal area(Enclosed in red)

d) The adoption of the route option will lead to the blockage of wildlife movement between the park and the dispersal area which will insularize the park, fragment wildlife populations and reduce wildlife range.

e) The adoption of the route option will significantly affect the movement of wildlife in and out of the NNP. The affected wildlife corridor is one of those which have already been mapped by the Department of Resource Surveys and Remote Sensing (DRSS) in partnership with KWS as part of the environmental goal of Vision 2030 of "Securing the Wildlife Corridors and Migratory Routes"

f) The adoption of Option 7 will seriously affect the ecological viability of NNP by permanently decimating the traditional linkages with surrounding ecosystems on which the survival of the park is based. The future construction of the proposed Greater Southern Bypass will lead to a "Double Tragedy" for the future of the NNP. **Figure 3-10** shows the routings for Option 7 and the proposed route for the Greater Southern Bypass. Since the alignment of the proposed Southern Bypass is less flexible in comparison to the SGR which has 7 options, it is environmentally preferable to re-route the SGR away from the critical NNP support environment to the south of the park by picking on one of the other 6 route options.

a) SGR-IIA Route option 7



b) Proposed Greater Southern Bypass

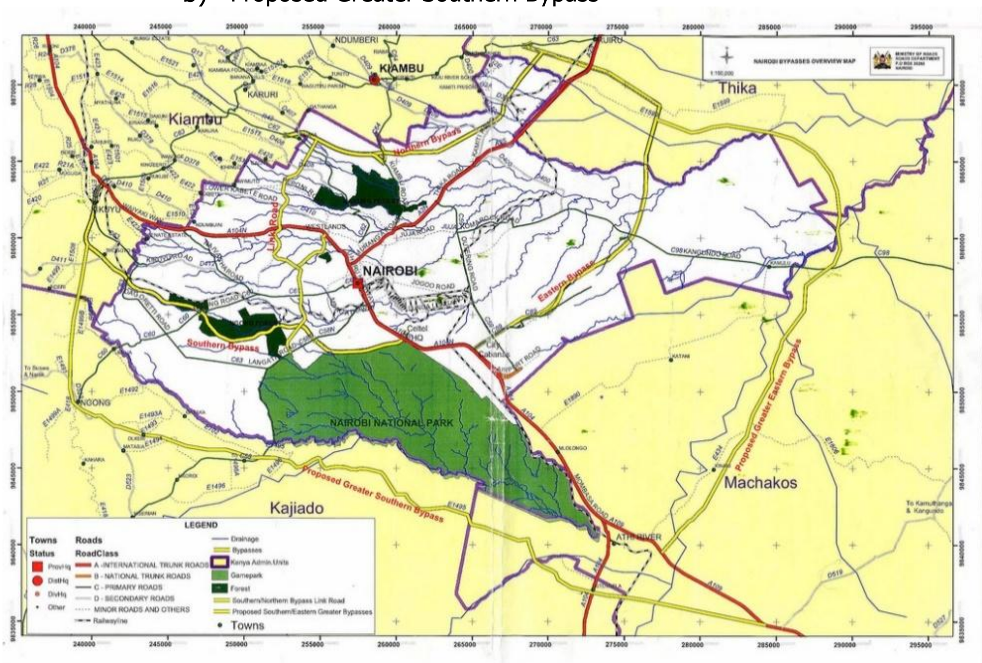


Figure 3- 10: The routings for Option 7 (a) and the proposed route for the Greater Southern Bypass (b)

Finally, the adoption of route Option 7 will have a negative socio-economic impact in the wildlife dispersal area which is heavily used by the Maasai pastoralists as a communal grazing area with numerous livestock (sheep, goats, and cattle) which co-exist with the wildlife. However, the SGR would have an impact on wildlife, pastoralism and human structures in the corridor.

3.7: SGR Alternatives Route Evaluation and Criteria for DK 00-DK 50

The main purpose of comparing environmental impacts of the project alternatives is to provide the decision makers with the complete environmental and socio-economic background information to be able to make an informed decision on what project alternative to proceed with in the DK00-DK50 section. The selection of project alternative was made based on both the feasibility study and the EIA study.

Seven alternative routes for the SGR were evaluated in the DK00-DK50 section within the Nairobi area especially around the NNP because of the complexity of engineering and environmental issues that exist within that section. This was an interactive process that involved inputs from ESIA team in consultation with other technical professionals (design and survey engineers) from the proponent (KRC), the project contractors (CCCC) and other government agencies like KWS, KFS, NEMA, NLC, Ministry of Transport and Infrastructure, and Ministry of Environment & Natural resources among others. The purpose of this multi-level and multi-agency interactive process was to allow the team to identify and select out the best route alternative from the engineering, social, environmental and economic perspectives. The consultants were also carefully monitoring public debates on the project in the media including social media. The objective of this was to use information from such consultations, literature, field visits and measurements, and knowledge of conservation issues especially around Nairobi National Park to recommend the best potential route, advice on mitigation strategies of ecological impacts, and present both a monitoring and a management plan for the proposed best route for which the SGR would use to exit Nairobi South Station to Malaba.

3.8: Route Suitability Evaluation Criteria for Section DK00-DK50

The detailed criteria used for evaluation of the seven route alternatives for the first 50 km of the project are outlined in this section. After the first 50km, all the options follow one route to DK 120. The evaluation for the DK00-DK50 section was done according to the total Life Cycle Approach (LCA) by which essentially includes the planning, feasibility, design, construction and operation and maintenance of railways. The evaluation criteria for the route alternative analysis was based on the EMCA (Environmental Impact Assessment and Audit) Regulations 2003 and the guidelines in the EAC Transport Facilitation Strategy - Harmonization of Environmental Policies, Laws and Regulations (2012). The analysis of the route alternatives was done on the basis of four (4) thematic factors and twenty seven (27) environmental and social attributes as shown in **Table 3-2**. A description of the criteria considered when analyzing the alternatives is given hereunder.

Table 3- 2: SGR Route Suitability Evaluation Criteria

Evaluation criteria	Parameters
1. Route suitability (12 parameters)	**P1**-Direct connectivity to the Mombasa-Nairobi SGR line (Engineering design & cost and operational cost)
	P2-Route turnings (Engineering challenges, high operational costs)
	P3-Route distance (Construction and operation cost)
	P4 – Route elevation to D20 (m)
	P5-Terrain suitability (Engineering challenging areas)
	P6-Total bridge length (Construction cost – time & money)
	P7-Number of key utility crossings – roads, narrow gauge railway, power lines& oil pipelines (Construction cost & level of inconvenience)
	P8-Obstructions on the right-of-way (High density residential estates, institutions and establishments) – Displacement, resettlement cost
	P9-Operation convenience (Cheap operation)
	P10-Total construction cost upto Ngong Tunnel

	P11- Operational cost upto Ngong Tunnel
	P12-Extra operational cost
	P13- Route economic return upto Ngong Tunnel
	P14 - Proposed SGR distance over the national park
2. Social impacts	**P1**-Noise & vibration (Potential receptors)
3. Affected ecosystems outside Nairobi National Park	**P1**-SGR river crossings
	P2-SGR forest crossings
4. Environmental impacts in Nairobi National Park	**P1**-Proposed SGR distance over the national park
	P2-Encroachment into park environment
	P3-Loss of valued wildlife habitats in NNP (Ha)
	P4-Encroachment of wildlife dispersal and migratory routes outside NNP
	P5-Park forest crossings
	P6-Park river crossings
	P7-Visual impact (Number of park road crossings directly interacting with SGR)
	P8-Types of affected vegetation
	P9-Potential area of affected vegetation tyes
	P10-Key wildlife species and potential habitat impact (ha) in the different routes

Tables 3-3, 3-4, 3-5 and 3-6 provide the route suitability analysis and ranking matrices for the 7 route options in section DK00-DK50 based on **Table 3-2**.

Table 3- 3: Route analysis and ranking matrix for the 7 route options in section DK00-DK50

Route alternative	**Project phase**	**1. Route suitability**				
		P1-Direct connectivity to SGR Phase I	**P2-** Number of route turnings **(Fig-3.11)**	**P3** – Route distance (km)	**P4** – Route elevation to D20 (m) **– Fig 3-12**	**P5** – Terrain suitability – ‰
Option 1	Construction	Directly connected		41	1737	+2.8
	Operation		5	41		
Option 2	Construction	Directly connected		39.4	1745	2.8
	Operation		8	39.4		
Option 3	Construction	Directly connected		36	1739	0.2
	Operation		6	36		
Option 4	Construction	Directly connected		36.2	1739	0.2
	Operation		4	36.2		
Option 5	Construction	Not directly connected		41.5	1715	-16
	Operation		6	41.5		
Option 6	Construction	Not directly connected		43.85	1693	-13
	Operation		9	43.85		
Option 7	Construction	Not directly connected		64.3	1561	-12
	Operation		6	64.3		
Best Options	Construction	Routes 1, 2, 3 & 4		**Route 3, 4**	**Route 1 & 3/4**	**Route 3 & 4**
	Operational		Route 4	**Route 3, 4**		
Worst options	Construction	Routes 5, 6 & 7		**Route 7**	**Route 7 & 6**	**Route 5 & 6**
	Operational	Route 7	Route 9	**Route 7**		

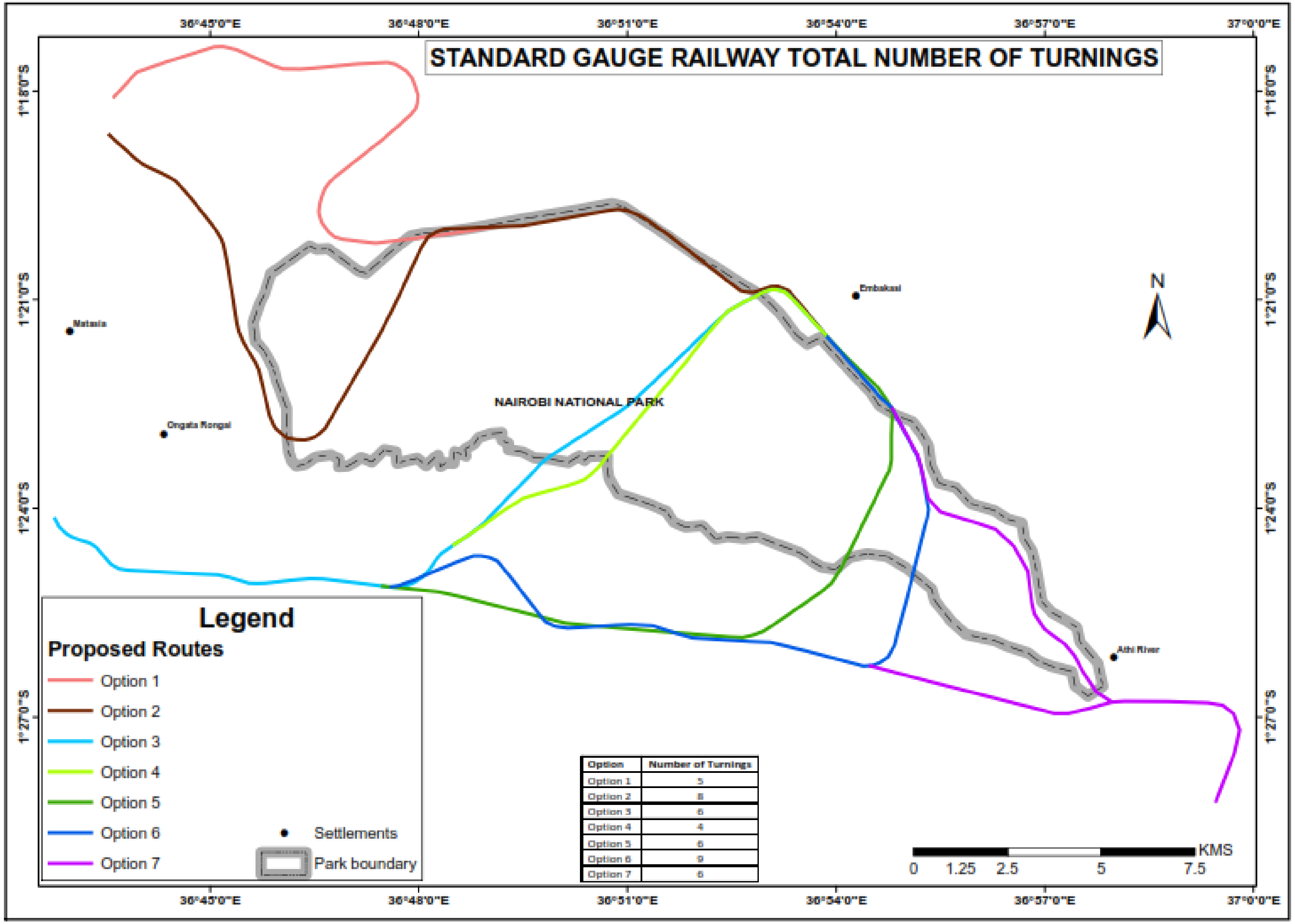


Figure 3- 11: Turnings along the SGR alternative routes

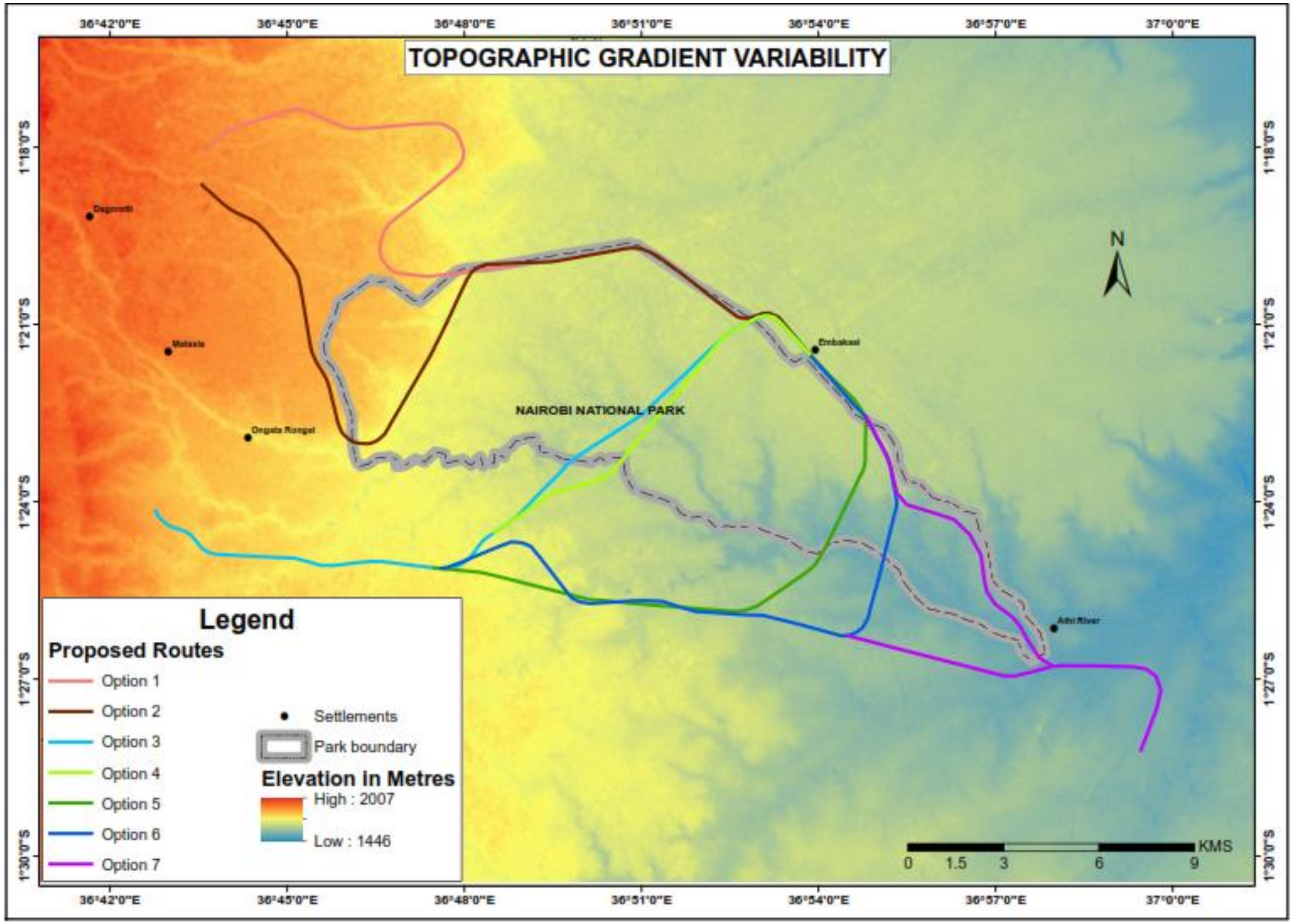
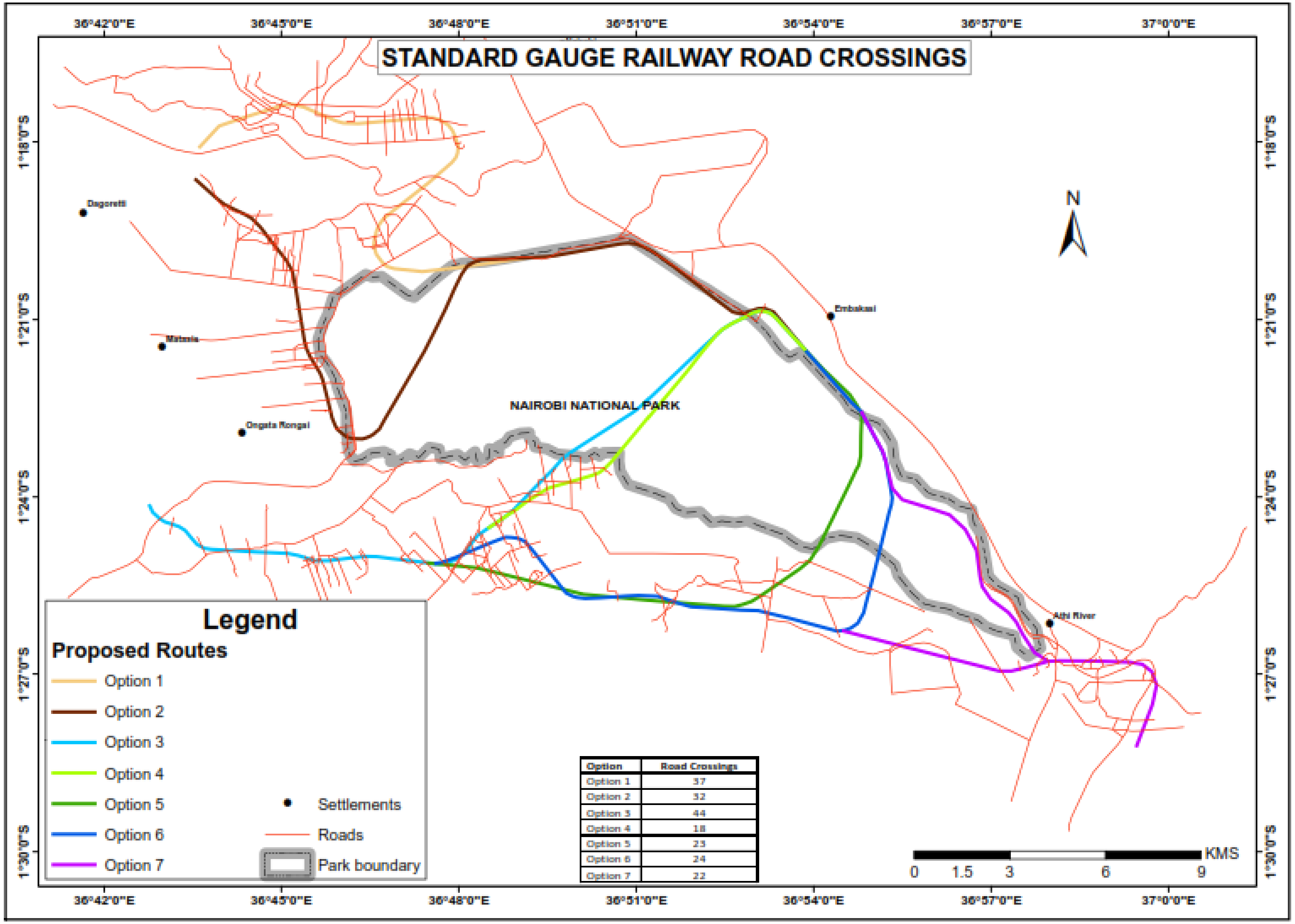


Figure 3- 12: Elevation in the in the SGR alternative routes

Route alternative	**Project phase**	**Route suitability**			
		P6 – Total bridge length (km)	**P7** – Number of key crossings **(Figure 3-13)**	**P8** – Key obstructions on the right-of-way	**P9-**Operation convenience (Cheap operation**)**
Option 1	Construction	9.64	**12** (Langata Rd, Southern Bypass, Meter gauge railway 1, Kibera Drive, Joseph Kangethe, Lagiri Rd, Ngong Rd, Kingara Rd, Riara Rd., Naivasha Rd, Ngong Rd, Meter gauge railway 2)	KDF, KWS, Langata Cemetry, Kibera, Kilimani	
	Operation				Less expensive
Option 2	Construction	8.14	**7** (Magadi Rd, Mukoma Rd, Kisembe Rd, Bogani Rd, Langata Rd, Southern Bypass, Ngong Rd)	KWS dam, KWS Central Workshop & Staff Quarters, Multimedia University, Banda School, Brooke House Sch., Karen End Estate, Galleria Shopping Centre, Bomas of Kenya and the proposed Bomas International Convention, Kuwinda	
	Operation				Less expensive
Option 3	Construction	8.55	**2** (Magadi Rd, Ngong Road)	NNP,	
	Operation				Less expensive
Option 4	Construction	6.79	**2** (Magadi Rd, Ngong Road)	NNP	
	Operation				Less expensive
Option 5	Construction	6.69	**3** (KETRACO power line, KPL oil pipeline, Magadi Rd, Ngong Road)	Ngurunga quarries,	
	Operation				More expensive
Option 6	Construction	5.8	**3** (KETRACO power line, KPL oil pipeline, Magadi Rd, Ngong Road)	Sheep & Goat Holding Land, Ngurunga quarries	
	Operation				More expensive
Option 7	Construction	15.2	**7** (KETRACO power line, KPL oil pipeline, Athi River Rd, meter gauge railway, Namanga Rd X2, Magadi Rd, Ngong Road)	Sheep & Goat Holding Land, Ngurunga quarries	
	Operation				More expensive
Best options	Construction	**Route 6**	**Route 3 & 4**	**Route 3 & 4**	
Worst options	Construction	**Route 7**	**Route 1 & 7**	**Route 1 & 2**	**Route 4 - Direct & shortest**
Best route	Construction				
Worst route	Construction				**Route 7 – Indirect & longest**



Option	Road Crossings
Option 1	37
Option 2	32
Option 3	44
Option 4	18
Option 5	23
Option 6	24
Option 7	22

Figure 3- 13: Road crossings along the SGR alternative routes outside Nairobi National Park

Route alternative	Project phase	Route suitability				
		P10-Total construction cost upto Ngong tunnel (million $)	**P11-** Operational cost upto Ngong Tunnel (Million US$)/Km/Year	**P12**-Extra annual operational cost (million $)	**P13**- Net Returns upto Ngong Tunnel (Million US$)/Km//Year	**P14-**Proposed SGR distance over the national park (km)
Option 1	Construction	664				8.5
	Operation		0.6705	2.12	0.5671	
Option 2	Construction	615				16.4
	Operation		0.6529	1.34	0.5848	
Option 3	Construction	523				7.2
	Operation		0.6127	- 0.22	0.6250	
Option 4	Construction	543				6
	Operation		0.6188	0.0	0.6188	
Option 5	Construction	611				6.5
	Operation		0.6991	3.33	0.5386	
Option 6	Construction	635				5.8
	Operation		0.7101	4.0	0.5276	
Option 7	Construction	832				10.6
	Operation		0.8073	12.12	0.4304	
Best options	Construction	Route 3 & 4				Route 5 & 6
	Operation		Route 3,4	Routes 3 & 4 – Cheaper operation	Routes 3,4	
Worst options	Construction	Route 7 & 1				Route 2 & 7
	Operation		Route 7	Route 7	Routes 7	

Table 3- 4: Route social impact analysis

Route alternative	**Project phase**	**2. Social impact** **P1** – Noise & vibration (Population density & overall estimate of key receptors) – **Fig 3-14 & Fig 3-15**	**Res**	**Edu**	**Hos**	**PA**	**Hot**	**Ind**	**No. of Sensitive receptors**
Option 1	Construction & operation	**≥20** (Vitafoam factory, Furniture Industry, Simba Motors, Ole Serani, Amboseli Estate, Green Estate, College of Insurance, Ridgeview Estate, Gamepark Apartments, Langata Barracks, Langata Cemetery, Royal Park Estate, St. Mary Hospital, Kibera, Adams Arcade, Maziwa, Riara Gardens, Dagoreti, Race Course, Lenana Forest Estate, NNP, Ngong Rd. Forest)	14	1	1	2	1	12	**19**
Option 2	Construction & operation	**≥17** (Vitafoam factory, Furniture Industry, Simba Motors Ole Serani, Amboseli Estate, Green Estate, College of Insurance Ridgeview Estate, NNP, Sheldrick Orphanage, KWS Central Workshop, MMU, Banda School, Al Jamea, Bogania area, CUEA, Bomas of Kenya, Kuwinda, Karen C, Karen, Ngong Rd. Forest)	7	1	-	3	3	12	**14**
Option 3	Construction & operation	**≥7** (Vitafoam factory, NNP, Tuala, Kandisi, Southern Rongai, Adventist University of Africa, Nkoroi, Ololua Forest, Bulbul)	5	1	-	2	-	3	**7**
Option 4	Construction & operation	**≥6** (Vitafoam factory, NNP Tuala, Kandisi, Southern Rongai, Adventist University of Africa, Nkoroi, Ololua Forest, Bulbul)	5	1	-	2	-	3	**7**
Option 5	Construction & operation	**≥12** (Kapa Oil Refineries, Mabati Rolling Mills, Orbit Industry, Sheep & Goat Holding area, Embakasi Primary Sch, Ngurunga Quarries,Industrial area, NNP, Tuala, Kandisi, Southern Rongai, Adventist University of Africa, Nkoroi, Ololua Forest, Bulbul)	5	2	-	3	-	7	**10**
Option 6	Construction &	**≥12** (Kapa Oil Refineries, Mabati Rolling Mills,	5	2	-	3	-	8	**10**

	operation	Orbit Industry, Mlolongo Weigh bridge area, Sheep & Goat Holding area, Embakasi Primary Sch, Ngurunga Quarries,Industrial area, NNP, Tuala, Kandisi, Southern Rongai, Adventist University of Africa, Nkoroi, Ololua Forest, Bulbul)							
Option 7	Construction & operation	≥17 (Kapa Oil Refineries, Mabati Rolling Mills, Orbit Industry, Mlolongo Weigh bridge area, Mlolongo estates, Southern NNP, Valley View Park Estate, Hillcrest Park, Bamburi Cement, Athi River Seniors Estate, Athi River Shalom Hospital, Athi River town, East African Portland Factory, Sheep & Goat Holding area, Embakasi Primary Sch, Ngurunga Quarries,, Tuala, Kandisi, Southern Rongai, Adventist University of Africa, Nkoroi, Ololua Forest, Bulbul)	5	3	1	3	3	14	**15**
Best options	Construction & operation								**Route 3 & 4**
Worst options	Construction & operation								**Routes 1 & 7**

Note:
Res = Residential estates
Edu = Educational institutions
Hos = Hospitals
PA = Protected (conservation) areas
Hot = Hotels
Ind = Industries (**Figure 3-16**)

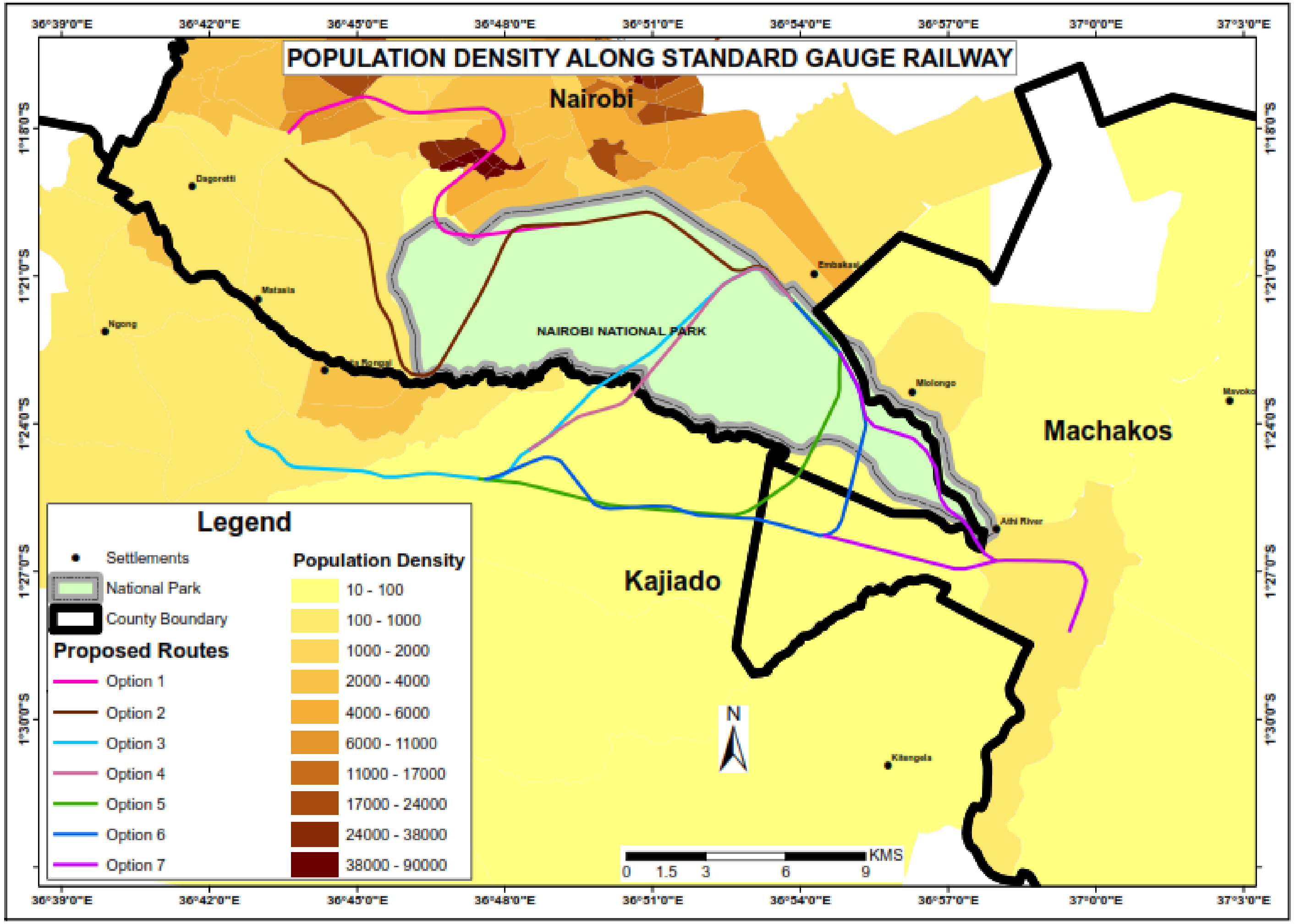
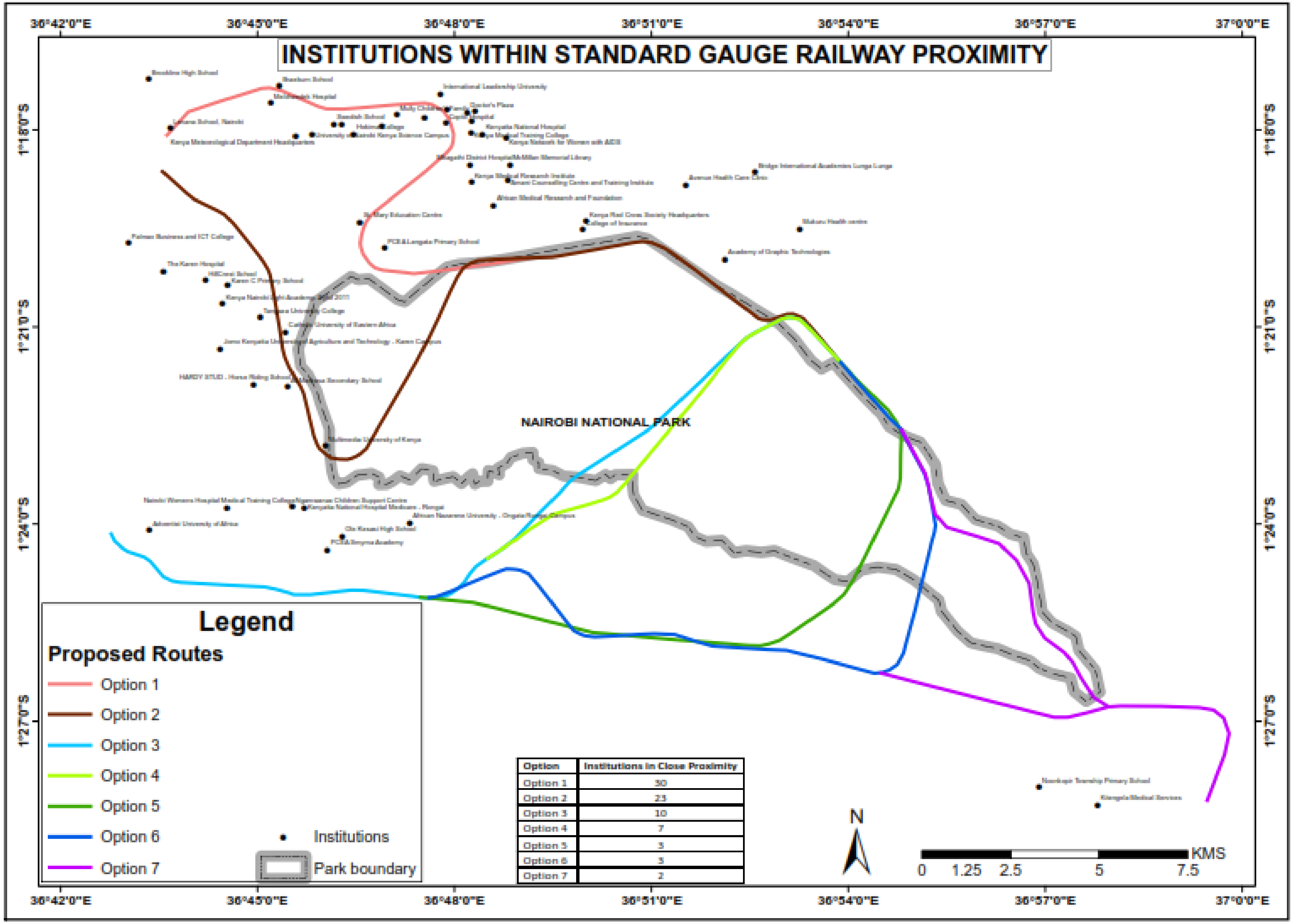


Figure 3- 14: Population density along the SGR alternative routes



Option	Institutions In Close Proximity
Option 1	30
Option 2	23
Option 3	10
Option 4	7
Option 5	3
Option 6	3
Option 7	2

Figure 3- 15: Population density along the SGR alternative routes

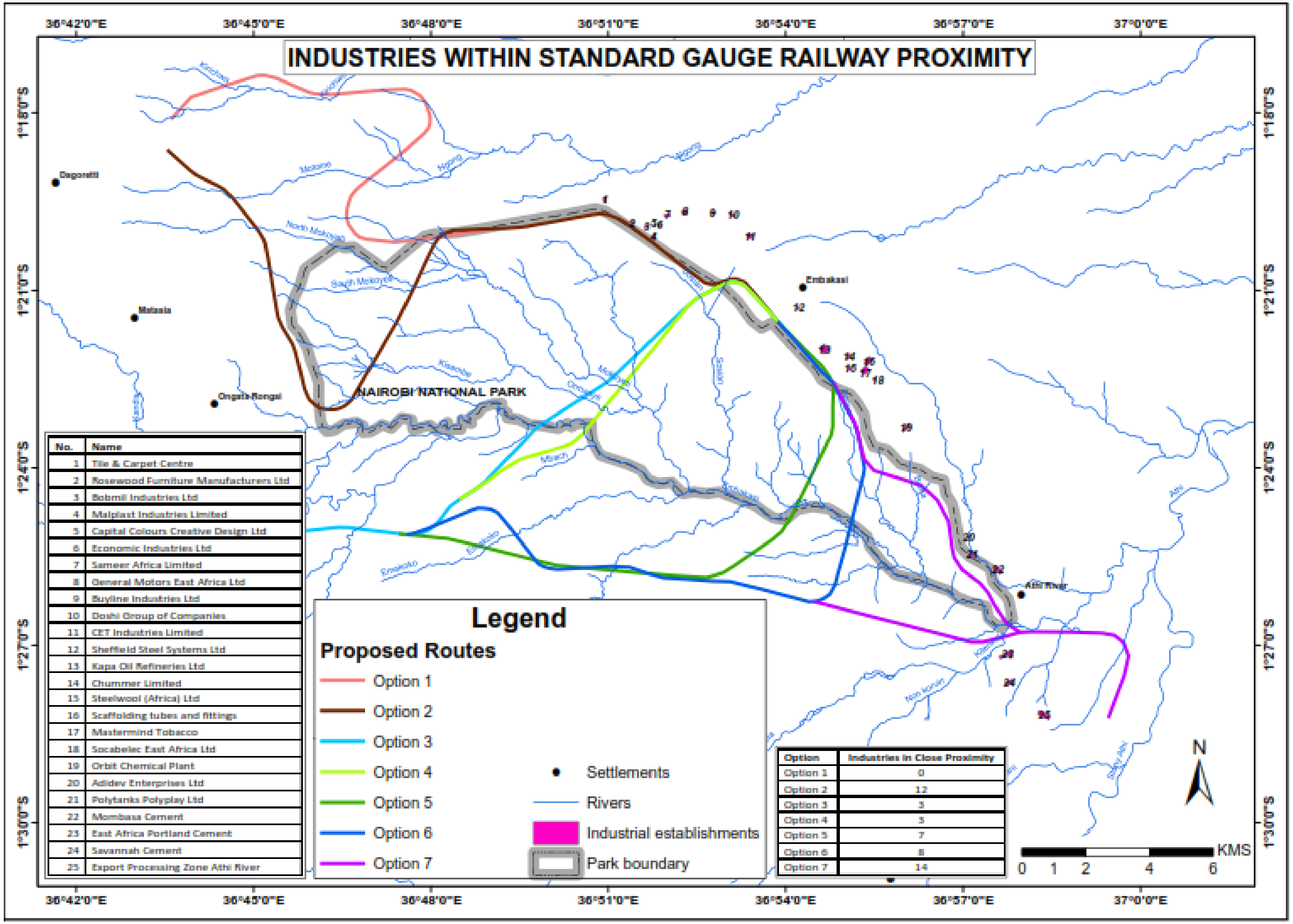


Figure 3- 16: Industries along the SGR alternative routes

Table 3- 5: Analysis of ecosystems outside Nairobi National Park

		3. Affected ecosystems outside Nairobi National Park **P1** – SGR river crossings **(Figure 3-18)**	**P2** – SGR forest crossings **(Figure 3-17)**
Route alternative	**Project phase**		
Option 1	Construction	11	2
Option 2	Construction	4	2
Option 3	Construction	6	2
Option 4	Construction	5	2
Option 5	Construction	4	2
Option 6	Construction	7	2
Option 7	Construction	7	2
Best options	**Construction**	**Route 4 & 5**	**Similar**
Worst options	**Construction**	**Route 1 & 6/7**	**Similar**

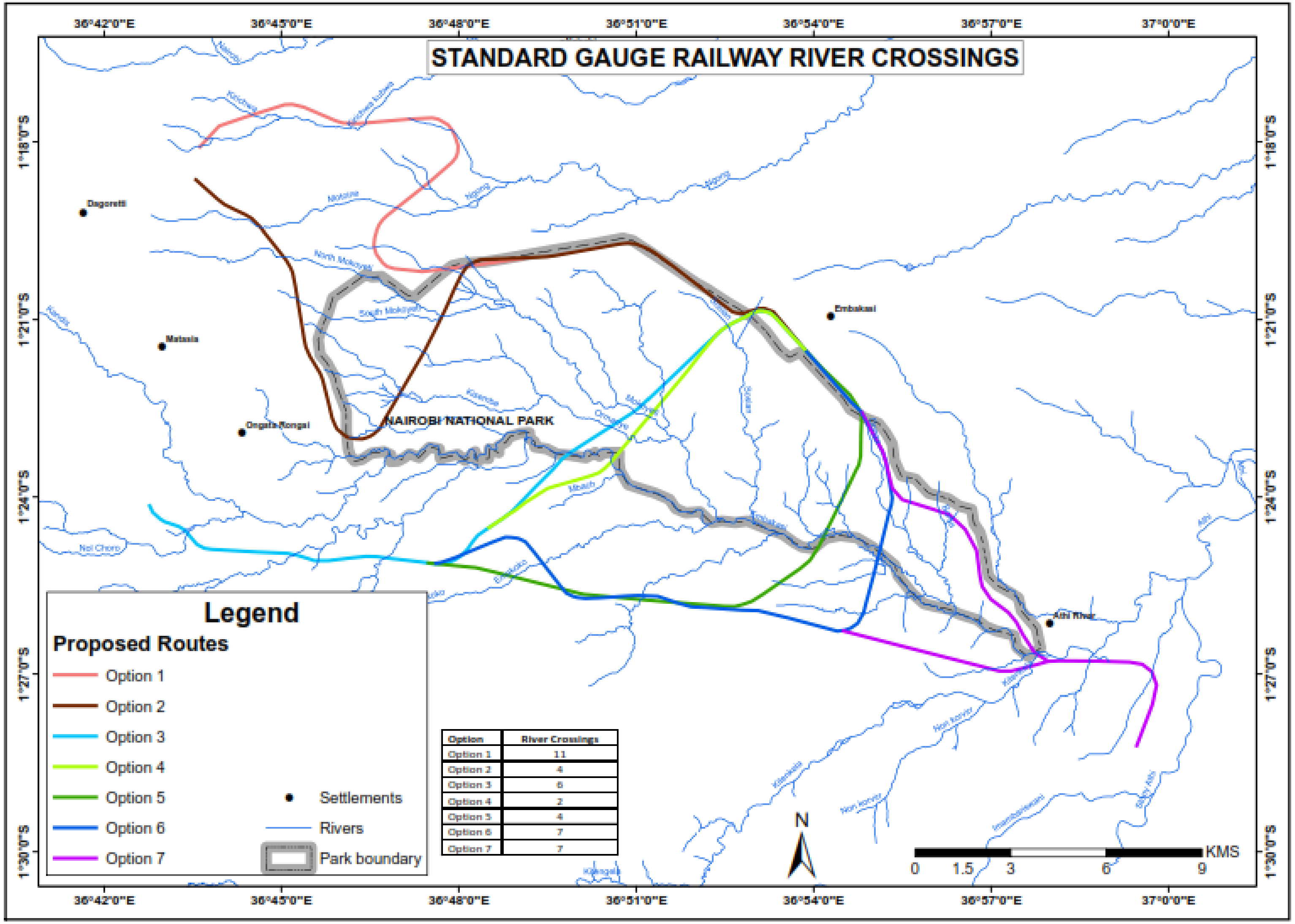
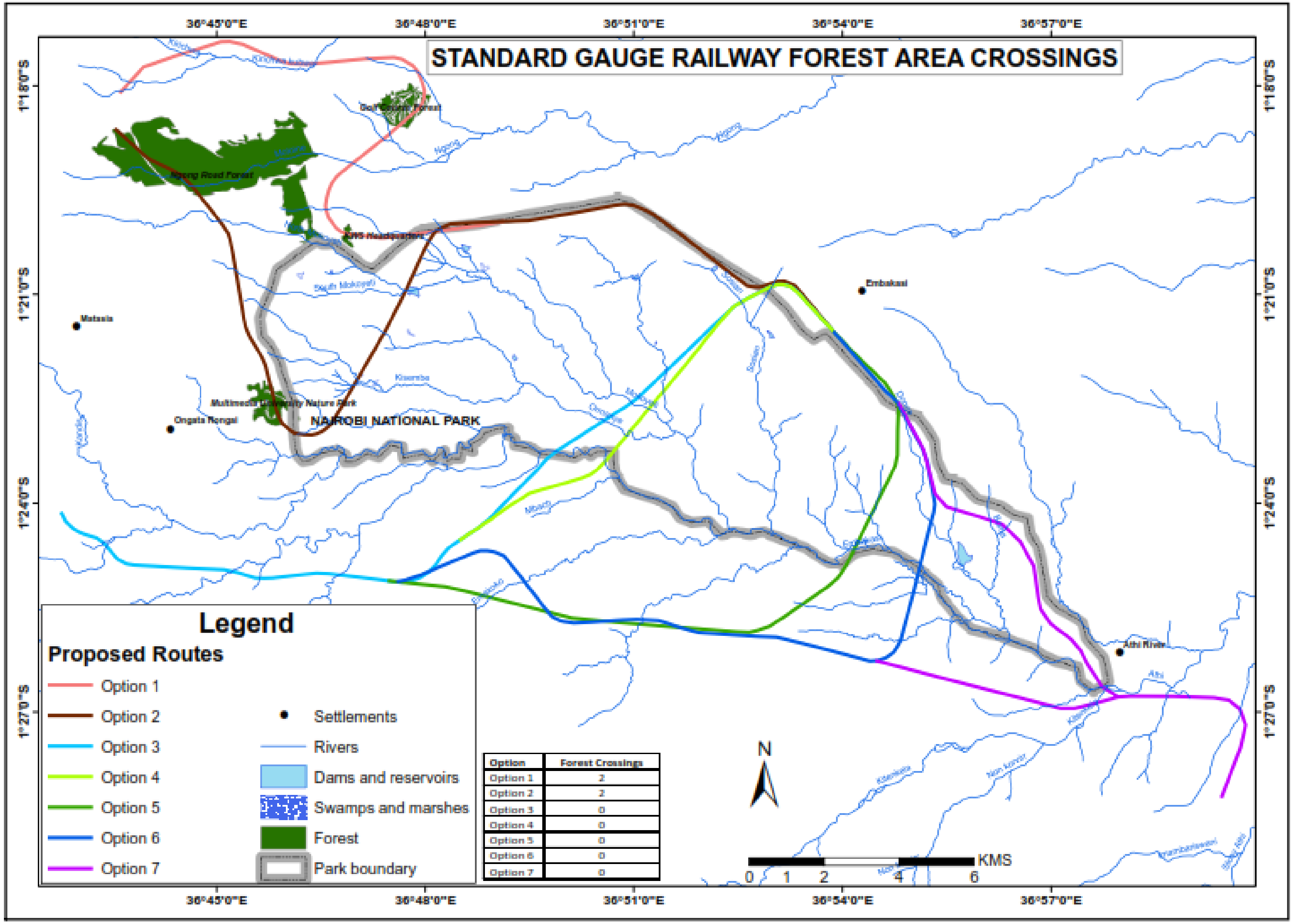


Figure 3- 17: River along the SGR alternative routes



Option	Forest Crossings
Option 1	2
Option 2	2
Option 3	0
Option 4	0
Option 5	0
Option 6	0
Option 7	0

Figure 3- 18: Forests along the SGR alternative routes

Table 3- 6: Route environmental impact analysis in Nairobi National Park

Route alternative	Project phase	4. Environmental impacts in Nairobi National Park			
		P1 – Total distance over the Nairobi National Park – NNP (km)	**P2**–Encroachment into park environment (ha) with 15m Way leave	**P3** - Loss of valued wildlife habitats in NNP (Ha)	**P4** - Encroachment of wildlife dispersal and migratory routes outside NNP with 15m Way leave
Option 1	Construction & operation	8.5	12.8	27.9	0
Option 2	Construction & operation	16.4	24.6	27.9	0
Option 3	Construction & operation	7.2	10.8	0	0
Option 4	Construction & operation	6	9.0	0	0
Option 5	Construction & operation	6.5	8.7	5.1	5.8 km of Athi River wildlife dispersal routes encroached, 15 ha of dispersal space lost
Option 6	Construction & operation	5.8	8.7	9.0	5.8 km of Athi River wildlife dispersal routes encroached, 15 ha of dispersal space lost
Option 7	Construction & operation	10.6	15.9	32.4	5.8 km of Athi River wildlife dispersal routes encroached, 15 ha of dispersal space lost
Best options	Construction & operation	**Route 6 & 4**	**Routes 5/6 & 4**	**Routes 3 & 4**	**Routes 1,2,3 & 4**
Worst options	Construction & operation	**Route 2 & 7**	**Routes 2 & 7**	**Routes 7 &1/2**	**Routes 5,6 & 7**

Route alternative	**Project phase**	**P5** – Number of park forest crossings by SGR (**Figure 3-19, Figure 3-20**)	**P6** - Number of park river crossings by SGR (**Figure 3-21**)	**P7** – Visual impact (Number of park road crossings directly interacting with SGR) – **Figure 3-22**
Option 1	Construction & operation	0	0	0
Option 2	Construction & operation	4 fragments	8	18
Option 3	Construction & operation	0	5	9
Option 4	Construction & operation	0	4	9
Option 5	Construction & operation	0	5	6
Option 6	Construction & operation	0	5	3
Option 7	Construction & operation	0	3	2
Best options	Construction & operation	**Routes 1, 3, 4, 5, 7**	**Route 2, 3, 4, 5**	**Route 1 & 7**
Worst options	Construction & operation	**Route 2**	**Route 1, 7**	**Route 2 & 3/4**

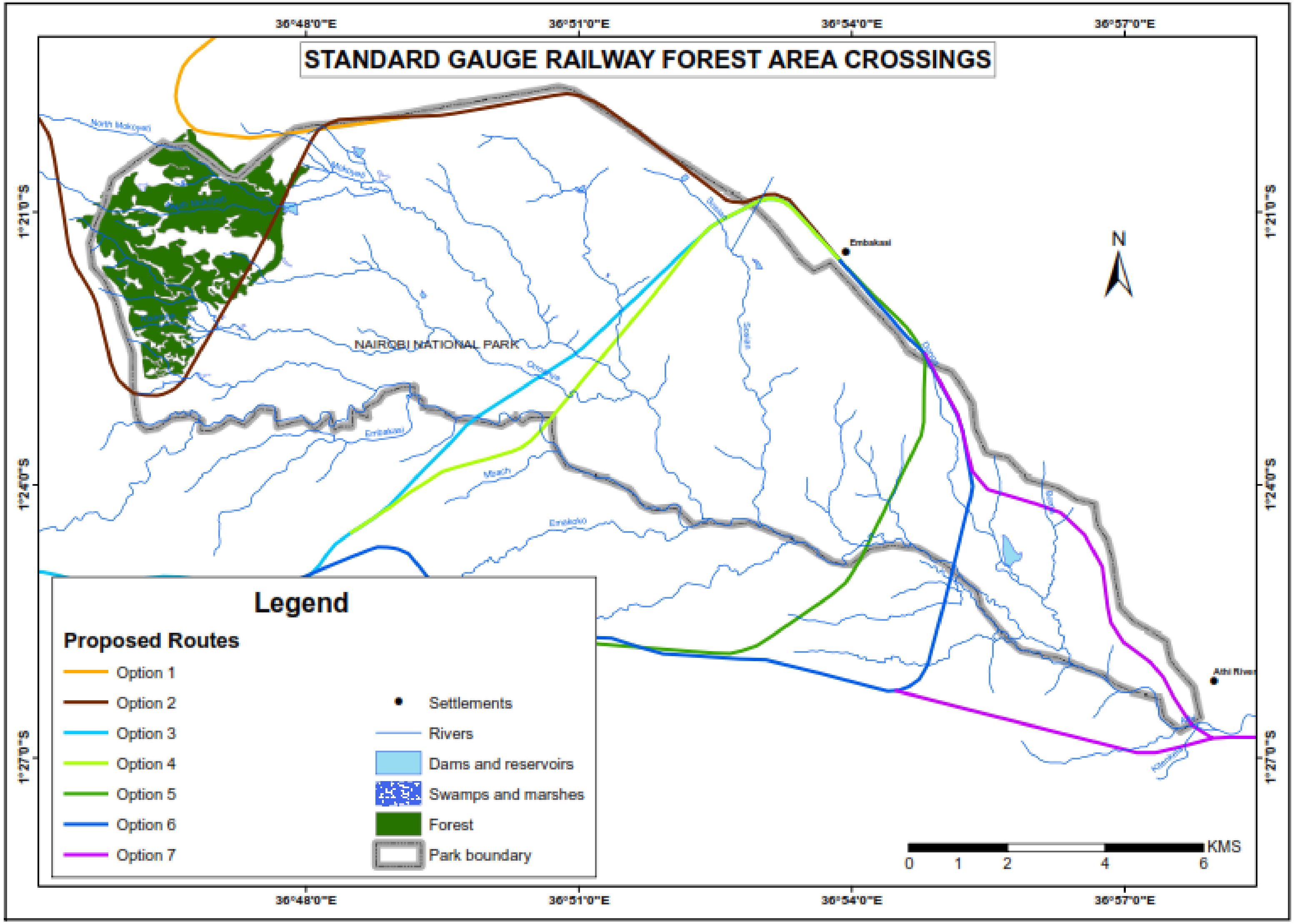


Figure 3- 19: Forest disturbance within Nairobi National Park

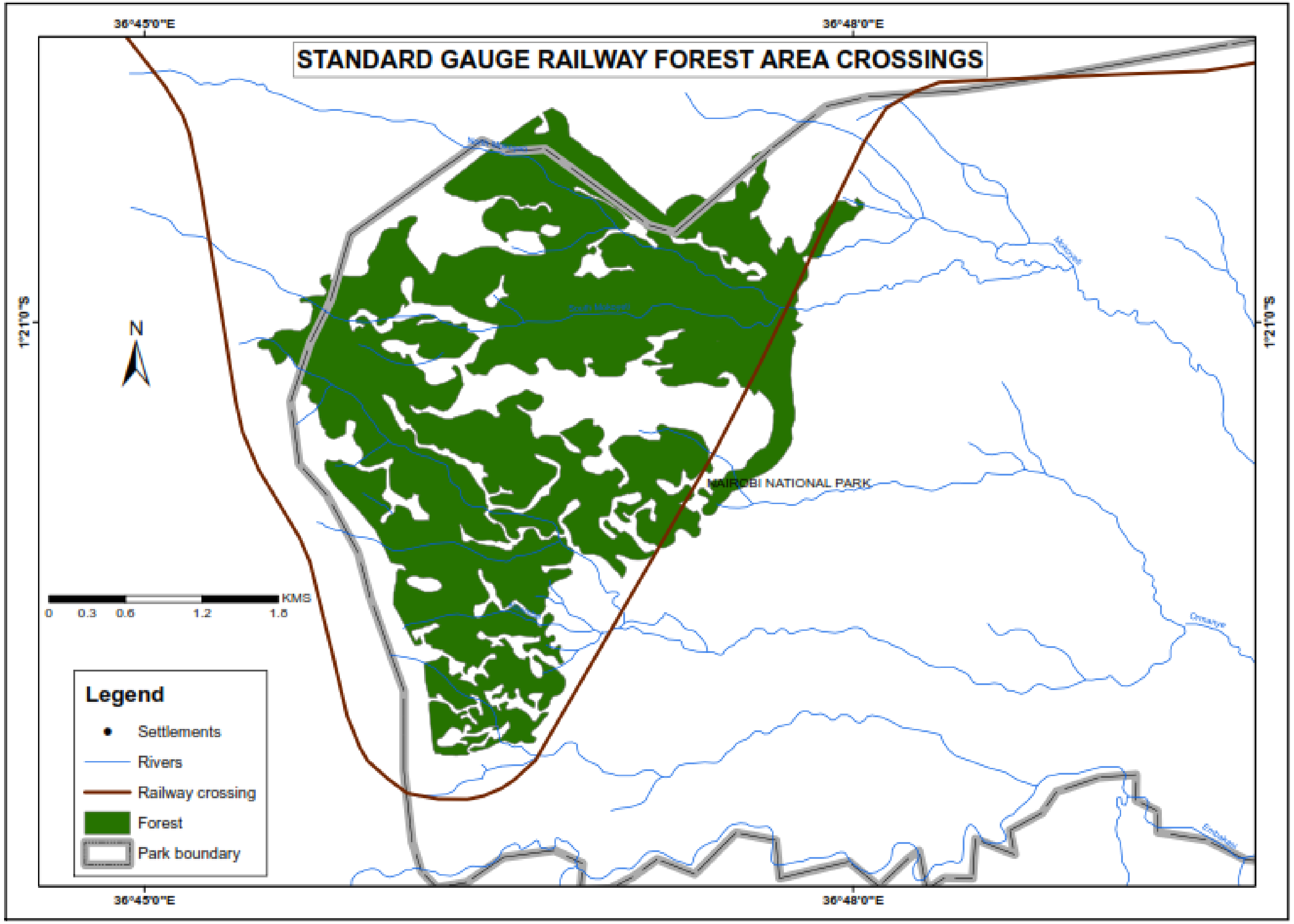
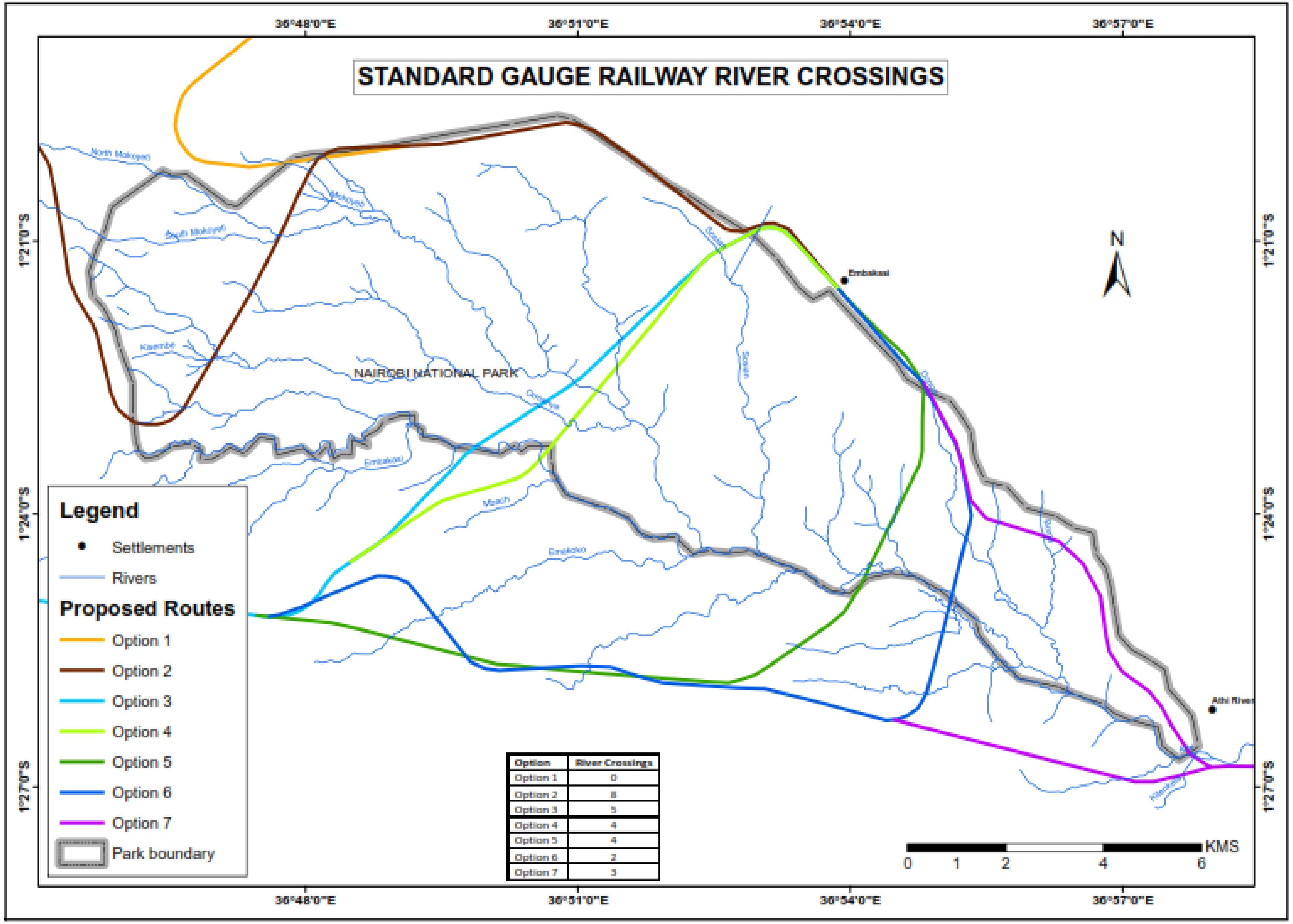
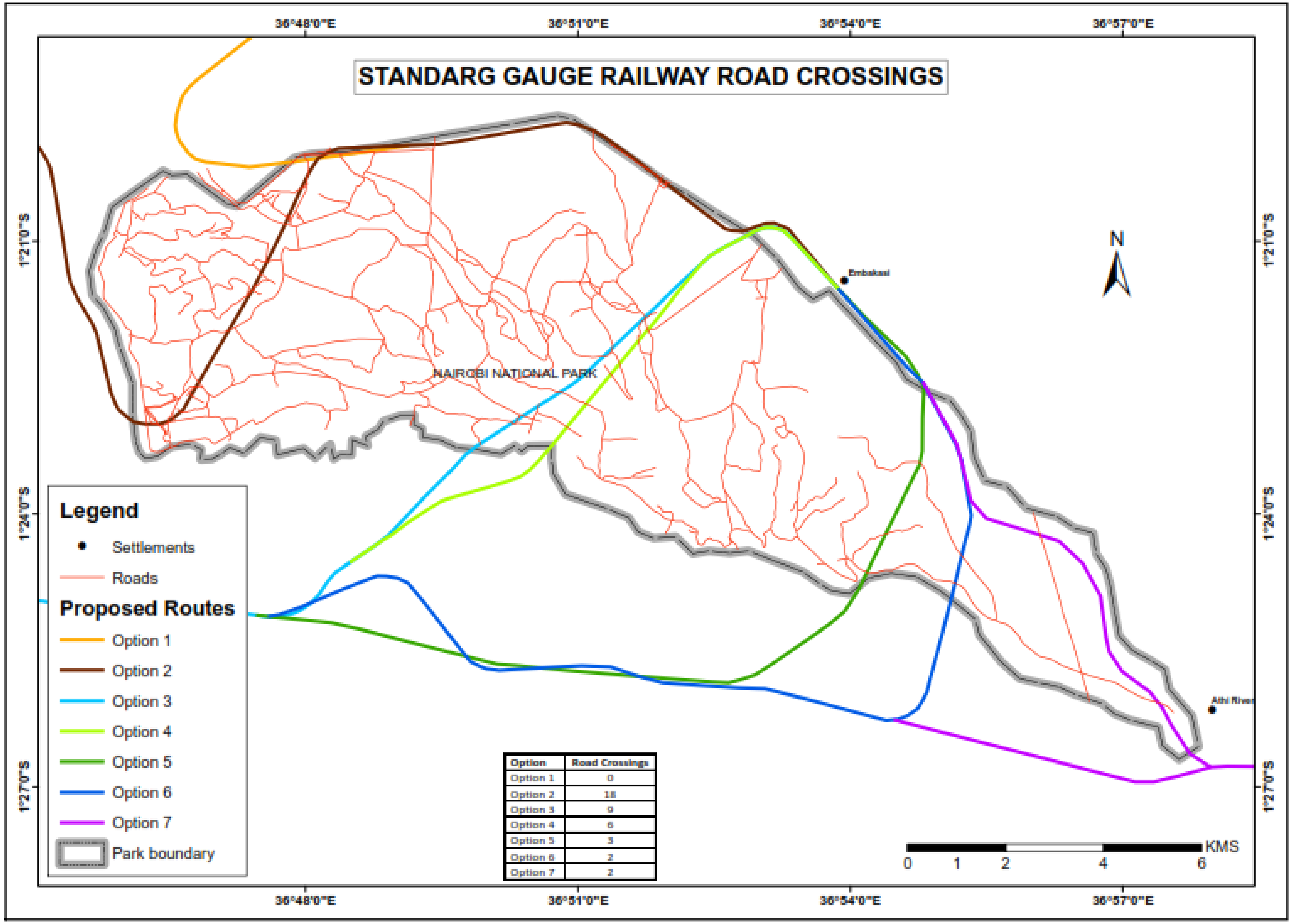


Figure 3- 20: Affected forest fragments within Nairobi National Park



Option	River Crossings
Option 1	0
Option 2	8
Option 3	5
Option 4	4
Option 5	4
Option 6	2
Option 7	3

Figure 3- 21: Nairobi National Park river crossings in the SGR alternative routes



Option	Road Crossings
Option 1	0
Option 2	18
Option 3	9
Option 4	6
Option 5	3
Option 6	2
Option 7	2

Figure 3- 22: Nairobi National Park road crossings in the SGR alternative routes

Route alternative	**P8**–Types of affected vegetation (**Figure 3-23**)	**P9** - Potential surface area to be affected (ha)/Percentage of total vegetation area
Option 1	**1.** Dense forest	0.48/0.05%
	2. Grassland	3.96/0.11%
	3. Open dwarf tree grassland (*Acacia drepranolobium*)	0.44/0.02%
	Total = 3	**Total area = 4.88ha**
Option 2	**1.** Dense forest	3.12/0.31%
	2. Grassland	3.50/0.10%
	3. Open low shrubland	0.44/0.02%
	4. Scattered low-tall tree grassland)	3.32/0.30%
	Total = 4	**Total area = 10.38ha**
Option 3	**1.** Grassland	2.64/0.08
	2. Open low shrubland	2.51/0.14%
	3. Open dwarf tree grassland (*Acacia drepranolobium*)	5.43/0.22%
	4. Riverine vegetation	0.38/0.09%
	5. Scattered low-tall tree grassland)	1.95/0.18%
	Total = 5	**Total area = 12.91ha**
Option 4	**1.** Grassland	2.06/0.06%
	2. Open low shrubland	3.35/0.19%
	3. Riverine vegetation	0.30/0.08%
	4. Open dwarf tree grassland (*Acacia drepranolobium*)	0.72/0.03%
	Total = 4	**Total area = 6.43ha**
Option 5	**1.** Grassland,	4.73/0.14%
	2. Riverine vegetation)	0.66/0.17%
	Total = 2	**Total area = 5.39ha**
Option 6	**1.** Grassland	4.07/0.12%
	2. Open dwarf tree grassland (*Acacia drepranolobium*)	0.08/0.003%

	3. Open tall riverine woodland,	0.81/0.05%
	4. Riverine vegetation)	0.17/0.04%
	Total = 4	**Total area = 5.13ha**
Option 7	1. Open dwarf tree grassland (*Acacia drepranolobium*)	7.89/0.32%
	2. Grassland	1.67/0.05%
	3. Open dwarf grassland (*Acacia mellifera*)	9.0/1%
	Total = 3	**Total area = 18.56ha**
Best options	**Routes 2 & 1/7**	**Routes 1 & 5**
Worst options	**Routes 3 & 2/4/6**	**Routes 7 & 3**

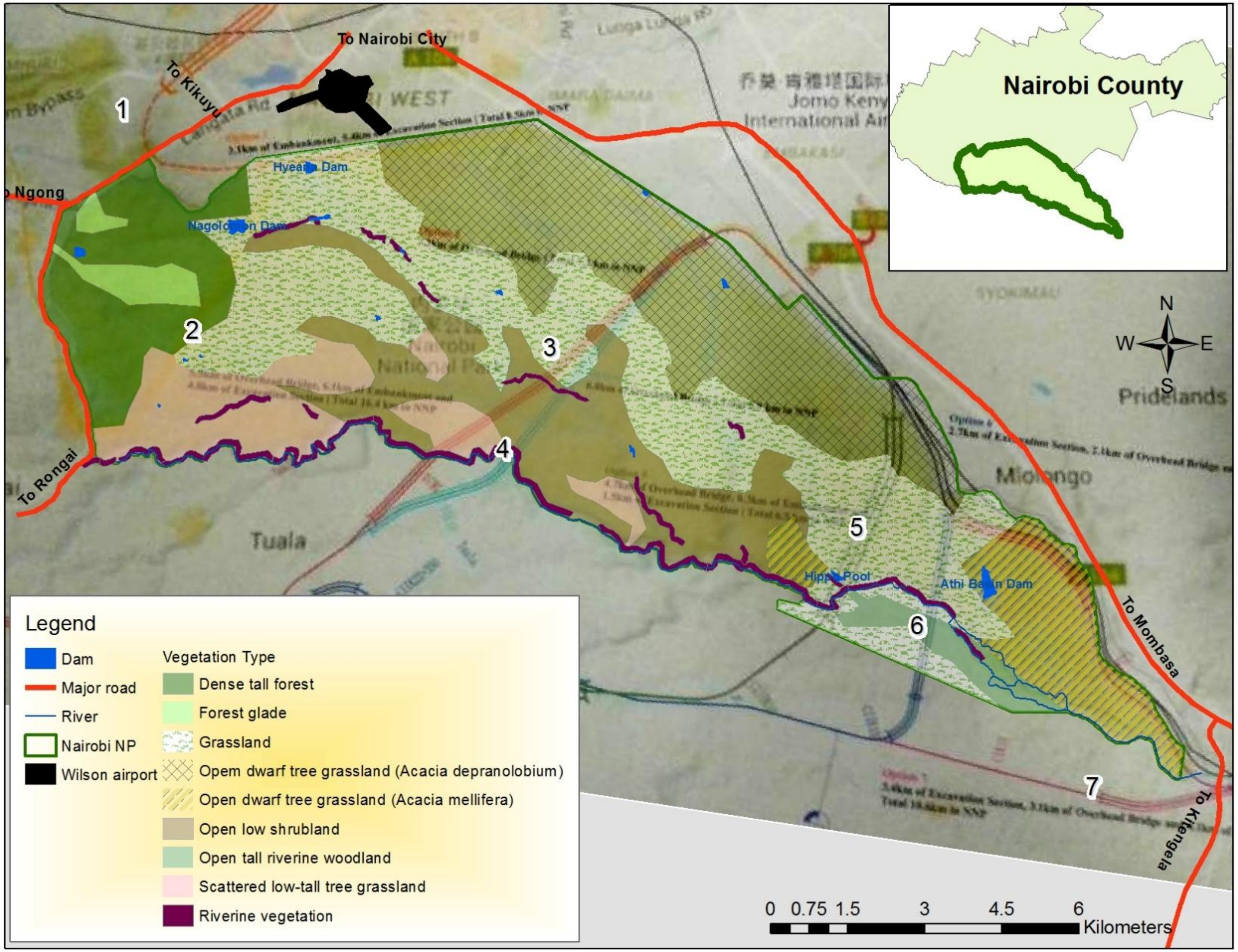
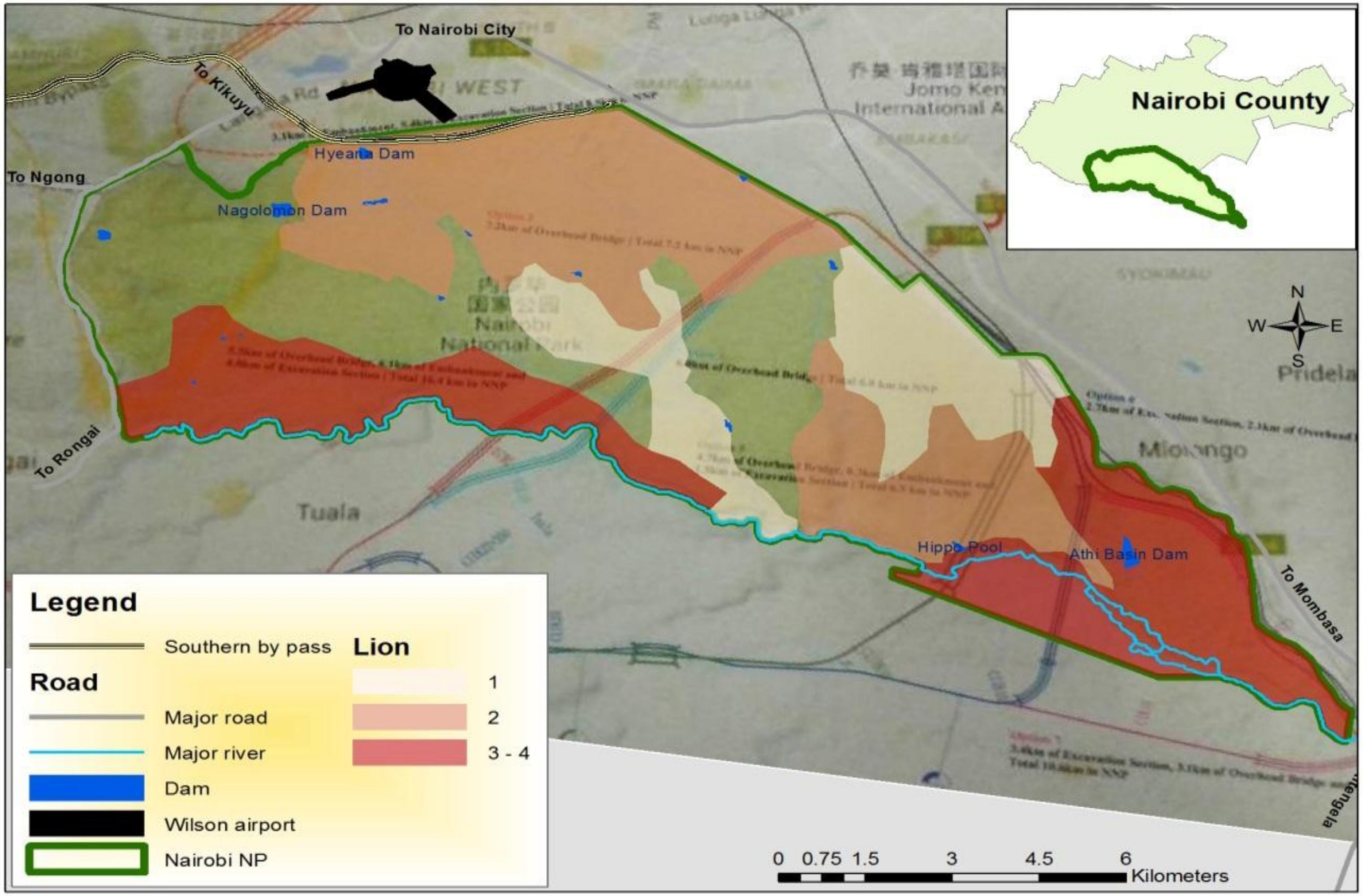


Figure 3- 23: Types of vegetation types to be affected by SGR in Nairobi National Park

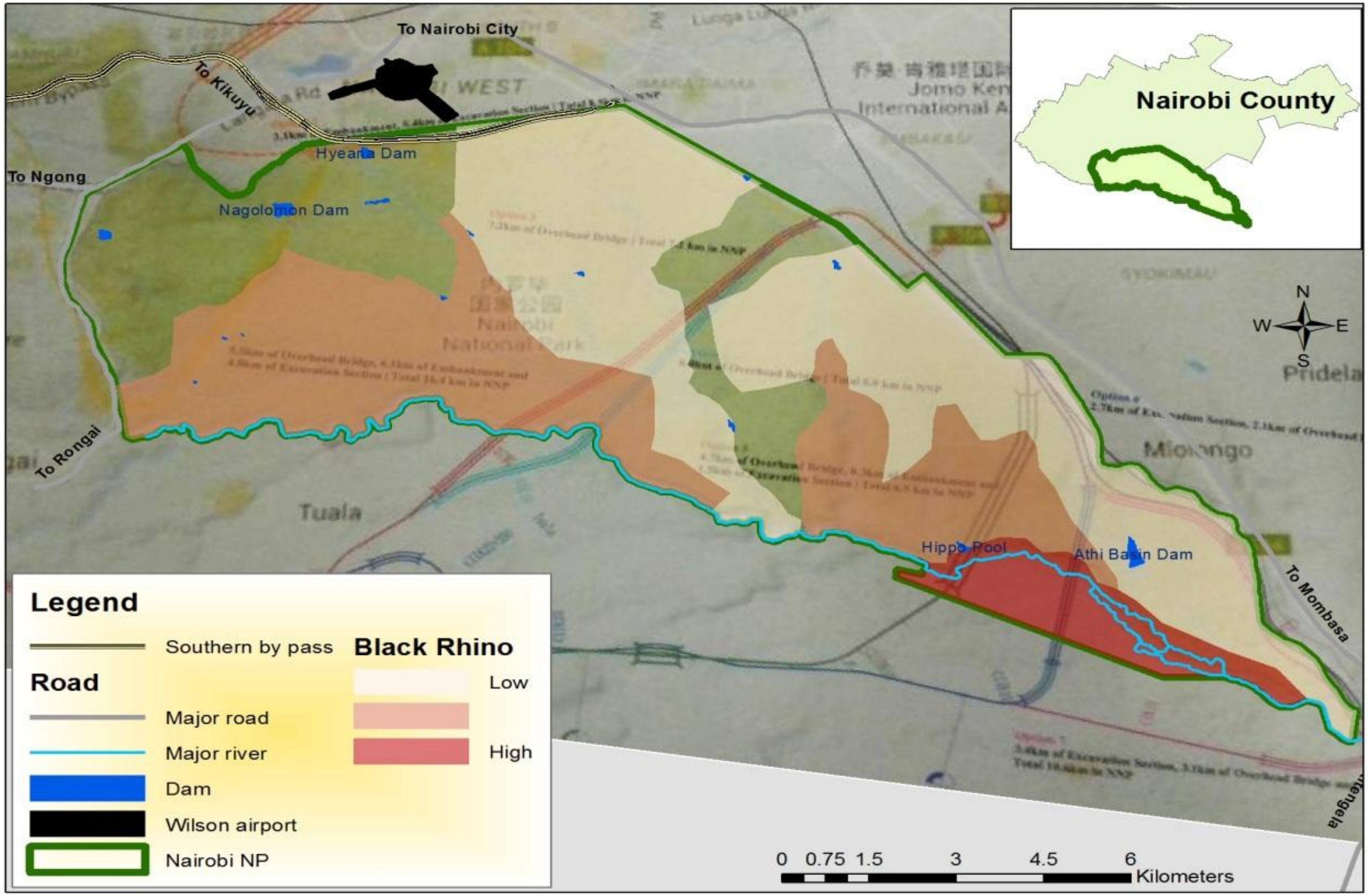
		P10 – Key wildlife species and potential habitat impact (ha) in the different routes (Fig 3-24)											
Route alternative	**Project phase**	Lion	Black Rhino	Zebra	Wildebeest	Coke's Hartebeest	Grant's Gazelle	Thomson's Gazelle	Impala	Buffalo	Maasai Giraffe	Eland	Total species	Total area
Option 1	Construction	4.4	0	4.4	3.96	4.4	4.4	4.4	0	4.4	4.4	0	8	34.8
Option 1	Operation	0	0	0	0	0	0	0	0	0	0	0	0	0
Option 2	Construction	6.62	9.94	9.94	3.32	9.94	9.94	9.94	9.94	9.94	9.94	3.5	8	92.9
Option 2	Operation	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	8	3.96
Option 3	Construction	13.34	7.48	10.58	12.53	10.58	5.43	10.58	7.10	10.58	10.58	5.15	8	98.8
Option 3	Operation (viaduct)	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	8	3.96
Option 4	Construction	3.08	5.71	6.13	6.13	6.13	0.72	6.13	6.13	6.13	6.13	5.4	8	57.9
Option 4	Operation (viaduct)	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	8	3.19
Option 5	Construction	11.45	11.45	11.45	11.45	11.45	11.45	11.45	11.45	11.45	11.45	11.45	8	126.0
Option 5	Operation (viaduct)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	8	2.20
Option 6	Construction	12.58	12.58	12.58	12.58	12.58	12.58	12.58	12.58	12.58	12.58	12.58	8	138.4
Option 6	Operation (viaduct)	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	8	1.76
Option 7	Construction	18.66	0	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	18.66	10	205.3
Option 7	Operation	0	0	0	0	0	0	0	0	0	0	0	0	0
Best options	Construction	4,1	7,1	1,4	2,1	1,4	4,1	1,4	1,4	1,4	1,4	1,2		
	Operational	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7	1,7		
Worst options	Construction	7,3	6,5	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6	7,6		
	Operational	2/3,4	2/3,4	2/3,4	2/3,4	2/3,4	2/3,4	2/3,4	2/3,4	2/3,4	2/3,4	2/3,4		

a) Lion

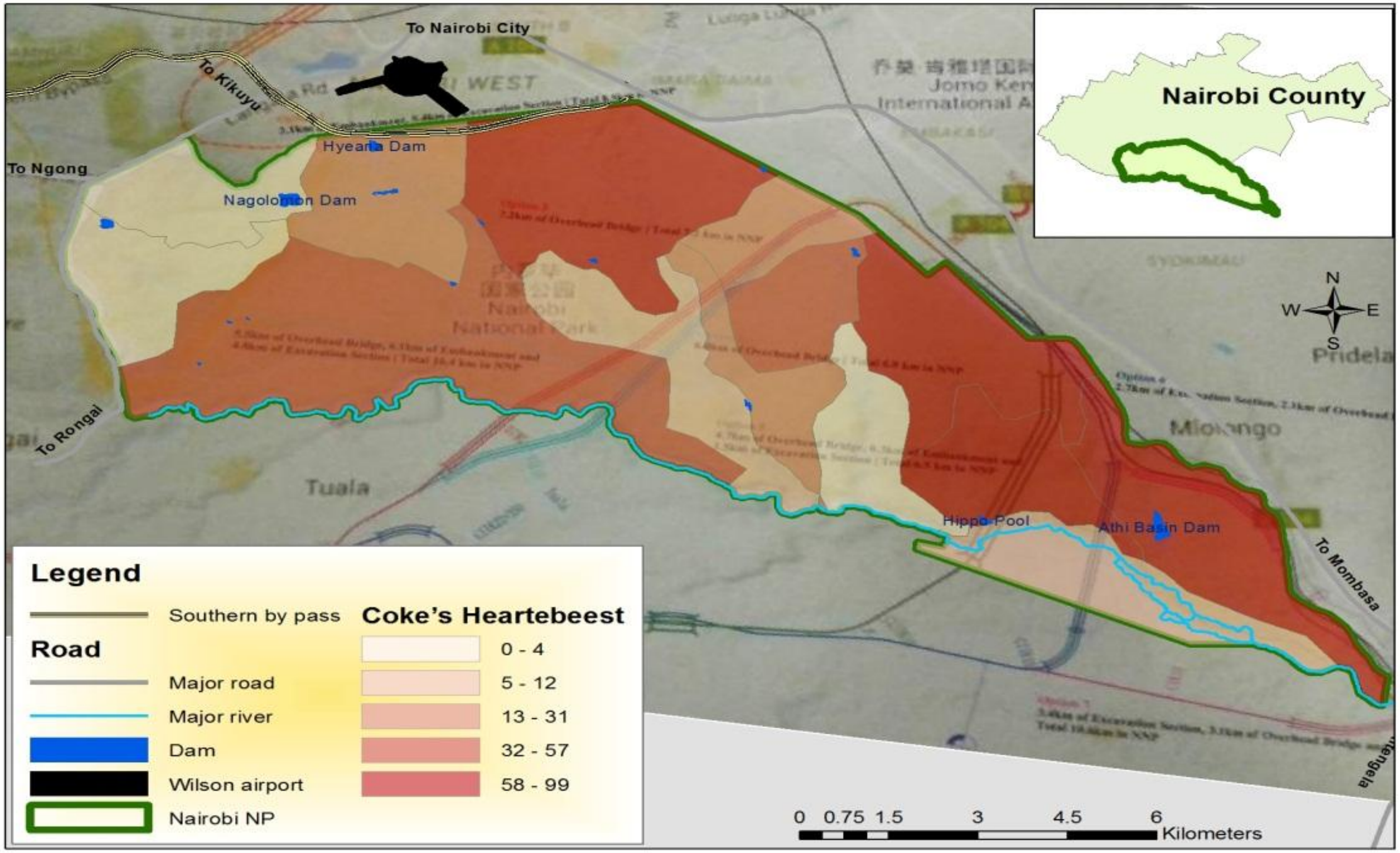


To Nairobi City
To Kikuyu
To Ngong
Hyearia Dam
Nagolomon Dam
Nairobi National Park
To Rongai
Tuala
Hippo Pool
Athi Basin Dam
To Mombasa
Mlolongo
Nairobi County
N
W
E
S
Legend
Southern by pass
Road
Major road
Major river
Dam
Wilson airport
Nairobi NP
Lion
1
2
3 - 4
0 0.75 1.5 3 4.5 6
Kilometers

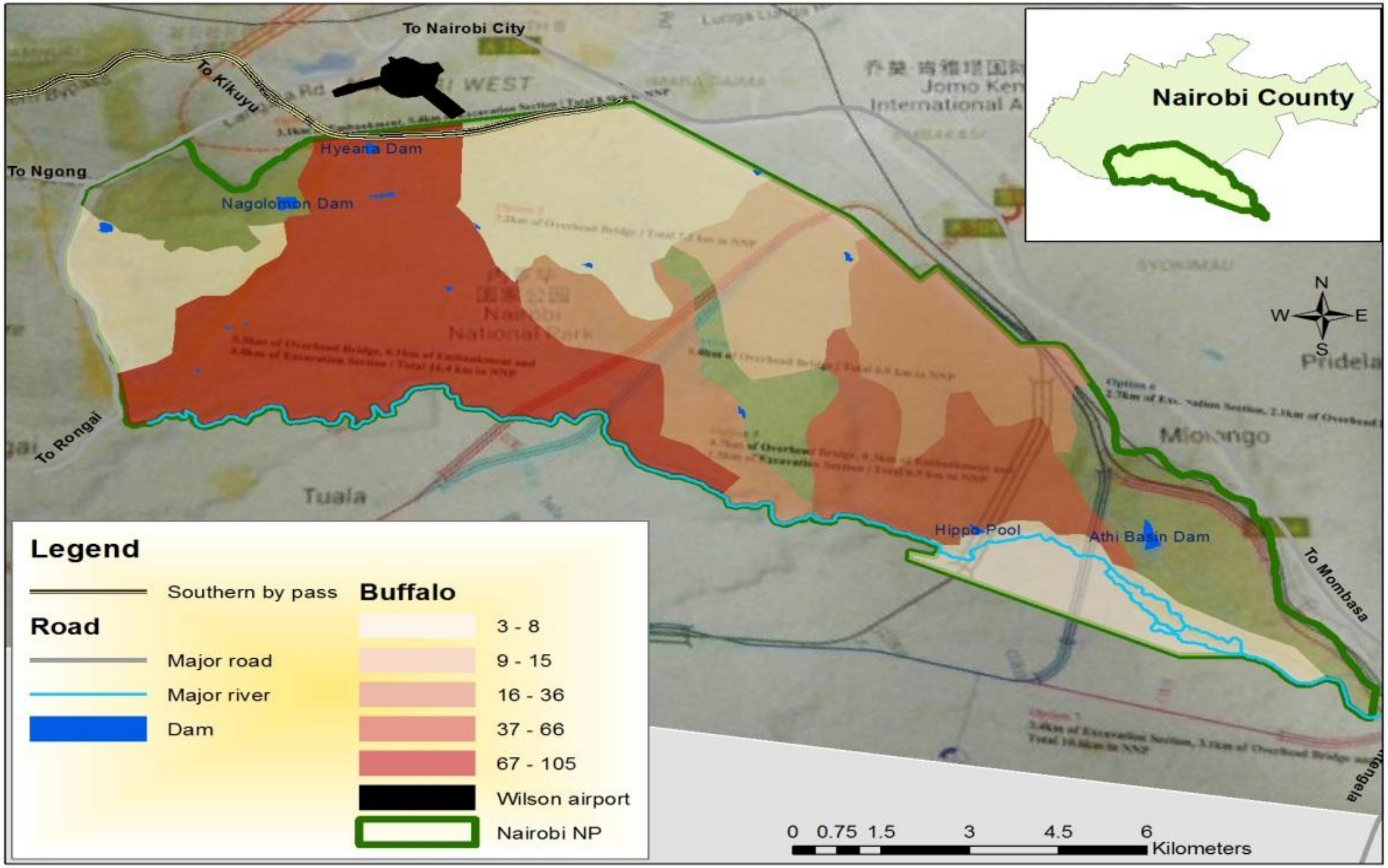
b) Black rhino



c) **Coke's Hartebeest**

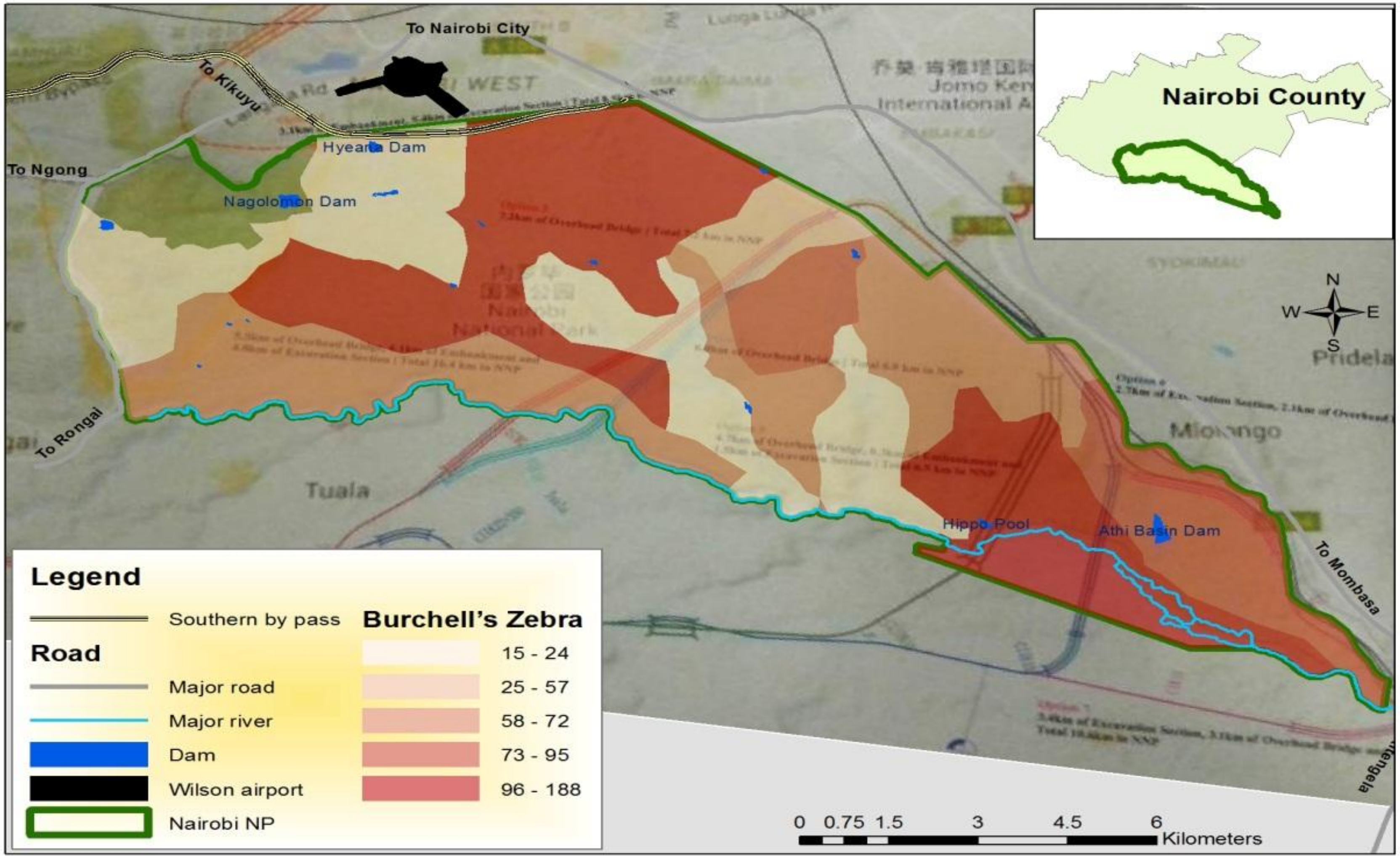


d) Buffalo

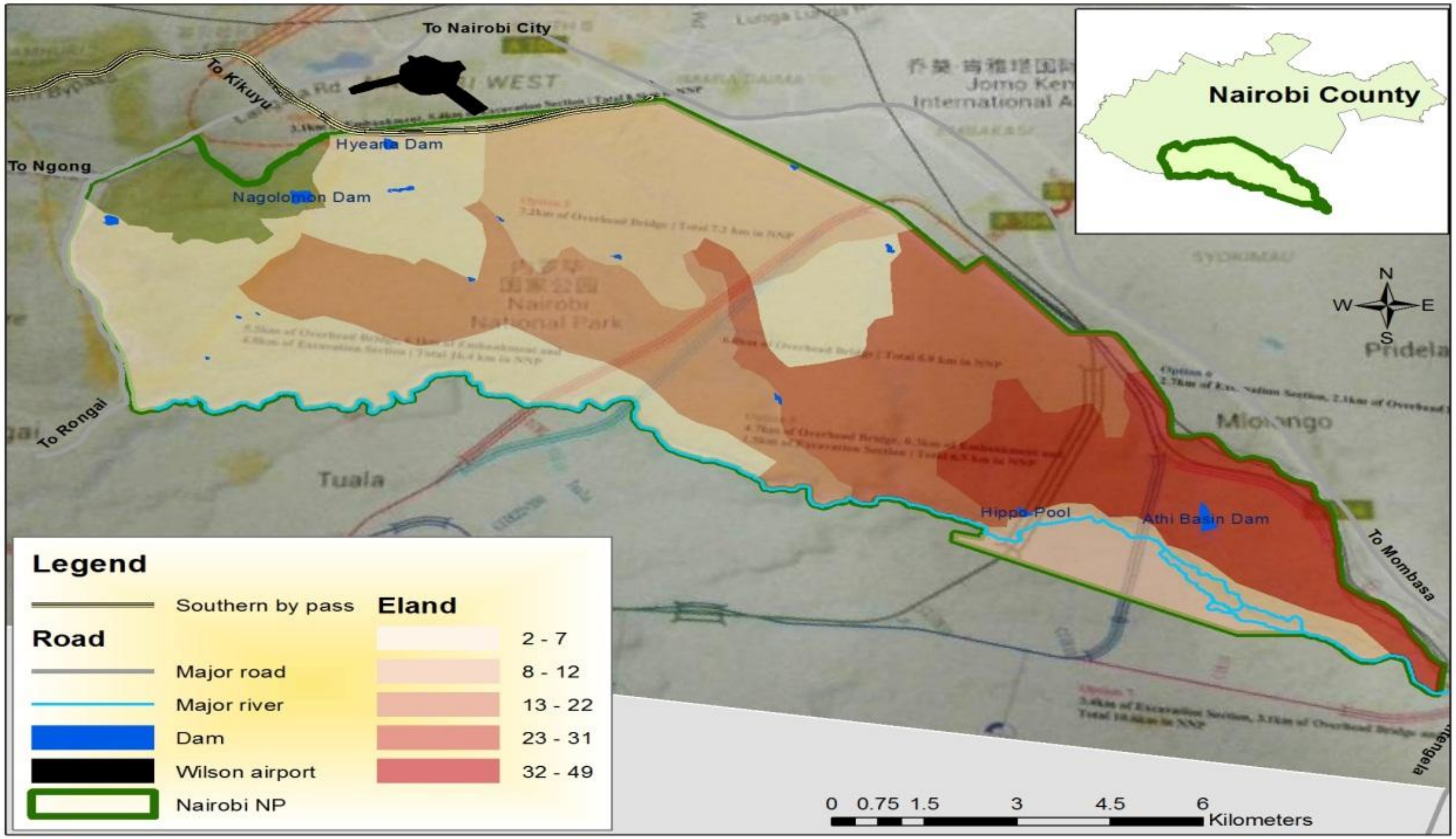


To Nairobi City
To Kikuyu
To Ngong
To Rongai
To Mombasa
Hyeana Dam
Nagolomon Dam
Hippo Pool
Athi Basin Dam
Nairobi County
Legend
Southern by pass
Road
Major road
Major river
Dam
Buffalo
3 - 8
9 - 15
16 - 36
37 - 66
67 - 105
Wilson airport
Nairobi NP
0 0.75 1.5 3 4.5 6
Kilometers

e) Burchell's zebra



f) Eland



To Nairobi City
To Kikuyu
To Ngong
Hyearia Dam
Nagolomon Dam
To Rongai
Tuala
Hippo Pool
Athi Basin Dam
To Mombasa
Mlolongo
Nairobi County
N
W
E
S
Legend
Southern by pass
Road
Major road
Major river
Dam
Wilson airport
Nairobi NP
Eland
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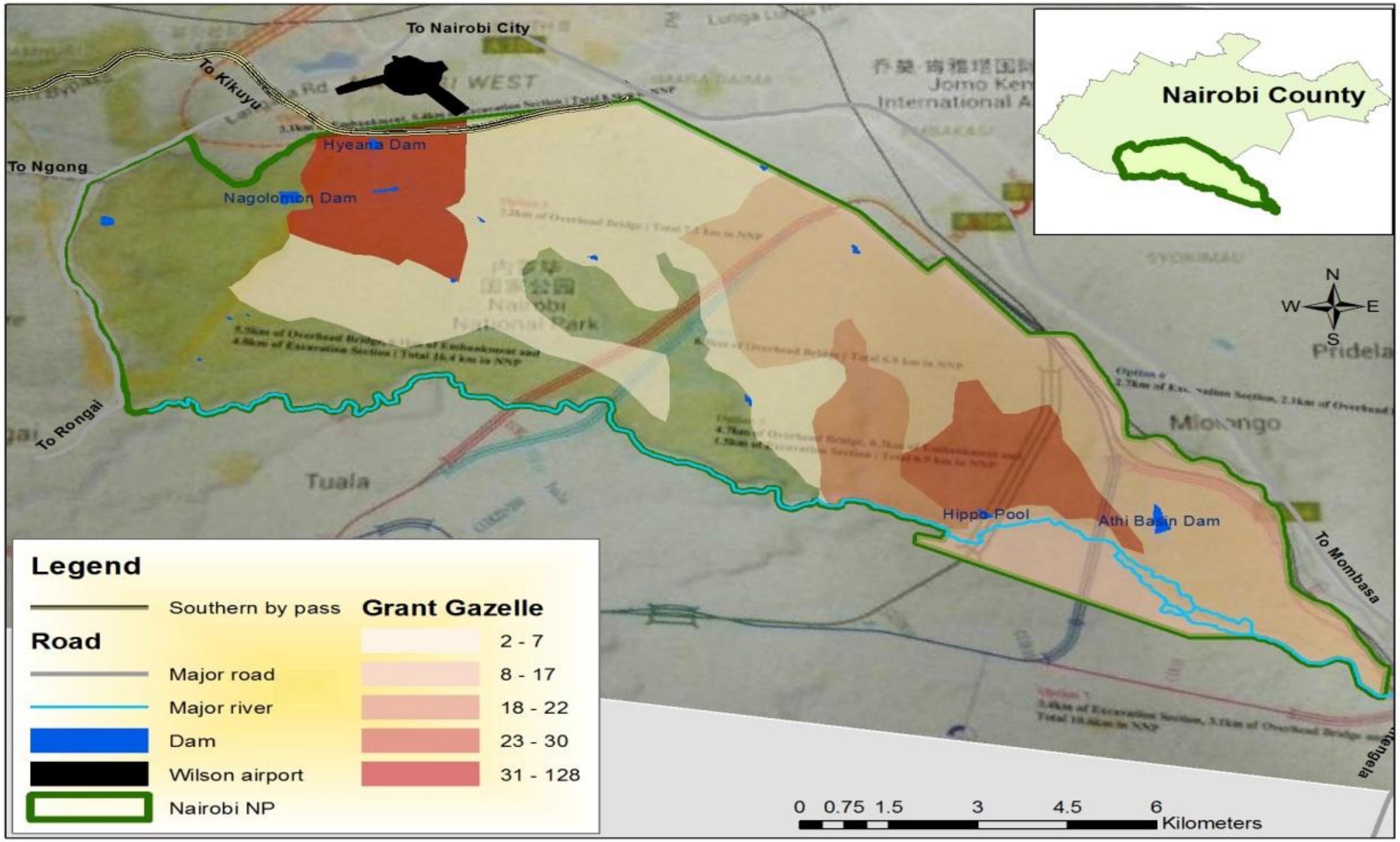
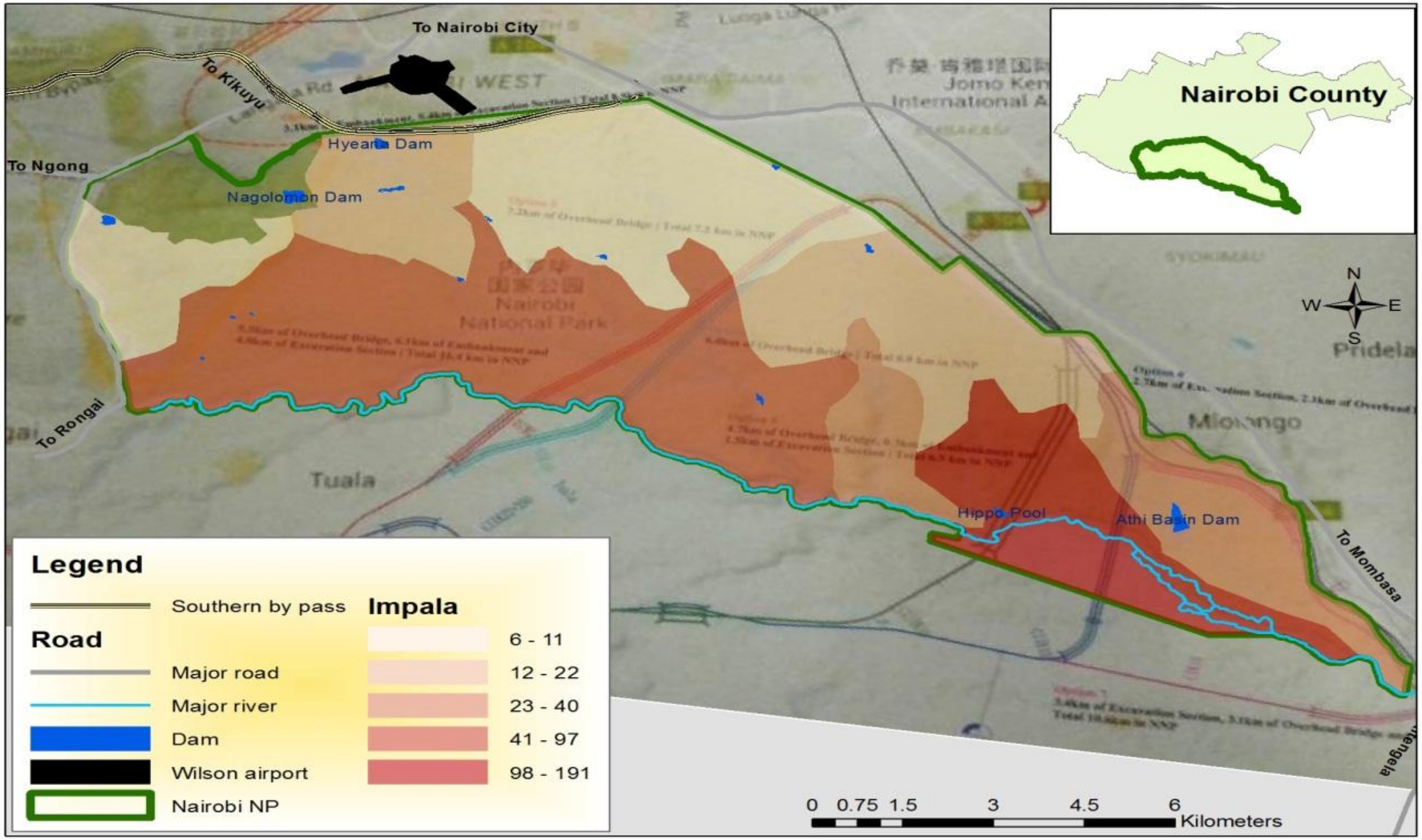
8 - 12
13 - 22
23 - 31
32 - 49
0 0.75 1.5 3 4.5 6
Kilometers

g) Grant gazelle



h) Impala


To Nairobi City
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To Rongai
To Mombasa
Hyena Dam
Nagolomon Dam
Hippo Pool
Athi Basin Dam
Nairobi National Park
Tuala
Nairobi County
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Road
Major road
Major river
Dam
Wilson airport
Nairobi NP
Impala
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12 - 22
23 - 40
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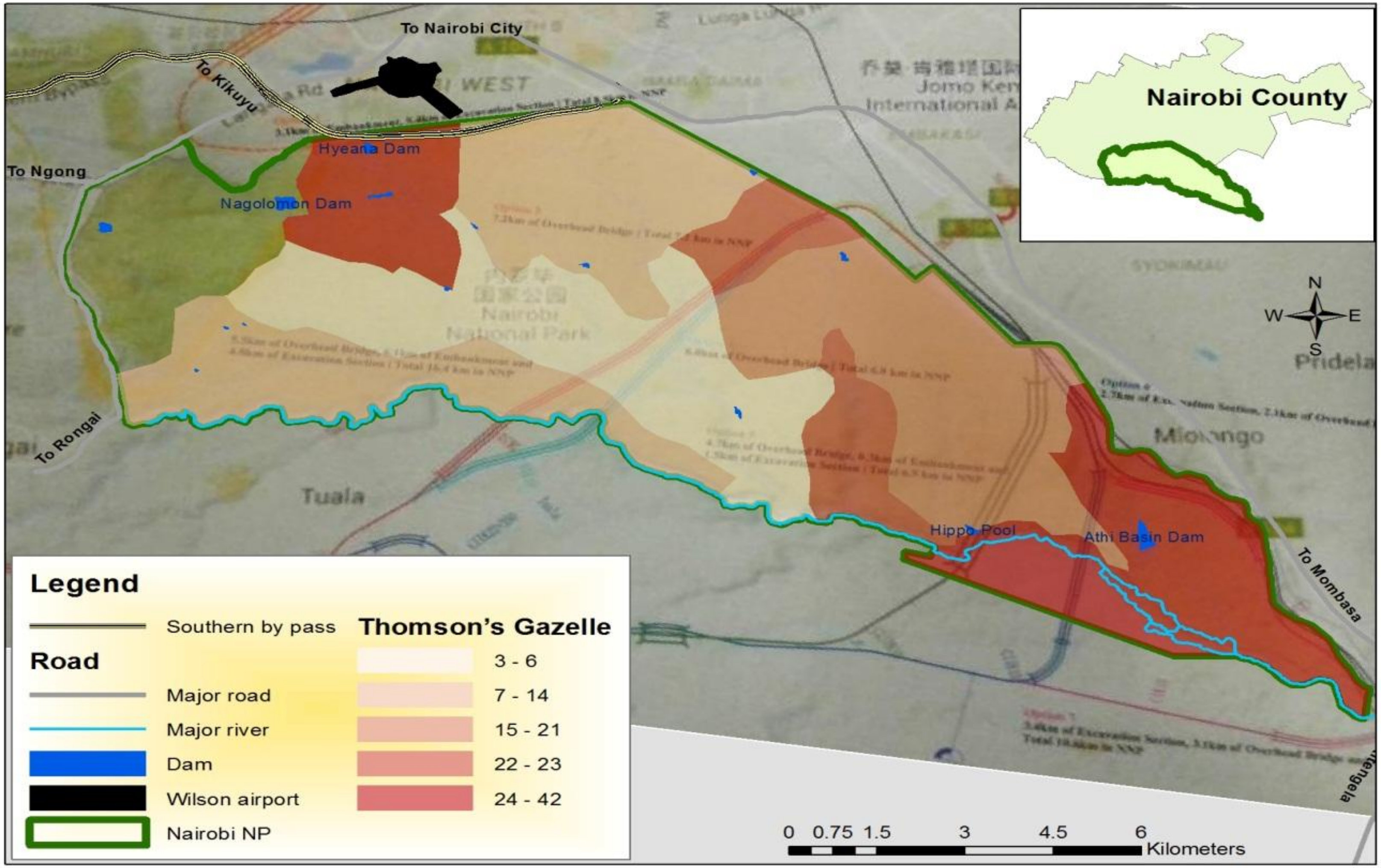
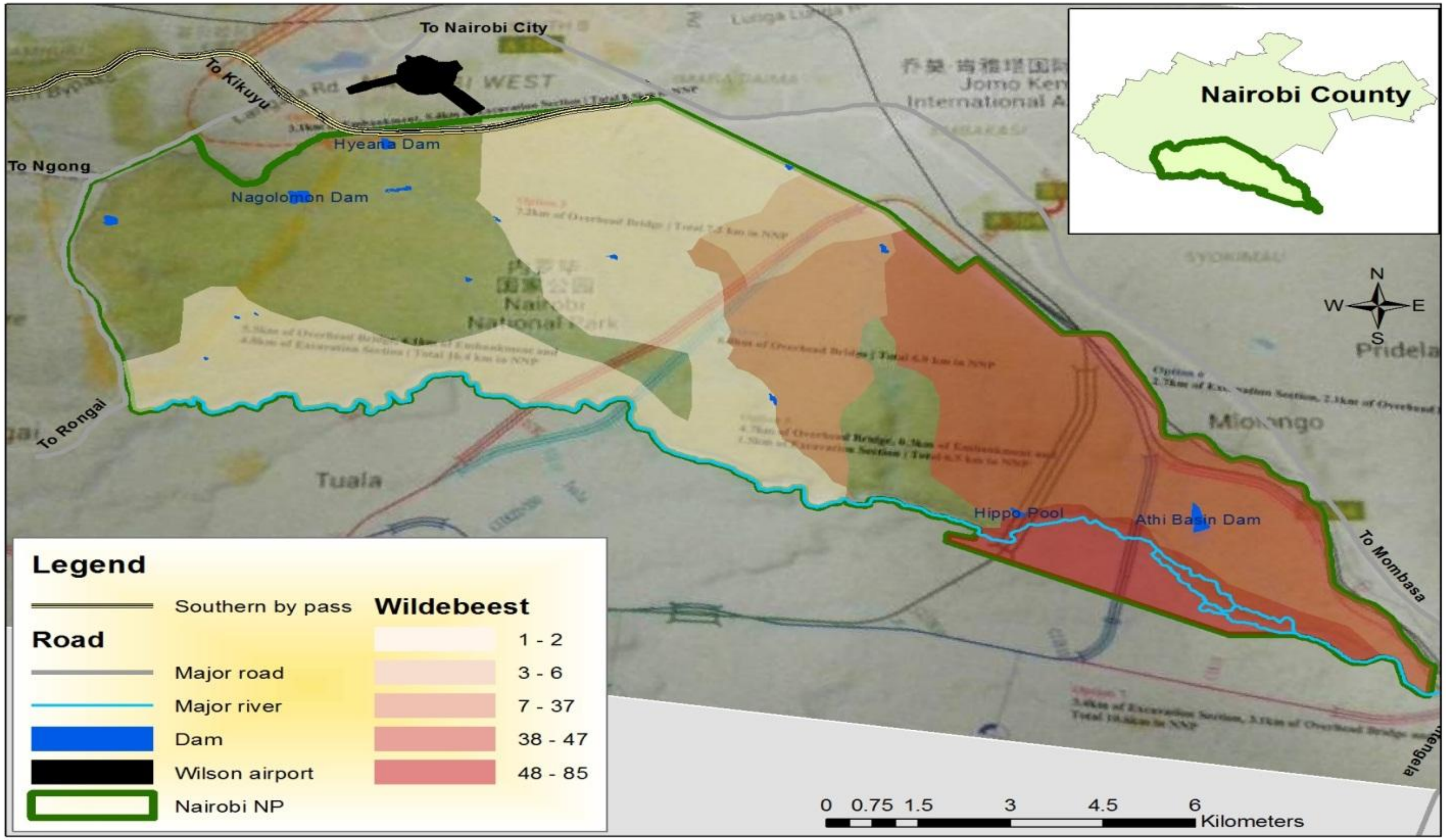
98 - 191
0 0.75 1.5 3 4.5 6
Kilometers

i) Thompson's gazelle



j) **Wildebeest**



k) Masaai giraffe

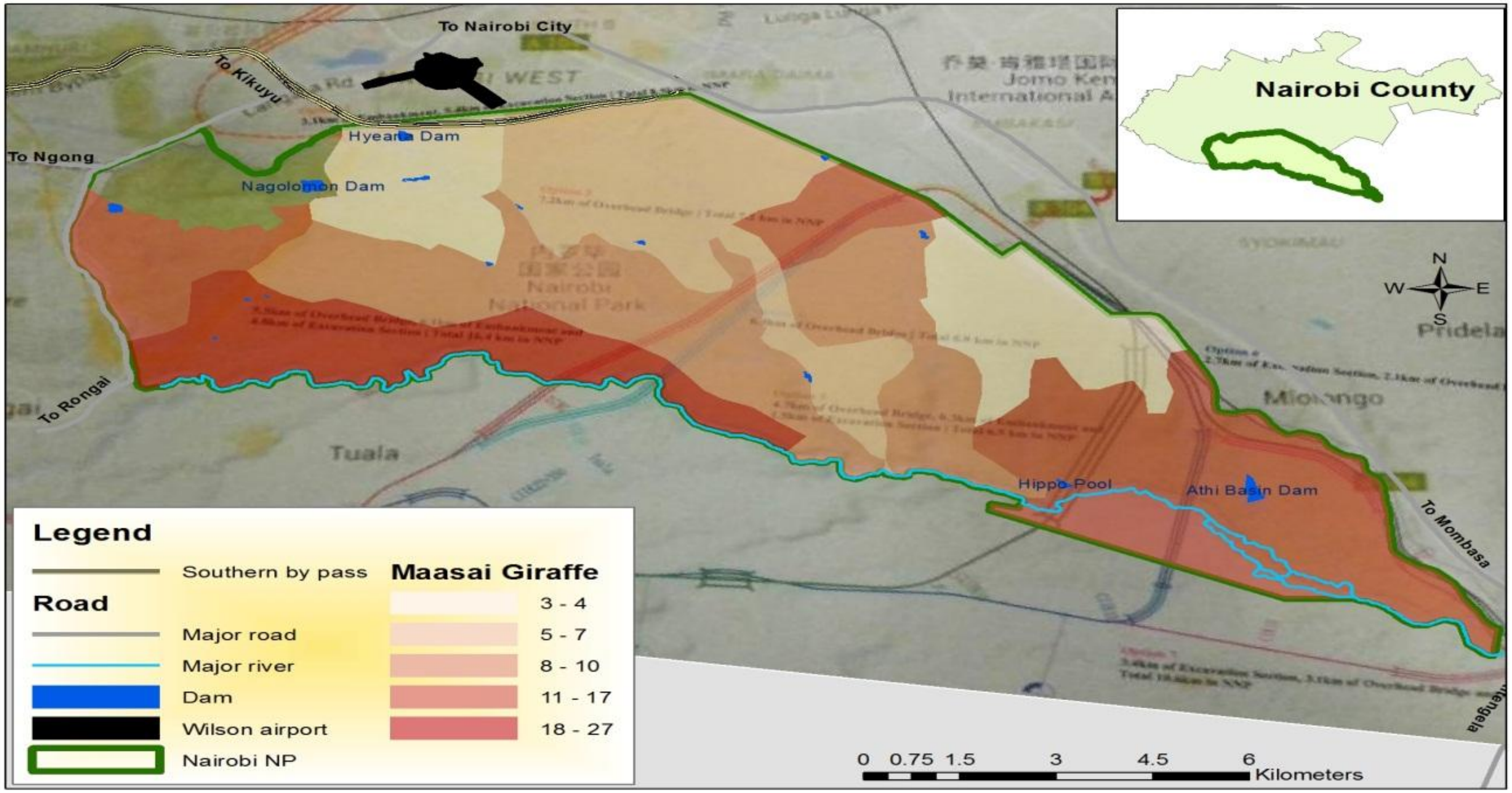


Figure 3- 24: The wildlife habitats to be affected by SGR in Nairobi National Park

Table 3- 7: Summary of the overall ranking of route options

Criteria	Ranking parameters	Best route options (Construction)	Best route options (Operational)	Worst route options (Construction)	Worst route options (Operational)	Overall best route	Overall worst route
Route suitability	**P1**-Direct connectivity to the Mombasa-Nairobi SGR line (Engineering design & cost and operational cost)	Routes 1, 2, 3 & 4	Route 7	Routes 5, 6 & 7		1,2,3,4,7	5,6,7
	P2-Route turnings		Route 4		Route 7	4	7
	P3-Route distance (Construction and operation cost)	Route 3, 4	Route 3, 4	Route 7	Route 7	3,4	7
	P4 – Route elevation to D20 (m)	Route 1 & 3/4		Route 7 & 6		1,3,4	6,7
	P5-Terrain suitability (Engineering challenging areas)	Route 3 & 4		Route 5 & 6		3,4	5,6
	P6-Total bridge length (Construction cost – time & money)	Route 6		Route 7		6	7
	P7-Number of key crossings – roads, narrow gauge railway, power lines & oil pipelines (Construction cost & level of inconvenience)	Route 3 & 4		Route 1 & 7		3,4	1,7
	P8-Obstructions on the right-of-way (High density residential estates, institutions and establishments) – Displacement, resettlement cost	Route 3 & 4		Route 1 & 2		3,4	1,2
	P9-Operation convenience (Cheap operation)		Route 4 - Direct & shortest		Route 7 – Indirect & longest	4	7
	P10-Total construction cost upto Ngong Tunnel	Route 3 & 4		Route 7 & 1		3,4	1,7
	P11-Operational cost upto Ngong tunnel		Routes 3 & 4		Route 7	3,4	7
	P12-Extra operational cost		Routes 3 & 4 – Cheaper operation		Route 7	3,4	7
	P13 – Net returns upto Ngong Tunnel		Routes 3 & 4		Route 7	3,4	7
	P14- Total distance of Nairobi	Route 5 & 6	Route 5 & 6	Route 2 & 7	Route 2 & 7	5,6	2,7

	National Park – NNP						

Criteria	Ranking parameters	Best route options (Construction)	Best route options (Operational)	Worst route options (Construction)	Worst route options (Operational)	Overall best route	Overall worst route
Social impacts	**P1**-Noise & vibration (Potential receptors)	Route 3 & 4	Route 3 & 4	Routes 1 & 7	Routes 1 & 7	3,4	1,7
Affected ecosystems outside Nairobi National Parks	**P1** – SGR river crossings	Route 4 & 5		Route 1 & 6/7		4,5	1,6,7
	P2-SGR forest crossings	Similar		Similar		Similar	Similar
Environmental impacts in Nairobi National Park	**P1**-Proposed SGR distance over the national park	Route 6 & 4	Route 6 & 4	Route 2 & 7	Route 2 & 7	4,6	2,7
	P2-Encroachment into park environment	Routes 5/6 & 4	Routes 5/6 & 4	Routes 2 & 7	Routes 2 & 7	4,5,6	2,7
	P3-Loss of valued wildlife habitats in NNP (Ha)	Routes 3 & 4	Routes 3 & 4	Routes 7 &1/2	Routes 7 &1/2	3,4	1,2,7
	P4-Encroachment of wildlife dispersal and migratory routes outside NNP	Routes 1,2,3 & 4	Routes 1,2,3 & 4	Routes 5,6 & 7	Routes 5,6 & 7	1,2,3,4	5,6,7
	P5-Park forest crossings	Routes 1, 3, 4, 5, 7	Routes 1, 3, 4, 5, 7	Route 2	Route 2	1,3,4,5,7	2
	P6-Park river crossings	Route 2, 3, 4, 5	Route 2, 3, 4, 5	Route 1, 7	Route 1, 7	2,3,4,5	1,7
	P7-Visual impact (Number of park road crossings directly interacting with SGR)		Route 1 & 7		Route 2 & 3/4	1,7	2,3,4
	P8-Types of affected vegetation and potential area to be affected	Routes 2 & 1/7	Routes 2 & 1/7	Routes 3 & 2/4/6	Routes 3 & 2/4/6	1,2,7	2,3,4,6
	P9-Potential area of affected vegetation area	Routes 1 & 5	Routes 1 & 5	Routes 7 & 3	Routes 7 & 3	1,5	3,7
	P10-Types of wildlife species to be affected and the potential area of affected habitat	Routes 1 & 3/4	Routes 1 & 3/4	Routes 5/6/7	Routes 5/6/7	1,3,4	5,6,7
	P11- Potential area of affected wildlife habitat	Routes 1 & 4	Routes 1 & 7	Routes 1 & 7	Routes 4 & 3	Routes 1 & 4	Routes 1 & 7

Table 3-8shows the best and worst route options based on the overall route suitability analysis in **Table 3-7**.The table shows that Route Option 4 is the most suitable followed by Option 3 while Route Option 7 is the least suitable followed by both Route Options 1 and 2.

Table 3- 8: SGR route suitability based on prevalence of screening criteria

Route Options	Suitability prevalence based on overall screening criteria	Overall best route option ranking		Unsuitability prevalence based on overall screening criteria	Overall worst route option ranking
1	9			**8**	**2**
2	4			**8**	**2**
3	**16**	**2**		3	
4	**22**	**1**		2	
5	6			4	
6	4			7	
7	4			**22**	**1**

3.9: The most suitable route option

The overall score indicates that **Route Option 4** - **Nairobi South Station-NNP-Tuala-Rongai-Nkoroi-Ngong–Kamangu Route** (**Light blue line**) is the best option followed by **option 3**, then **option 1** and **option 5 while** option 7 is the least preferred routefollowed by route 1, 2 and 6. Hence, this ESIA is based on the best option (Option 4) which will be similar in alignment to Option 3 but slightly shorter by 1.2km.**Figure 3-24** shows the routing for the preferred **Route Option 4**. The alignment for this route starts from the western end of the Nairobi South Station (DK0+00) and runs on an embankment straight on in a north-east direction for approximately two (2) kilometres outside the NNP in a corridor to be acquired before making a bend in the south-western direction and entering the NNP near East Gate. It will then cross over the NNP through the savannah region in an almost straight line through a 15m way-leave Single Track in NNP along a 6km viaduct or super bridge consisting of precast T frame girders of an average height of 18m. The viaduct will lie parallel to option 6 on the right hand side, and is designed to allow for passage and general movement of wildlife and also ensure natural water flow in the park is not affected. The precast T-frames will have a low structural height of 20-30m to prevent interference with aircraft landings at the Jomo Kenyatta International Airport. T-frames will be factory pre-built with precise quality control and will also include a noise-deflector so as to reduce noise pollution during the operation phase. The T frame structure and span will be the same shape and size, and appearance and color will be enhanced to blend with the surrounding natural environment to reduce visual intrusion and impact. The SGR will exit the park near the Maasai gate, then turn west past Tuala and Ongata Rongai Towns then cross Magadi Road next to the Adventist University of Africa and then Ngong Road at Embulbul before heading to the Ngong Hills tunnel. From there it proceeds north-west to Kamangu and drops into the rift valley towards the proposed Naivasha Industrial Park near Suswa after Mai Mahiu, and then crosses B3 at Duka Moja to Enosupukia in Narok County. Its approximate construction cost is about $523 million, and the annual cost of operation will be lower compared to Options, 1 and 2.Implementation of the SGR project through Route Option 4 has factored in compensation to be given to KWS through an endowment fund and CSR activities.

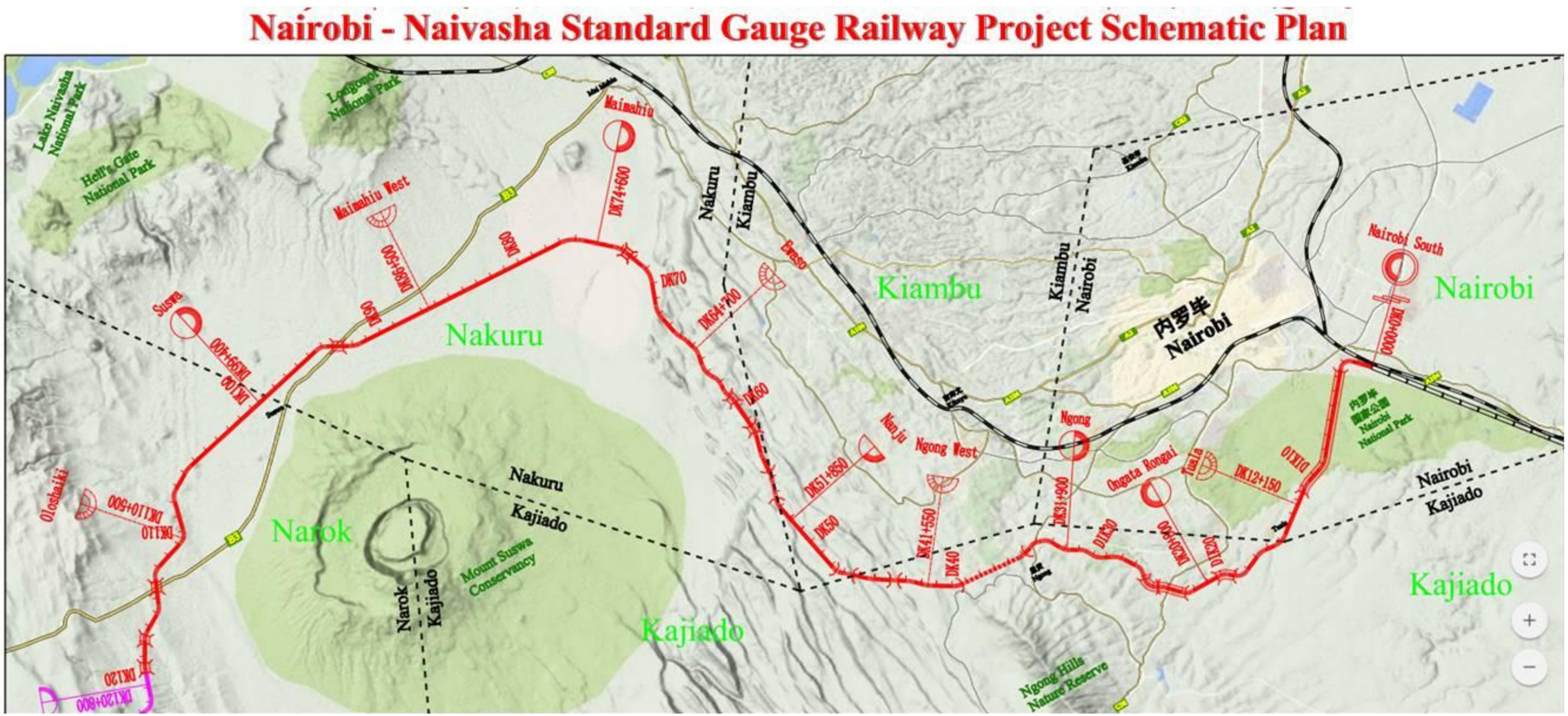


Figure 3-24: Spatial layout for thesuitable SGR route Option 4

Based on field assessment, literature review and overall ranking of route options against diverse evaluation criteria, we make the following recommendations:-

Route 1

Abandon this proposed route due to the following adverse negative environmental effects

a) **Route unsuitability** – (i) high number of key utility crossingsi.e. roads, narrow gauge railway, power lines & oil pipelines which will cause a lot of public inconvenience during the construction phase, (ii) passage through high density residential estates, many institutions and establishments which will lead to high displacement and resettlement cost,

b) **Socio-economic impacts** – (i) high number of potential noise and vibration receptors,

c) **Number of affected ecosystems –** (i) potential disturbance of riverine ecosystems due to the high number of river crossings by the SGR,
Environmental impacts in Nairobi National Park – (i)NNP land excision which will lead to a huge loss of wildlife habitats, (ii) high potential disturbance of riverine ecosystems during the construction phase due to the high number of river crossings by the SGR in the park

Route 2

Abandon this proposed route due to the following adverse negative environmental effects:**-**

a) **Route unsuitability** – (i) high number of obstructions on the right-of-way (i.e. high density residential estates, institutions and establishments) which will lead to high displacement and a huge resettlement cost, (ii) high construction cost which will over-burden the tax payer

b) **Environmental impacts in Nairobi National Park** – (i) very long distance in and over the NNPenvironment, (ii)highNNPland excision e which will lead to a huge loss of wildlife habitats, (iii) high loss of valued wildlife habitats, (iv) potential disturbance of the forest ecosystem in the NNPwhich is vital in watershed ecosystem services for wildlife water supply and air cleaning through carbon sequestration, (v) high number of NNPvegetation types that willbe affected, (vi) potential noise and vibration for sensitive receptors such as the David Sheldrick Wildlife Sanctuary, (vi) high visual impact due to the high number of NNProad crossings where visitors will directly view and interact with the SGR super bridge.

Route 3

Abandon this proposed route. Althought it is **the second best option** thoughit will have the following negative impacts;

a) **Environmental impacts in Nairobi National Park** – (i) high number of vegetation types to be affected, (ii) the area of NNPvegetation to be affected (iii) high visual impact due to a high number of NNP road crossings where park visitors will directly view and interact with the superbridge, (iv) potential interference of wildlife movements and disruption of habitat use are likely at both stages (construction and operational stages) but this will be temporary or short time since the animals will adapt to the infrastructure over time after nearly 2-3 years after construction

Route 4

This is the best and suitable option andwill have the following advantages**:-**

a) **Route suitability** – i) Direct connectivity with SGR-I from the Nairobi South Station, (ii) shorter distance, (iii) better route elevation and terrain suitability, (iv) lower number of key crossings through roads, narrow gauge railway, power lines & oil pipelines hence lower level of inconvenience during the construction phase, (v) lower number of obstructions on the right-of-way (i.e. high density residential estates, institutions and establishments) hence low displacement and low resettlement cost,(vi) route directness and operation convenience which will mean cheaper costs in the long-term, (vii) lower construction cost which is good in saving tax payers money

b) **Socio-economic impacts** - (i) lower number of potential human-oriented noise, and vibration receptors.

c) **Environmental impacts in Nairobi National Park** – (i) shorter distance over the NNPin a viaduct instead of viaduct and embankment as in the other route options, (ii) lower number of river crossings in the park (ii) lowerNNPland up take hence lower loss of wildlife habitats, (iii) zero disturbance of the valued park forest and watershed ecosystem services, (iv) lower number of wildlife species to be affected.

However, the route may have the following negative impacts which should be properly mitigated during the construction and operation phase:-

a) Visual impact since the route cross through a number NNProads used by tourists.
b) Impacts of noise, vibration and night-time linear light by moving trains on wildlife in the park
c) Inevitably affects some vegetation types especially during the construction phase) like in any other development project where some environmental sacrifice must be made.

Route 5

Abandon this proposed route due to the following adverse negative environmental effects**:-**

a) **Route unsuitability** – (i) indirect connectivity to the Mombasa-Nairobi SGR line will create engineering challenges in building of marshaling site at Nairobi South stationturning, (ii) high degree of terrain unsuitability based on the SGR route requirements
b) Environmental impacts in Nairobi National Park – (i) encroachment of wildlife dispersal and migratory corridor at the southern section of the NNPwhich is the key wildlife movement landscape between NNP and the Kitengela Wildlife Dispersal Area, (ii) high number of wildlife species to be affected and potential area of affected habitats.

Route 6

Abandon this proposed route due to the following adverse negative environmental effects:**-**

c) **Route unsuitability** – (i) indirect connectivity to the Mombasa-Nairobi SGR line will create engineering challenges in building of marshaling site at Nairobi South station the turning, (ii) high degree of terrain unsuitability based on the SGR route requirements
d) Environmental impacts in Nairobi National Park – (i) encroachment of wildlife dispersal and migratory corridor at the southern section of theNNPwhich is the key wildlife movement landscape between NNP and the Kitengela Wildlife Dispersal Area, (ii) high number of wildlife species to be affected and potential area of affected habitats.

Route 7

Abandon this as the worst of all the proposed route options due to the following adverse negative environmental effects:**-**

a) **Route unsuitability**- (i) indirect connectivity to the Mombasa-Nairobi SGR line will create engineering challenges for the train marshaling area for turning back to Athi River, (ii) it's a long distance making the route more expensive to construct which is a disadvantage to the tax paper, (iii) unsuitable route elevation based on the SGR route requirements, (iv) high length of super bridge which will make the construction more expensive in terms of time and money, (v) high number of key crossings i.e. roads, narrow gauge railway, power lines & oil pipelines will make the construction more expensive in terms of time and money, (vi) operational inconvenience due to the turn-back to Athi River,(vii) extra annual operational cost, (viii) very long distance in the edge of NNP to construction a second line to Athi River .
b) Socio-economic impacts – (i) High number of potential noise and vibration receptors (both people and wildlife)
c) Number of affected ecosystems – (i) potential disturbance of riverine ecosystems due to the high number of river crossings by the SGR.
d) Environmental impacts in Nairobi National Park – (i)very long distance in the edge of NNP to construction a second line to Athi River, (ii) high NNP land excision which will lead to a huge loss of wildlife habitats to pave way for a second line back to Athi River town, (iii) high level of permanent loss of valued wildlife habitats due to park land encroachment due to construction of a second line to Athi River town, (iv) encroachment and possible blockage of the wildlife dispersal and migratory corridor at the southern section of the park which is their key movement landscape between NNP and the Kitengela Wildlife Dispersal Area (v) high number of park river crossings, (vi) high number of vegetation types in NNP to be affected as the railway line turns back to Athi River, (vii) high number ofwildlife speciesthat are likely to be affected due to the SGR turn-back to Athi River town and as it passes through the borderland between the south part of the park and the sheep and goat land (viii) the cumulative negative environmental impact for this SGR route in addition to the construction of the proposed Greater Southern Bypass will be disastrous to Nairobi National Park.

3.9.1: No project option analysis

The *No Project option* in respect to the proposed project implies that the status quo is maintained. This option is the most suitable alternative from an extreme socio-economic and environmental perspective as it ensures non-interference with the existing environmental conditions. This option will however involve several losses both to the proponent, government and the society as a whole. For instance, the Kenya Vision 2030 is the country's new development blue print covering the period 2008 to 2030. The blue print aims at transforming Kenya into a newly industrializing "middle-income country providing a high quality life to all its citizens by the year 2030". After a comprehensive analysis of Kenya's global competitiveness, key different sectors with the potential of assisting in the realization of the vision were identified in each of the three key pillars. The construction of the SGR is responding to the different sectors in all pillars either directly or indirectly. In the economic pillar, six key sectors were identified to deliver the 10 per cent economic growth rate per annum. The SGR construction and operation will contribute positively in enhancing the transport system in the country and the East African Region at large and thus help propel Kenya to a middle-income country as envisioned in Vision 2030. It will influence all the pillars directly, indirectly or induce economic benefits. Economic estimates project that the development of the SGR is expected to add up to 1.5 per cent to GDP by influencing the Vision 2030 pillars directly or indirectly.

In addition, the SGR will reduce congestion and enhance the volumes that will be handled at the port of Mombasa thus spurring intra-country and regional trade. For instance, currently, the completed cargo handling capacity at Mombasa port is about 25 million tonnes/year. It is predicted that upon the completion of the project, the cargo handling capacity at Mombasa port will almost double to 44 million tonnes/year in 2025; 55.6 million tonnes/year in 2030; and 67.46 million tonnes in 2040. This will help securing the port as a preferred facility in the region.

The proposed SGR construction will also generate employment opportunities for both skilled and semi-skilled workers resulting directly from the construction and maintenance of the SGR-Line and from transport of passengers and freight. There SGR construction will also generate indirect employment opportunities for people who will be supplying construction materials to the site.The operation phase of the SGR will enhance the transport system in the country, which will also ease freight haulage on Kenyan roads. This will make transportation of people, goods and services cheaper, more efficient and safer. Projections are indicating that transport costs will reduce by up to 40%. This will in turn spur industrial growth through establishment of new industries to serve the railway.

The economic analysis undertaken as part of the feasibility study report evaluated the project against a 'without project' scenario where passengers continued to travel by the existing modes. In the 'without project' scenario, the total demand for individual modes is expected to continue to grow at its current pace, with air, private car, bus, and conventional rail traffic growing every year. In the absence of high speed rail, this growth would need to be accommodated over the evaluation horizon by an increasing volume of air and road traffic. The growth in road-truck traffic would also engender increases in air pollution, fuel consumption. Also, over the evaluation period, this growth in road freight would also require expanded highway capacity at key network bottlenecks. In the 'with project' scenario, the new high speed rail service is able to offer a service competitive enough to divert a significant volume of air traffic. Based on this analysis, there are clear environmental benefits from the project including a reduction in external costs associated with emissions, congestion, and safety.

The *No Project Option* is the least preferred from the socio-economic and partly environmental perspective due to the following factors:-

- Increased cargo congestion at the Mombasa Port.
- Continuation of using the existing old railway line which as numerous challenges
- Increased cost of transporting goods in the country and the East Africa region.
- Increased accidents on highways due to high prevalence of cargo trucks
- Increased cases on HIV/AIDS among along major highways
- There will be no economic and development value addition to other establishments in the neighbourhood of the SGR
- The proponent will not benefit from the revenue expected from the SGR project.

- The government kitty will not benefit from the revenue to be earned due to the establishment of the proposed project. The economic status of the Kenyans and the local people would remain unchanged.
- The local skills would remain underutilized.
- Reduced socio-economic interactions at local, national, regional and international levels.
- No employment opportunities will be created for thousands of Kenyans who will work in the SGR project
- Increased urban and rural poverty and crime in the country due to lack of employment opportunities.
- Discouragement for potential investors establishing business ventures in Kenya and the East African region.

From this perspective it is apparent that the *No Project Option* is not a suitable alternative to the proponent, Kenyans, and the government of Kenya.

3.9.2: The Proposed Development Alternative

After analysis of various alternatives, NEMA is requested to issue an EIA License for the project described in this ESIA report and based on the alternatives recommended above. In issuing the EIA license, NEMA would approve the proponent's proposed development of the project, provided all environmental measures are complied with during the planning, construction and operational phases.

4. ENVIRONMENTAL BASELINE INFORMATION

4.1: Kenya National Socio-Economic Profile

4.1.1: Environment: The environment inKenya consists of a wide range of natural ecosystems including arid and semi-arid areas, savannah and forests within its total area of 581,700 km^2. The Great Rift Valley is a mega geomorphic landscape which cuts across the country from North to south with a total length of over 800km in Kenya, a width of 50-100km, and a depth of 450-1000 m, The rift valley is characterized by geological instability due to on-going tectonic motion and is therefore a major challenge in engineering operations. The country, like the rest of the world, has a rapidly expanding built environment in the urban areas. The water or aquatic environment is composed of marine and coastal ecosystems, inland freshwater and saline lakes and a network of periodic and permanent rivers. The aquatic environment includes 14,300 km^2 and 143,100 km^2 ofterritorial waters and Exclusive Economic Zone (EEZ) respectively in the Indian Ocean. The country has over 35 000 known species of flora and fauna for which remarkable conservation efforts have been made with about 53 national and international protected areas including 5 Biosphere Reserves, 4 Ramsar Sites and 3 World Heritage Sites .

4.1.2: Administration: Kenya is divided into 47 counties and each county is further divided into sub-counties and wards, which are now the focal points of service delivery. The total land area covered by Kenya is approximately 583,000km^2, which consists of land area of 569,300 km^2, water area of 13,400 km^2 and other area of 536 km^2.

4.1.3: Population: Currently, the national total population had reached about 40 million, with an annual population growth rate of 2.2%. 20% of the population is in urban areas. Although the level of urbanization is still low in Kenya, the rate of urbanization is high. The rate of 7.0 percent for the period 1995-2000 was above the average for African cities of 4.3 percent and 2.5 percent for the world. Forty-five (45) percent of the urban population is located in Nairobi out of the 194 urban centers in Kenya. The rise of squatter settlements and slums in urban centers is a major obstacle in the establishment of social infrastructure such as roads and railways. The country has a total of 42 tribes and economic development is expected to penetrate into all ethnic groups.

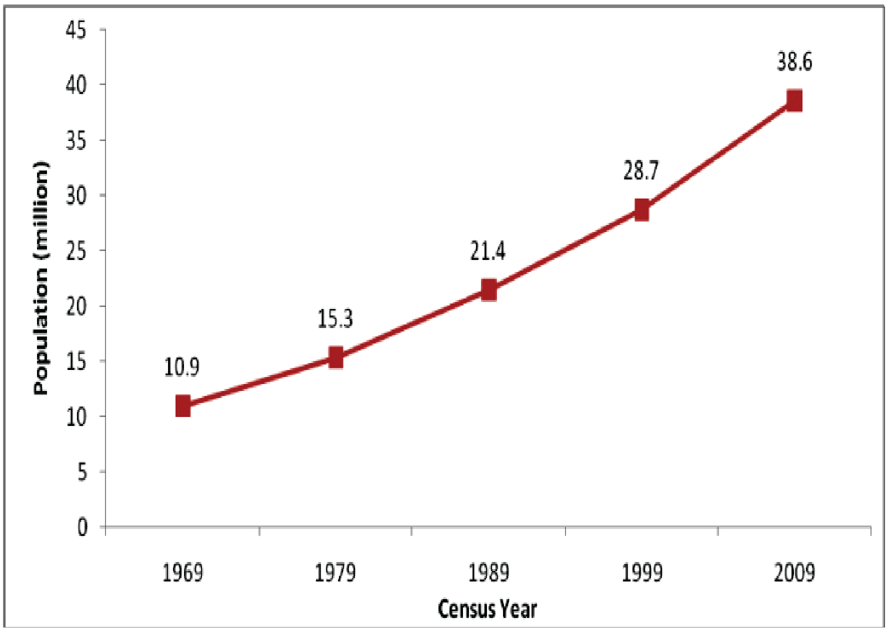


Figure 4- 1: Population Growth in Kenya - Source: The 2009 Kenya Population and Housing Census (GoK, 2010)

4.1.4: Status of regional economic development: Kenya is one of East African countries that have good economic foundations. It adopts a "mixed economic" system with the private economy as mainstay in coexistence with multiple economic forms, the private economy accounting for 70% of overall economy. Agriculture, service trade and industry are three pillars of national economy, and tourism is well developed among the main foreign exchange earning trades. Since independence, Kenya has been in rapid economic development but during the period of late 1970s-early 1980s, Kenya's economy got into trouble under influence of the global economic situation. Since 2002, the Kenya government has implemented strict macro-economic stabilization policies in order to intensify the strength of fiscal adjustment policies, and implemented more aggressive monetary policies as well as deepened structural reform, so as to maintain rapid economic growth.

4.1.5: Agriculture: Agriculture is one of Kenya's national economic mainstays. Kenya's agricultural growth rate is currently at about 2.3%, with an output value accounting for around 23.9% of the GDP,withagricultural export accounting for more than half overall exports and growing at a rate of 4.15% per annum. Over 70% of population nationwide is engaged in agriculture, with an output value accounting for around 24% GDP. The nationwide arable land covers an area of around 105,000 km^2 (around 18% of national surface area), including cultivated land accounting for 73%, mainly in the southwest area. Under the normal year's harvest, food supply can basically achieve self-sufficiency with a bit of export. Main food crops consist of corn, wheat, paddy, legumes and yams, and corn is the most important grain crop. Economic crops mainly consist of tea, flowers, coffee, pyrethrum, sisal, fruits and Kenya beans, which are mainly for export to the markets in European Union and other countries. The pyrethrum yield accounts for 80% of global production, besides, the outputs of black tea and flowers both lead around the world.

Overall, the value of marketed crops decreased by 1.4 per cent from KSh 242 billion in 2013 to KSh 238.5 billion in 2014. The value of marketed fresh horticultural produce increased marginally from KSh 83.4 billion in 2013 to KSh 84.1 billion in 2014. The value of marketed dairy produce increased by 11.9 per cent from KSh16.8 billion in 2013 to KSh18.8 billion in 2014, as a result of higher quantities of marketed raw milk and better prices of milk. Agricultural commodities that fetched higher prices in 2014 compared to 2013 included maize, coffee, sisal, pyrethrum, pig meat, and dairy produce. Tea, sugar cane and wheat prices were lower in 2014 compared to the previous year.

4.1.6: Industry: Kenya is the most industrialized country in East Africa. In recent years, Kenya's industry has shown gradual recovery, with the industrial average growth rate of 4.3% in 2012. Compared with serious decline of pillar industries including agriculture and tourism, Kenya's industry has basically maintained stable development trend and provided support to the stability and development of domestic economy. Kenya's manufacturing output accounts for 16.4% of GDP, with a relatively complete range, including the large-sized enterprises engaged in oil refining, tyre, cement, steel rolling, power generation and automobile assembly. 85％ daily consumer goods are produced domestically; petroleum is dependent on import, electricity also partially dependent on import.

4.1.7: Foreign trade: Foreign trade occupies a key status in Kenya's economy. The principal export commodities are composed of horticultural products, tea, coffee, steel, refined oil products and tobacco. The principal import commodities consist of crude oil, refined oil products, industrial machinery, automobile and steel. The principal trade partners are South Africa, UK, Netherland, Germany, France, USA, UAE, Saudi Arabia, India, Japan, China, and Uganda, Tanzania and other countries.

4.1.8: Mineral resources: Kenya's mineral reserves are among others mainly composed of soda ash, salt, fluorspar, limestone, barytes, diatomite, gold, silver, copper, zinc, titanium, niobium and thorium. Most mineral deposits are as yet unexploited except for soda ash, diatomite and fluorspar. The main minerals consist of barytes in the southeast, titanium and niobium in the south coast and gold at Kakamega in the southwest. Gilgil is one of the largest diatomite deposits in the world, and Lake Magadi is abundant in natural alkali and salt. Recent discoveries of oil fields in Turkana in the northern parts of Kenya are yet to be documented fully in terms of their economic values and quantities. There are also large prospects of natural gas in north eastern and the north coastal parts of the country.

4.1.9: Tourism: Tourism is the third largest source of foreign exchanges in Kenya. The main tourist resources include spectacular ocean beaches and seashore, wildlife parks, museums, East Africa Great Rift Valley, Mount Kenya and scenic lakes. East Africa Great Rift Valley is a geologic and geographical wonder running longitudinally throughout East Africa, which is the world's largest sunken rift zone. Kenya is also known as "a paradise of birds and beasts", with 59 national natural wildlife parks and reserves that cover an area of 11% national surface, which is a paradise of numerous wild animals and birds.

Oil 4.2: National transportation infrastructure

Globalization has transformed the world's economy. The steady growth in world economies has tremendously increased industry demand for rapid and timely delivery of goods and Kenya's industry has risen to the challenges and opportunities that have been occasioned by globalization. The country's transport infrastructure bears the weight of rising levels of rail and road traffic. At the same time, limited maritime infrastructure and poor inland infrastructure are under immense pressure from massive increase in imports and exports (KRC Strategic Plan, 2012-2017). Kenya's economic blueprint, the Vision 2030, outlines the need to provision and expand physical infrastructure in the country, thus developing Kenya to a country firmly interconnected through an excellent network of roads, railways, ports, airports, water and sanitation facilities and telecommunications.

Port congestion, falling reliability levels, a challenged road transport capacity to meet demand, strain the existing logistics operations, and the ever increasing user demands for reliable and predictable services. This presents a golden opportunity for Kenya Railways to be at the forefront of the future; in transforming transportation and reducing the cost of doing business in Kenya and the region.

Kenya mainly provides 4 passenger and freight trip modes consisting of roadway, railway, maritime and air transportation. In these 4 transport means the transport volume of roadway has the largest proportion and is the most important form of transportation (**Table 4-1**). The railway development is relatively laggard and not making any progress, hence restricting the rapid economic development of Kenya.

Table 4- 1: Transport sector percentage (%) value contribution by sub-sector

Sub-Sector	2010	2011	2012	2013	2014
Road transport	345,625	431,867	474,458	5 20,915	600,209
Railway transport	4,605	5,247	5 ,731	4 ,849	5,357
Water transport	20,754	23,392	26,294	28,650	31,438
Air transport	88,988	103,993	114,596	131,456	136,181
Services Incidental to Transport	51,930	50,625	61,598	62,583	79,519
Oil pipeline t	13,906	15,474	17,938	19,862	20,622
Total	**525,808**	**630,598**	**700,615**	**768,315**	**873,326**

Source: Economic Survey 2015

The vision of the Kenya Integrated National Transport Policy -Moving a Working Nation (2009) is to ensure a "world-class integrated transport system responsive to the needs of people and industry". The policy mission is "to provide efficient, reliable, safe and secure railway transport services that are integrated with national and regional railway, road, water, pipeline and air transport services for the transportation of goods and passengers on a sustainable and competitive basis".

4.2.1: Road transport

Road transport is the most important transportation mode in Kenya at present, undertaking 93% of freight and passenger transportation in the country. With the constant development of Kenya's economy, the regional transportation demand is bound to greatly increase; with lots of freight being imported or exported or transported through highway, the quantities of freight cars, trucks and heavy trucks will also be greatly increased, and the regional highway transportation system will be on greater transportation pressure in future. **Figure 4-2** shows the highway network in Kenya while **Figure 4-3** show the overall accessibility levels across key urban areas in the country.

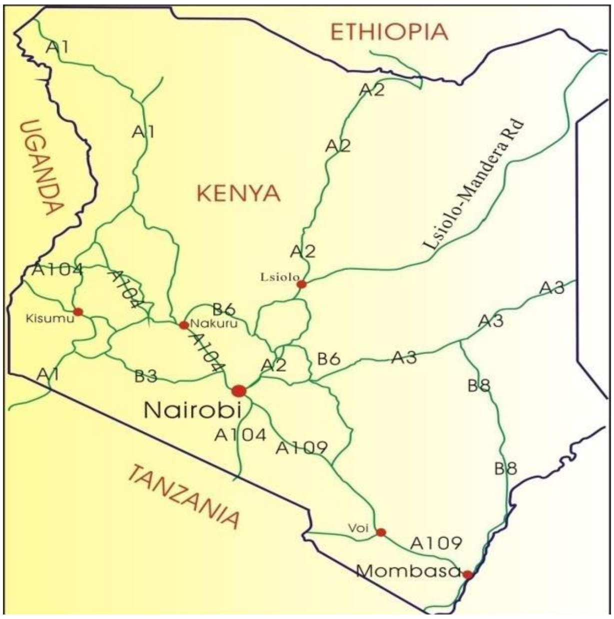


Figure 4- 2: Map of the Existing Highway Network in Kenya(CCCC, 2015)

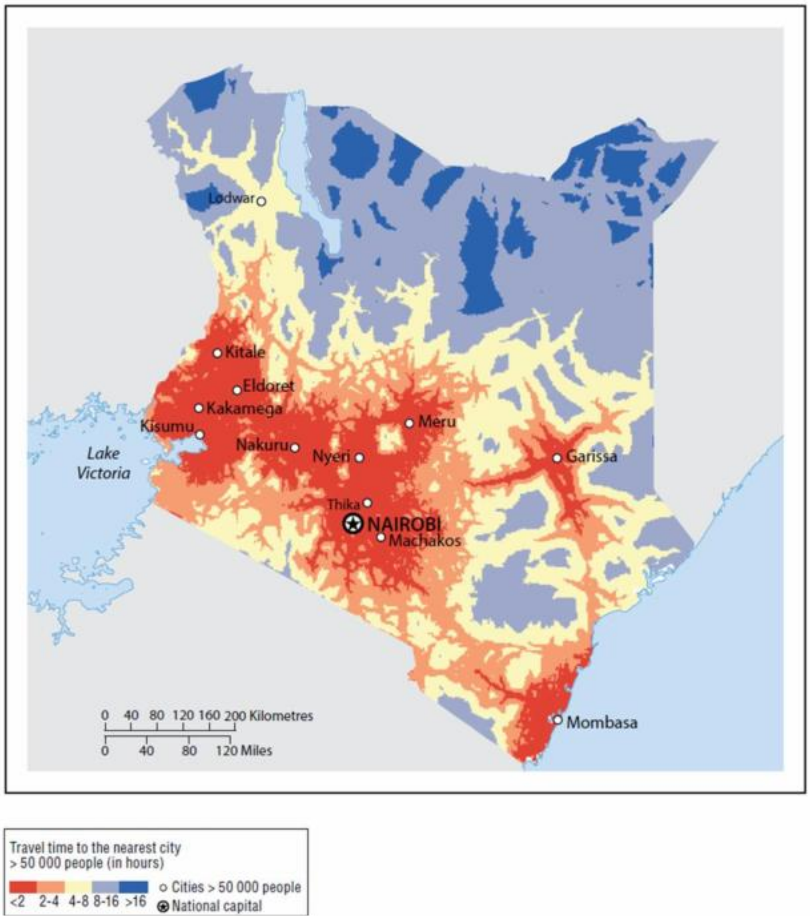


Figure 4- 3: Overall accessibility map in key urban areas

According to Kenya's current distribution of highway networks, there are multiple transportation paths between Nairobi and Malaba that formpart of the Northern Corridor. The Northern Corridor runs from Mombasa at the Coast through Nairobi, Nakuru, Eldoret, to Malaba at the Kenya Uganda Border; and the Nakuru-Mau Summit through Kericho and Kisumu to Busia at the Kenya Uganda Border. The Nairobi-Malaba section of Highway A104 (Grade A highway) is parallel to Nairobi-Malaba Railway and it is an important part of the "Northern Transport Corridor" in the East Africa region, as well as a vital trunk transportation highway within Kenya and between Kenya and Uganda. In addition, Highway B3 starts from Mai Mahiu town along Highway A104, and ends at Kisii where the highway intersects with Highway A1.The Nairobi South Railway Station-Naivasha Industrial Park-Enoosupukia, Narok will cross the Maimahiu–Narok road (B3) at DK 83.

4.2.2: Maritime transport: Kenya has enjoyed a well-developed port in Mombasa for a long time, and its many berths, large freight handling capacity and high mechanization level all stand the first in East Africa. Mombasa is not only a major collection and distribution hub of inward and outward freights, but also an important outgoing sea port for the freights from Uganda, Burundi, Rwanda, Congo (K) and South Sudan. However, upto 69.1% of the cargo handled at the Port of Mombasa is destined for the Kenyan economy with a huge portion destined for the City of Nairobi. The Port of Mombasa is the gateway to East and Central Africa, and is one of the busiest ports along the East African coastline. The Port provides direct connectivity to over 80 ports worldwide and is considered as a critical nerve centre of business serving a vast hinterland comprising Uganda, Rwanda, Burundi, Eastern Democratic Republic of Congo, Northern Tanzania, Southern Sudan, Somalia and Ethiopia by road. A railway line also runs from the Port to Uganda and Tanzania. The port is well-connected in the region with over 33 shipping lines calling.

The Port of Mombasa can trace its history to many centuries back to a time when dhows called at the Old Port on the north side of Mombasa Island. The Old Port is next to Fort Jesus, which was built by the Portuguese navigator Vasco da Gama. This was during the famous spice trade between the Arabian Gulf, the east coast of Africa, the Indian subcontinent and the Far East when navigators were looking for a new route to the Far East.In the 18th and 19th centuries East Africa was colonized by various nations including Great Britain and Germany. In the 1890s the region was partitioned, with Tanzania coming under German control and Kenya and Uganda being controlled by Britain. Trade began to boom and in 1895 work began on a railway from Mombasa to Kampala in Uganda to open up the hinterland for coffee, tea, ivory and skins. As trade expanded and the new railway opened up the interior of East Africa, so demand grew for a fully-fledged seaport with a spacious deep-water harbour. A new jetty was needed to handle larger ships bringing construction materials for the new railway.

As a result, a new port was created at Kilindini Harbour in 1896 with the building of a jetty at Kilindini on the west side of the island which was used mainly for transferring goods between seagoing vessels and the Kenya to Uganda railway. Later, three more jetties were built to handle rail borne goods and other import and export traffic. As container traffic continued to grow, more berths were converted into container handling berths. The rapid increase in container traffic through Mombasa prompted the port authority to extend the container handling operation upcountry and in the years that followed it set up two inland container depots at Embakasi in Nairobi (which opened in 1984) and at Kisumu (1994).

The Port of Mombasa is the largest port in east-central Africa, which possesses 21 deep-water berths, 2 large-scale oil docks, able to take in freighters of 20kt capacity, with a total throughput up to 22mt. The Port has a draft above 9.45m, open 24 hours to navigation. The Nos. 16, 17 and 18 berths of which are container berths, with a draft of 10.45m. It has four 40-ton container cranes. The port's current imports are about 13.311mt. The completion and operationalization of the first phase of the Second Container Terminal at the Port of Mombasa will boost the container handling capacity by 50% with an 550,000 (TEUs) annually enabling it to currently stand at a million TEUs. The cargo throughput of Mombasa Port is expected to increase rapidly along with the economic development in Kenya and associated East African countries. The implementation of the Mombasa-Malaba SGR is expected to be a timely boost to the Port of Mombasa. Currently, Kenya government plans to further expand Mombasa and Construct the new Lamu Port in the North Coast in order to meet the demand of future growth of inward and outward cargoes.

As the domestic and regional economy continues to grow, so does the volume of goods passing through the Port of Mombasa. In the last 10 years, the total cargo traffic through the port increased by 7.1% per annum, rising from 14.42 million tons in 2006 to 26.73 million tons in 2015. The growth was boosted by increased container traffic which recorded a growth rate of over 9.4% per annum, rising from 479,355 TEUs in 2006 to 1,076, 118 TEUs in 2015. Over the last four (4) years, the Port of Mombasa has consequently appeared in the list of 120 World Container Ports, and among the Top

5 container ports in Africa after Port Said (Egypt), Tanger Med (Morroco), Durban (RSA) and Alexandria (Egypt).

4.2.3: Air transport: The nation has3 international airports, 4 domestic airports and more than 300 small airfields and airstrips. Kenya Airways currently is operating over 50 international and domestic flight courses, with a network covering more than 50 destinations in Africa, Middle East, Asia and Europe, including 36 African countries, and is one of the major regional airways companies.

4.2.3.1: Jomo Kenyatta International Airport:JKIA is East Africa's largest airport with terminals and apron designed, developed and operated to handle over 1100 international arrival passengers in the planning peak hour; 970 departing international passengers in the planning peak hour; 175domestic arrival passengers in the planning peak hour and 200 departing domestic passengers In the planning peak hour. The airport served 6,348,635 passengers in 2014,making it the ninth-busiest airport in Africa by total passenger numbers. JKIA is the home of Kenya Airways which is one of the leading airlines in Africa as shown in **Plate 4-1**. The landing approach Runway 16 at JKIA is located over the Nairobi National Park for a stretch of about 7km from the Tuala area.

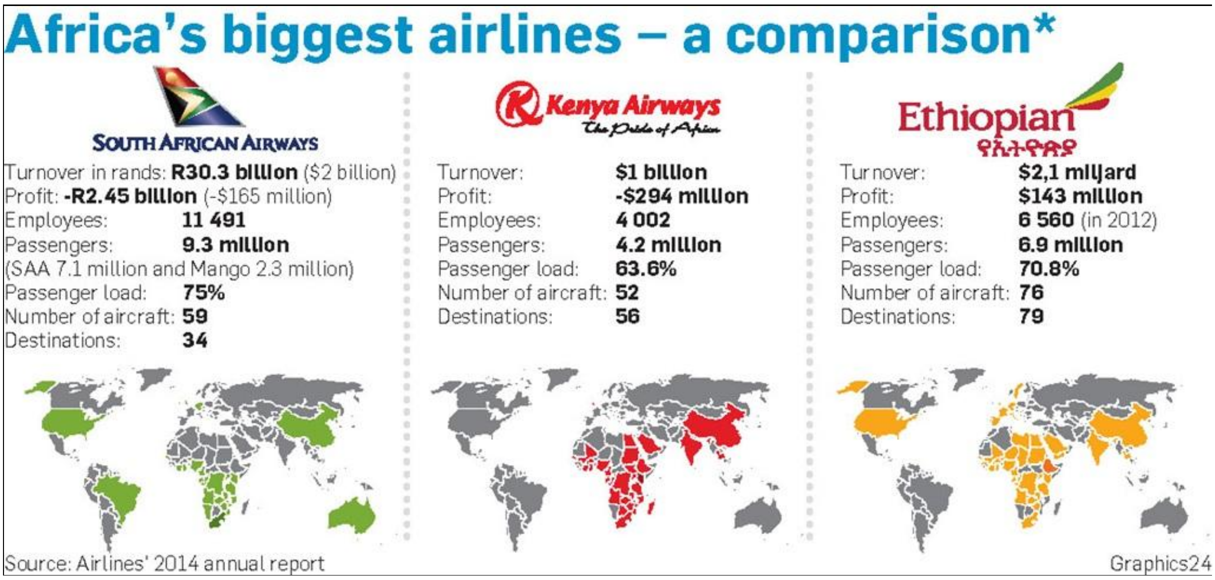


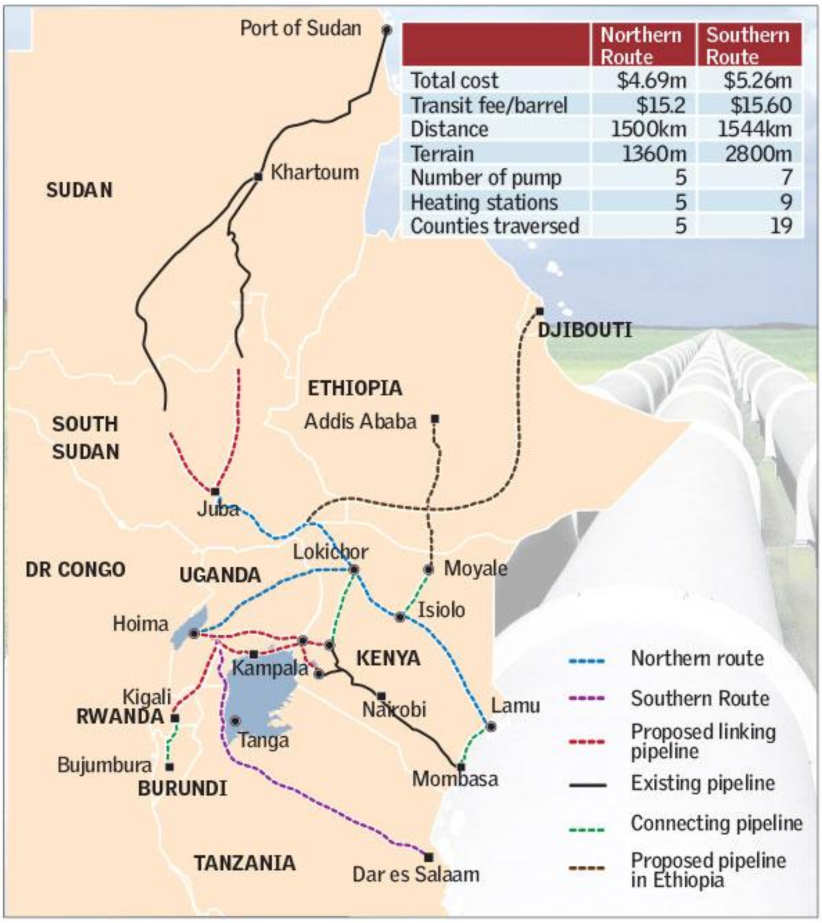
Plate 4- 1: Africa's biggest airlines

4.2.3.2: Wilson Airport: Wilson Airport is located to the South of Nairobi and immediately to the South of Langata Road. Wilson Airport is one of the busiest airports in terms of aircraft movement in East and Central Africa. Domestic flights constitute 90% of the total flights from the Airport with international flights accounting for 10%. The Airport is a fast and convenient gateway from Nairobi into Kenya's magical interior lands. Destinations served from the Airport include Maasai Mara, Mombasa, Amboseli, Lamu, Kilimanjaro Diani, Lokichogio and Nanyuki. It is also a modern hub of General Aviation in East and Central Africa. The departure route for Runway 14/32 at Wilson Airport is located over Nairobi National Park just after the Southern Bypass.

4.2.4:Oil pipeline: Kenya Pipeline Company Ltd was established in 1973 and currently possesses a pipeline system with a length of 896km, consisting of pipelines in diameter of 14ft, 8ft and 6ft and 14 pump stations. The Company has a storage facility capacity of 612,000m^3 covering all over the country. The oil pipeline network in Eastern Africa is set to expand significantly as a result of the recent oil discoveries in the region. **Figure 4-4** shows the proposed oil pipeline routes in the region.

4.2.5: Railway network: Kenya is planning to build two new railways, one of which is from the Nairobi the capital city to Addis Ababa the capital of Ethiopia, and Juba the capital city in Sudan, the other is to be constructed parallel to the existing railway linking Mombasa with Kampala in Uganda. Works are currently ongoing for the initial leg of the project, which is the Mombasa-Nairobi SGR, this portion is slated for completion in 2017. The SGR Phase I from Mombasa to the Nairobi South Station is almost complete while the proposed Nairobi South Railway Station-Naivasha Industrial Park - Enoosupukia, Narok County SGR will be the nexus between the Mombasa-Nairobi SGR and the Narok

- Malaba SGR. This Project is a key skeleton line for East African railway networks and will connect to South Sudan, Rwanda, Burundi and Congo to form a regional railway network. According to Kenya's annual financial budget report, Kenya will invest a large sum to give full support to the construction and modernized construction of the East African Railway Network. These two new railways will become the trunk line of large volume of freight transportation in the East African countries.



Proposed Project Implementation Schedule

Activity	Start Date	End Date	Duration
Front End Engineering Design	June 2015	Mar 2016	9 months
Engineering, Procurement and Construction	March 2016	Dec 2018	33 months
Commissioning and Defect Liability Period	Dec 2018	Dec 2019	12 months

The EastAfrican

Figure 4- 4: Proposed oil pipelines in Eastern Africa

4.3: Railway operations in Kenya

The total length of Kenya railway network is 2,210 km. The network runs from Mombasa through Nairobi, Nakuru, to the Uganda border at Malaba, a distance of some 1,083 km. A branch line of 217km is going from Nakuru to Kisumu, where it links with a ferry service on Lake Victoria. There is a set of additional branch lines, 618km long in total, to Magadi, Taveta (Tanzania border), Nanyuki, Kitale, Butere, Nyahururu and Solai. The existing railway line links Mombasa Port to Nairobi and then Nairobi to Nakuru, Kisumu and Malaba) and facilitates import and export trade in the country and also to the neighboring countries. Figure 4-5 shows the current distribution of railway network in East Africa. The railway network distribution in Kenya is shown in **Figure 4-5**.

The Mombasa Port is the center of operation and experiences serious congestion. Consequently, the road network has been congested. The proposed Nairobi South Railway station-Naivasha Industrial Park -Enoosupukia, Narok county will decongest the Mombasa Port as there will be a small extension to the Inland Container Depot which be handling all goods from Nairobi and it's environs and exports to neighboring countries such as Rwanda, Tanzania among others. The proposed SGR will also decongest the Mombasa–Nairobi and Nairobi –Nakuru-Kisumu highway.

From 1996 to 2010, the total number of vehicles registered in Kenya has grown by more than 2.5 times (**Table4-2**). While cars have seen a growth of approximately 7%, buses have grown at a rate of 7.24% and Trucks have grown by averagely about 6.87%. Currently, about 108,000 trucks operate on Kenyan roads. The 108,000 trucks are mainly operating on the Mombasa-Nairobi and Nairobi-Nakuru Highways and are the most likely to be affected by the new railway proposed. As the rail system gradually deteriorates, the number of trucks is expected to increase in future and make the road almost impassible unless this proposed rail project is implemented.**Figure 4-6** shows the existing railway between Mombasa and Malaba.

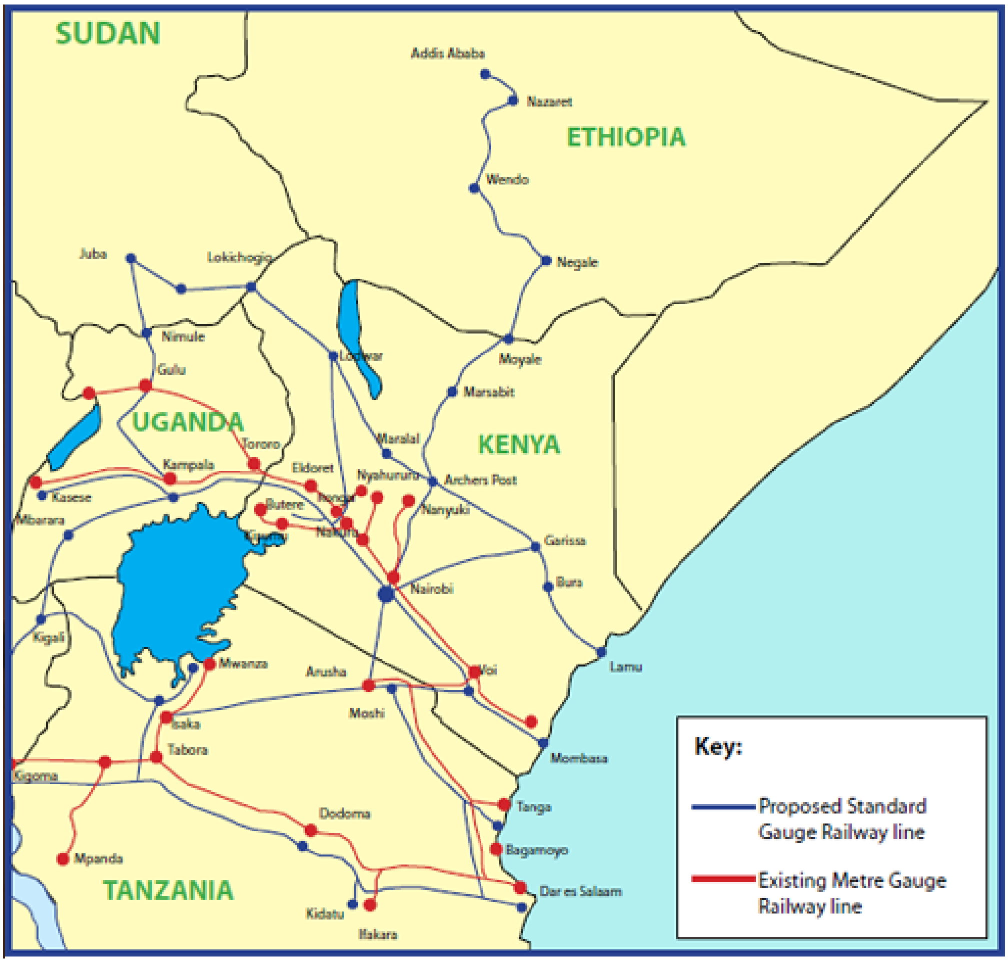


Figure 4- 5: Major railway networks existing in East Africa

Table 4- 2: Registered Vehicles, 2010-2014

Type of motor vehicle	2010	2011	2012	2013	2014
Saloon cars	16,165	11,026	12,985	16,343	15,902
Station wagons	37,553	31,199	39,862	48,662	53,542
Panel vans, Pick-Ups etc.	6,975	7,442	7,945	9,819	12,568
Lorries/ trucks	4,924	5,247	7,821	9,570	10,681
Buses and coaches	1,264	1,662	1,638	2,062	2,210
Mini buses/matatu	3,600	451	78	235	213
Trailers	2,379	2,556	3,761	3,973	2,925
Wheeled tractors	1,161	1,179	1,386	1,902	2,032
Other vehicles	3,648	2,724	1,753	1,451	2,533
Total motor vehicles	**77,669**	**63,486**	**77,229**	**94,017**	**102,606**
Motor and Auto Cycles Three wheeler	117,266 1521	140,215 2,140	93,970 1,845	125,058 3,103	111,124 4,327

Total Motor Cycles	**118,787**	**142,355**	**95,815**	**128,161**	**115,451**
Total Units Registered	**196,456**	**205,841**	**173,044**	**222,178**	**218,057**

Source: Kenya Revenue Authority /National Transport and SafetyAuthority

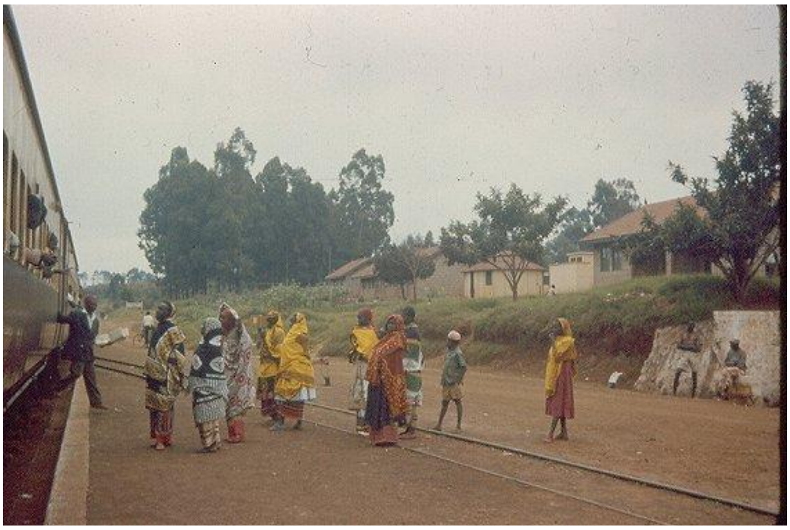
Figure 4- 6: Existing Nairobi - Malaba Railway Network

In Mombasa, rail freight operations begin or end at the Port of Mombasa where most cargo is picked or destined for export and import depending on the source and its final destination. Most of the marshaling operations in Mombasa are confined at the Changamwe yard for trains bound to and out of the Port. Upto 69.1% of the cargo handled at the Port of Mombasa is destined for the Kenyan economy, mostly in Nairobi. In Nairobi, most freight trains start and terminate at the Kenya Port Authority (KPA) Internal Container Depot (ICD) at Embakasi from where they are delivered to customers by road or sidings.

4.3.1: Track structure and stations: The current railway track structure is composed of rails, sleepers and fastening laid on a ballasted formation traversing on the line from Mombasa to Nairobi-Malaba. It is designed as a single-track one metre gauge up to speeds of 80km/hr maximum on straights. There are many areas of curvature up to 10 degrees and has bridges at major crossings with road. The railway network includes several stations from Mombasa through Nairobi to Kisumu. The current railway line has approximately 30 railway stations from Nairobi to Nakuru (See Appendix B for list of existing stations). Some of the stations include; Embakasi, Imara Daima, Kibra, Dagoretti, Kikuyu, Kijabe and Longonot among others. Most of the existing stations are old and dilapidated (**Plate 4-2**). The proposed SGR will have a total of twelve (12) stations along the route between Nairobiand Narok.

a) **Imara Daima Station**

b) **Kibera Station**



c) **Dagoretti Station**


GORETTI

d) **Kikuyu Station**

e) **Longonot Station**

Plate 4- 2: Existing railway stations serving the metre gauge railway

4.3.2: Bridges and terrain: The metre gauge railway line runs through hilly terrain as it climbs from Mombasa to Nairobi and from Nairobi to Malaba. It cuts through hills and valley fillings. It has embankment built to connect with bridges and culvert. The railway has numerous bridges and culvert openings along the route particularly on hilly terrain and areas prone to floods during heavy rainfall. The bridges are built from concrete and others from steel. The proposed SGR will have approximately 255 culverts and 47 bridges for animal and human passage.

4.3.3: Railway corridor: The corridor size is generally 60m wide, namely 30m from centre of the track on either side of the track, and it increases to 100m on both side for minor stations, andeven wider than this on either side for major depot stations. On station yards, line interchanges are facilitated by turnouts laid on wooden sleepers. The proposed SGR will have a corridor size of 70m wide with 35m from the centre of the track on either side and will increase to 150m for minor stations, and wider than this figure (250m-300m) for major terminal stations.

4.3.4: Interaction with other services: The existing railway generally runs alongside the existing road highway from Mombasa to Nairobi through Nakuru and Kisumu to Malaba. The two facilities criss-cross each other in several areas, with either road over the railway and vice-versa. Hence there are several underpasses and overpasses along the route. Additionally, the railway passes through many urban centres where it crosses with service supply lines to the towns including water supply, power supply, telephone and sewer lines. The crossings are prone to collisions with vehicles and running trains because of the existing level crossings.

The proposed SGR phase 2A will start at the Nairobi South Station (DK0+00) run on embankment straight on in a north-east direction for approximately two (2) kilometres outside the NNP before making a bend in the south-western direction and entering the NNP near the East Gate. It will then cross the park through the savannah region in an almost straight line through a 15m way-leave Single Track in NNP along a 6km viaduct in a super bridge. The SGR will exit the park to the east of the Massai Gate after which it will pass through Tuala Market and then turn westwards and run in the outskirts of the Ongata Rongai Town and head towards Ngong town. Therefore, between DK31-DK36 the line will pass through a tunnel on the Eastern side of Ngong Hills and then run northwards to meet option 1 above around Kamangu Area DK 50 and then proceeds to DK 120.

4.3.5: Accidents and derailments: Rift Valley Railways as the operator of the concessioned rail network is required by law to investigate all accidents that occur in all the operations of the concessioned network. This includes collision, derailments of any train on a running line and any accident, which causes or is likely to cause loss of human life or serious injury to persons or property in the operation of train services. Mechanical failures, track defects, staff error/train crew may cause derailments; while collisions and accidents may be due to level crossings, trespassing, staff on duty or line blockage. **Table 4-3** shows a summary of derailments recorded since the year 2000 with the highest number being recorded in 2010.

Table 4- 3: Mainline/Branch line Goods Train Derailments 2000-2012

Year/ Month	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Jan	8	7		1	2	9	8	3	1	5	5		0
Feb	9	1	3	7	6	8	0	5	1	1	1		4
Mar	4	5	3	6	4	1	7	2	3	2	8	7	2
Apr	3	3	6	5	5	8	3	4	5	3	4	8	1
May	8	5	0	7	2	9	9	6	7	8	1	3	0
Jun	4	5	4	6	2	7	4	8	4	9	9	9	7
Jul	3	7	4	6	0	2	0	2	4	5	6	1	
Aug	2	4	4	0	6	9	2	4	6	0	9	6	
Sept	1	2	4	5	4	3	0	8	1	2	0	9	
Oct		8	9	5	2	3	9	8	0	1	9	7	
Nov	1	3	7	2	3	4	8	0	1	2	0	9	
Dec	2		0	0	4	6	1	6	0	4	0	2	
Total	**94**	**67**	**83**	**60**	**20**	**49**	**70**	**06**	**23**	**42**	**52**	**01**	**34**

Source: Kenya Railways Corporation Periodical Reports

4.3.6: Analysis of current freight traffic volume of existing railways: Currently, the maximum transportation capacity for the Mombasa-Nairobi-Malaba meter-gauge railway in Kenya is 4,500,000t. The existing rolling stocks in Kenya are not sufficient and the cargoes may be stacked in ports for loading and unloading for a long time, usually lasting between 50-55 days. This is far more than the duration of stacking in ports for loading and unloading by road transportation which is about 15 days. Moreover, the existing railway equipment is old and has been long neglected and in disrepair, with poor safety and usually causing derailment and high maintenance cost. The actual traffic volume of meter-gauge railway is far less than its transportation capacity and its significance in the national economic development cannot be exerted effectively.

The traffic volumes of existing meter-gauge railways have gradually reduced in recent years because of the restriction on railway transportation safety and capacity. The actual freight traffic volume by railway was 1,600,000t in 2012 compared to 1,214,000t in 2013. **Table 4-4** shows the passenger and freight traffic volumes by railway during 2008 -2013.

The KRC and KPA have entered into an agreement to authorize the Inland Container Depot in Kisumu to handle formalities related to customs declaration and clearance of receiving and departure goods. This will lead to reduction in time of clearance of goods from the Mombasa Port, thus greatly increase the convenience in container transportation, and reduce tedious formalities and unnecessary time wastage.

Table 4- 4: Statistics of Passenger and Freight Traffic Volumes by Railway during 2008-2013

Item	Unit	2008	2009	2010	2011	2012
Freight traffic volume	10^4t	162.8	153.2	157.2	159.6	139.4
Turnover volume of freight traffic	10^6t/km	1109	1060	1105	1135	995
Passenger traffic volume	10^4 persons	322.6	886.1	341.1	600.4	407.7
Turnover volume of passenger traffic	10^6persons/km	105	389	270	283	221

4.3.7: Inland Container Depot

Currently, an Inland Container Depot (ICD) has been established by the KRC in Embakasi area in Nairobi. The Embakasi ICD is mainly responsible for stacking, transfer and customs clearance for the containers from Mombasa Port to the City of Nairobi and beyond as well as the stacking, transfers and customs clearance for the containers transported by railways from Nairobi to Mombasa. The main container customs declaration and clearance formalities of containers are still handled at Mombasa Port. The containers at the port are the transported to the Embakasi Inland Container Depot by train. The meter-gauge railway runs through the Inland Container Depot.

The handling capacity of containers at Mombasa Port was 900,000t TEU in 2012, including 40,000t TEU transported by the existing meter-gauge railway, which only accounts for 4.4% of all cargo. The coupling of sea-railway transportation is a general trend for the world's container transport. At present, some leading ports such as Rotterdam and Hamburg account for about 20% in the utilization of sea-railway combined transportation while the USA holds the highest proportion of about 40% while France takes up 30%-35% and German accounts for 20% of the European sea-railway combined transportation of containers.

Compared with the above countries and regions, Mombasa Port currently accounts for low percentage in the utilization of sea-railway combined transportation, with a huge space for expansion. At present, the container transport volume accounts for 39.1% in the port handling capacity. With the on-going expansion of the container terminal, there will be an increase in the share of container transport volume port traffic with the share of container transport predicted to reach over 40%. It is expected that the railway transportation of containers will be allocated in accordance with different transport distances, in consideration of the absolute advantages in the long–distance transport of containers through the through the Mombasa-Nairobi-Malaba SGR.

In addition, the expansion and functional transformation of the Embakasi Inland Container Depot will dramatically increase Kenya's container transport proportion by railways, and provide support for the SGR project in terms of the demand for cargo transport. The SGR is expected to transport containers transferred from Mombasa Port to Uganda and surrounding inland countries. It is predicted that the container transport ratio in Mombasa Port by railroad will reach 33.7%, 42.4% and 42.9% respectively in the initial stage, in the short term and in the long term.

In summary, it is predicated that the container transport volumes from Mombasa Port to Uganda, South Sudan, Congo, Tanzania, and surrounding countries will increase by 2,430,000t, 4,020,0004t and 4,980,000t respectively, in the short term, medium term and in the long term during the initial stages. On the other hand, the container transport volumes transported by SGR from the surrounding countries to Mombasa Port are expected to grown by 410,000t, 670,000t and 860,000t respectively.

4.3.8: Goods to be transported by the SGR

The key goods to be transported along the proposed SGR are highlighted below.

a) Cement: With its abundant limestone resource, Kenya is relatively developed in the cement industry, while its production is now still realized in small and medium-sized cement plants. In 2013, 5,059,000t cement was produced in Kenya, in which 4,257,000t was for domestic consumption and most of the remaining part was exported to the surrounding countries. Cement in Kenya is mainly transported by road and only a part is transferred to other regions by the existing railway. After completion of the SGR, cement from the Athi River area which is a hub for the sector will be transported to Kenyan surrounding countries through the proposed SGR. The expected transport volumes of cement in this railway are respectively 280,000t, 350,000t and 550,000t in the initial stage, in the short term and in the long term

b) Coal: At present, the coal for the industrial and mining enterprises is majorly imported from Mombasa Port to other parts of Kenya, Uganda and other countries. The continuing development and improvement of all kinds of industries in East African countries will bring higher demand to coal production step by step. It is predicated that the SGR will eventually deliver 1,200,000t, 1,700,000t and 2,500,000t of coal respectively in the initial stage, in the short term and in the long term after its completion.

c) Phosphate: Currently, the major phosphate fertilizer producing and consuming countries headed by China and the USA are protecting phosphorite,which is a non-renewable resource and are now beginning to import from other countries. Africa and the Middle East will become the new centers in increasing phosphorite production due to its affluent phosphate resource and speeding up of investment. There will be huge market potential of fertilizers dominated by phosphate in countries generally dominated by agricultural production in Africa. It is predicated that the SGR will deliver 300,000t, 400,000t and 600,000t of phosphate and fertilizer respectively in the initial stage, in the short term and in the long term after its completion.

d) Petroleum: Kenya has established a petroleum refinery plant in Mombasa with a petroleum refinery distillation capacity of 1,600,000t per year. The petroleum products are mainly exported to Uganda, Rwanda and Tanzania. The crude oil for production is mainly transported through the Port of Mombasa and the refined petroleum products (gasoline and diesel oil) delivered by pipeline. Other oil and crude oil by-products are mainly delivered by road and railway. It is predicated that the SGR will deliver 300,000t, 500,000t and 800,000t of refined oil product separately to Kenya and surrounding countries in the initial stage, in the short term and in the long term after its completion.

4.3.9: Urban development along the line: There are several towns along the old one-metre gauge line. There is little or no dependence on the old railway line and the entire railway system by towns along the old line. This is due to inefficiency of the system and also the fact that the passenger and cargo trains do not operate on a regular basis mainly due to the slow speed at which they move. The rail system has been neglected and is in a state of disrepair.

In the past, when the passenger and cargo trains were still reliable in terms of its travel schedule, residents in towns along the old line especially in those towns with stations such as Kibera, Dagoretti, Kikuyu, Muguga and so on depended significantly on the railway line for transport. However, there is little dependence on the railway line at the moment since only a small percentage of these residents still use it to travel and for transporting goods.

The proposed Nairobi South Railway Station-Naivasha Industrial Park -Enoosupukia, Narok County SGR will be the nexus between the Mombasa-Nairobi SGR (currently under construction and is expected to be complete by 2017), and the Narok -Malaba SGR Upon completion. The Mombasa-Malaba SGR will be the most important railway channel in Kenya, and it will link the Port City of Mombasa to the rest of East Africa through the Terminal station in Malaba. The Nairobi South Railway Station-Naivasha Industrial Park - Enoosupukia, Narok County SGR will significantly open up

Nairobi, Kajiado, Kiambu, Nakuru and Narok Counties for increased economic activities, especially farming and industrial development.

Based on the location of the proposed railway line, the baseline study covered a description of existing railway operations and baseline environmental and socio-economic information for Nairobi, Machakos, Kajiado, Kiambu, Nakuru and Narok Counties.

4.4: Link between SGR project and the City of Nairobi

4.4.1: Nairobi Metro 2030

Nairobi Metro 2030 is a key national government policy document for the planning and development in Nairobi Metropolitan Region (NMR). The Nairobi Metro 2030 policy document is the equivalent of Kenya Vision 2030 and outlines priority development options in Nairobi Metropolitan Region that covers the counties of Nairobi City, Kiambu, Murang'a, Machakos and Kajiado (Government of Kenya, Ministry of Nairobi Metropolitan Development, 2008).

In addressing transportation sector, the Nairobi Metro 2030 policy is focused mainly on road transport. Railway transport is seen as only a commuter rail network serving the metropolitan region. There is no mention of Nairobi City or Nairobi Metropolitan Region being connected to the national railway system (Kenya, 2008,pp 60-64) or at all to the national Standard Gauge Railway (SGR).

4.4.2: Integrated Urban Development Master Plan for the City of Nairobi (NIUPLAN, 2014)

The Nairobi Master Plan (2015) has just been prepared by Nairobi City County government. The master plan gives very limited focus on the railway and air transport systems. The transport sector is mainly focused on road transport. The transport survey did not cover rail traffic (Section 7-1.3) (Nairobi City County Government/JICA, 2015).

The NIUPLAN provides an integrated framework based on a comprehensive and holistic view of urban development. It was formulated through a thoroughly participatory and inclusive process marked by stakeholder participation from inception to validation. The development vision for the plan is **"Nairobi 2030: An Iconic and Globally-attractive City Aimed at Regional Integration and Sustainability"** which is anchored on four pillars: i) Economy, ii) Environment, iii) Governance, and iv) Social Culture capturing the views and aspirations of the city residents, and is as a result of numerous grassroots meetings and consultations held in each of the nine sub-counties of the City.

In Section 7-2, the master plan is focused on the railway system but gives limited analysis on demand and supply. The development policy is focused on the existing railway infrastructure and the construction of new MRT/LRT routes in the CBD and along 5 corridors- Thika, Juja, Jogoo, Ngong, Waiyaki and Outer Ring roads. An outer ring rail loop line is proposed to connect these radial corridor lines (Sector 7-2.3).The new Nairobi Master Plan (2015) does not provide for a new and modern national rail system (e.g. SGR) serving the city or linking Nairobi to the rest of the county and beyond.

NIUPLAN 2014 recognizes that the main line of the Kenyan Railways Corporation (KRC) is the line from Mombasa to Uganda through Nairobi. Many railway commuters are using this line from the Athi River (south-east direction) to Nairobi, and from Kikuyu, (north-west direction) to Nairobi. Many passengers are also commuting from Ruiru, (north-east direction) to Nairobi, on a branch line towards Thika Town. A short branch line towards Embakasi is also used by commuters. The NIUPLAN also recognizes the need for mass transit systems due to the increasing severe traffic congestion in the city. There are two approaches for the development of a rail-based mass transit system in Nairobi: 1) utilization of the existing KRC facilities and 2) construction of a new light rail transit (LRT) line or mass rapid transit (MRT) line. The NIUPLAN indicates that when the SGR is constructed, all the freight trains will be shifted to the new track, and the existing meter gauge track will be dedicated for passenger services.

4.4.3: Spatial Planning Concept for Nairobi Metropolitan Region

The spatial plan concept looks at multi-modal transport system in Nairobi Metropolitan Region. The spatial plan concept notes that the present transport network in Nairobi Metropolitan Region is inadequate and requires being re-structured, up-graded and technology modernized (Government of Kenya, Ministry of Nairobi Metropolitan Development, 2012).

The spatial concept identifies the three existing national railway lines serving Nairobi Metropolitan Region–namely Nairobi/Nakuru/Uganda; Nairobi/Mombasa; and Nairobi/Nanyuki lines. The plan concept however fails to analyze the potential capacity of these existing railway lines and are only proposed to serve Nairobi Metropolitan Region commuter service (**Figure 4-7**). No proposal is made on up-grading or re–development of these existing lines to serve national and international passengers and freight traffic.

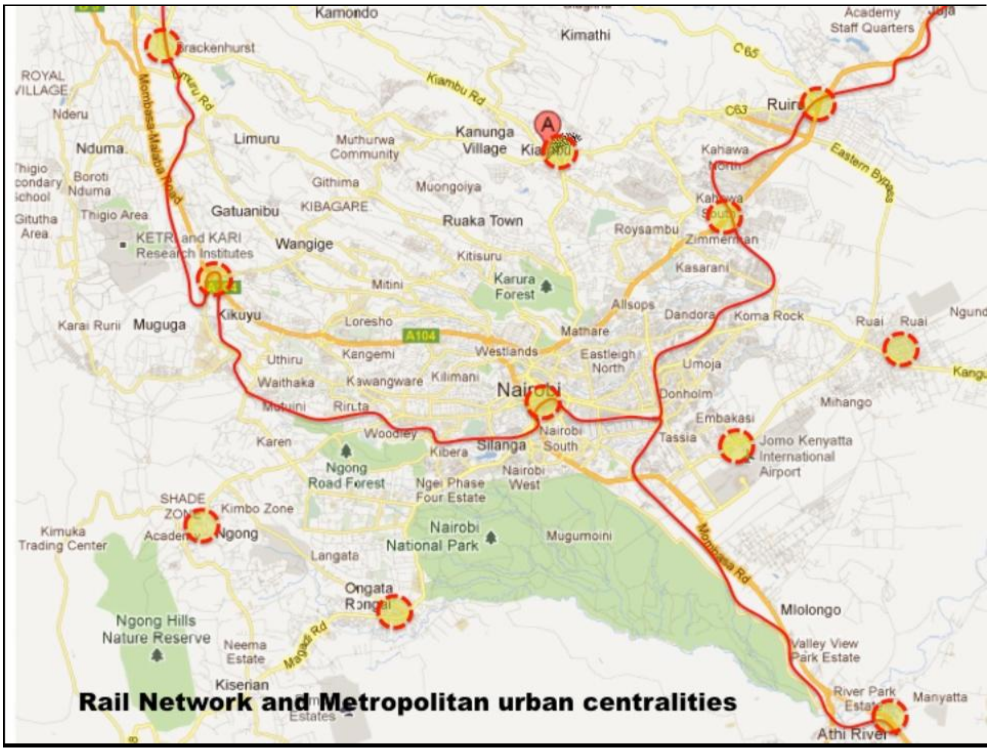


Figure 4- 7: Map of Nairobi railway network

The plan concept proposes the development of Nairobi Metropolitan Region (NMR) mass rapid transit system (MRTS) - bus rapid transit (BRT) and light rail rapid transit (LRRT) (**Figure 4-8**).The present Nairobi railway station is to be up-graded and developed as the Central Hub for Nairobi Mass Rapid Transit System (MRTS). **Figure 4-9** shows the main bus feeding hubs and routes in proposed BRT in the Nairobi Metropolitan Region. According to **Figure 4-9**, the proposed SGR will connect well with the Ongata Rongai and Ngong MRTs hubs.

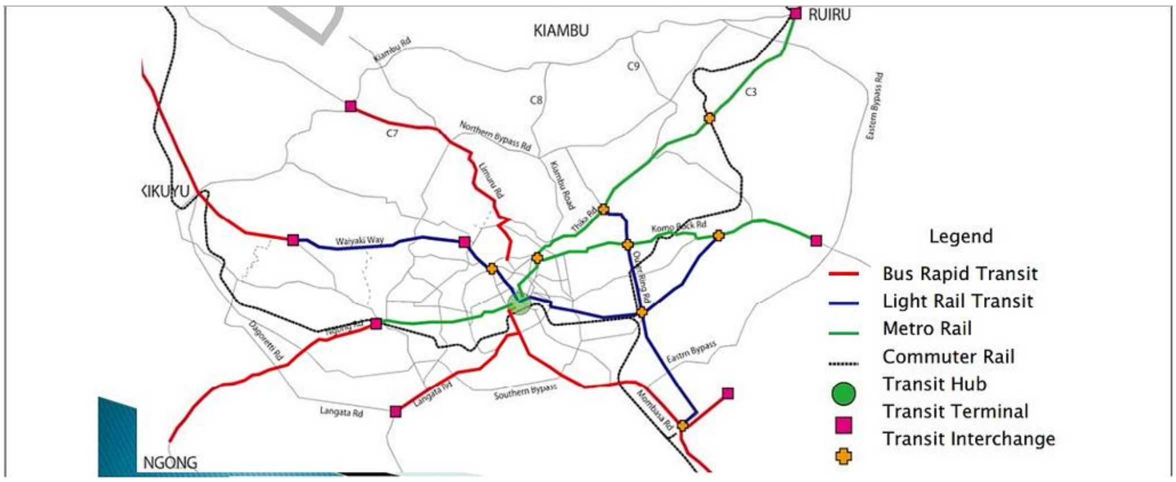


Figure 4- 8: Proposed Integrated Mass Rapid Transit System (MRTS) of Nairobi Metropolitan Region (NMR)

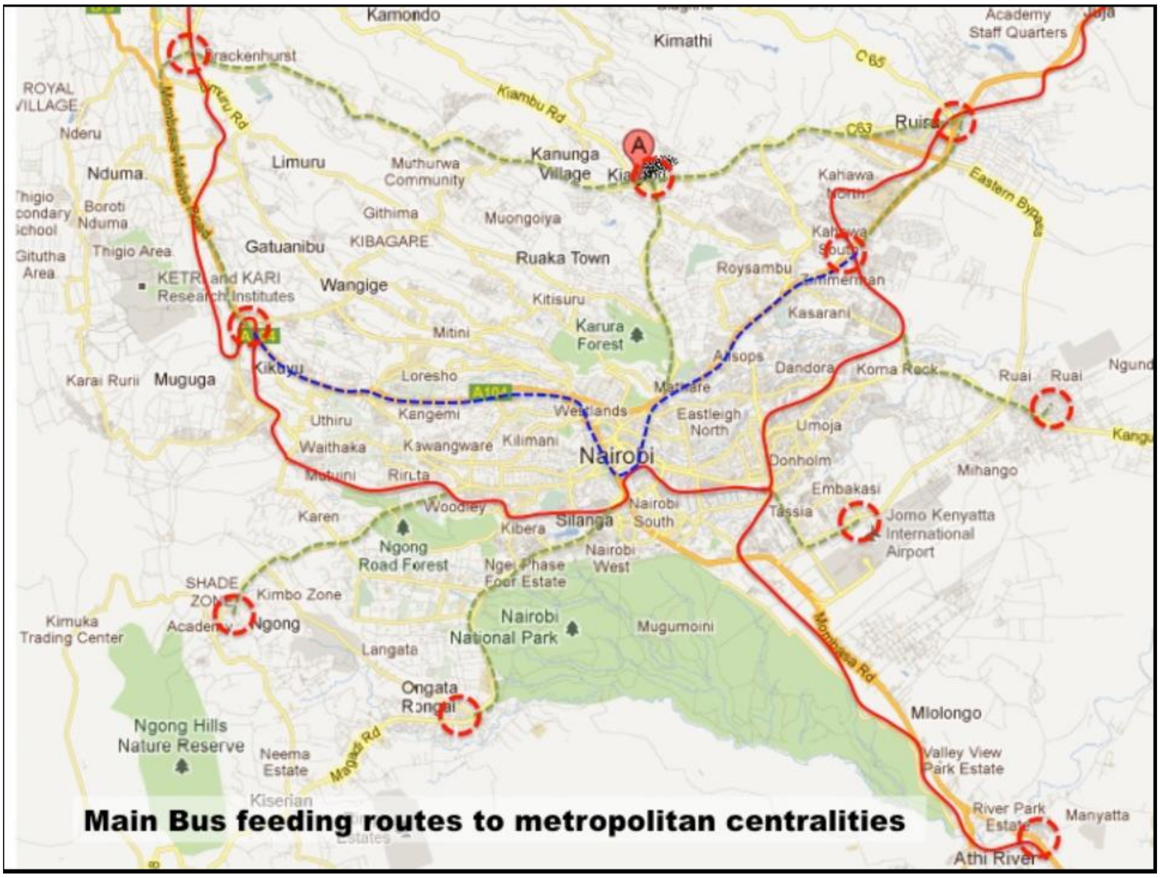


Figure 4- 9: Map of the main bus feeding hubs and routes in proposed BRT in the Nairobi Metropolitan Region

The plan concept proposes integrating mass rapid transit system (MRTS) of Nairobi Metropolitan Region (NMR) with the National rail system (**Figure 4-9**). It is proposed that the main Kenya National Railway transport hub be located in Kajiado (p. 9/38). All national rail traffic, both passenger and goods, will originate or terminate at this Kajiado national transport hub. The Kajiado national transport hub will be connected to Nairobi central railway station by radial mass rapid transit system (MRTS) lines. The SGR-IIA would therefore connect well with the urban bus road network including the busy Langata and Ngong Roads**(Figure 4-9)**. The railway project will also link up with a number of key transport nodes such as Ongata Rongai and Ngong to the west of south west of the CBD.

To avoid congestion at Kajiado national transport hub, it is proposed to have three other national railway stations at Thika, Machakos and Limuru. The plan concept however does not indicate the type of national railway system required - whether it is to be a metre gauge or Standard Gauge Railway (SGR) system. The plan concept identified a hierarchy of 3 main transport networks in Nairobi Metropolitan Region-

- Multimodal Corridor serving national/ international road/railway traffic,
- Regional Corridor that serves NMR and within the multimodal corridor; and
- Radial corridor system that run from Nairobi city Centre to the orbital corridors.

From the spatial concept plan, the national multimodal railway system is not to enter Nairobi City County and will terminate in Konza in Machakos County. The national railway system is then to run along the outer corridor of the metropolitan region and along four corridors-

- *Eastern corridor:* Konza/Mombasa road, Machakos town, Kangundo and Kenol/ Murang'a;
- *Western corridor:* Namanga, Kajiado town, Kiserian, Uplands and to Nakuru;
- *Northern corridor:* Uplands, Thika town, and Kenol/Murang'a; and
- *Southern corridor:* Kajiado town, Konza/Mombasa road.

A review of existing development plans shows that the development of the proposed standard gauge railway has not been included or integrated in the development plans for Nairobi City or its metropolitan region. Virtually all development plans for Nairobi city and its metropolitan region, including the new City Master Plan 2015, are only concerned with rehabilitation of the existing metre gauge railway infrastructure and introduction of the light rail rapid transit (LRRT) system in Nairobi

CBD and the metro-region.It is only the Nairobi metropolitan spatial plan concept (2012) that attempts to introduce a new railway network that accommodates the proposed SGR. The national SGR network will not get into Nairobi city but will run along an outer metro corridor in Machakos, Kajiado and Kiambu. The main multi-modal hub will be in Kajiado and with complementary stations in Machakos, Thika and Limuru.

4.5: Link between SGR project and the county integrated development plans

4.5.1: Kajiado County Integrated Development Plan 2013-2017
The existing Mombasa- Nairobi national railway and the proposed Standard Gauge Railway (SGR) run through northern part of Kajiado County. The county also has the Konza-Magadi railway branch. The County Integrated Development Plan (CIDP) 2013-2017 has however not included the railway in its future transport development programs (sections 3-2 and 7-27).

4.5.2: Kiambu County Integrated Development Plan 2013-2017
The county accommodates two national railway lines, namely - Nairobi-Kikuyu-Limuru-Nakuru line to the west and Nairobi-Ruiru-Thika line to the north. Kiambu CIDP, in section 7-4.1, looks at the railway infrastructure. The CIDP proposes to only rehabilitate the existing infrastructure in Ruiru, Thika, Kikuyu and Limuru stations. The CIDP does not provide for the development of the national Standard Gauge Railway (SGR) through the county.

4.5.3: Nakuru County Integrated Development Plan 2013-2017
The county has a railway line length of 192 km connecting major urban areas of the county namely; Naivasha, Gilgil, Nakuru, Njoro, Molo and Rongai. It has ten railway stations serving as drop/collecting points for agricultural and industrial good as well as providing public transport from Nakuru to the Mombasa via Nairobi and Nakuru to Uganda via Eldoret, Kisumu, Busia and Malaba. However, the CIDP does not highlight any plans regarding the integration of the county railway network to the national SGR project.

4.5.4: Narok County Integrated Development Plan 2013-2017
Narok County does not have any railway line within its 17,944km^{2}territory. However, the national SGR project is expected to pass through the county with Phase IIA terminating at Enoosupukia. Enoosupukia is bordered by Hells Gate to the East, Suswa to the South, Keekonyokie to the west and Kongoni Sub-locations to the North. Apart from boosting human transportation, the SGR project is expected to boost tourism in the area as well as the transportation of goods such as wheat, barley and livestock. The Narok CIDP does not highlight any plans regarding the integration of the county railway network to the national SGR project.

4.6: Socio-Economic Profiles for Counties along the Proposed Railway Corridor
The proposed railway line project passes through five (5) Counties: Nairobi, Kajiado, Kiambu, Nakuru and Narok Counties. The counties, through which the proposed railway will traverse, are shown in **Figure 4-10**.

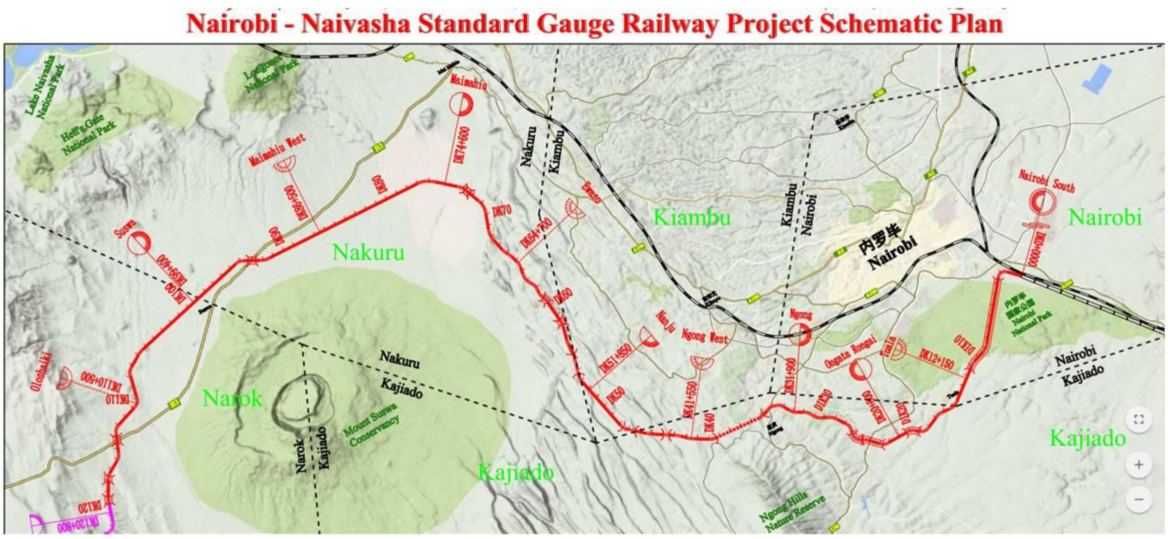


Figure 4- 10: SGR-IIA route map

4.6.1: Nairobi County

The County has a railway network of 298km and a total of 10 functional railway stationswhich are: Embakasi, Makadara, and Nairobi main terminal, Dandora, Githurai, Kahawa,Kibera, Dagoretti, JKIA and Syokimau. The establishment of Makadara and Imara Daimarailway stations and expansion of Nairobi platform will help to improve publictransportation in Nairobi for socio-economic development.**Figure 4.11** shows the exisiting railway network in Nairobi as well as the key missing links.

Figure 4- 11: Exiting railway lines and missing links in the City of Nairobi

The proposed railway will start from the Nairobi South Station (DK0+00), which is the terminating station for the Mombasa-Nairobi SGR portion of the railway in Nairobi County. From there it will move along the Nairobi National Park (NPP) boundary behind the industrial area upto to the NPP East Gate and then enter and cross over the NPP for a 6km stretch and exit near the Masai Gate. From here it will head towards the Tuala area and cross into Kajiado County.

4.6.1.1: Location and size

Nairobi County (700km^2) lies so close to the Equator at an average altitude of about 1680m above sea-level. The City of Nairobi is located at the edge of the central and rift valley regions of Kenya. The day-time population of Nairobi City was estimated to grow from 3.2 million people in 2009 and is expected to increase to about 5.5 million in 2030 (Nairobi City County 2014). The county has a total of 17 Sub-counties including Westlands, Dagoretti North, Dagoretti South, Langata, Kibra, Roysambu, Kasarani, Ruaraka, Embakasi South, Embakasi North, Embakasi Central, Embakasi East, and Embakasi west, Makadara, Kamukunji, Starehe and Mathare. It is bordered to the north and west by Kiambu County, Kajiado County to the south and Machakos County to the east (**Figure 4-12**). The county shares the longest boundary with Kiambu County.

4.6.1.2: Physiography, climate & hydrology

The county is characterized by diverse physiographic characteristics. The terrain in the eastern side of the county is gently rolling but divided by steep valleys towards the city boundaries. The main types of soils are the vertisols and the red soils. The mean annual temperature is 17^{0}C and the mean daily maximum and minimum temperature are 23^o C and 12^o C respectively. On the other hand, the mean annual rainfall is 1080 mm falling in two distinct seasons: the long rains from March to May and the short rains from mid-October to December. There are a number of perennial streams and rivers flowing through the county from the west including Mbagathi, Motoine and Makoyeti rivers. The Mbagathi River rises in the Dagoretti forests, flows along the southern boundary of the Nairobi National Park and onto Athi River Town where it where it joins the Stony Athi River. The Motoine

River rises in the Dagoretti Forest, Kiambu District; and flows along the northern boundary of the plan area through the Ngong Road Forest and into the Nairobi Dam. Most of rivers are highly polluted as open sewers and industrial waste is directed towards them. Nairobi dam, which is along the Ngong River, and Jamhuri Dam and Nairobi Dam are some of the main water reservoirs in the County. Mokoyeti River, which arises as the discharge from the Karen oxidation ponds and flows eastwards north of the Langata Road and into the Nairobi National Park north east of Bomas of Kenya.

Figure 4- 12: Location of Nairobi County

4.6.1.2: Population

Although it covers only 0.1 per cent of Kenya's total surface area, Nairobi has about eight per cent of the country's total population. In 2012, the county population was projected to be 3,517,325 and is expected to rise to 3,942,054 in 2015 and 4,253,330 in 2017 with an inter-censual growth rate of 3.8%. The female population projections from age cohorts 5-9, 10-14, 15-19 and 20-24 remain slightly higher than that of male except for under 5 where the number of boys is higher than that of girls. From the age bracket 25-29 the population of males overtakes that of females and remains higher up to the age bracket 70-74 where the female overtakes the male population up to the age above 80 years. The population distribution shows a pyramid that is heavy at the base, with the population less than 15 years being about 30.3 per cent in 2012. It is worth noting that the population pyramid is not heavy at the very bottom since the population of youth (15-

29) accounts for 38.5per cent of the total population. At the higher age cohorts above 50 years the population of both male and female continues to decline with advancement of age.

4.6.1.3: Economic sectors

Nairobi is the political, economic, cultural, industrial and communication center of the country. The county has mainly manufacturing industries, including tobacco, processed food and beverage products and papermaking. Nairobi is an important transportation junction in Africa, a transit of aerial lines stretching across Africa. The JKIA Airport that is located in the suburb is an international airport where more than ten airlines pass through to link with dozens of cities in 20-30 countries. Nairobi possesses direct railway and roadway lines through to neighboring countries such as Uganda and Tanzania. In recent years, tourism has become another major source of income in the city especially from the Nairobi National Park, which is the first choice of tourist spot of short-term, or transit visitors.

4.6.1.4: Transport infrastructure

Nairobi County hosts Jomo Kenyatta International Airport (JKIA) which is the biggest Airport in East and Central Africa, and is the focal point for major aviation activity in the region. Its importance as an aviation Centre makes it the pacesetter for other airports in the region. JKIA, located 18 kilometers to the East of Nairobi City centre, is served by 49 scheduled airlines. JKIA has direct flight connections to Europe, the Middle East, Far East and the rest of Africa. JKIA has five cargo facilities with a capacity to handle 200,000 tonnes of cargo annually, and an animal holding facility which occupies 4,318.95 square feet. The Airport has a runway measuring 4,117m long and 45m wide on 4,472.2ha of land.

The County government intends to lay more emphasis on infrastructure development; a number of strategies will be employed to improve the available infrastructure facilities to maximize economic and social goals. Some of the strategies to be pursued include: -

a) Strengthening the existing framework and accelerating the speed of implementation.
b) This will also include raising efficiency and quality. Enhancing local content of identified projects.
c) Support identified flagship projects and benchmarking infrastructure facilities with globally accepted standards.
d) Entrenching a programmed and well financed routine and periodic road repair and maintenance.
e) Targeting projects in otherwise neglected areas to increase connectivity and stimulate economic activities.
f) Enhancing Private Sector participation in provision of infrastructure facilities and services strategically complimented by Public Sector Interventions.
g) Enhancing capacity for road construction through acquisition of assorted equipment and facilities as well as enhancing supervisory capacity of the County.
h) Enhancing capacity for street lighting construction, rehabilitation and maintenance.
i) Infrastructure Financing through Capital Markets-The government will explore mechanisms to increase private sector participation in the provision of infrastructure services to rehabilitate the County infrastructure. The target is to lower the costs of doing business in Kenya, provide affordable & efficient modes of transport for Kenya and increase overall living standards. The domestic bond market will enable the Government to source for funds domestically to finance rehabilitation of the county infrastructure.

4.6.2: Kajiado County

The proposed railway will enter the county from the Nairobi National Park near Tuala from where it will pass south of Ongata Rongai and head to Ngong.

4.6.2.1: Location and size

Kajiado County (21,900.9 km^2) is located in the southern part of Kenya. It borders Nairobi County to the North East, Narok County to the West, Nakuru and Kiambu Counties to the North, Taita Taveta County to the South East, Machakos and Makueni Counties to the North East and east respectively, and the Republic of Tanzania to the South (**Figure 4-13**). The county is divided into five administrative Sub-Counties, namely Kajiado North, Kajiado Central, Isinya, Mashuru and Loitokitok.

4.6.2.2: Physiography, climate & hydrology

The county is dominated by plains, valleys and occasional volcanic hills ranging from an altitude of 500m metres above sea level at Lake Magadi to 2500m above sea level in Ngong Hills. The county capital is Kajiado town but the largest town is Ngong which located to the west of Nairobi. The other major town in the area is Ongata Rongai. Topographically, the county is dominated by the Rift Valley to the northwest and the Athi Kapiti plains to the east. Rift Valley is a low depression on the western side of the county running from north to south. It is made up of steep faults giving rise to plateau, scarps and structural plains. The depression has important physical features such as Mount Suswa and Lake Magadi. The lake has substantial deposits of soda ash and it is commercially exploited. The altitude ranges between 600 and1740metres above sea level. The Athi Kapiti Plains consist mainly of gently undulating slopes, which become rolling and hilly towards the Ngong hills. The altitude ranges from 1580 to 2460m above sea level. Temperatures range between 14°C and 34°C while rainfall range from 500mm to 1050mm per annum. The hills are the catchment areas for Athi River, which is fed by Mbagathi River and Kiserian tributaries.

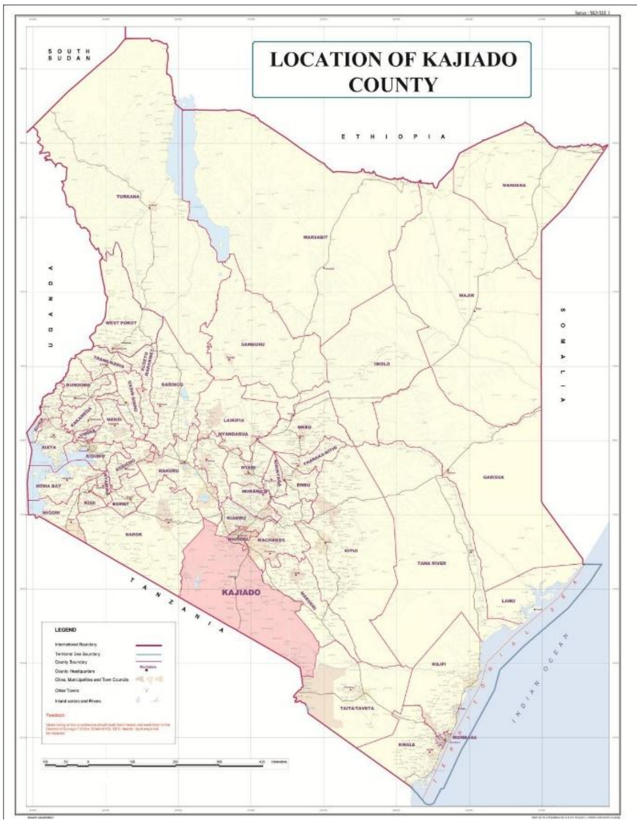


Figure 4- 13: Location of Kajiado County

The county consists of three geological regions: quaternary volcanic, Pleistocene and basement rock soils. Alluvia soils are also found in some areas. Quaternary volcanic soil is found in the Rift Valley. The Basement System Rocks which dominate the area comprise various gneisses, cists, quartzite and crystalline limestone, are found mainly along the river valleys and some parts of the plains.

4.6.2.2: Biodiversity

The county boasts of a wide range diverse fauna and flora. The Isinya–Kitengela area, part of a larger ecosystem that includes Nairobi National Park, Ngong Hills, Kipeto and the Athi-Kaptei plains (**Figure 4-13**). This ecosystem is unique in that it still supports a large and long distance wildlife migration, while facing the challenge of being next to the City of Nairobi. The Athi- Kaputiei ecosystem covers an area of approximately 2200 km (Gichohi 1996) and includes Nairobi National Park in its northern end. In addition to supporting large herds of wildlife, over 75% of this ecosystem also holds a large number of livestock. Twenty four species of large mammals including some endangered ones, live on these rich plains, although not the elephant, which was exterminated before 1962.

The former Olkejuado county council initiated the preparation of the Isinya-Kitengela Master Plan 2006-2026 for the long term conservation of the wildlife dispersal area. In the recent past Kajiado county physical planning department is currently preparing a 2006-2026 Isinya-Kitengela zonation master plan. The master plan is expected to describe an overall development concept including present uses and future land development plans for the area.

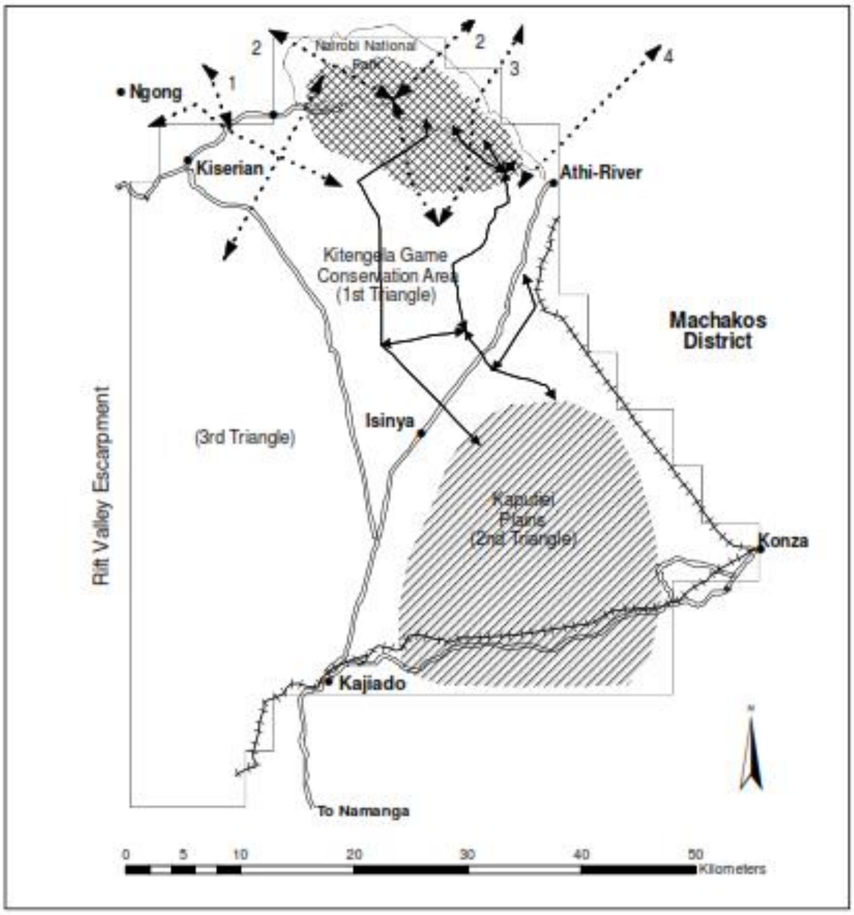


Figure 4- 14: Wildlife migration in Kajiado County

4.6.2.2: Population

The population of Kajiado according to the 2009 national census was 687,312. The county has a population was estimated at estimated at 807,070 with 401,785 being females and 405,245 males as at the statistics of 2012 with growth rate of 5.5 percent. The population is projected to grow to 1 million by the year 2017. Ngong town holds more of the urban population than any other town in the county with 41 percent of the total. The other towns are Kitengela with 23 percent, Ongata Rongai with 16 percent and Kajiado with 6 percent. The population of Ngong town is estimated at 107,188 compared to 40,178 people in Ongata Rongai.

4.6.2.3: Economic sectors

Livestock rearing is a major economic activity in Kajiado County, providing a source of livelihood for many residents. Dairy farmers mainly sell their milk to neighboring hotels and households, with the surplus being sold in Nairobi. The county also provides a huge market for beef and goat meat, with over 2,000 animals being slaughtered daily for its market. Although Kajiado's climate is not conducive for agriculture, a growing number of farmers in Kimana, Rombo and Entonet are engaged in irrigation farming to support subsistence crop farming. Crops that are mainly grown under irrigation include kale, cabbages, onions, tomatoes, pepper, beans and maize. Economic growths and development in the county is mainly pegged on the future investments in a number of economic sectors, namely agriculture, horticulture, livestock production, dairy and beef production, hides and skins, and poultry. In addition, tourism is a strength that Kajiado holds dear owing to booming wildlife tourismin Amboseli National Park, and several community and privately run wildlife conservancies, with potential for further investment in this area.

The county is also associated with the production and export of soda ash or trona from Lake Magadi. This represents one of the rare renewable minerals in the world. The Magadi Soda Company manufactures soda ash at the Kenyan town of Magadi, which is in southwestern Kenya. Magadi is a subsidiary of Brunner Mond, Imperial Chemical Industries, and of Tata Chemicals, and is headquartered in Magadi, Kenya. It is the largest manufacturer of soda ash in Africa. The company was founded in 1911 and mines trona from Lake Magadi, in the Rift Valley. Lake Magadi has one of the purest surface deposits of trona. The trona is converted by Magadi to soda ash, at a facility near the mining operations, and the soda ash is transported by rail to Mombasa for onward shipping. Tata Chemicals Magadi (TCM) extracts about 350,000 tonnes of soda ashannually at Lake Magadi. Over 95 per cent of the soda ash that TCM produces at Lake Magadi is exported via rail to the Port of Mombasa and it is then shipped to its main markets that include South East Asia, India, the Middle East and to the rest of Africa. While the current demand for soda ash is around 49 million tonnes, it’s been forecast that the global demand for soda ash will reach 58 million tonnes by 2015. The SGR is expected to greatly improve the export of this important product.

4.6.2.4: Transport infrastructure

The total length of roads in the county is 2,344.2 km which include 300km of tarmac roads. The five major tarmac roads in the county are Emali-Loitokitok, Namanga-Athi River, Isinya-Kiserian, Magadi-Mbagathi and Kiserian-Ngong-Karen roads. The other road network includes 932.3km of gravel roads and 1111.9 km of earth roads. The county has a total railway line length of 147km which connects Tata Chemicals Ltd (formerly Magadi Soda Company) to the Nairobi-Mombasa railway line (**Figure 4-14**). The railway is used to transport Soda Ash and its by-products to Mombasa. There are seven airstrips in Kajiado County, with at least one in each Sub-county. The airstrips are in Kajiado Town, Loitokitok, Olooloitikosh, Ngong, Magadi, Daraja and Amboseli National Park.

Figure 4- 15: Magadi-Kajiado-Mombasa railway

4.6.3: Kiambu County

The proposed railway will enter the county from the Ngong station in Kajiado County heading to a straight direction through a tunnel in Lusigetti area (DK 46+490 to DK 46+960) in Kiambu County. The SGR line will then proceed to Kamangu station (DK 52+200) after which it will go through a tunnel of about 760m (DK53+600 to DK 54+360) still in Kamangu area within Kikuyu sub-county in Kiambu County before crossing down into the rift valley and heading to a station in Maimahiu, Nakuru County

4.6.3.1: Location and size

Kiambu County (2,543.5 km^2) is located in the central region of Kenya and generally lies between 1,200 and 2,500m above sea level. It borders the Counties of Nairobi and Kajiado to the South, Machakos to the East, Murang'a to the North and North East, Nyandarua to the North West, and Nakuru to the West (Republic of Kenya 2013, **Figure 4-15**). Kiambu County is divided into ten (10) sub-counties, namely Gatundu North, Gatundu South, Ruiru, Thika East, Thika West, Githunguri, Kiambu, Limuru, Lari and Kikuyu where the proposed railway will pass through.

Figure 4- 16: Location of Kiambu County

The county is one of the high agricultural potential and high population density areas in Kenya with the average farm size below 2 acres. The key crops which are grown in the county include tea, coffee, maize, beans and potatoes. Maize growing in the area is largely for subsistence use. Upto 476.3 km^2 of the county is under forest cover.

4.6.3.2: Physiography, climate & hydrology

Kiambu County is divided into four broad topographic zones viz, Upper Highland, Lower Highland, Upper Midland and Lower Midland Zone. The Upper Highland Zone is found in Lari Constituency and it is an extension of the Aberdare ranges that lies at an altitude of 1,800-2,550 metres above sea level. It is dominated by highly dissected ranges and it is very wet, steep and important as a water catchment area. The upper midland zone lies between 1,300-1,500 metres above sea level and it covers mostly parts of Juja and other constituencies with the exception of Lari. The lower midland zone is found in parts of Kikuyu (Karai) and Limuru (Ndeiya) Divisions. The soils are dissected erosional plains and vary from well drained, shallow, and dark red to yellowish red, stony loamy sand to imperfectly drained, very deep, dark brown and strongly calcareous soils with sodic clay topsoil.

The Kikuyu area experiences high temperatures throughout the year. Annual rainfall in the district is about 560mm to1630mm. This falls into two rainy seasons but 70% of the rains are received during the long rains. The annual mean temperature ranges from 20^0C-38^0C and the district's altitude range between 1,135m-1600m above sea level. June and July rank as the coldest months while January-March and September-October are the hottest months. The Kikuyu area of Kiambu County does not have any rivers and is generally a water scarce zone.

4.6.3.3: Biodiversity

The Kikuyu area is privileged to have relatively high forest coverage of more than 60 ha of forest in Thogoto, and Muguga forest. However, most of the natural forests however have been cleared for firewood, agriculture and settlement posing a threat to water catchments in the area. Common trees in the area include: Eucalyptus spp, *Markhamia lutea*, *Cupressus lusitanica*, *Bischovia javonica*, *Croton megalocarpus* and *Pinup sp*. There is limited wildlife in the area due to a long history of human settlement.

4.6.3.4: Population

The county's population was 1,766,058 in 2009 with 873,200 males and 892,857 females. This population is expected to reach 2,032,464 people by the end of 2017. This is influenced by the county's high population growth rate, which is at 2.81 per cent and the influx of people working in the city who prefer to stay in Kiambu and its environs where there is less congestion and well developed infrastructure. Kikuyu sub-county had a population of 194,524 in 2009 including 3,724 urban dwellers.

4.6.3.5: Economic sectors

Kiambu County relies mostly on agriculture and industries to sustain its economy. The combination of good soils, suitable climate, well developed infrastructure and the proximity to the most important capital city in the region has all served to make Kiambu the most lucrative farming County in the country. Farms range from less than 0.3 ha to large plantations of well over 1,000 ha. Over 90% of the total rural land mass is suitable for farming. Agricultural activity has a major new competitor in the form of real estate as housing, trading centers and shopping malls offer more reliable dividends to investment than farming. Horticulture, the growth industry of the last two decades appears capable of out-earning tea and coffee – the traditional cash crops of this region. Other agricultural activities include dairy farming, and growing of pyrethrum and subsistence crops such as maize, beans and locally consumed vegetables.

4.6.3.6: Transport infrastructure

The county has a good road network. It has a total of 2,033.8 km of roads under bitumen standards, 1,480.2 km under gravel surface and 430.1 km under earth surface. There is a great need in improving the condition of the roads since during the rainy season, most of the roads become impassable. However, the terrain poses a great challenge for road maintenance. There has been a lot of improvement in the roads subsector with the example of Thika-Nairobi highway. It also has 131 km of railway line and four railway stations in Ruiru, Thika, Kikuyu and Limuru towns. The rail is not fully utilized in the county and only passenger trains operate in the morning and evenings between the City of Nairobi and the four stations. However, there is a great potential in the sector and hence efforts need to be put in place to ensure the infrastructure is improved which will encourage introduction of modern efficient trains.

4.6.4: Nakuru County

The proposed railway will enter Nakuru County from the Nanju Station (DK51+850) in Kiambu County, the alignment will cross the Mai Mahiu-Narok Highway (B3) at DK83 and proceed to the Mai Mahiu District Station (DK74+600) after which it will head straight to Mai-Mahiu West Internmediate Station (DK86+500) both in Nakuru County and. From there it will proceed to the proposed Naivasha Industrial Park (NIP) in the Olkaria area.

4.6.4.1: Location and size

Nakuru County (7,495.1 km²) is one of the largest counties in the Kenya and lies within the Great Rift Valley bordering eight other counties, namely Kericho and Bomet to the west, Baringo and Laikipia to the north, Nyandarua to the east, Narok to the south-west and Kajiado and Kiambu to the south (**Figure 4-16**). The county is divided into 9 administrative Sub-Counties, namely Naivasha, Gilgil, Nakuru, Rongai, Nakuru North, Subukia, Njoro, Molo, and Kuresoi. Njoro and Kuresoi were hived off from Molo Sub-County, Gilgil from Naivasha, Rongai from Nakuru Town, and Subukia from Nakuru North. Naivasha Sub-County occupies the largest land mass at 1,960.2 km^2. This can be partly attributed to existence of large uncultivated plains, vast cattle ranches, parks and animal conservancies as well as the lake Naivasha water body. The county headquarter is Nakuru Municipality, one of the fastest growing towns in East Africa region. The county has five towns and one Municipality, namely Gilgil, Molo, Njoro Subukia, Mai Mahiu and Naivasha. The proposed railway project will be undertaken in the Naivasha sub county to the south of Nakuru County.

Source: Kenya National Bureau of Statistics, 2013

Figure 4- 17: Location of Nakuru County

The Naivasha-Longonot-Mai Mahiu area stretches from the Mirera-Karagita area to the east of the lake and extends to the north as far as the Ilkek Plain towards Gilgil where the bed is 20 km across, thinning to less than 5 km just south of Gilgil. The western lacustrine margin is bordered by the volcanic hill masses of Kongoni and Maiella-Ndabibi Plain. The eastern lacustrine margin is bordered by the railway line especially, near Naivasha Town opposite the Kihoto area and elsewhere by the Kinangop fault scarp. The rift floor extends southwards towards Mount Longonot (2750 masl) south westwards towards the Olkaria hills complex (2400 masl) which are traversed by the Ol Njorowa Gorge (1920 m). The northern margin of the rift floor is interrupted by the Eburru Hills (2400m) which are part of the Mau Escarpment. The Eburru hills form the drainage divide between the lake and Lake Elementaita. The key environmental features and principal natural resources in the region include Lake Naivasha, Malewa River, wildlife, conservation areas, fisheries, geothermal resources.

4.6.4.2: Physiography, climate & hydrology

The main topographic features in Nakuru County are the Mau Escarpment on the western part of the county, the Rift Valley floor, Ol Doinyo Eburru Volcano, Akira plains, Menengai Crater, elaborate drainage and relief system and the various inland lakes on the floor of the Rift Valley where nearly all the permanent rivers and streams in the county drain into. Mau Escarpment is the source of Njoro River that drains into Lake Nakuru which is inhabited with flamingos, making it one of the premium parks in Kenya. These rivers include river Njoro, Makalia which drain into Lake Nakuru, Malewa which drains into Lake Naivasha and Molo River which drains into Lake Baringo among others. The topographic features are an interesting niche for research as well great tourist attraction sites. The most predominant is the Hells gate gorges in Naivasha which are an important tourist sites. The County's topographic features namely Menengai crater, Longonot crater and Hells gate among others are an interesting niche for research as well great tourist attraction sites. The county has a bimodal rainfall pattern with a high of 1800mm and a low of 500mm. The drainage pattern is strongly influenced by the rift valley with most rivers flowing from the rift escarpments into the rift floor. These rivers include river Njoro, Makalia which drain into Lake Nakuru, Malewa which drains into Lake Naivasha and Molo River which drains into Lake Baringo among others.

4.6.4.3: Biodiversity

The Naivasha-Longonot area is characterized by mountain ranges and savannah and lake ecosystem which that support a wide range of wildlife. The Lake Naivasha ecosystem has a wide a variety of water bird species, both resident and migratory and currently holds over 150 species. Various wildlife species are found within and around the lakeshore and its riverine entries. Hippopotamus amphibious is the largest fauna found in the riparian zone, followed by the ungulates such as antelopes, buffaloes, waterbucks, zebras, giraffes and elands. Lake Naivasha was designated as Kenya's second Ramsar site after Lake Nakuru (a wetland of international importance) in 1995. This is a unique Ramsar site, which is entirely surrounded by private land. Kenya Wildlife Services (KWS) is the custodian of Kenyan Ramsar sites and as such is an important and influential stakeholder in Lake Naivasha. Birdlife International has also been designated Lake Naivasha as an Important Bird Area (IBA). The region has several tourist attraction sites; two National parks (Hell's Gate National Park and Longonot National Park) and a number of wildlife sanctuaries (KWSTI, Marula, Kedong, Oserian, Crater Lake, Mundui, Crescent Island and Sanctuary farm).

4.6.4.3: Population

The county population projection in 2012 is estimated at 1,756,950, comprising of 881,674 male and 875,276 females with a population density of 234 per square kilometer. With a county population growth rate of 3.05% per annum the population is projected to increase further to 2,046,395 in 2017 assuming constant mortality and fertility rates. The county population is predominantly youthful with about 51.87% aged below 20 years and about 71.63% of the total population aged below 30 years. Both Naivasha and Mai Mahiu have a population of 84,857 and 5,617, respectively which is projected to increase to 215,883 and 14,333, respectively by 2017.

4.6.4.4: Economic sectors

The county economy is characterized by a wide range of sectors including agriculture, horticulture, livestock production, fisheries, forestry, mining, geothermal energy, tourism and industry. Agriculture in the county is associated with the production of maize, beans, Irish potatoes, pyrethrum and wheat. The types of fruits and vegetables produced in the county are tomatoes, peas, carrots, onions, french beans, citrus fruits, peaches, apples, cabbages, kales, strawberries, asparagus and leeks. The county has some of the largest flower farms in the county include Homegrown, Oserian, Karuturi and Preesman. The bulk of flowers grown in these farms are mainly exported to Holland, UK and Germany. The livestock sector is associated with dairy cattle, poultry, sheep, goats, beekeeping and rabbits. Among them, dairy production is a major livestock income earner. Fishing in Lake Naivasha is one of the main economic activities for the community living around supporting 50 fishing boats each with 10 fishing gears as the current sustainable fishing effort. The major on-going mining activity in Nakuru County is that of Diatomite at Kariandusi located along the Nairobi-Nakuru highway about 2Km east of Lake Elementaita. The region has several tourist attraction sites; two National parks

(Hell's Gate National Park and Longonot National Park) and a number of wildlife sanctuaries (KWSTI, Marula, Kedong, Oserian, Crater Lake, Mundui, Crescent Island and Sanctuary farm). The aesthetic beauty of the lake Naivasha riparian area, rich wildlife including birds, proximity to Nairobi, and availability of hotels and campsites attract both local and international visitors. The region has substantial geothermal resources within the Olkaria Geothermal Field which is located in to the south of Lake Naivasha, in the Naivasha Sub-County (**Figure 4-17**). A significant area of the Olkaria Geothermal Field lies within Hell's Gate National Park.

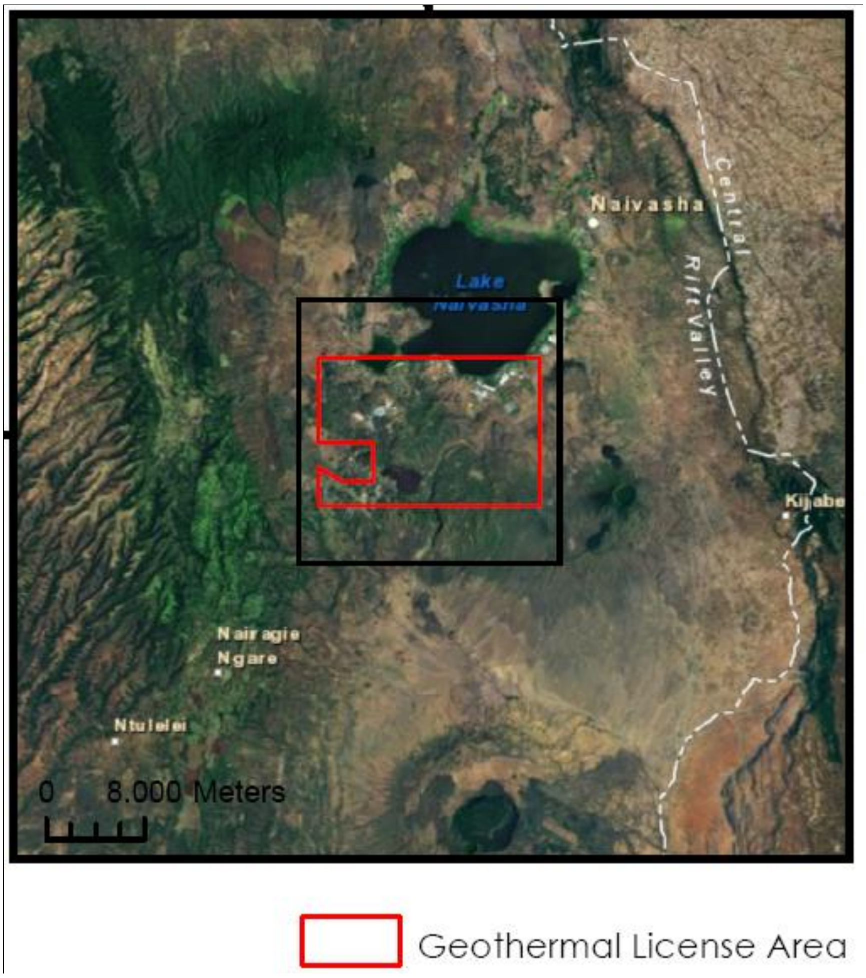


Figure 4- 18: Olkaria geothermal field

KenGen currently operates two Geothermal Power Stations at the geothermal field, namely Olkaria I and Olkaria II, located about 120 km Northwest of Nairobi. Olkaria I Power Station has three units that were commissioned in 1981, 1982 and 1985 respectively. Each of these three units produces 15MWe. Olkaria II has three units each generating 35MWe. The first two units were commissioned in September 2003 and the third in June 2010. There is a third operational Independent Power Producer (IPP) geothermal plant in Olkaria, owned and operated by Orpower 4 Inc, producing 48 MWe. Phase I commenced commercial operation in 2000 and phase II in January 2009. In addition, KenGen has also installed a wellhead generator producing 5MWe. Units 4 and 5 at Olkaria I and a new power plant, Olkaria IV, are currently under construction/commissioning. These two projects aim to deliver 280MWe before the end of the year (2014). Olkaria III IPP is also being expanded, and it has increased its installed capacity to 110MWe (by January 2014) from 13.6MWe (as at 2000). Plans to further increase the installed capacity are in place. The Government is planning to establish an industrial park in the Olkaria area near power generation areas. This will avoid the losses, costs and impacts of transmission lines and help to diversify the geographic spread of industry in Kenya. It will also allow for cascading uses of geothermal energy.

4.6.4.5: Transport infrastructure

The county has approximately 911.9 km of roads including 1,110.8km bitumen surface and 2,326.6km of gravel surface and of earth surface roads. The Nairobi – Uganda highway runs across the county thus promoting cross-border interconnections within the three East African countries. The county has a large network of unclassified roads that are maintained through funds disbursed from various agencies including County Government, Kenya Urban Roads Authority, Kenya National Highway Authority, Kenya Rural Roads Authority and Constituency Development Fund. In addition, the county has a railway line length of 192km connecting major urban areas of the county namely; Naivasha, Gilgil, Nakuru, Njoro, Molo and Rongai. It has ten railway stations serving as drop/collecting points for agricultural and industrial good as well as providing public transport from Nakuru to the Mombasa via Nairobi and Nakuru to Uganda via Eldoret, Kisumu, Busia and Malaba.

4.6.5:Narok County

The proposed railway will enter the Narok County from the Naivasha Industrial Park through Suswa and onwards to Enoosupuukia, Narok County.

4.6.5.1: Location and size

Narok County (17,944 km^2) is located on the South Rift Valley on the north of Tanzania, it borders six counties with Nakuru to the North, Bomet, Nyamira and Kisii to the North West, Kajiado to the East and Migori to the West (**Figure 4-18**). The county It constitutes 6 sub-counties namely, Kilgoris, Narok North, Narok South, Narok East, Narok West and Emurua Dikirr.

Figure 4- 19: Location of Narok County

4.6.5.2: Physiography, climate & hydrology

Narok County has an elevation of 1827m altitude above the sea level. It has a minimum of 8 and a maximum of 28^{0}C in temperature. The county receives two rainy seasons with an average of rainfall ranging from 500 to 1800 mm per year. Soils here are sandy loam with high nutrient content. However in order to fully utilize the soils farmers have to implement certain soil management practices in order to improve soil fertility for agricultural purposes. Floods are experience in some parts of the county which are low lying and generally flat. However this only happens during the heavy rainy seasons. Farmers have constructed dams in order to prevent soil erosion and conserve some of the run off for agricultural purposes.

4.6.5.3: Biodiversity

Narok County is well endowed with rich diversity of both flora and fauna. It is one of the wealthiest counties in terms of wildlife. The county is the home of the world famous Maasai Mara Game Reserve which offers one of the world's most important habitat areas for a great variety of wild animals. The Masai Mara ecosystem plays host to one of the most spectacular wildlife sceneries: the great wildebeest migration. The has over 54 species of wildlife mammals, 300 species of birds and over 123 species of plants and several species of insects, fish, amphibious and reptiles. The county has many species of microbes, which play various important economic and ecological functions. It also has wide varieties of crops and livestock species which contribute significantly towards socio-economic development. The variability of ecosystems in the district includes: forested, wetlands mountainous/hilltops rangelands/conservation areas. In the past, large numbers of roan antelopes, kudus and wild dogs were found in large numbers in the 1970s. However, currently these species are no longer found. The black rhino and cheetah despite been placed under appendix1 of the CITES (endangered species) heir population has continued to decline. The striped hyena has disappeared from the Maasai Mara National Reserve and is traced more than 20 km in the group ranches while wild dogs which dominated the park some years ago are only found far flung areas such as Loita forest. Wildlife decline to the tune of 58% has been recorded in the district in the last two decades.

4.6.5.4: Population

Narok County has a population of 850,920 according to the census that was conducted in 2009, the totals percentage of women to men is equal being 50%. The percentage of those living in the urban area being 6.9% while the other resides in the rural area.

4.6.5.5: Economic sectors

Narok County has rich soil that is suitable for agriculture. There is growing of wheat and barley which are grown in large plantation for local use and international by exporting it to neighbouring countries Maize production in the county is grown in small scale for own consumption and for large scale farmers who use it for own use and selling the quantity yield to the surrounding towns. Livestock keeping is also practised in the county both in large scale and small scale. There are a number of ranges that keeps: goats, cows, and sheeps, some of the animals keeps are for beefs while others are for milk production. Poultry keeping and bee keeping are the emerging agriculture activity that the government is encouraging the people to invent one as a source of income. Just like in most of the other Counties in the country, Agriculture is main economic activity carried out in Narok County. Most of the residents are either livestock farmers all grow the various crops on large scale or small scale depending and this depends on the size of land available for a particular activity. Some of the crops grown are wheat, maize and barley which are processed and used to make food products such as flour and beer. The tourism sector is quite vibrant in the county due to the annual wildebeest migration in the Maasai Mara National Reserve which attracts many local and international visitors from June to October. Apart from the wildebeest, the other key attractions are lions, leopards, cheetah; hippos, wildebeest, elephant, zebra, impala, topi, giraffe, Thomson’s gazelle.

4.6.5.6: Transport infrastructure

The County has a road network of approximately 2,798.4km, (260 km bitumen, 840km gravel surface and 1,698.4km earthen), connecting the various administrative areas of the County. The county has no railways.

4.7: Characteristics of key areas in the SGR route

The key built up areas and valued ecosystems and sensitive environments along the proposed SGR route are highlighted below.

4.7.1: Ongata Rongai

Ongata Rongai is a fast-growing, mainly residential area at the outskirts of Nairobi. The suburb is located outside the western edge of Nairobi National Park. The town is located between the Kaputei plains and the western slopes of Ngong hills approximately 17km from Nairobi. Ongata Rongai is densely populated in its eastern side where there are multi-storey apartment buildings while the western side is settled with individual medium to high-cost houses. It is a multi-class area which is dominated by the middle-class living in middle-class housing situated mostly around the urban centre. Ongata Rongai urban centre comprises four sub-locations. Ongata Rongai sub-location is located south of Magadi Road and comprises the main commercial area surrounded by low-cost apartment houses as well as high and medium cost housing areas located between Magadi Road and Kandisi River. On the other side of Magadi Road are Kware and Mosoi Range sub-locations which are densely populated areas with mainly low-cost housing. Middle class housing estates have developed mainly in Kandisi sub-location.

4.7.2: Ngong Hills

Ngong is a town near the Ngong Hills along the Great Rift Valley, located in the southwest of Nairobi, in southern Kenya. The word "Ngong" is a Maasai word meaning "knuckles", referring to the 4 hill peaks of the ridge, which stands alone rising from the plain around Nairobi. The Ngong Hills, from the eastside slopes, overlook the Nairobi National Park game reserve and, off to the north, the city of Nairobi. Ngong town is 1,961 meters in altitude, but the altitude of the hills is about 2,460 meters above sea level. The Ngong Hills, from the westside slopes, overlook the Great Rift Valley dropping over 1,000m below, where nomadic Maasai live.

The Ngong area is characterized by the Ngong forest reserve and sanctuary (1329.25ha) is located 6km to the west of Nairobi Central BusinessDistrict in a gently undulating landscape. Ngong Forest was first gazetted in 1932 and covered nearly 3,000 hectares; this size has however reduced drastically due to deforestation. The forest is composed of forest plantations and natural vegetation. Itis bordered to the east, Langata road to the west and Ngong Road to the South. According to the Kenya Forest Service, 80% of the sanctuary is indigenous forest with trees such as *Doryopteris concolor, Pleopeltis macrocarpa, Croton megalocarpus,* Drypetes *gerrardii, Juniperus procera* while 20% is composed primarily of Eucalyptus (Blue Gum species) plantations, bush, thicket, shrubs and open grasslands interspersed with Eucalyptus tree species. It lies between 1800-1820m. Such flora include*: Dovyalis caffra, Dovyalis macrocalyx, Dombeya burhessiae, Hibiscus calyphyllus. The common g*rass species include D. *macroblepharis*, *cynodon dactylon* and H.*schimperi*. The forest reserve is a valued habitat for birdlife and other wild animals. The forest reserve and sanctuary has over 175 bird species, over 35 mammals and numerous insects, reptiles, amphibians and fish. The common bird species include; grebes, cormorants, darters, herons, ibises, storks, ducks, geese and hamerkops among others. Reptiles include; snakes, lizards, tortoises, toads and frogs.The mammals found in the forest include among others: bush buck, dik dik, duiker, Sunni antelope, leopard, hyaena (spotted), baboon, vervet monkey, aardvark, porcupine, squirrel, tree hyrax. The size of the forest reserve has recently been reduced as a result of urban developments such as new housing estates in Langata and the Southern By-pass road. The Ngong Hills are also associated with the Ololuwa forestwhichis a typical dry forest composed of natural and isolated forest plantation stands. Main vegetation type is almost similar to what is found in Ngong forest.

4.7.3: Kamangu area

Kamangu is located within the Karai-Ndeiya area of Kikuyu Sub-county which is one of the driest parts to the west of Kiambu County with a rainfall of 350-800mm. The area is characterized by flat terrain and rolling hills at the rim of the rift valley. The hills are generally elongated and their crests run in a north-south direction. The slopes range in steepness from gentle (5-10%) to high (20-30%) with steep slopes (40-60%) occurring on slopes that consider with geological faults along the Great Rift Valley. The area has no major streams and rivers due to the overall state of arididity. However, some areas are characterized by springs associated with underground water flow the southern Aberdares. Some areas are also characterized by bogs and marshes as a result of the impended drainage associated with black cotton soils (vertisols) which are common in the area. The average altitude is between 2000 and 2200 m and is generally underlain by the Limuru Trachytes. The original vegetation in the area was semi-decidious *Brychylaena-Croton* forest in the hills and thickets in the lowlands. From 1910 onwards, the forest and thickets were progressively lost through cultivation and grazing. In recent years, reforestation in the area has progressively increased vegetation cover through the introduction of *Eucalyptus*, *Grevillearobusta*, as well as the remnant *Croton megalocarpus*. The common herbaceous species include, *Justicia* and *Rhamphicarpa*, *Digitaria gazensis*, *Hyparrhenia lintonii* and *Cynodon dactylon*.The area marks the boundary between the Kikuyu to the east and Massai communities to the west. Prior to the arrival of the sedentary Kikuyu to the area in the early 20th century, the area was frequently used by the migratory Masai pastoralists. The names of the villages and other landmarks in the area still bear Masai origin. Agriculture is the key landuse in the area with maize, beans, peas, sweet potatoes, pyrethrum and vegetables as the principal crops. Livestock production is also a key livelihood for the people in the area.

4.7.4: Ewaso Kedong

This is the area immediately to the west of Kamangu down in the rift valley floor to the south of Mai-Mahiu. The area is generally flat with an almost uniform elevation at approximately 1800m. The semi-arid area with a rainfall of 300-500mm is characterized by the pastoral Masai pastoral communities who are rearing cattle, sheep and goats. It is characterized by dry rangeland vegetation dominated by *Tarconanthus camporatus* and *Acacia drepanolobium* with the riverine environments also supporting *Acacia xanthophloea*. Ewaso Kedong is an area associated with tectonic activity and has previously been associated with the occurrence of mild earth tremors at an average of one every 50 years. It is a water scarce area which has previously experienced water related conflicts.

4.7.5: Mai Mahiu

Mai-Mahiu (544km2) is located approximately 50km to the northwest of the City of Nairobi. Mai-Mahiu town is a key intersection for the Northern Transport Corridor with key connections to Kericho, Kisii, Eldoret and Kisumu through Naivasha, Gilgil and Nakuru (A104) or the same destinations through Narok, Kilgoris and Bomet (B3). It is a dryland town with low rainfall in the range of 200-800mm. It is bordered by Longonot to the north, Kijabe, Kiambogo and to the east, Ewaso Kedong to the south and Satellite and Suswa to the west. The town is an important stop for cargo trucks along the Northern Transport Corridor. Mai Mahiu area had a population of 29,796 people in the 2009 national population census. The town had 11,230 people which is expected to increase to 14,333 people in 2017. During the 20017-2007, the town received a large number of post-election violence (PEV) internally displaced people (IDPs) from Narok, Eldoret and other parts of the country most of whom are still settled there in a number of IDP camps.

4.7.6: Longonot

Longonot Town is along Mai Mahiu Naivasha Road approximately 60km to the north west of Nairobi. It is a small town also used as a transit town. It has parking area for the Transit Trucks. It is located next to Mount Longonot, a stratovolcano located southeast of Lake Naivasha in the Great Rift Valley. Mount Longonot is protected by Kenya Wildlife Service as part of Mount Longonot National Park. The Longonot National Park is one of the geoparks in Kenya consisting of a savannah ecosystem. It covers 52 km2 most of it being occupied by Mt. Longonot a young volcano rising to 2,776 meters above sea level. Mount Longonot is a stratovolcano created during the formation of the Great Rift Valley, and located southeast of Lake Naivasha in Kenya. It is thought to have last erupted in the 1860s. Longonot town is currently served by the narrow gauge railway operated by the RVR. The Longonot area had a total of 8,750 people in the 2009 national population census.

4.7.7: Olkaria

The Olkaria area comprises volcanic features that consist of steep sided domes formed from pyroclastic rock and lava flows (**Plate 4-3**). The domes enclose an approximately circular depression that has been cut by the Ol Njorowa Gorge, which was formed by out flowing water from Lake Naivasha. Within this complex, there are several small valleys that drain the upper slopes and discharge runoff and sediments to the foot slopes and plains below. The climate in the Olkaria area just like the rest of the Rift valley floor is characterized by high temperatures with the mean minimum monthly levels ranging from 15.9 - 17.8°C with a mean of 16.8°C.

Plate 4- 3: Olkaria area

Previous biodiversity surveys in the area have indicated that the area is dominated two vegetation communities, namely the mixed open grassland and shrub-lands and the bushlands. The bushland have a strong presence of *Tarchonanthus camphoratus*, dotted with *Acacia drepanolobium* and a diversity of herbaceous and grass species. A characteristic grass tussock (*Hyparrhenia dregeana*) very effective in binding soil and preventing soil erosion occurs underneath some parts of *Tarchonanthus* bushland area. The wildlife is characterized by the presence of the buffalo, zebra, impala, eland, Thomson's gazelle, grant's gazelle, giraffe, waterbuck, dik dik, warthogs, leopards, and more than 100 species of birds including the ruppel's vulture and white-backed vulture.

KenGen currently operates two Geothermal Power Stations at the geothermal field, namely Olkaria I and Olkaria II, located about 120 km Northwest of Nairobi. Olkaria I Power Station has three units that were commissioned in 1981, 1982 and 1985 respectively. Each of these three units produces 15MWe. Olkaria II has three units each generating 35MWe. The first two units were commissioned in September 2003 and the third in June 2010. There is a third operational Independent Power Producer (IPP) geothermal plant in Olkaria, owned and operated by Orpower 4 Inc, producing 48 MWe. Phase I commenced commercial operation in 2000 and phase II in January 2009. In addition, KenGen has also installed a wellhead generator producing 5MWe. KenGen is also implementing its vision 'to be the market leader in the provision of reliable, safe, quality and competitively priced electric energy in the Eastern Africa Region', through its Good to Great (G2G) Transformation Strategy. Part of the G2G vision is to add at least 3000MWe to KenGen's current generation capacity by 2018. Geothermal expansion is listed under the Capital Planning and Execution strategic pillar of the G2G strategy.

Maasai communities live within and around the National Park. The Maasai are generally pastoralists, and use the land for grazing cattle, sheep and goats, and for firewood collection amongst other activities. Resettlement Action Plans have been implemented in the geothermal area when KenGen has acquired new land to expand geothermal operations (**Plate 4-4**). The Resettlement Action Plan (RAP) for Olkaria IV involved 1,737 people.

Plate 4- 4: Maasai resettlement area in Olkaria

Kengen has set aside 1,300 acres in Olkaria Naivasha for the construction of an industrial park. Five sites in the geothermal rich area have already been identified for the park with Kengen targeting high consumers of electricity. Kengen is planning to partner with Export Processing Zone Authority (EPZA) in setting up the industrial park. The company would offer subsidized power to factories within the industrial park among other incentives. The SGR is expected to connect with the Naivasha Industrial Park in order to provide the means for the easy transportation of cargo to and from the park.

4.7.7: Suswa

Suswa is located about 80 km by road from the capital city of Nairobi (**Figure 4-19**). It is an important cultural area for the Maasai community. The Suswa area is also associated with Mount Suswa which is located about 10km to the south of Suswa shopping centre (Figure 4-20). The Suswa volcanic caldera is part of the Kenya Dome, an elevated area about 2000 m above sea level.

Mount Suswa has a geothermal potential which is associated with the shallow hot magma that exists under the inner caldera. The magma may be within a depth of 3-5km. Gravity data at Mount Suswa show existence of shallow magma beneath the calderas and geothermometric temperatures exceeding 250^{0}C. In the northern section, fumaroles emanate from the outer caldera fault indicating that some vertical permeability exists in this zone.

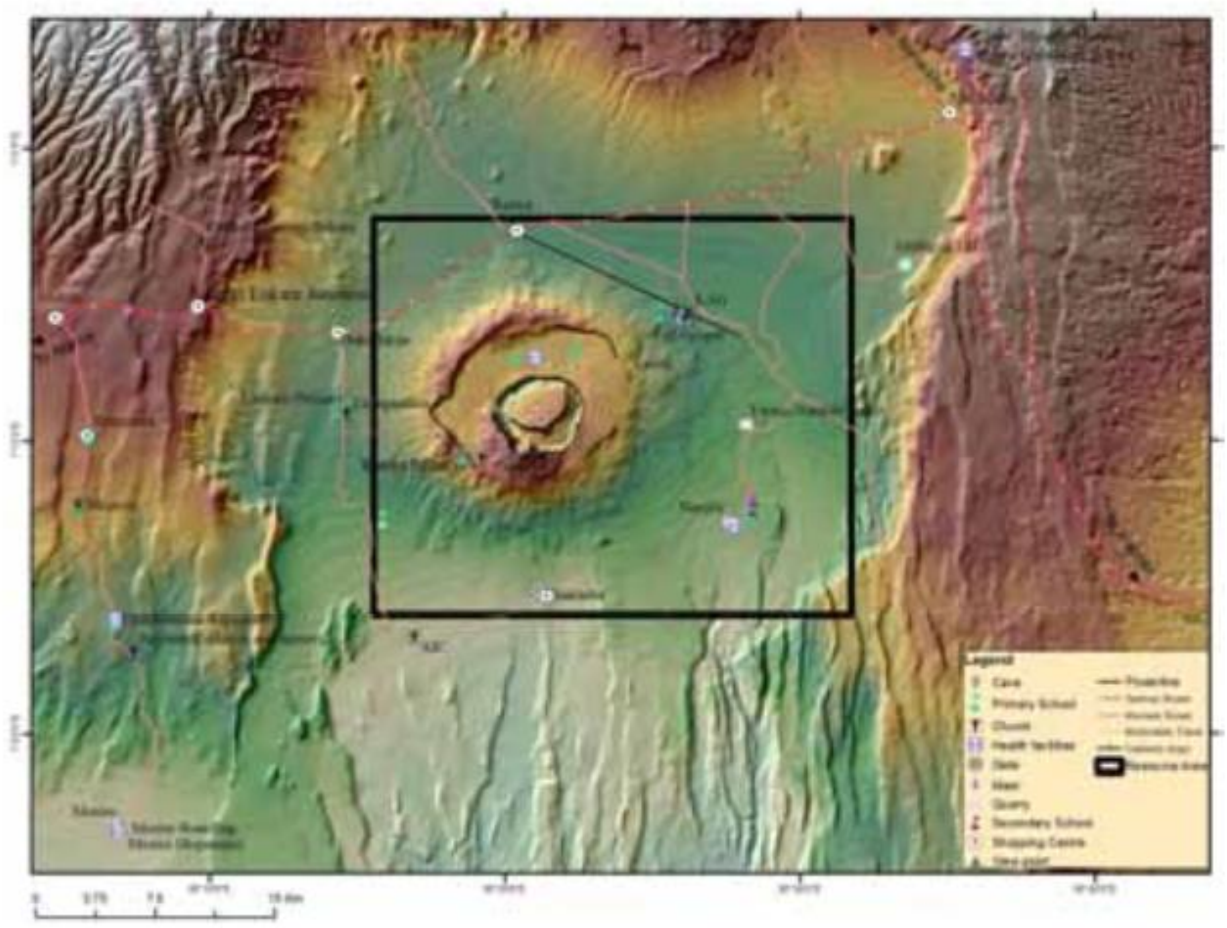


Figure 4- 20: Location of Suswa market

A recent assessment by GDC (2014) showed that the landcover in the Suswa area is characterized by about seven rangeland vegetation communities including open grassland, bushed grassland, shrub-grassland, bushland, woodlands, mixed bushland and shrubland. The largest open grassland consists of *Cynodon/Digitaris* associations in the relatively flat areas around Mt. Suswa. The dominant grass species in these areas are *Cynodon dactylon* and *Digitaria scalarum*, although the former dominates the dense tall clumps. Other common species include *Themeda triandra*, *Harpachne schimperi*, and *Justica sp*. There is also a sparse distribution of *Tarchonanthus camphoratus* (Leleshwa) and *Acacia drepanolobium* in the clump areas. The bushed grasslands are dominated by *Tarchonanthus camphoratus* and *Acacia dreponolobium*. The bushland is open and extensive with diverse topography which forms micro habitats in the Suswa areas. The most common woody species are *Acacia drepanolobium* and *Tarchonanthus camphoratus*. The bushland areas also have combinations of grasses and other herbaceous species including *Setaria sphacelata* and *Eragrostis cilianensis*. *Chloris gayana* appears in patches that are more open.

The bushed grassland community occupies extensive parts of Suswa area where the dominant woody species are *Tarchonanthus camphoratus*, *Acacia drepanolobium and Dodonea latifolia*. The dominant grasses of this vegetation community are *Digitaria macroblephara*, *Cymbopogon caesius*, *Setaria sphacelata*, *Themeda triandra* and *Cynodon* dactylon. The bushed shrubland community dominate the Olugumi area of Mount Suswa, continues upward the Suswa outer caldera and ends at the top of the caldera. The area is characterized by shallow soils with Acacia drepanolobium being the dominant species. There is also *Tarchonanthus comphratus* but tends to be stunted in growth. Within the shrubbed grassland community, the dominant species include *Tarconanthus, Acacia*, *Cymbopogon*, *Themeda* and *Setari*a. The woodlands cover various parts of the area in the Suswa caldera and foot of the mountain. The most dominant species are *Acacia xanthophloea*, *Juniperus procera* (cedar), *Ficus thonningi*, *Dodonea viscose*, and *Euphobia inequilatera*. The distribution of this community of vegetation is probably related to differing water retention capacity of soils and geothermal features such as steam vents. These areas are also likely to form important grazing areas of the local Maasai people.

Suswa area is characterized by a number of wildlife species which include giraffes, Thomson's gazelle, dik-dik, Grant gazelle, rock hyrax, leopard, hyena, and buffalo. Primates including baboons and monkeys are commonaround Mt. Suswa. However, the zebras and Thomson's gazelle are the most dominant species in the Suswa ecosystem. The common avifauna in the area include Kori Bustard and Secretary Bird. The Kenya Electricity Transmission Company (KENTRACO) is establishing a power transmission sub-station in Suswa. The expanded sub-station with a capacity for 1000 megawatts will distribute electricity from the Olkaria geothermal power stations to other areas including the City of Mombasa. The Kenya-Ethiopian power grid will also be connected in Suswa substation.

4.7.8: Enosupukia

Enoosupukia Location (Narok County) and the neighbouring Maiella Sub-location (Naivasha Sub-County, Nakuru County). Enoosupukia location covers an area of approximately 215km^2, and includes a diverse topography. From its lowest point, around 1,600m above sea level at the foot of Mount Suswa, a massive extinct volcano on the Rift Valley floor, the location stretches over a gently rising plain before climbing up the south-eastern end of the Mau Escarpment to a ridged plateau with a maximum elevation of around 2,800 meters above sea level. The locality from which Enoosupukia location takes its name is found in the highland portion of the location, and was once blanketed by a thick, Afro-montane forest. Enoosupukia derives its name from the Maa-language word osupukiai, which identifies a species of tree (*dombeya dombeya*) that blooms seasonally with clustered white flowers, from which bees produce a very sweet, white honey. Enoosupukia was, literally, the place of *dombeya* trees, most of which, along with numerous other species that composed this portion of the Mau forest. Apart from Maasai, villages in Enoosupukia area is occupied by Kikuyu and other non-Maa people (e.g. Kamba, Baganda, Kalenjin, Luhya etc., who also rent farmland). The SGR Phase IIA will terminate at Nairagie Enkare in Enosupukia location.

4.8: Baseline environmental characteristics for the proposed railway route

4.8.1: Physiography, geology and lithology

The Railway runs across parts of Nairobi, Kajiado, Kiambu, Nakuru and Narok Counties. The terrain along the railway fluctuates from low lying areas around the Nairobi area climbing to the eastern Rift escarpment before descending to the floor of the Rift Valley and then rising towards DK120 which lies on the flanks of the western escarpment of the Rift Valley. The area along which the line passes can be divided into: the volcanic plateau area around the Nairobi and Kajiado section, rising section around the escarpment of the Great Rift Valley/Ngong hills within Kajiado and Kiambu giving way to the middle-low section within the Rift Valley floor in Nakuru marked with several volcanic cones and the rising west plateau area around DK120 which lies on the western side of the Rift Valley in Narok County.

The overall lithographic profile along the SGR-IIA route generally varies from one section to the other and can be described based on the following sections:

a) Section I: Volcanic plateau area

This is the first section associated with the area west of the Kapiti volcanic plateau where the altitude is about 1600-1800m and the terrain slightly tilted to the east and the topographic relief is small. In this section the formation lithology is mainly of Neogenephonolite, tuff and basalt, with a Quaternary over burden mainly composed of black clayey soil layer (Vertisols) forming a thin layer with depths not exceeding 2m.The overburden is expansive some section towards Athi river are however comprised of non-expansive variety an example being around the cement factories.

b) Section II: Middle-low mountainous area

This section crosses the shoulder of the Great Rift Valley with a large section of the railway running parallel to the ridges and relatively gentle valleys because of the action of the serious fracture and subsidence. Some sections have steep cliffs. In terms of lithology, it comprises mainly of trachytes and basalts with intercalations of pyroclastics. The overburdenis thin and is mainly composed of brownish red silty clay and sporadic vertisols soil in the low lying areas. The section is highly fractured with a dense fault pattern oriented mainly in a North-South direction which has been associated with the formation of the Rift Valley system (Saggerson, 1991). The series of faults in this section is of great hydrogeological significance since the faults act as conduits for ground water recharge thus potentially a good source of ground water and source of streams. As the integrity of the rock mass is poor, the section can be subject to collapse and rockfall.

c) Section III: Rift valley floor

The rift valley bottom has an open terrain and large scale of volcanoes.Thesection is made relatively of gentle valleys and minor ridges and has less visible linear structures relative to the previous section. It has been reported to be subject to subsidence due to Quaternary overburden that is distributed unevenly and is generally thick in the valley bottom. This section of the railway passes between Longonot and Suswa mountains with lithology comprising of mainly Neogene-Quaternary basalt and trachyte with a mix of pyroclastic deposits, evidence of which is a quarry around Namucha (CK74+000) where welded tuff is quarried. Pumice was observed at CK104+000 with the volcanic ashes being dominant in large section of the area and being extracted for construction.

d) Section IV: West mountainous area

The west section of the line CK106+000-CK120+000, has a higher elevation, steeper terrain and greater variation in relative height difference than that in the east part with the hillside geology at CK104+000 observed to comprise of a mix of trachytes and pyroclasts and an evidence of layered lacustrine deposits. Some valleys can be found between steep ridges and the strike of ridges is approximately in parallel with that of the Great Rift Valley. The lithology is mainly of Quaternary basalt and trachyte with evidence of phonolites at the section CK110+000 but with an overburden of thin brownish red silty clay, and sporadic Vertisols in the low-lying areas. Some sections have many steep cliffs and the integrity of the rock mass is poor with the possibility of collapsing resulting in rock fall. This is common in the southern end of Njorowa Gorge over which the proposed SGR will be constricted (**Plate 4-5**). Structurally controlled drainage system within this section indicates presence of linear structures which however is of lower intensity than that of the Eastern side. **Figure 4-20** shows the physiographic profile of the proposed SGR-IIA route.

Plate 4- 5: Njorowa gorge near Suswa over which a super bridge will be built for the proposed alignment

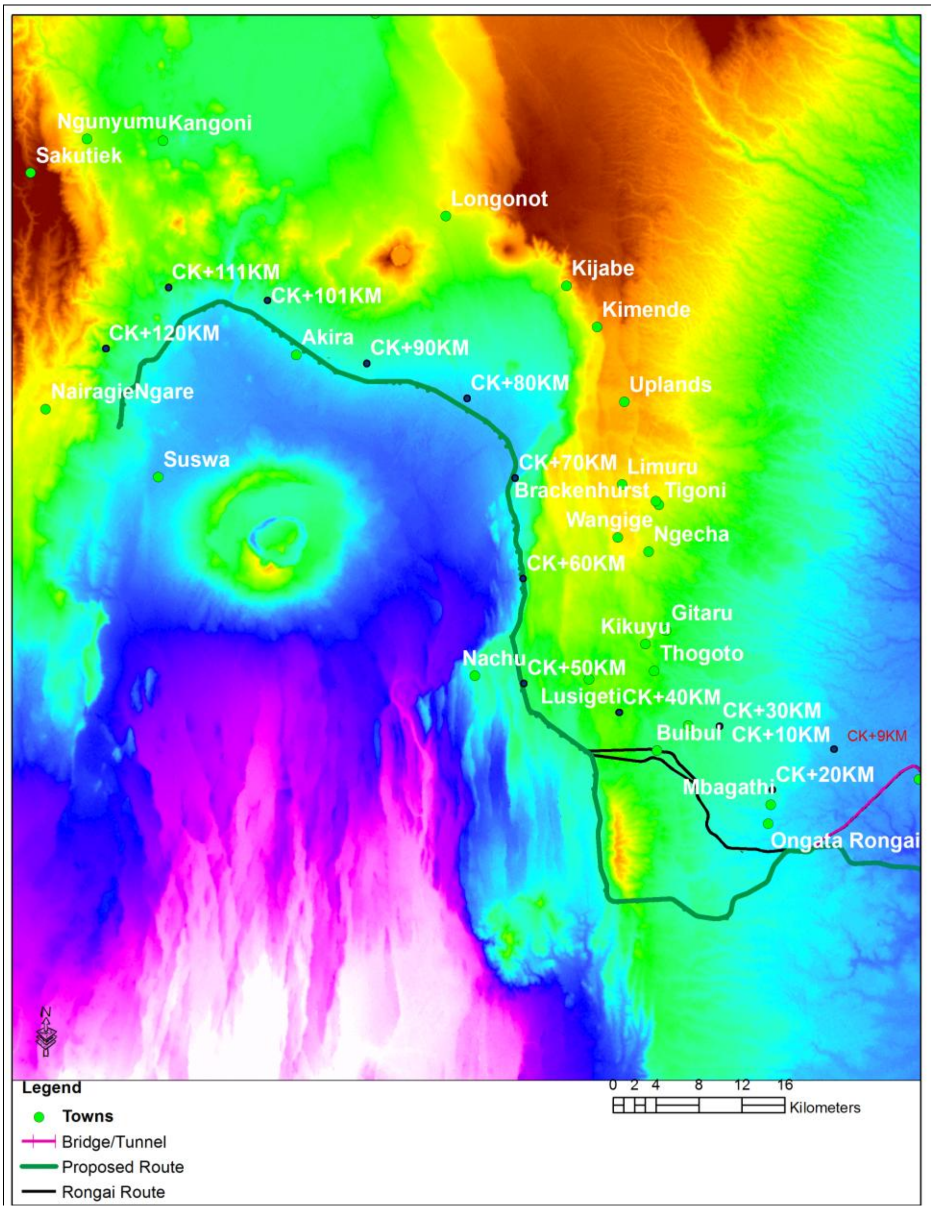


Figure 4- 21: Topographic profile of the proposed railway route (ILRI GIS database)

Figure 4-21 shows the geological profile of the railway route. The stretch of the railway lies mostly on the eastern and central parts of the Rift Valley composed of tertiary volcanic rocks and quaternary sediments overlying the basement system rocks at depth. The lithology of the entire section is mainly of Neogene-Quaternary volcanic rocks namely basalt, trachyte, phonolite, pumice and tuff. This is overlain by Quaternary overburden that is distributed unevenly, generally thick in the valley bottom and the gullies on both wings and thin in especially the higher terrains. There is also artificial filling soil mainly distributed in the cities and towns, villages along the railway and near existing roads and railways, as artificially filled foundation of existing works (CCCC Feasibility report, 2015).

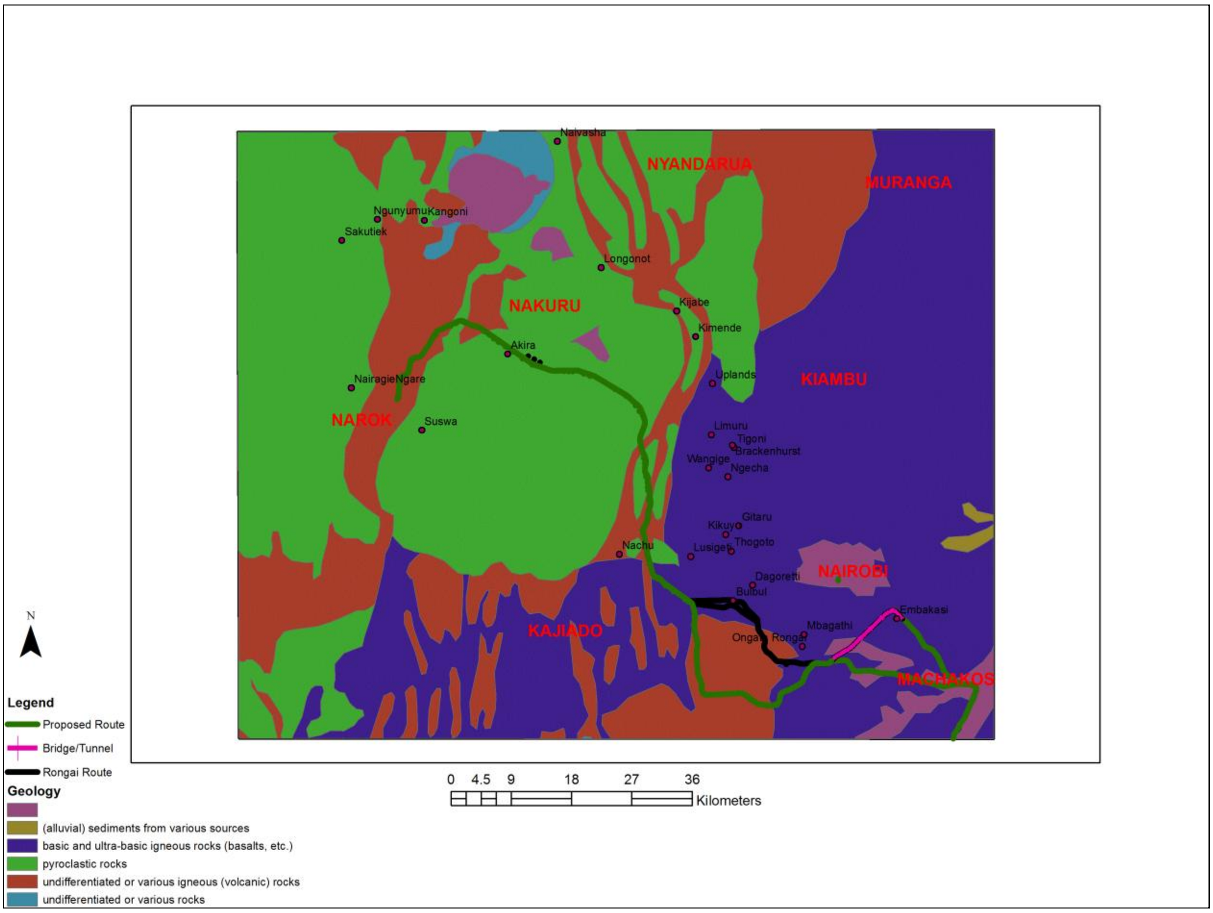


Figure 4- 22: Geological profile of the proposed railway line route (FAO database)

The rocks comprise of both Quaternary Pleistocene and Neogene Pliocene epoch series. The Quaternary series comprise of Basalt which are dark green to black gray with a porphyritic texture. They are mainly distributed in the mountainous area on both wings of the rift valley. Phonolites which form massive structure, with joint fissure development, rigid lithology and strong weathering resistance are the other formations in this series. Trachytes which are light gray-light yellow, with pores, porphyritic and trachytic structures are the other group in this series. These formations are relatively stable in terms of engineering properties. Tuffs found in this group are light yellow and grey white, with bedding and large thickness of completely weathered layer. Relatively to the other rocks they are of poor engineering properties. The Neogene Pliocene series comprise of mainly the Kapiti volcanic plateau near Nairobi and the mountainous areas on both wings of the rift valley and comprise of phonolites, tuffs and pumice.

The railway crosses the eastern branch of the Great Rift Valley described as the largest fault depression in the world that is also an active zone of crustal movement. Both wings of the Rift Valley are the zones with relatively active fault depression development, especially the cliff zone close to thevalley bottom (CK32+000-CK71+000 and CK106+000-CK120+000) in which the fault depression activity is the most prominent. A large number of normal faults are developing along the strike of the rift valley. These faults are very long, wide, densely spaced and relatively active. Currently, both wings are the zones of relatively active faults and a large number of normal faults are developing along the strike of the rift valley in a north-south direction. The area is therefore subject to a lot of seismic activity and thus prone to earthquakes. The proposed line also passes through sections comprising of volcanic centres such as Mt. Longonot, Mt. Suswa and Mt. Margaret. These volcanoes have been reported to have erupted in the last 10, 000 years. Mount Suswa**,** witha 12 x 8 km caldera is said to be volcanically active (Johnson, 1969). **Figure 4-22** shows the lithographic lineaments and volcanic centres along the proposed rail route.

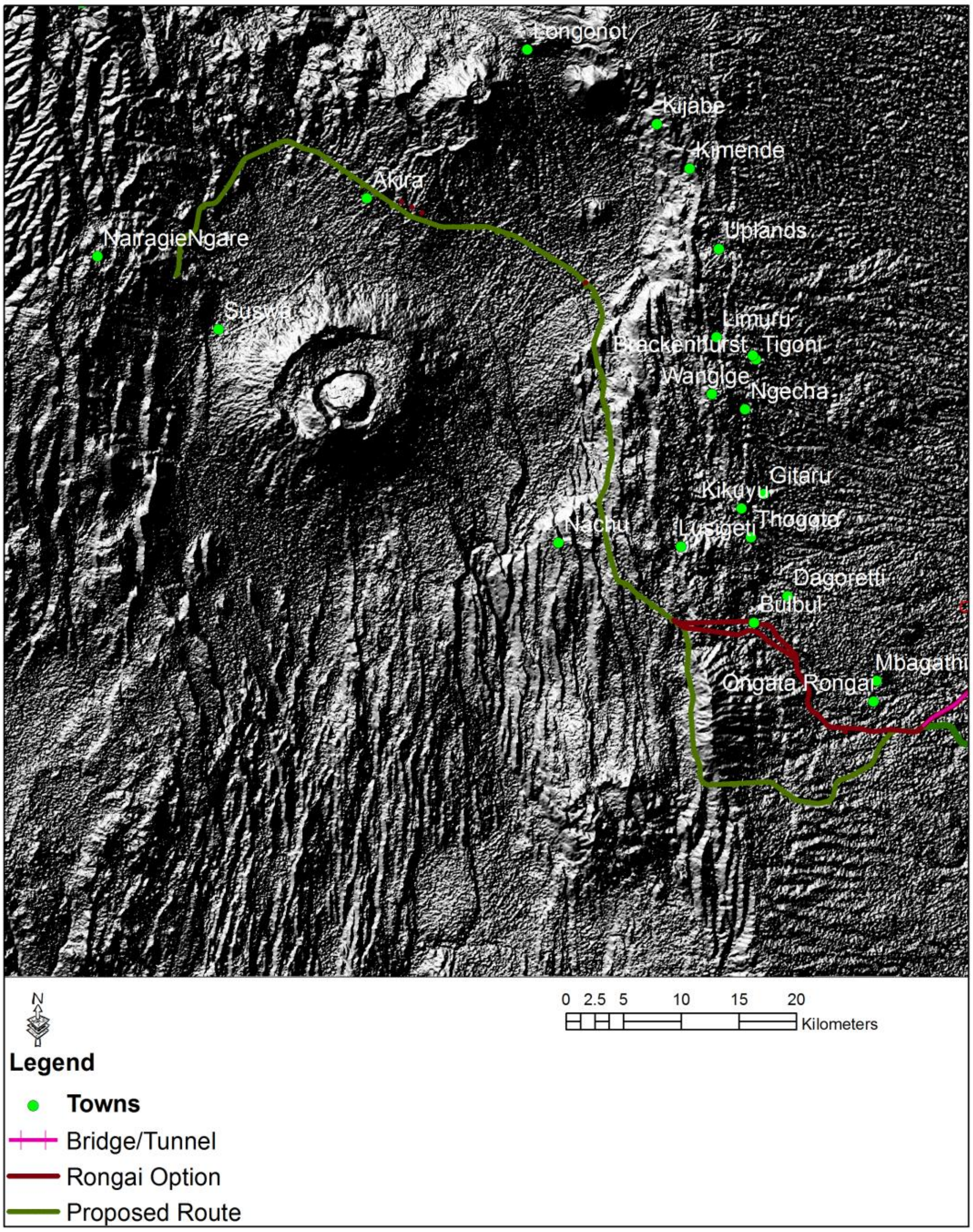


Figure 4- 23: Lineaments and volcanic centres in the route area (ILRI database)

4.8.1.1: Potential geological risks

The main unfavorable geological conditions along the route for the proposed SGR-IIA include dangerous rockfall, highly seismic zone, collapsible and expansive soils and in the long term, and potential volcanic eruption. The main environmental risks are discussed below.

a) Surface collapse and rock falls

Both wings of the rift valley features large topographic relief and complex geologic structures in form of active faults and large joint features on the rocks. Rocks exposed on the abrupt slopes due to such faults with joints and at high topographic relief are subject to collapse and rock fall.

b) Seismicity

The entire section of the line is in the seismic zones of high intensity VII (CK0+000-CK32+000) and VIII-IX (CK32+000-CK120+000) as shown in **Figure 4-23**.

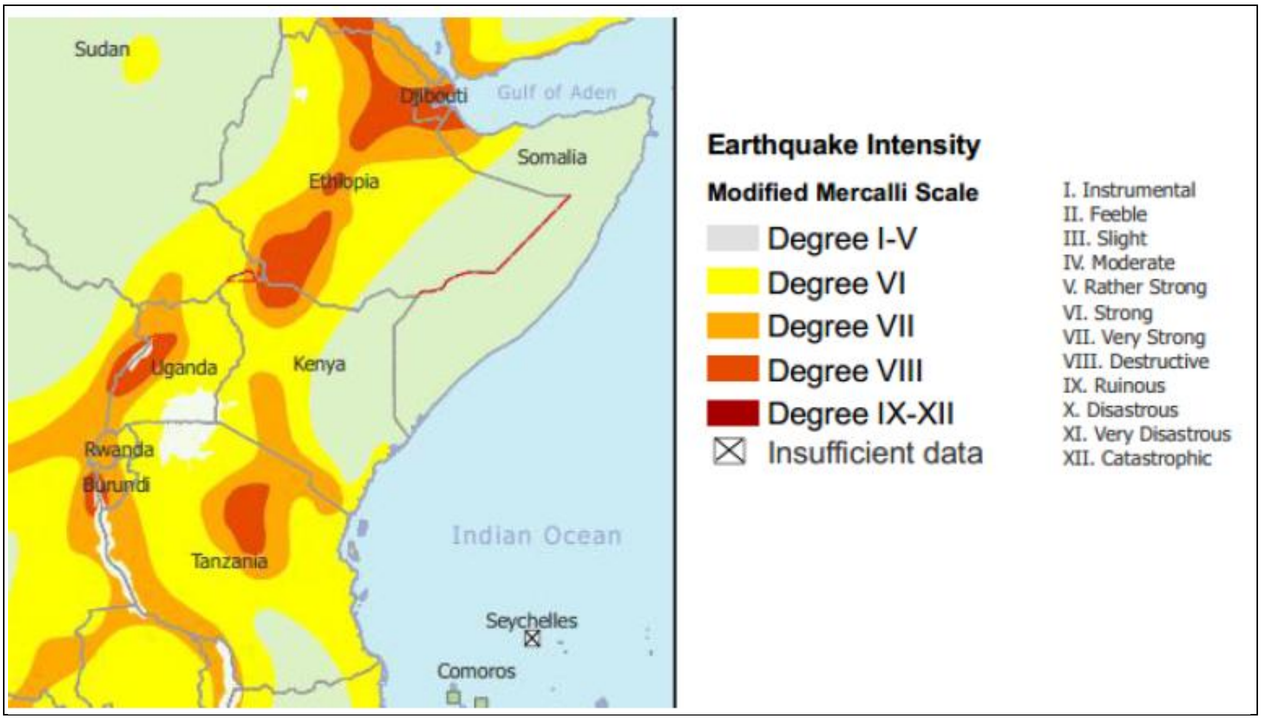


Figure 4- 24: Earthquake Intensity Map for Eastern Africa (OCHA (2007)

Earthquakes due to these active faults is therefore a possibility and should be taken into consideration together with their secondary effects such triggering of landslides coupled with rock falls, rock slides or debris flows in the hilly areas and the steep slope area sections. The Subukia Valley earthquake, magnitude 6.9, which occurred on January 6 1928 (Ambraseys, 2007) provides an indication of such a probability. The earthquake triggered rock falls and minor landslides and exhibited long-period effects at large distances. In the process of studying this earthquake, the seismicity of the (Gregory) Kenya Rift Valley has been re-evaluated. Mulwa and Kimata (2012) indicated that earthquakes in Kenya are common along the Kenya Rift Valley due to the slow divergent movement of the rift and hydrothermal processes within the geothermal fields implying slow but continuous radiation of seismic energy which relieves stress in the subsurface rocks. (WHO, 2010) Seismic Hazard Distribution Map and Code of Practice for the Design & Construction of Buildings & Other Structures in Relation to Earthquakes (KENYA, 1973), show the ground motion peak acceleration along the railway ranging between 0.1-0.15g for section CK0+000- CK32+000) and 0.20-0.40g for CK32+000 -CK120+000) section. Attention should therefore be paid to the impact of the potential earthquakes.

a) Volcanic eruptions

In the longer term the presence of volcanic centres within close proximity to the line such as Suswa, Longonot and Margaret could provide a source of risk in terms of volcanic activities. This makes the proposed line susceptible to likely volcanic eruption based on the fact that the line passes 10.6km south of Mt. Longonot and is less than 20km from Suswa. Eruptions are also associated with seismic activities prior to their happening and such also brings secondary effects as previously described.

4.9: Soils

The geology and geomorphology along the proposed route for the SGR-IIA have significantly influenced soil formations. The Quaternary overburden which characterizes a large part of the railway route has given rise to a variety of soils which area however dominated by Vertisols, Eutric-nitosols, Ando-haplic/Luvic Phaeozems, Calcaric Regosols and Gleyic Solonetz*.* **Figure 4-24** provides a detailed soil map for the proposed SGR-IIA route.The *vertisols* are mainly distributed in the low-lying region of Kapiti plateau area and ridge surface layer on both wings of the Rift Valley. The soils comprise of over 70% clay content comprising mainly of the Montmorillonite clay mineral type with silt and sand forming between 15 and 20%. The high percentage of the clay content made up of the said mineral type makes sections where it is found risky in terms of the soil expanding during the rainy season and contracting during the dry season by greater than 50% due to absorption of free water in the inter-layers of the crystal structures. This will offer a great challenge to engineering works where such soils are present and will require some mitigative measures in the process of project design.

Red soils comprising of the *Eutric-Nitisols* comprise of 70% clay with silt and sand forming between 13% and 17% composition respectively. The major clay mineral content in this soil is the kaolinite group which makes the soil stable despite the high percentage of clay since it is not known to undergo major changes in volume when it gets into contact with water unlike the *vertisols*. Sections with these soils are not expected to have major problems. *Ando- Haplic*/Luvic *Phaeozems* consist of 50% clay content and 25% each of silt and sand. These are soils in Plateaus and high-level structural plains. They are known to possess some Vertic properties but due to their relatively low clay content comprising mainly of allophone it does not offer as much challenge as that of the *Vertisols.* The *Ando-calcaric Regosols* are on the volcanic plains (**-6**) and consist of 10% clay, 25% silt and over 65% sand. This makes them highly non-cohesive and could therefore offer challenge on the line due to subjection to erosion and subsidence.

Calcaric Regosols on the other hand are along Uplands of undifferentiated levels and consist of relatively low clay content of 20% and silt and sand content of almost similar amount at approximately 40% making them slightly better in terms of cohesiveness and stability relative to the *Calcaric Regosols.* They are also however relatively unstable when subjected to erosional processes and thus will require some remedy. *Gleyic Solonetz* occupies a small section through which the line passes. The soil comprise of clay at around 10% with silt at 48% and sand at around 42%. They are found in volcanic plains around CK106+000. They are known to exhibit greenish-blue colour and are said to be hard to work where the gleying is caused by surface water. They are not expected to offer a big problem to the line construction since they only occupy a small section of the line.

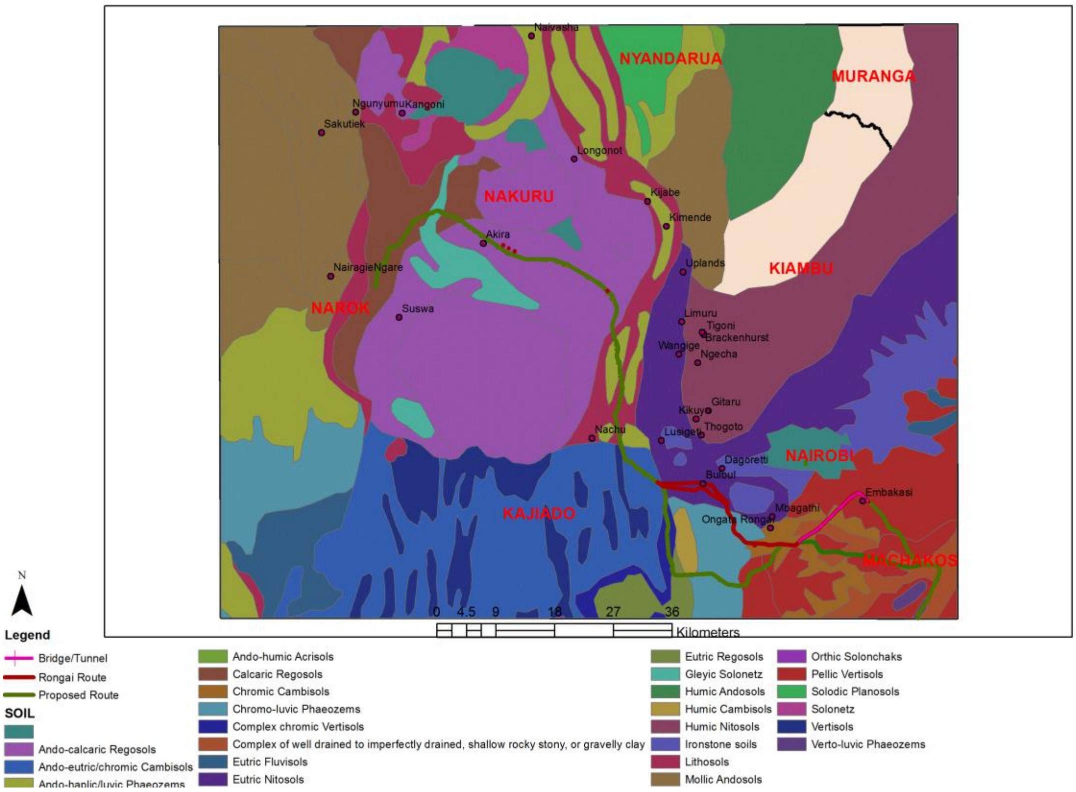


Figure 4- 25: Soil map along the railway line route: Source FAO database

Plate 4- 6: Volcanic ash deposits in Njorowa Gorge near Hells Gate

Vertisols are mainly distributed in the low-lyingregions as is the case in the Nairobi section of Kapiti plateau area. These are volcanic soils developed on the volcanic and pyroclastics rocks and go all the way between CK0+000 to CK16+000 where the line passes over *Eutric Nitisols* from which it again gets into *Vertisols* at CK28+000 to CK34+000 where it again passed over *Eutric Nitisols* with a small section at CK40+000 being on *Vertisols.* The line exits *Eutric Nitisols* at CK46+000 where it runs through *Ando- Haplic*/Luvic *Phaeozems*over a small section getting into *Lithisols* at CK50+000 and back to *Ando- Haplic*/Luvic *Phaeozems* at CK61+000 all the way to CK67+000. At CK68+000 the line gets into *Ando-calcaric Regosols* in the Rift Valley floor exiting it at CK98+000 where it enters a section with *Calcaric Regosols* from which it enters into *Gleyic Solonetz* upto CK106+000 and back to *Calcaric Regosols* to the end at CK120+000 (FAO, 1990).

4.9.1: Risk of unstable soils

Soils within the Kapiti plateau area and Nairobi region are known to expand with increased water absorption by the dominant smectite clay minerals which take up to five times their crystal size (Kariuki & Meer, 2004). The soils are subject to cracking and shrink in similar proportions upon loss of this interlayer water making them unsuitable for buildings (**Plate 4-7**). Consideration should therefore be made on mitigative measures where they are present. The soils in the rift valley and the surrounding environs comprise of mainly volcanic ash and could pose a problem of subsidence along some parts of the railway such as around CK104+000. Attention should therefore bepaid to the impact of these.

4.10: Climate

The area along the DK0-DK120km section of the proposed railway is mainly of tropical savanna climate and the average annual temperature is 16-20℃. The temperature is mainly affected by altitude, featuring a gradual temperature drop along with the increase of altitude. The mean annual precipitation is 600 - 1,100 mm and the mean annual evaporation is 1,550 - 2,200 mm. **Table 4-5** shows a summary of mean annual temperatures and rainfall of all the counties along the SGR route.

According to the National Climate Change Response Strategy (NCCRS) in Kenya, the evidence of climate change in the country is unmistakable (GoK, 2010). Evidence of temperature rise is common throughout the country and rainfall has become more irregular, unpredictable and torrential. Figure 4-26 shows the projected temperature and rainfall change levels for country including the counties through which the proposed SGR-IIA is expected to pass through.

The NCCRS (2009) predicts that the more torrential rainfalls accompanied by floods could destroy roads, railways, bridges and other similar transport and telecommunication infrastructure. Figure 4-7 shows that the projected climate change scenarios for the proposed SGR route. The near-time scenario of upto 2025 predicts a 1.1^{0}C rise in temperature and a 100mm decrease in rainfall

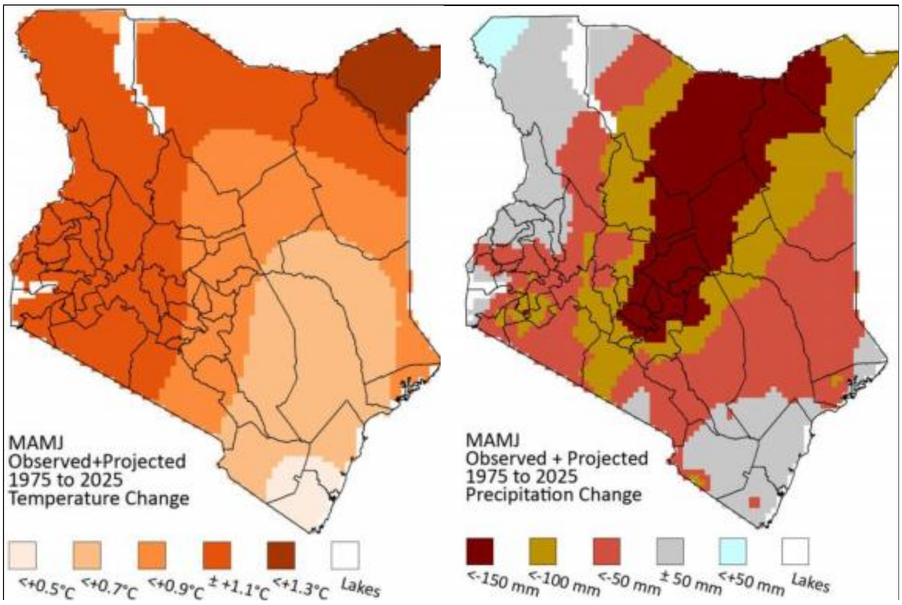
(USAID/USGS, 2010). The long term scenario predicts a 68mm increase in precipitation (Sweeney *et al* 2010) Construction aof the proposed SGR-IIA should therefore ensure sufficient mitigation strategies for climate change impacts.

Plate 4- 7: Vertisols along the railway line route in Embakasi, Nairobi Area.

Table 4- 5: Average ambient temperature levels along the SGR route

County	Mean annual temperature (^{0}C)	Mean annual rainfall (mm)
Nairobi	17	1080
Kajiado	18.9	500
Kiambu	26	1200
Nakuru	17.7	800
Narok	17.1	771

a) Near-time temperature and rainfall scenario



b) Long-term rainfall scenario

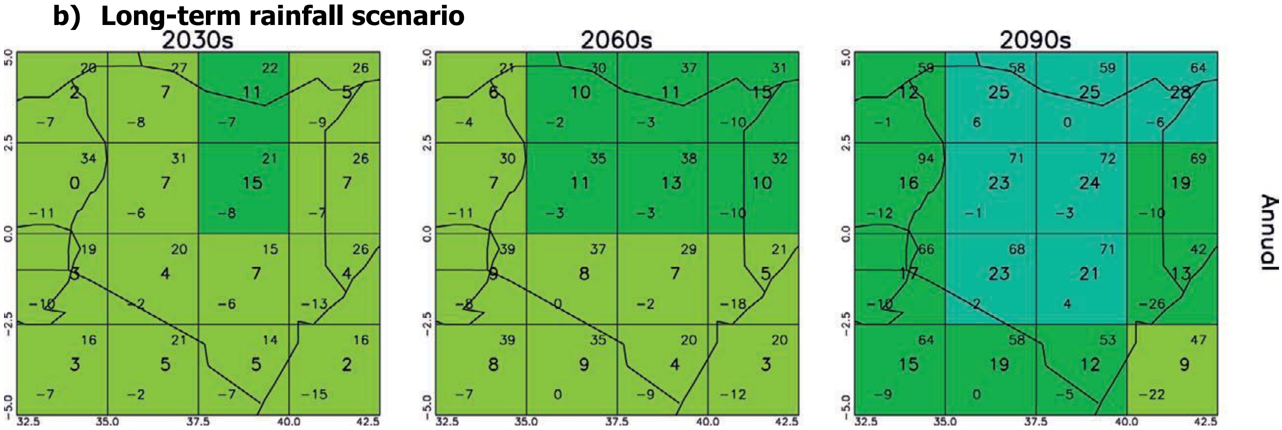


Figure 4- 26: Projected climate change in Kenya (USAID/USGS, 2010, Mc Sweeney, et al. (2010)

4.11: Noise and vibration baseline measurements

In 2009 the Government of Kenya established the standards on noise and excessive vibrationpollution control standards. In determining whether noise is loud, unreasonable, unnecessary or unusual, the following factors are usually considered; a) time of the day b) proximity to residential area; c) whether the noise is recurrent, intermittent or constant; and d) the level and intensity of the noise. Noise standards values for different categories in Kenya are shown in **Tables 4-6** and **Table 4-7**.

Table 4- 6: Maximum permissible noise levels in Kenya

Zone			**Sound level limits dB(A) (Leq,14 h)**		**Sound level limits dB(A) (Leq,14 h)**	
			Day	Night	Day	Night
A	Silent zone		40	35	30	25
B	Places of worship		40	35	30	25
C	Residential	indoor	45	35	35	25
		outdoor	50	35	40	25
D	Mixed residential (with some commercial and places of entertainment)		55	35	50	25
E	Commercial		60	35	55	25

Table 4- 7: Maximum permissible noise levels for construction activities within sensitive sites

	Facility	**Maximum noise level permitted (Leg) in**

		dB(A)	
		Day	Night
i.	Health facilities, educational institutions, homes for disabled etc.	60	35
ii.	Residential	60	35
iii.	Areas other than those prescribed in (i) and (ii)	75	65

The national noise standards as prescribed by the Environment Management and Co-ordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009 require day time (6.01a.m. - 8.00p.m) maximum permissible levels of 40 dB(A) (LAeq-10h) for commercial areas, residential areas and silent zones and night time (8.01p.m. - 6.00a.m.) levels of 35 dB(A) (LAeq-10h).

Noise levels during the project construction will mainly be caused by the construction machinery and equipment such as bulldozers, excavators, pile drivers and other stationary sources. Concrete mixer trucks, road roller, transport vehicles and other mobile sources can also exert a noise impact upto 10 metres from the source. The noise intensity of common construction equipment, transport machinery and vehicles is 76-92 dB(A) in earth and stone stage, 90-109 dB(A) in piling stage, 70-90 dB(A) in structural construction stage and 85-95 dB(A) in decoration stage, respectively.

After the project is completed and is put into operation, the main noise sources along the SGR**,** exerting certain impact on acoustic environment of the area within 200 m on both sides of the railway line, will be trains running and whistling, shunting at stations, departing, arriving as well as the locomotive servicing works. There is no shelter at the locations 30m away from the central line of the outer rail. Without considering other factors such as sound attenuation, the equivalent noise levels in the day and night time for different lines are predicted as shown in **Table 4-8**.

Table 4- 8: The predicted noise levels for the proposed SGR locomotives

Section/Item	Distance from the Central Line of Outer Rail to the Predicted point (m)	No. of Train Pairs (Pairs/Day)		Equivalent Sound Level Leq dB(A)			
				Day		Night	
Nairobi South Station-Nairegia North	30	Passenger train	Freight Train	Sub grade	Bridge	Sub grade	Bridge
		2+1/7	13	58.7	61.4	55.7	58.4

The vibration effect during the construction phase will mainly emanate from the operation of machinery and equipment, 10 m away from the source. The noise intensity of main construction machinery at each construction stage will be 78-85dB in earth and stone, 93-99 dB in piling stage and 74-76 dB in the transport stage, respectively. Among the construction machinery, the vibration intensity generated by the pile driver is the largest. Vibration generated by construction machinery will decrease as the distance increases. The main vibration source in sensitive environments along the SGR route during the operation phase will be the train operation and it will mainly be caused by the impact between wheels and rail during the train travel. The vibration source strength is directly related to the track structure, running speed of the train, train type, and axle load.

The noise baseline measurements for the proposed SGR-IIA were undertaken along Route 4 as the most suitable option in the following areas:

4.11.1: Nairobi National Park area

This was because of the sensitive nature of the park environment and the need to ensure disturbance of the valued wildlife in the park as the SGR goes over the protected area. However, it is important to note that the proposed railway will run over the park along the same corridor used by large aircrafts on their descent for landing at the JKIA. This corridor has been actively utilized by aircrafts since 1958 when JKIA became operational, initially as Embakasi International Airport. The measurement of baseline ambient noise levels along SGR-IIA route over the park therefore included the current noise levels originating from the large-bodied aircrafts over-flying the area at low altitude.

The baseline noise measurements were measured at the SGR Route 4 entry into the NNP near the East Gate on Tuesday September 20, 2016 from 11:00 am to 19:00 capturing both daytime and nighttime noise levels (**Plate 4-7**). This is also the area of aircraft exit from the Nairobi National Park on their JKIA landing approach. **Table 4-9** shows the flight arrivals at JKIA on the noise measurement dayincluding the type of aircraft.The baseline noise measurements were measured at the SGR Route 4 exit from the NNP near the Masaai Gate in Tuala area on Saturday September 20, 2016 from 11:00 am to 13:00. This is also the area of aircraft entry into the Nairobi National Park airspace on their JKIA landing approach. **Table 4-10** shows the flight arrivals at JKIA on the noise measurement day including the type of aircraft.

The frequency of aircraft fly over varied from about 20 minutes a minimum of 2 minutes especially in the evening between 5:00 pm and 7:00 pm. The noise level varied from background at the planes approached to a maximum of 50 to 80 Db as the planes flew overhead over a period of 1 to 2 minutes. Thus, the Route 4 corridor currently experiences a constant background noise of 36.5 to 45.2 DB and airplanes fluctuating noise of up to 80 Db every 2 to 20 minutes.The overall baseline noise situation at the Park entry indicated the following key sources of noise:-

a) Background noise (12:00 pm when construction stopped for lunch): 35.5 – 37.5 DB
b) Background and construction noise: 40.5 – 45.2 DB
c) Combined aircraft overhead noise: 48 - 80 DB
d) Night time noise that captured outdoor wind sound: 42.3 – 45.2 DB

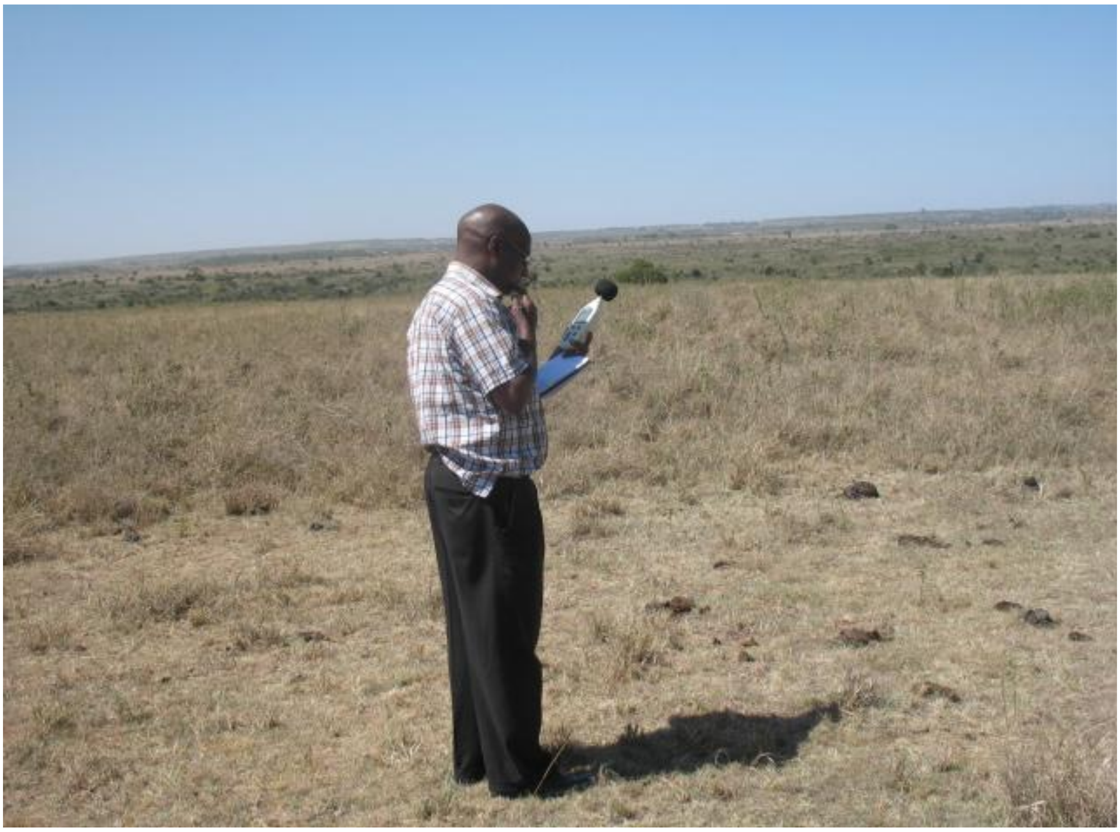


Plate 4-7: Habitat Planners engineer measuring baseline noise levels in Nairobi National Park

Table 4- 9: Flight arrivals at JKIA on Tuesday 20th September 2016

No.	Time	Flight No	Type of Aircraft	Origin
1.	11.00	KQ305	B736	Dubai
2.	11.10	FH43	CRJ	Eldoret
3.	11.25	KQ655	E190	Kisumu
4.	11.30	KQ351	E190	Juba

5.	11.40	SUA431	A330	Medina
6.	11.50	JX5691	DH4	Ukunda
7.	12.00	KQ401	B737	Addis Ababa
8.	12.00	MK534	A319	Port Louis
9.	12.25	KQ8603	B733	Mombasa
10.	12.35	KQ605	E19	Bujumbura
11.	13OO	EY641	A320	Abu Dhabi
12.	1300	K3917	72F	Johanesburg
13.	1305	JX8684	DH4	Lamu
14.	1310	ET304	B738	Addis Ababa
15.	1330	K3909	72F	Addis Ababa
16.	1350	JX8681	DH4	Malindi
17.	1400	KQ731	E190	Lilongwe
18.	1425	TM442	E90	Pemba
19.	1430	KQ483	E190	Dar er Salaam
20.	1435	QR1335	A320	Doha
21.	1435	KQ413	E190	Entebbe
22.	1435	KQ657	E190	Kisumu
23.	1500	5H430	BE1	Kitale
24.	1500	5H442	ATR	Mombasa
25.	1505	SA184	A320	Johannesburg
26.	1515	PW727	ATR	Kilimanjaro
27.	1525	WB452	DH8	Entebbe
28.	1540	KQ607	E190	Mombasa
29.	1540	WB402	CRJ	Kigali
30.	1600	KQ702	E190	Lusaka
31.	1645	KQ8607	B733	Mombasa
32.	1650	EY952	33X	Eldoret
33.	1700	K3911	-	Muscat
34.	1705	KQ761	B738	Johannesburg
35.	1730	5H440	CRJ	Mombasa
36.	1740	KQ353	E190	Juba
37.	1805	KQ609	E190	Mombasa
38.	1810	KQ522	B737	Younde
39.	1830	KQ415	E190	Entebbe
40.	1840	ET306	B738	Addis Ababa
41.	1835	PW713	ATR	-
42.	1835	KQ537	E190	Abuja
43.	1840	TK6492	31Y	Entebbe
44.	1850	KQ586	E190	Ndola
45.	1850	KQ527	E190	Antananarivo
46.	1850	KQ485	E190	Dar er Salaam
47.	1910	5H410	CRJ	Kisumu
48.	1920	PW725	ATR	Kilimanjaro
49.	1925	EK9745	B77L	Eldoret
50.	1930	JX8655	DH3	Kisumu
51.	1940	JX8645	DH4	Malindi
52.	1950	KQ555	B787	Kinshasha
53.	1955	JX8688	DH4	Malindi
54.	2000	KQ542	B738	Cotonou

Table 4- 10: Flight arrivals at JKIA on Saturday 24th September 2016

No.	Time	Flight No	Type of Aircraft	Origin
1.	11.00	KQ305	B736	Dubai

2.	11.10	FH43	CRJ	Eldoret
3.	11.25	KQ655	E190	Kisumu
4.	11.30	KQ351	E190	Juba
5.	11.40	SUA431	A330	Medina
6.	11.50	JX5691	DH4	Ukunda
7.	12.00	KQ401	B737	Addis Ababa
8.	12.00	MK534	A319	Port Louis
9.	12.25	KQ8603	B733	Mombasa
10.	12.35	KQ605	E19	Bujumbura
11.	13OO	EY641	A320	Abu Dhabi
12.	1300	K3917	72F	Johanesburg
13.	1305	JX8684	DH4	Lamu
14.	1310	ET304	B738	Addis Ababa
15.	1330	K3909	72F	Addis Ababa
16.	1350	JX8681	DH4	Malindi

Figure 4-26 shows the overall noise levels for the area near the East Gate where both Route Options 3 and 4 will enter into the park and which is also the national park exit point for aircrafts heading to the JKIA. **Figure 4-27**shows the aircraft noise envelope from time of approach from Tuala area through Nairobi National Park towards the East Gate to the time of overflying the East Gate area.**Figure 4-28** shows the overall noise levels for the area near the Masaai Gate where both Route Options 3 and 4 for the SGR will exit the park and which is also the entry point into the national park airspace for aircrafts heading to the JKIA. **Figure 4-29**and **Figure 4-30** shows the aircraft noise levels from time of aircraft overhead in Tuala area to the farthest point in the Nairobi National Park towards the East Gate as they head to the JKIA. The results indicated that the aircraft noise levels in the national park are already above the EMCA Noise regulations (2009) thresholds of 45 DB (Day-time) and 35 DB (Night-time). The results indicate that the wildlife in the national park are already used to the aircraft noise whose frequency is much higher compared to the expected frequency of train noise emission over the national park.

4.11.2: Nairobi-Kamangu-Mai-Mahiu-Naivasha Industrial Park-Duka Moja section

Figure 4-31 shows the noise measurement points along the SGR route from Nairobi National Park to Duka Moja in Narok County. The aim was to determine the current ambient noise levels and mitigate against any noise pollution for the communities along the proposed route. Baseline noise levels were measured along the SGR Phase II Route at locations of public and regulatory interests (**Table 4-11**). The objective of the measurements was to quantify the existing noise in order to establish a baseline against which the results of subsequent measurements and audits can be compared. The general procedure used to determine the noise impact was guided by the requirements of the Environmental Management and Coordination *Noise and Excessive Vibration Pollution Control* Regulations of 2008.

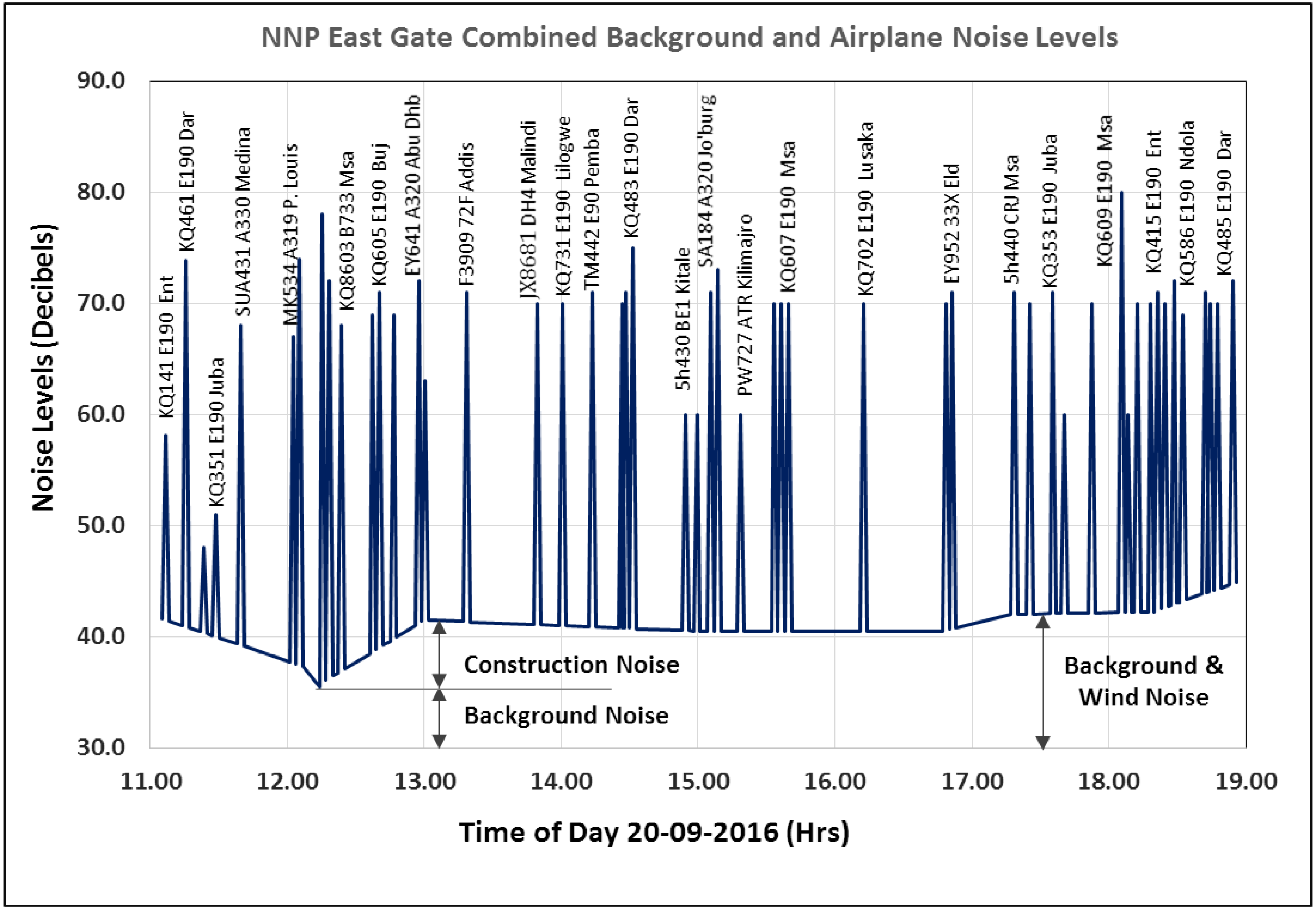


Figure 4- 27: Combined background and aircraft noise levels at the East Gate (20th September 2016)

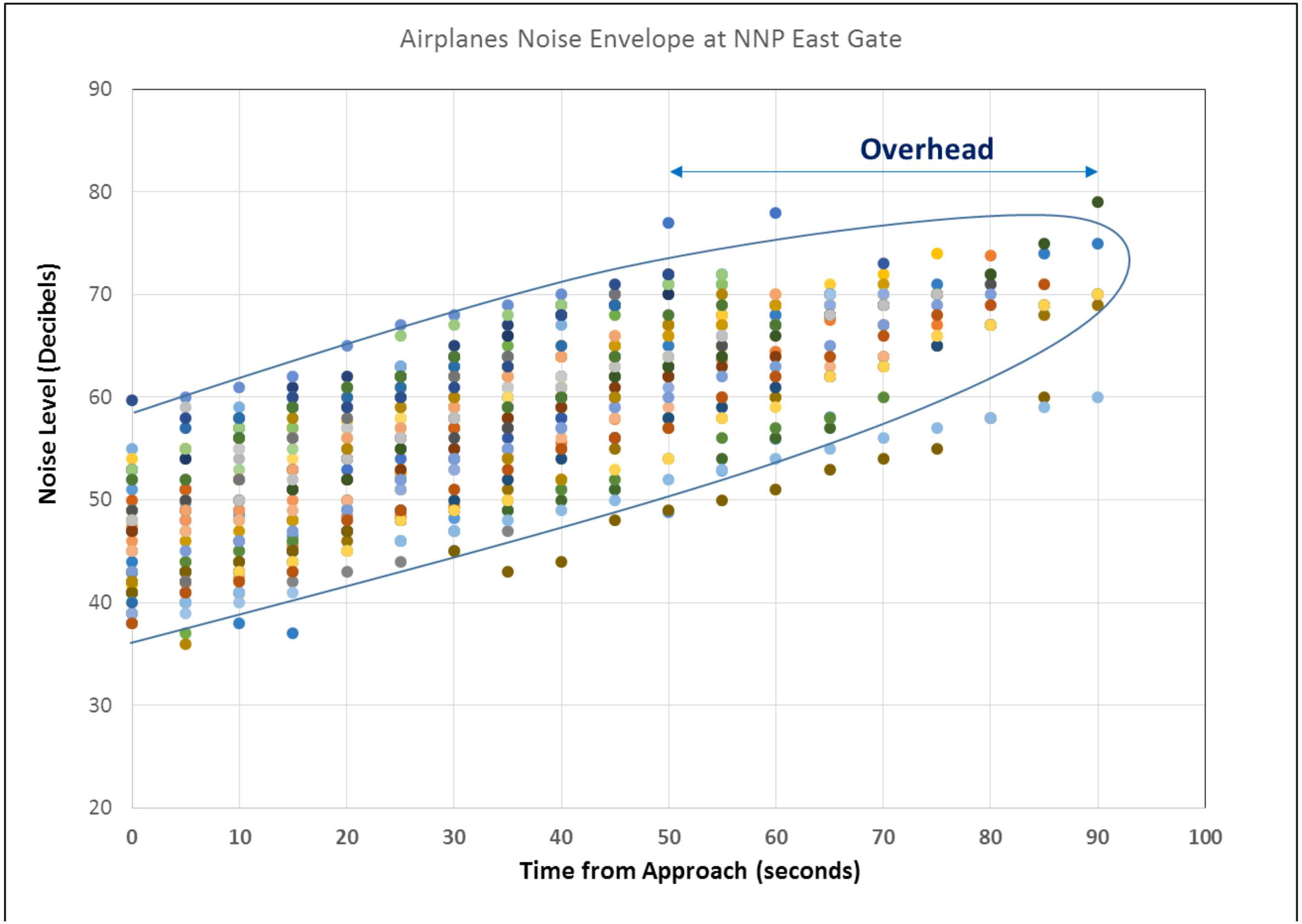


Figure 4- 28: Aircraft noise envelope from Tuala approach through Nairobi National Park until the East Gate area overfly

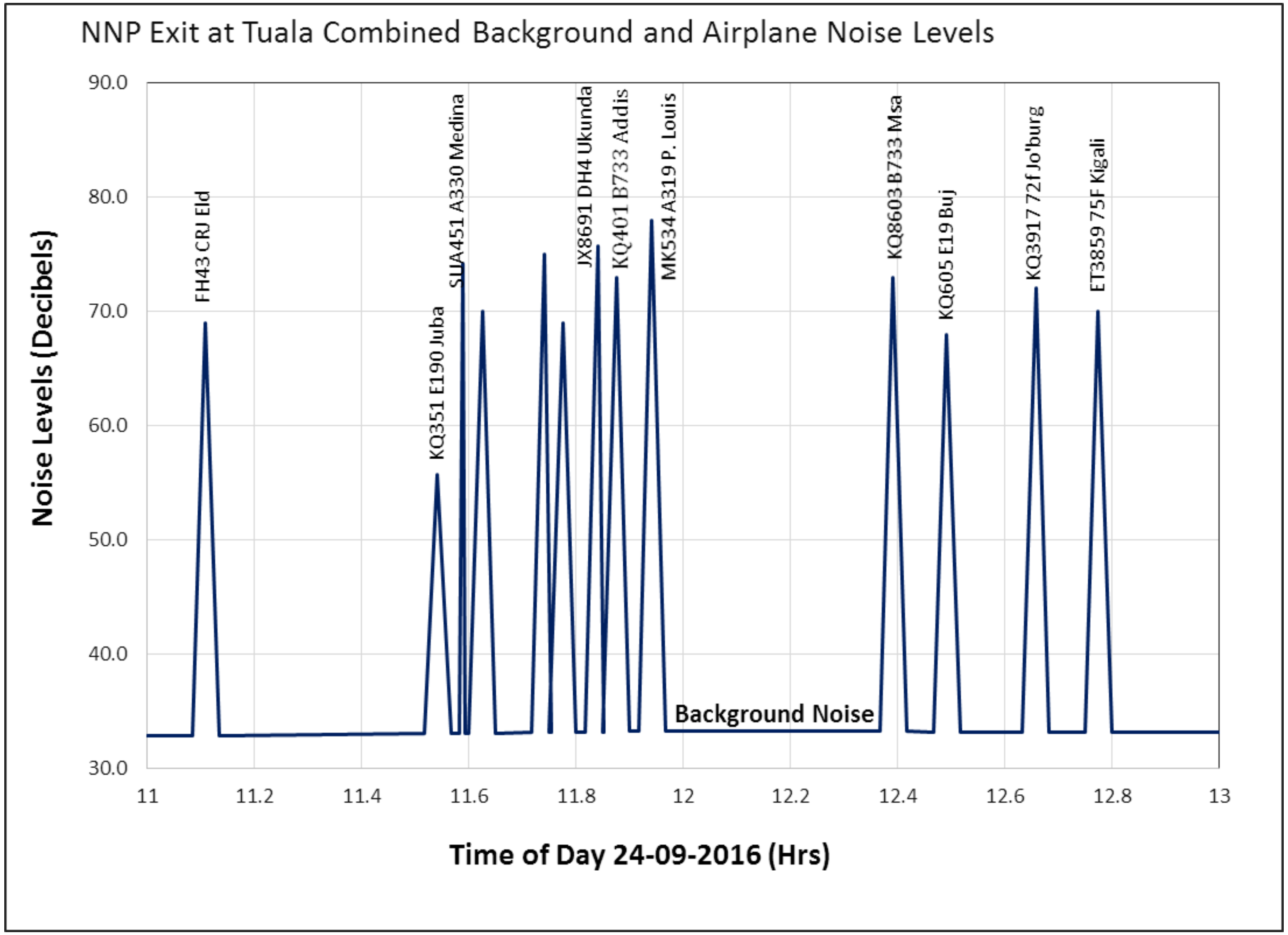


Figure 4- 29: Combined background and aircraft noise levels near the Masaai Gate (24th September 2016)

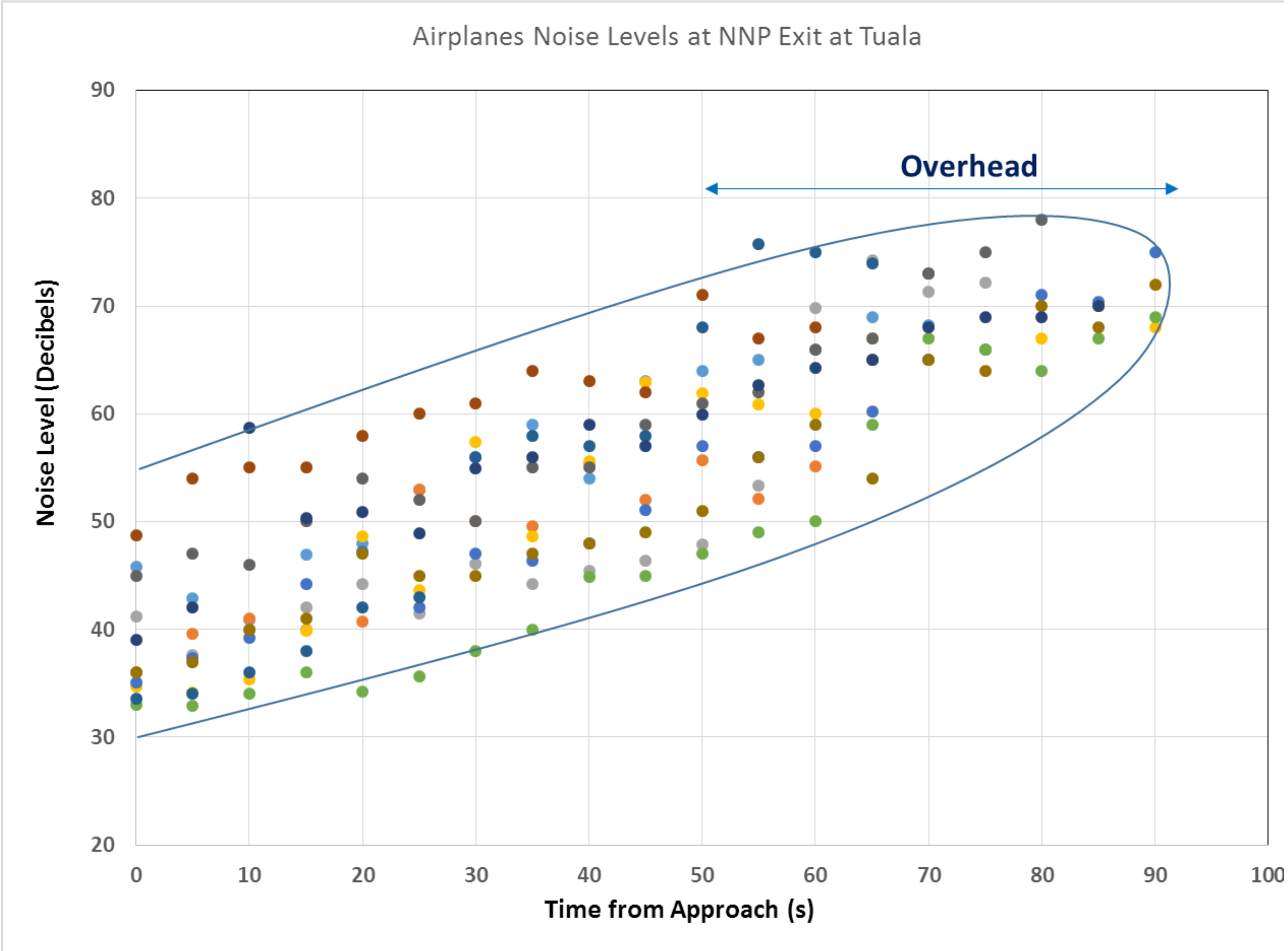


Figure 4- 30: Aircraft noise envelope from Tuala with aircraft overhead and flying through Nairobi National Park towards the East Gate

Figure 4- 31: Location of baseline noise measurements sites from Nairobi National Park to Duka Moja in Narok County

Table 4-11 shows that the baseline noise in Nairobi-Kamangu-Mai-Mahiu-Naivasha Industrial Park section was mostly in the range 32–45 dBA with exceptions of commercial and roadside areas that experienced trading, entertainment and traffic noise of up to 67.1 dBA. The noise levels were largely within the Environmental Management and Coordination *Noise and Excessive Vibration Pollution Control* Regulations of 2008 (**Table 4-11**).The minimum noise levels represented background noise that also included prevailing wind noise. The recorded maximum noise was associated with occasional noise such as kitchen noise in schools, passing motor cycles, vehicles and planes, dog barking, farm animals, construction and conversations, insects, and birds in forests, and radio and music in commercial centers. Large standard deviations indicated occurrence of large occasional noise or passing noise source.

Table 4- 11: Baseline Noise along SGR Phase II Route in the Nairobi-Kamangu-Mai-Mahiu-Naivasha Industrial Park section

	Name of Location	Zone	SGR km	Coordinates South (°)	Coordinates North (°)	Baseline Noise (dBA) Min	Max	Ave	Sdev
1	Nairobi National Park (NPP) Entry	Park	02+600	1.36644	36.86288	32.0	36.6	**32.8**	0.8
2	NNP near JKIA Communication Stn	Park	05+300	1.36644	36.86288	32.7	34.4	**33.5**	0.5
3	NNP near SGR Exit	Park	08+300	1.38542	36.84611	33.1	36.2	**34.0**	1.1
4	Tuala Island Dream Rd: Lihanda - Rusinga Drive Block	Residential/ Livestock	11+850	1.395206	36.825850	32.0	36.6	**32.8**	0.8
5	Tuala Market Centre	Commercial	13+300	1.40289	36.808250	41.5	57.5	**48.6**	5.1
6	Kampi ya Moto Catholic Church	Place of Worship	21+000	1.41452	36.74398	35.1	48.7	**39.1**	2.7
7	Kampi ya Moto PCEA Church	Place of Worship	39	40	38.6	35.2	42.7	**37.9**	2.0
8	Clarence Ministries,Adventist Univ. O. Rongai-Kiserian Rd	Institution	24+100	1.40389	36.72087	36.0	43.8	**38.9**	2.0
9	Karen View School, Merisho	Education	26+300	1.38710	36.71407	38.7	61.6	**45.5**	4.8
10	Merisho Nkoroi Catholic/Kingdom Life Church	Place of Worship	26+600	1.38433	36.71345	36.3	54.1	**41.3**	4.6
11	Ololua Forest at Forest Lane Crossing	Silent zone	28+100	1.37264	36.70582	37.7	42.6	**39.4**	1.1
12	Merisho Rural	Residential/ Rural	28+500	1.37192	36.70233	37.2	49.5	**43.3**	2.7
13	Kianugu near Ololua Forest	Residential/ Rural	30+600	1.35746	36.69112	34.8	78.3	**44.1**	10.4
14	Kangawa Near Ngong Station	Residential	31+900	1.35064	36.68128	36.6	62.9	**45.1**	6.4
15	Embulbul-Ngong Rd Crossing	Roadside	33+900	1.33715	36.67030	59.6	75.1	**67.1**	3.2
16	Ngong Veterinary Farm near Entrance to Ngong tunnel	Livestock	34+250	1.33452	36.66718	41.1	54.5	**45.8**	2.2
17	Kimuka Tunnel Exit	Rural	39+600	1.33730	36.61666	37.9	66.4	**45.4**	6.6

18	Nanju	Pastoralism	52+500	1.24934	36.55136	35.5	48.7	**39.7**	3.3
19	Pipeline Pumping/Station	Pastoralism	74+000	1.06365	36.54013	36.7	50.6	**41.7**	3.2
20	Pipeline Rd Crossing	Pastoralism	79+000	1.04755	36.49916	32.0	44.1	**34.5**	2.3
21	Narok Rd crossing	Traffic	92+800	1.03610	36.37732	32.4	75.7	**49.4**	13.8
22	Suswa Town near SGR	Commercial	98+200	1.04564	36.33195	44.5	77.3	**55.0**	8.6
23	Duka Moja Narok Rd Crossing	Traffic	114+300	1.10493	36.21049	34.0	83.4	**53.3**	12.2

4.12: Air quality

Air pollution sources during construction mainly include dusts from earthwork construction and transportation vehicles. Exhausts from various construction machines have impacts on the environment as well. Construction dusts are occurred mainly in the earthwork construction fields and on the roads transportation vehicles passing by. When vehicles pass by on roads in poor conditions in continuously dry weather, TSP density of dusts on both sides of the road can reach 8~10mg/m in a short time. Medium and large size machines in the construction fields normally use diesel and gas as power that will discharge air pollutants such as NO_2, SO_2, $_3$, smoke and dust. When constructors station in the field, canteen normally use coal that will produce smoke and dusts, NO2and other air pollutants during burning.

The atmospheric pollutants emitted by the SGR diesel-powered train engines will be will be assessed after the construction finished to see whether it reaches the standards set by the Environmental Management and Coordination (Air Quality) Regulations, 2014 (Legal Notice 34 of 2014), whose objective is prevention, control and abatement of air pollution to ensure clean and healthy ambient air. The regulations apply to internal combustion engines, all premises, places, processes and operations. The potential pollutants in the case of the proposed SGR project include: Particulate matter (Dust, Black smoke, smog, aerosols); SO_X, NOX, CO, and CO_2). **Figure 4-31** shows the air quality levels in the Nairobi region. Figure 4-12 shows that the level of Total Suspended Particulates (TSP) within the project route in Nairobi is between 90-180μg/m^3. TheWorld Health Organization (WHO) recommends a maximum daily average TSP of 230μg/$m^3$and a maximum annual mean of 90 μg/m^3.

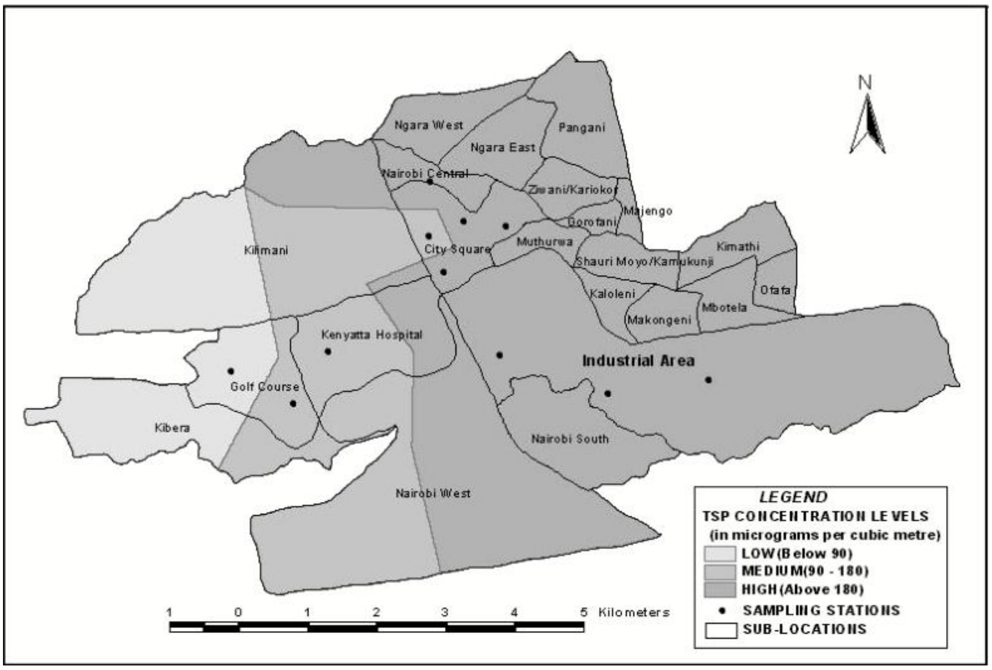


Figure 4- 32: Air quality levels in the City of Nairobi (Mulaku and Kariuki, 2001)

4.13: Water resources survey

The proposed line traverses several seasonal and permanent rivers, dams, ponds and wetlands. In addition, several water harvesting and distribution structures (water piping and storage systems, bore holes, earthen dams, swamps) are present along the project site. These very resources sustain the integrity of the country's environment, biodiversity, water resources and agricultural productivity. Therefore, as part of the surveys, a baseline assessment of the potential impacts of the Nairobi South Railway Station-Naivasha Industrial Park -Enoosupukia, Narok County project on the water resources situated along and within the vicinity of the proposed railway line was conducted.

a) Drainage units in the project area

Hydrology and drainage pattern of the proposed study area is influenced by the Great Rift Valley running north to south so that from the flanks of the Rift Valley, water flows westwards into lakes Baringo, Bogoria, Nakuru, Elementeita, Naivasha, Victoria, Turkana and Natron and eastwards to the Indian Ocean. The Rift Valley itself forms an internal drainage system. In this case therefore, two major drainage basins will be affected by the proposed SGR line (Athi River and Rift Valley basins). Both of these basins have water deficits and often rely on inter-basin water transfers to meet their basic water needs (Falkenmark, 1990, WRMA, 2015). As such, careful assessment ought to be done to avoid escalating the already existing water deficit and instituting appropriate mitigating measures.

i. Athi Basin

From KM 000, the proposed SGR will pass over the NNP and exit the park after crossing Mbagathi River and thenproceed to Ongata Rongai, Ngong and Kamangu before dropping into the rift valley. Water resources along this proposed line is part of the Athi River which is the second largest in Kenya. Apart from Mbagathi River, the SGR will interact with Ngong river and a few other streams (**Figure 4-32**). The passing of the SGR over the NNP will minimize the project impact on the Mbagathi River as compared to Route Option 7 through Athi River which will have to cross the river at three different points. The permanent streams and rivers in the Athi Basin are characterized by moderate flows (base flows) during the dry season and high flows during the rainy season. In contrast, seasonal rivers are characterized by very low or no flows in the dry season and high flows during rainy seasons, (April-May and November-December). Most of the ephemeral streams generally become dry within one month after the rainy season (Borst and De Haas, 2006). The flows are usually fast and turbid due to high sediment concentration associated with soil erosion in the catchment area.

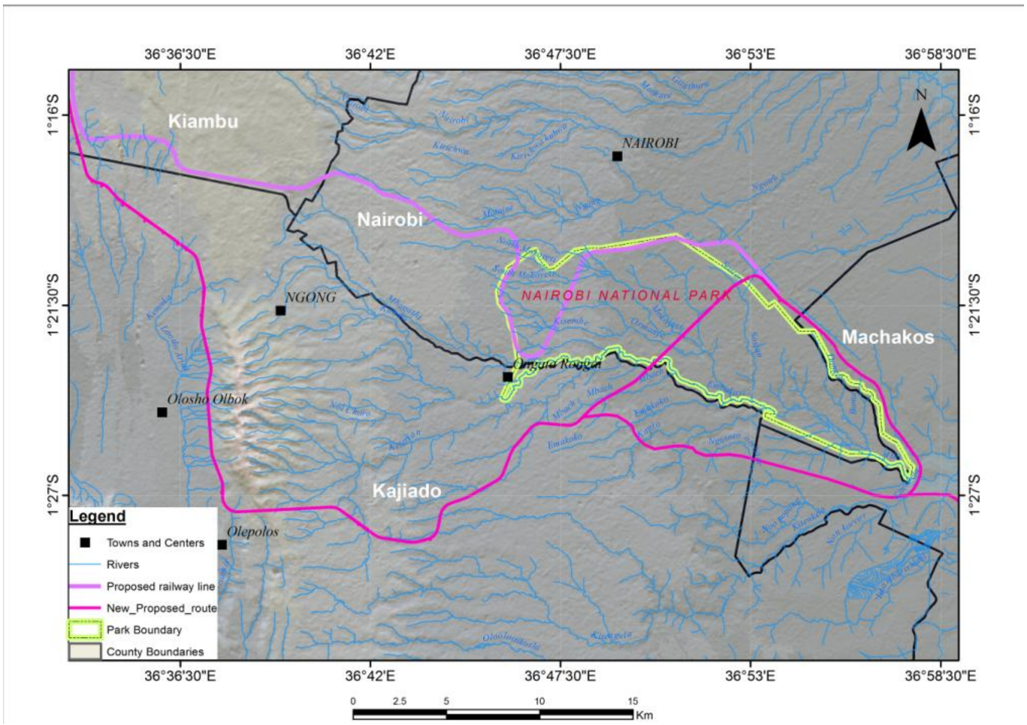


Figure 4- 32: The drainage network in the Nairobi-Kajiado-Kiambu SGR project area

The streams and rivers in the drainage basins are sustaining a wide range of flora and fauna. These water resources, such as Motoine River provide water for animals in the forest including browsers such as Duikers and Dikdiks, primates such as Vervet monkeys and various bird species. To protect such water resources and wetlands, bridges will bedesigned for the ecologically sensitive areas to allow for dispersal corridors. The proposed SGR line passes through the upper catchment of Kiserian River which originates from the Ngong Hills. Water resources around this region have witnessed increased effluents from the growing population in Kiserian town resulting in pollution impacts on the dam downstream. The increased numbers of greenhouses, expanded construction activities and extensive farming at Kiserian have interfered with the water resources/wetlands through land clearing, over browsing/grazing among others. This has continued in spite of the fact that water resources are critical as they provide water for livestock and other domestic uses for communities living within the catchment. Sustainable provision of this water is dependent on wise utilization of the resources in an integrated manner including taking deliberate steps to protect wetlands and all the water resources within the catchment. Siltation and sedimentation of water resources and wetlands from the project area in the upper catchment is likely. To protect such water resources and wetlands adequate measures will be taken such as having an environmental monitoring place in place to ensure compliance to recommendations.

Dams play a significant role in providing water to the local community particularly during dry seasons. However, most of the dams are small and dry up during the extended dry seasons due to the high water abstraction and evaporation rates. The expansive woodland and grasslands areas in the head water of the Athi River, whose major land use activities are irrigation, wildlife and livestock keeping, depend on these dams as watering points during seasonal scarcity. The dam provides water for irrigation of the small farms around Kiserian as well as for use by domestic animals.

ii. Rift valley drainage

The proposed SGR route in the rift valley will interact with an area of internal drainage where streams and rivers from the rift escarpment usually flow into the rift valley floor and either disappears as a result of the low precipitation, high temperature and evaporation and also through under-seepage due to the porous soils and fault lines. In other cases, the streams and rivers usually feed into the various lakes in the rift valley floor such as Lake Naivasha and Lake Magadi. The rift valley drainage area is generally a water scarce area. **Figure 4-33** shows the drainage network which the proposed SGR will interact with within the rift valley.

The Ewaso Kedong River is the only key river which the proposed SGR will cross in the rift valley apart from the smaller streams in the Enosupukia area. The river originates from the escarpment area in the Kijabe area from where it flows into the dryland areas of northern Kajiado and serves as a lifeline for the people, livestock and wildlife in the area. The river has previously been the centre of water related conflicts between the agrarian and business communities in the upstream and the pastoral communities in the downstream.

4.14: Water quality baseline assessment

Environmental processes, which include physical, chemical and biological attributes, interact at an ecosystem level to affect biota and productivity in the aquatic environment. Environmental baseline survey of the proposed project area was undertaken on 25th November, 2015 and 8th April 2016 to provide data that will act as reference for monitoring of the water resources in future (**Plate 4-8** and **Plate 4-9**) Sixteen water quality parameters were determined and analyzed from five sampling points. The water quality parameters analyzed showed that there were variations although nearly within the NEMA standards/guideline values. In particular, the pH range was within the acceptable levels except at Kiserian Dam. The pH range of a water body is largely related to total alkalinity which is a measure of pollution of a water body. Natural surface water and well water contain less alkalinity than sewage or waste water pH is an important determinant of the biological availability of essential nutrients such iron and phosphorous. The pH also governs the proportion of NH_{4+} to NH_4OH in water. NH_4OH is toxic to many aquatic organisms especially fish. Large dams like Kiserian that are extensively used by cattle and for agricultural purposes can have high nutrient concentrations (Table25). Typically, dams like these located in the lower parts of a growing urban environment accumulate pollutants from surrounding environments often leading to formation of massive algal blooms and offensive odours as a result of eutrophication.

Other water resources along the track line, such as at Athi River, Rangao, Kitilikini and Ewaso Kedong depicted ranges of water parameters that were within the NEMA guideline values (**Table 4-12**). The concentration of nitrites at Athi River were higher (3.99 mgl^{-1}) than the guideline values and could imply high nutrient loads associated with biological wastes in the area. In contrast to nitrites, the concentrations of nitrates never exceeded 1.2 mg^{-l} in all the studied sites; which is well below the guideline value of 10 mg^{-l}. Fluoride concentrations were determined in all the sampling sites and found to be within the background levels (<1.5 mg^{-l}). For heavy metal concentrations such as copper, lead, manganese, zinc and chromium at some of the studied sites (e.g. Athi River and Rangao) were all well above the guideline values. In particular, chromium, manganese and zinc in Athi River and Kiserian dam were over twice as high as the guideline values. These two areas are highly populated with some factories and industries in the vicinity that can contribute significantly to having high concentrations of these toxic heavy metals. However, cadmium, mercury and copper could not be detected in most sites. Concentrations of zinc at Ewaso Kedong were observed to be way above the guideline values and could be attributed to the quarrying activities in the region. The levels of the analyzed parameters were compared with the first schedule on quality standards for sources of domestic water (GoK 2006).

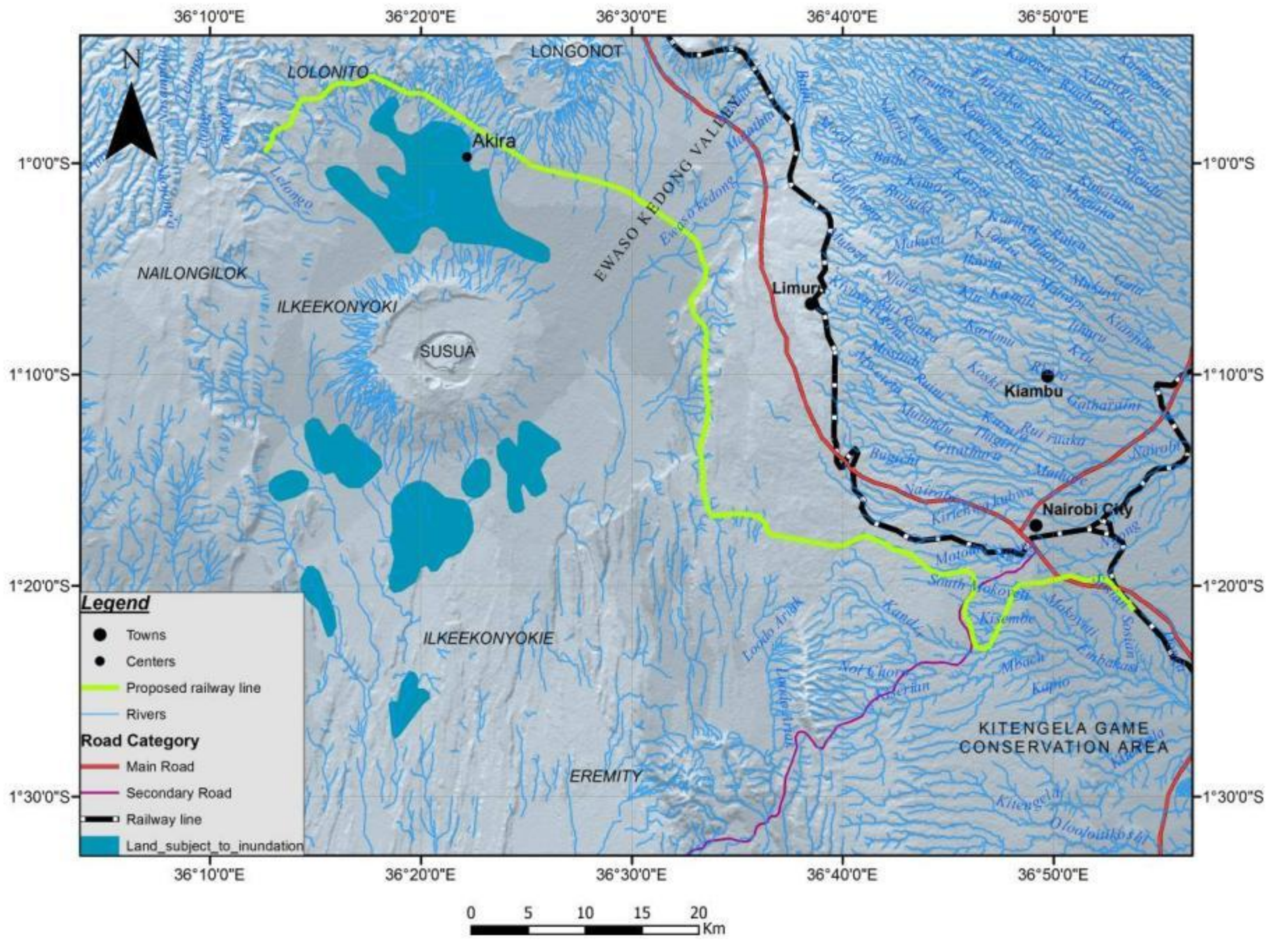


Figure 4- 33: The drainage network in the Nakuru-Narok SGR project area

Plate 4- 8: Baseline water quality measurement and sampling at Rangao Metropolitan (8-4-2016)


Plate 4- 9: Baseline water quality measurement and sampling at Kiserian dam (8-4-2016)

Table 4- 12: Baseline water quality in selected sites along the proposed SGR route (sampled on 26-11-2015 and 08-04-2016)

Water quality parameter	Athi River	Rangao Metro	Kiserian Dam	Kitilikini	Ewaso Kedong	NEMA limits
	01°26.70S 36°58.10E	01°25.86S 36°45.97E	01°27.19S 36°41.43E	01°03.20S 36°35.11E	01°04.48S 36°32.06E	
Temperature (°C)	22.0	30.5	27.5	23.8	20.4	30
Ph	6.3	6.9	8.1	8.0	8.0	6.5 - 8.5
Conductivity (μScm^{-1})	343	164	333	255	197	-
TDS (mgl^{-1})	170	325	143	157.2	505	1200
TSS (mgl^{-1})	285	201	119	40.8	889	30
Copper (mgl^{-1})	0.08	ND	ND	ND	ND	0.05
Lead (mgl^{-1})	0.13	80	ND	ND	ND	0.05
Zinc (mgl^{-1})	1.1	0.63	0.57	0.5	10.4	1.5
Cadmium (mgl^{-1})	ND	ND	ND	ND	ND	0.01
Manganese (mgl^{-1})	3.79	1.63	13.5			0.05
Chromium (mgl^{-1})	0.03	0.29	ND			0.05
Mercury (mgl^{-1})	ND	-	-			0.001
Nitrates (mgl^{-1})	0.53	0.16	0.96	0.8	1.2	10
Nitrites (mgl^{-1})	3.99	0.64	0.09	ND	ND	3
Phosphates (mgl^{-1})				0.5	ND	-
Fluorides (mgl^{-1})	0.4	0.40	1.35	0.85	2.7	1.5
Phenols (mgl^{-1})				0.1	ND	Nil
Chlorides (mgl^{-1})	34.0	11.3	36.9	56.7	34.0	-

4-15:Land tenure and landuse profile

The land tenure and landuse profile along the route is characterized by three key zones, namely, a) the Nairobi South Station Zone, Nairobi National Park and c) between Nairobi and CK+120km.

a) Nairobi South Station Zone

The land along the Nairobi South Railway Station-Naivasha Industrial Park -Enoosupukia SGR route is both privately and Government owned. From DK0 upto approximately DK4, the proposed SGR corridor is characterized by an open corridor in the urban zone bordering the Nairobi National Park which dominated by industrial installations as well as the Inland Container Depot.

b) Nairobi National Park

Nairobi National Park ($117km^2$) is one of the oldest national parks in Kenya gazette in 1946 and the only metropolitan national park in the world and ranks fifth in respect to visitation and income generation within the national park network in the country. Nairobi Park visitation and concomitant revenue levels, its strategic location in the largest city in East and Central Africa, scientific interest in terms of documenting economic development versus environmental conservation, and its sociological importance in integrating wildlife conservation in an urban environment, sets the park apart from other National Parks in the wildlife Protected Area System *(KWS, 2014 Unpublished).*

The Nairobi national park hasa wide range of indigenous vegetation which is critical in supporting wildlife within the park. The park's predominant environment is open grass plain with scattered *Acacia* bushes. The western uplands of the park have highland dry forest with stands of *Olea africana*, *Croton dichogamus*, *Brachylaena hutchinsii* and *Calodendrum*. The lower slopes of these areas are grassland. *Themeda*, Cypress, *Digitaria* and *Cynodon* species are found in these grassland areas. There are also scattered yellow-barked *Acacia xanthophloea*. There is a riverine forest along the permanent river in the south of the park. There are areas of broken bush and deep rocky valleys and gorges within the park. The species in the valleys are predominantly *Acacia* and *Euphorbia candelabrum*. Other tree species include *Apodytes dimidiata*, *Canthium schimperiana*, *Elaeodendron buchananii*, *Ficus eriocarpa*, *Aspilia mossambicensis*, *Rhus natalensis*, and *Newtonia* species. Several plants that grow on the rocky hillsides are unique to the Nairobi area. These species include *Euphorbia brevitorta*, *Drimia calcarata*, and *Murdannia clarkeana.*

The parkis home to lions, leopards, giraffes, wildebeest, zebra, antelopes, crocodiles, cheetah, gazelles, ostrich and endangered black rhinos among other valued species. NNP is rhino sanctuary used to breed and stock other parks and is the home to over 100 mammal species, which includes four of the big five large wild mammals (buffalo, lion, leopard and rhinoceros) known for their touristic attractions. Even though it does not have resident elephant populations, it serves as an elephant sanctuary for orphaned and sick elephants which are later reintroduced in the world in other national parks through the David & Daphne Sheldrick Sanctuary. Nairobi national park has also over 400 bird species, 400 of which are seasonal European migrants. The park receives in excess of 100,000 visitors since 1950s and Ksh 45,000,000 annually.

Every dry season, the park experiences wildebeest and zebra migration which are second to Serengeti-Mara magnitude. These movements used to link Nairobi to Ngong Hills and the Athi Kapiti plains all the way to Amboseli National Park and Loita Plains. In the past, the wildlife would disperse up to Kilimambogo/Oldonyo sabuk National Park in the north, Amboseli in the south, Narok in the west, Machakos in the east through the dispersal corridors in the Kitengela-Athi river area to the south east as well as the Tuala zone to the north east. The wildlife movements have been reduced in scope due to human settlement and loss of dispersal space to other land uses. The only remant of the dispersal area remains towards the Kitengela area. The park contains two major ecosystems, namely highland dry forest and savannah that supports endemic plant species such as the *Euphorbia brevitata*.

Nairobi National Park contains a number of important ecological and cultural heritage sites. It consisted of two key ecological zones including the dominant open grassland savannah in the eastern section bordering Nairobi City and the distinct dryland forest zone to the western side bordering Karen and Ongata Rongai. The southern boundary of the park consists of the Mbagathi River which flows from the Ngong Hills to the west and is a key lifeline in terms of water supply. One of the important national heritage sites in the park is the Ivory Burning Site which was established in 1989 in a bid to eliminate the mass slaughter of Africa's elephants.

In recent years, the national park has already suffered environmentally due to the increased loss of the traditional dispersal and migration areas due to a wide range of human disturbances including, human settlements, property fencing, flower farming, eucalyptus farming, quarrying, gypsum mining, manufacturing industries and general urban sprawl especially to the south of the national park as shown in **Figure 4-33**. The SGR will escalate the negative landuse change to the south of Nairobi National Park if constructed through Route Option 7.

There is always a lot of interest on Nairobi National Park from conservationists and researchers which leads to easy availability of information on the state of environment within the protected area. Consequently, the baseline environmental assessment for the Nairobi National Park was mainly focused on the current state of the vegetation types and the recent trends in wildlife population trends. The assessment was based on the based on the most recent secondary data from the various sources as highlighted below.

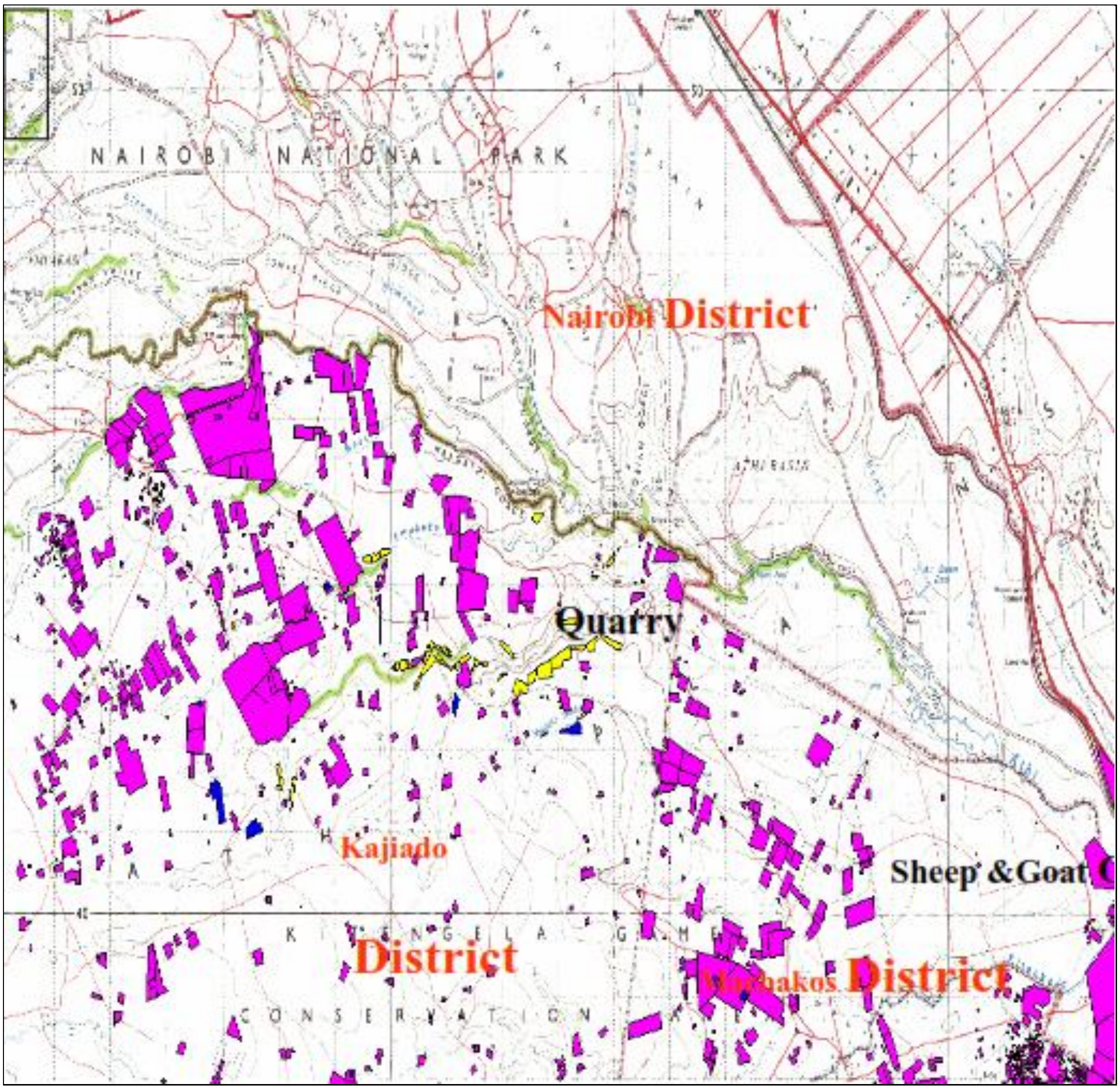


Figure 4- 34: Landuse changes around Nairobi National Park(**Note** – Pink shade represents human settlements and built-up areas)

i) **Vegetation**

The Nairobi national park contains a wide range of indigenous vegetation which is critical in supporting wildlife.The predominant environment is open grass plain with scattered *Acacia* bushes. The western uplands of the park have highland dry forest with stands of *Olea africana*, *Croton dichogamus*, *Brachylaena hutchinsii* and *Calodendrum*. The lower slopes of these areas are grassland. *Themeda*, Cypress, *Digitaria* and *Cynodon* species are found in these grassland areas. There are also scattered yellow-barked *Acacia xanthophloea*. There is a riverine forest along the permanent river in the south of the park including areas of broken bush and deep rocky valleys and gorges within the park. The species in the valleys are predominantly *Acacia* and *Euphorbia candelabrum*. Other tree species include *Apodytes dimidiata*, *Canthium schimperiana*, *Elaeodendron buchananii*, *Ficus eriocarpa*, *Aspilia mossambicensis*, *Rhus natalensis*, and *Newtonia* species. Several plants that grow on the rocky hillsides are unique to the Nairobi area. These species include *Euphorbia brevitorta*, *Drimia calcarata*, and *Murdannia clarkeana.*

The national park is associated with a wide range of vegetation types or associations as shown in **Figure 4-34**. The main ones include mainly; grassland, open dwarf tree grassland (*Acacia drepanolobium*), open dwarf tree grassland (*Acacia mellifera)*, forest glade, dense tall forest, open tall riverine woodland, scattered low-tall grassland, open low shrubland and riverine vegetation. The grasslands cover the largest area of the park (34 km^2), followed by open dwarf tree grassland (*Acacia drepanolobium*) and open low shrubland which cover nearly 25 $km^2$and 18 km^2 respectively. **Figure 4-35**shows an overlay between vegetation communities in NNP and the proposed SGR routes.

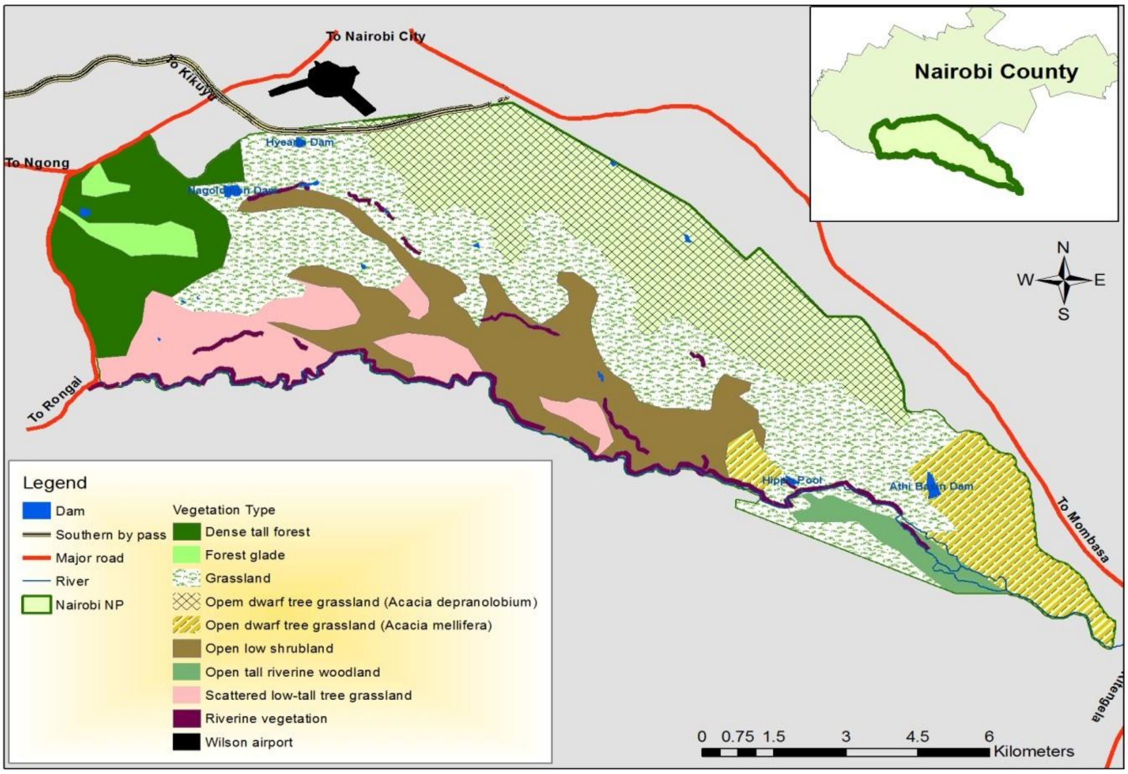


Figure 4- 35: The key vegetation types in Nairobi National Park

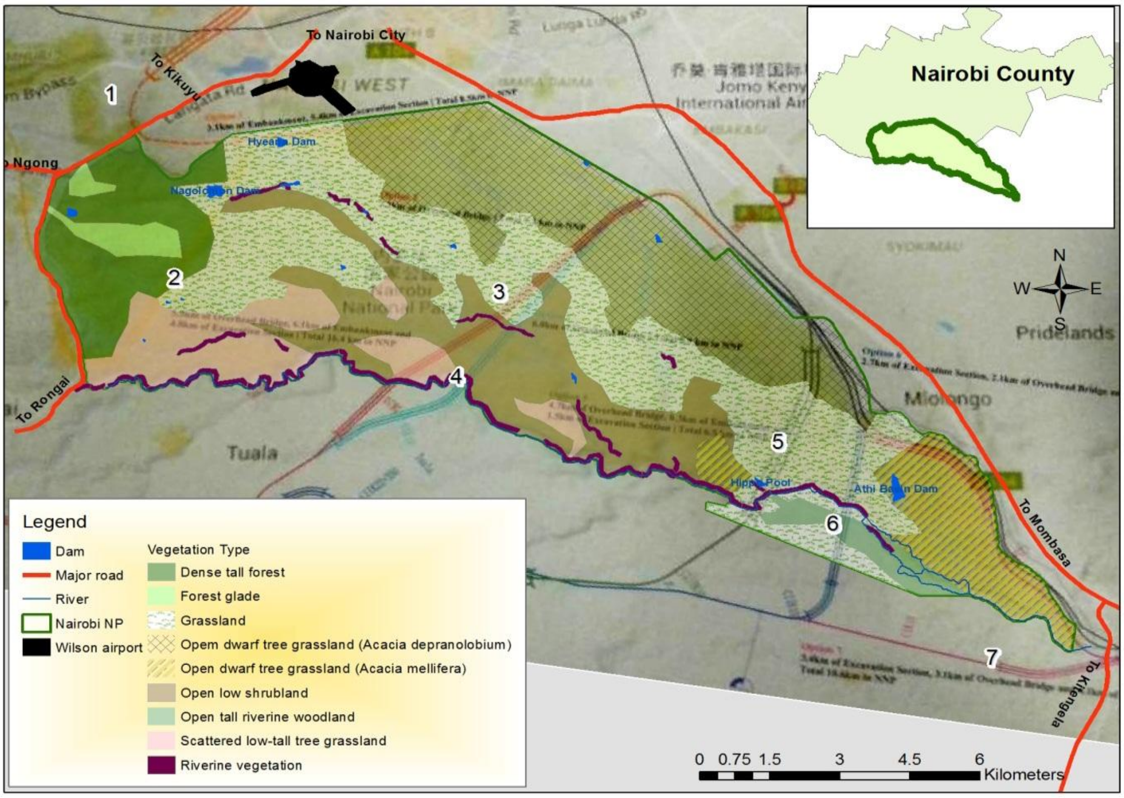


Figure 4- 36: Spatial overlay of NNP vegetation types and the proposed SGR routes

ii) Wildlife

Nairobi NP is endowed with diverse fauna species comprising of different taxa and since the early 1960s there has been consistent annual counts aimed at documenting their spatial distribution, population status and trends. For purposes of the phase 2A of the SGR ESIA, wildlife count data for 2010-2016 was sourced from the Kenya Wildlife Service database in order to document the baseline conditions of key wildlife species in NNP. Specifically, the synthesis and analysis of the data focused on; i) charismatic species which are a focal point of attraction to tourists (lion and black rhino), and, ii) the most abundant species (zebra, wildebeest, Maasai giraffe, Grant's gazelle, Thomson's gazelle, impala, eland, buffalo and Coke's) **(Table 4-13)**. Between 2010 and 2016, wildebeest, zebra, impala, coke's hartebeest and impala were the most abundant species in the park and were characterized by high numbers and density compared to the other key wildlife species.

Linear regression analysis carried out on the data, revealed that only four species showed a significant trend in their population increase over time(buffalo-F = 11.45, df = 1,5; p = 0.02; zebra-F = 9,23, df = 1,5; p = 0.043; coke's hartebeest-F = 11.45, df = 1,5; p = 0.029; impala-F = 10.12 df = 1,5; p = 0.025). The rest of the species had no significant ($p > 0.05$) linear increase or decline with time. This means from 2010 to 2016, the population of impala, buffalo, zebra and coke's hartebeest has been increasing while other species are declining or if not it's not significant on a linear scale.

Generally, from 2010-2016, the population of impala, coke's hartebeest, zebra and buffalo increased (**Figure 4-36 & 4-37**). However, during the same period, the populations of lion, Grant's Thomson's gazelle show a sharp decline in their population suggesting they could be faced by local extinction within the park unless effectively conservation measures are put in place (**Figure 4-38**). Further, some of the species had also declined sharply in the past e.g. the Maasai giraffe, wildebeest and black Rhinoceros but they seem to have stabilized or mildly fluctuating over small population sizes (**Figure 4-39**). Again, this suggests that these species could also crush and be locally extinct if any perturbations or stochastic (unexpected events that negatively impact the species) in the park occur.

ii) Spatial distribution of key wildlife species in NNP in 2015

Understanding spatio-temporal distribution of wildlife is vital in their effective conservation and management. In view of the potential impacts that are anticipated from the SGR in NNP, 2015 KWS count data for key wildlife species was used to characterize current baseline on their distribution in relation to the proposed SGR routes existing the Nairobi South station, and are herein outlined.

- **Cape buffalo:** Although this species was widely distributed in the entire park, most of population was largely concentrated in the western, north-western and south-western sectors of the park where 2, 3 and 4 traverse routes. It also occupied most of the central zone of the park where the proposed route 5 and 6 are found.

- **Coke's Hartebeest:** This is a highly mobile species and was widely distributed across the park but its highest concentration was mainly in the southern sector where hippo pools and Athi dams are located**;** where SGR routes 5, 6 and 7 as situated. A similar high concentration zone of the species was found in the north-western part of the park bordering the southern by-pass and the proposed route 1 and 2. The second highest concentration of hartebeest occupied in the western, north-western and south-western zones which are traversed by route 2, 3 and 4.

- **Zebra:** It's also a highly mobile species and was found occupy many sectors of the park with the highest concentration being in the southern zones towards the sheep and goat area, where route, 5, 6 and 7 pass through. Another notable high aggregation area for zebra was the north-western zone and partly in the north-western, south-western and western zones which are traversed by route 1, 2, 3 and 4.

- **Eland:** This is rather shy antelope and unlike other species, it tended to have a restricted distribution. It was therefore mostly confined in the zone starting almost at the middle of the park extending to the entire southern landscapes (where route 5, 6 and 7 pass through) with a smaller high concentration zone in the lower middle landscapes of the park which are traversed by route 2, 3 and 4.

- **Maasai Giraffe:** Giraffes tend to be highly mobile like most large sized mammalian wildlife species. In this regard, they tended to be distributed widely across the park. However, their highest concentration was in the lower parts of the park where route 2, 3 and 4 are proposed to pass through. Other sectors of where they were characterized by high aggregations was the southern parts of the park where route 5,6 and 7 are proposed as well as the western region where route 2 traverses.

- **Grant's gazelle:** These tended to be mostly concentrated from the middle of the park towards the southern sector where 3, 4, 5, 6 and 7 traverse through route. However, its highest aggregation was in the north-western zone where Nagolomon and Hyena dam are located.

- **Impala:** This is also mobile species and occupied large swathes of the park but the highest aggregations being in the southern zone where 5, 6 and 7 traverse through route. The second highest concentrations were found in the western, north-western and south-western zones which are traversed by route 2, 3 and 4.

Table 4- 13: Population status and density of key mammalian wildlife species in Nairobi National Park (2010-2016) (Source, KWS Database)

Species		2010		2011		2012		2013		2014		2015		2016	
		#	Density /km²	#	Densit y/km²	#	Densit y/Km²	#	Densit y/Km²	#	Densit y/km²	#	Densit y/km²	#	Density /km²
1.	Buffalo	70	0.60	253	2.16	405	3.46	153	1.31	409	3.50	439	3.75	699	5.97
2.	Black Rhinoceros	3	0.03	11	0.09	8	0.07	8	0.07	10	0.09	12	0.10	10	0.09
3.	Wildebeest	1030	8.80	132	1.13	114	0.97	50	0.43	198	1.69	203	1.74	91	0.78
4.	Burchell's zebra	10	0.09	1091	9.32	733	6.26	549	4.69	638	5.45	990	8.46	1271	10.87
5.	Eland	104	0.89	154	1.32	139	1.19	75	0.64	153	1.31	185	1.58	39	0.33
6.	Maasai Giraffe	84	0.72	94	0.80	101	0.86	73	0.62	111	0.95	120	1.03	92	0.79
7.	Grant's Gazelle	8	0.07	117	1	107	0.91	55	0.47	149	1.27	130	1.11	64	0.55
8.	Coke's	1	0.01	526	4.50	520	4.44	380	3.25	759	6.49	618	5.28	789	6.74

	Hartebeest														
9.	Impala	7	0.06	563	4.81	741	6.33	710	6.07	899	7.68	800	6.84	890	7.61
10.	Lion	51	0.44	17	0.15	9	0.08	4	0.03	9	0.08	11	0.09	9	0.08
11.	Thomson's Gazelle	19	0.16	222	1.90	188	1.61	154	1.32	231	1.97	181	1.54	133	1.14

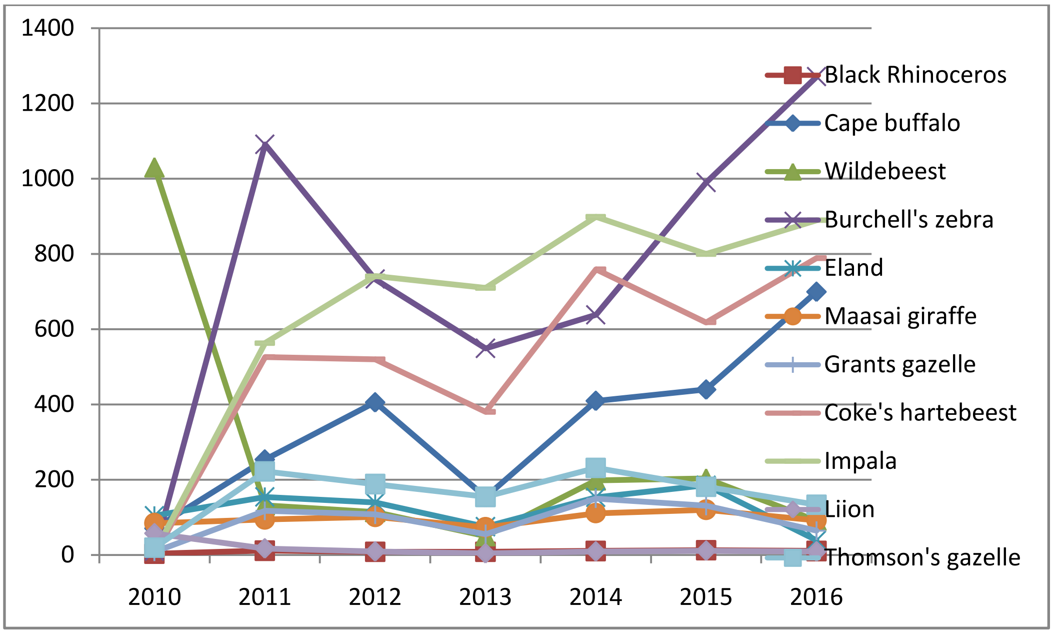


Figure 4- 37: Combined population status and trend of key wildlife species in NNP (2010-2016)

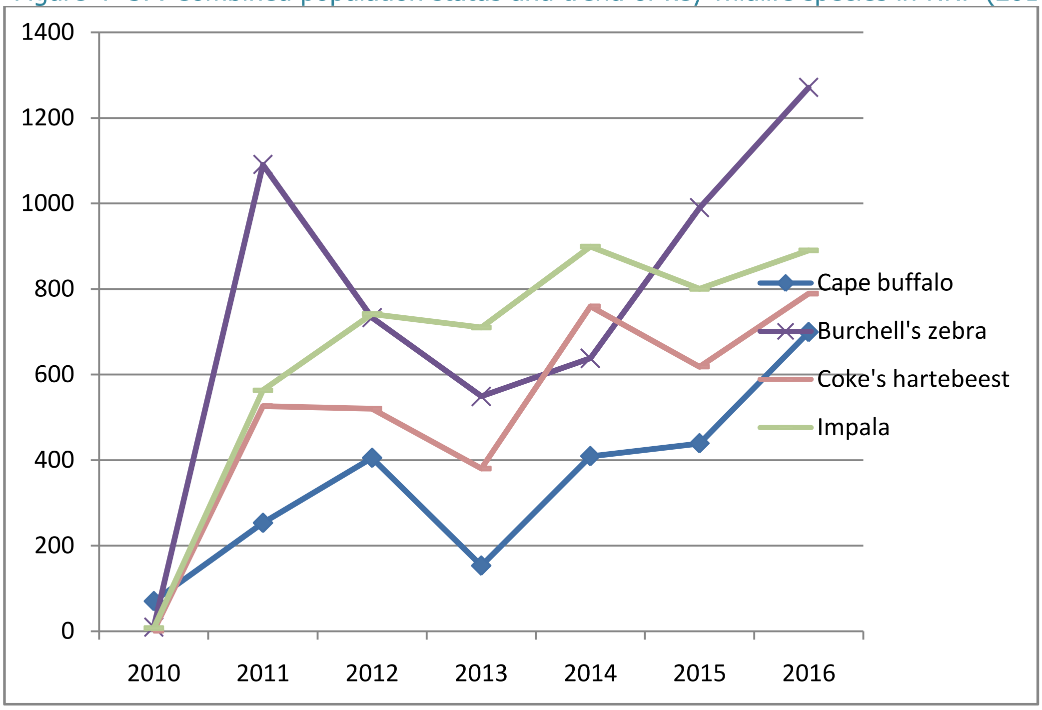


Figure 4- 38: The population status and trend of four species (buffalo, zebra, impala and Coke’s Hartebeest) in NNP that seem to be increasing (2010-2016)

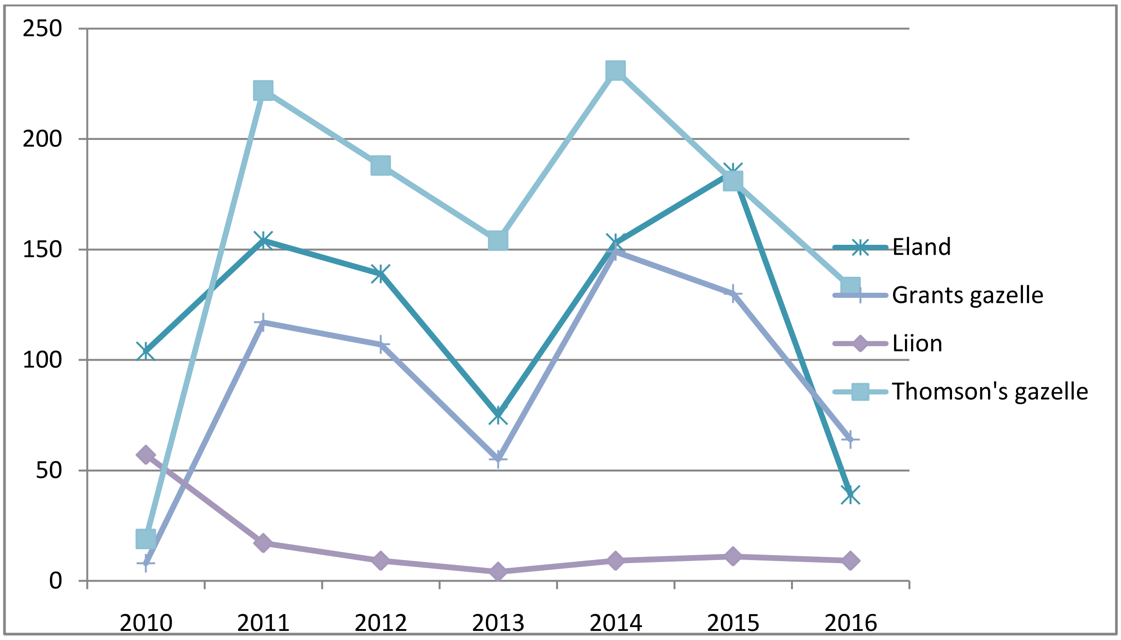


Figure 4- 39: The population status and trend of four species (eland, lion, and the gazelles)

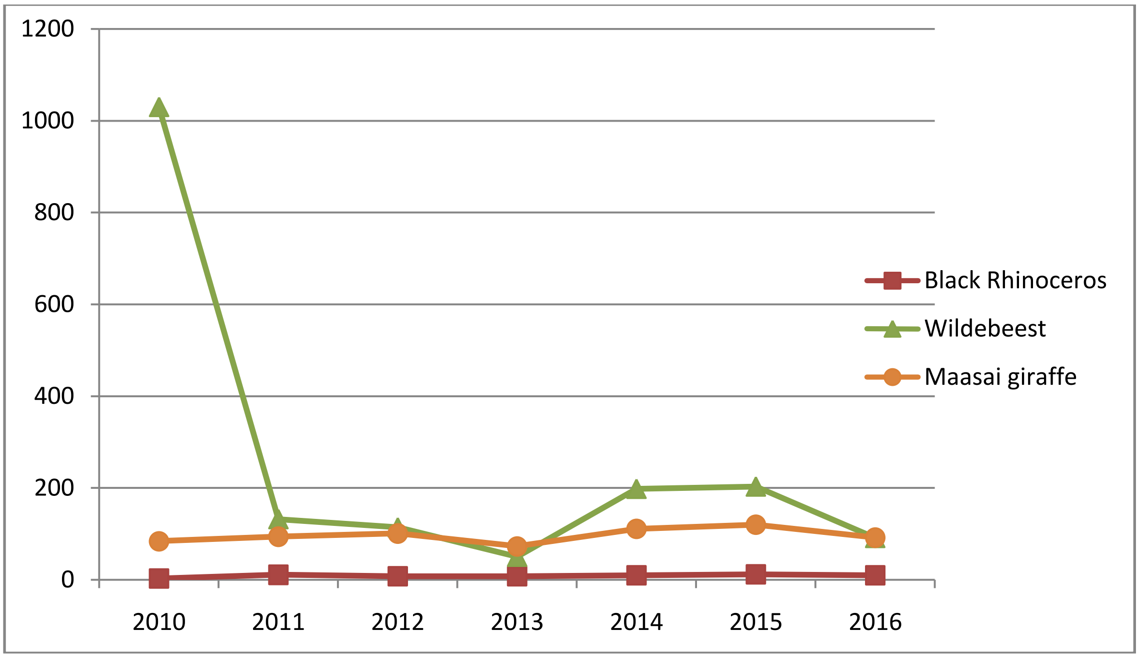


Figure 4- 40: The population status and trend of three species (black rhinoceros, wildebeest, and Maasai giraffe) that seem to have stabilized (2010-2016)

- **Lion:** Lions tend to be mobile depending on the time of the year and degree of prey availability. In this regard, they were found to have a wide distribution in the park perhaps overlapping with their prey species. However, they were mainly found to be in high aggregations in the southern parts of the park which appeared to overlap with some of their prey species like wildebeest and zebra which were also prevalent in the landscape. This region is traverse by the proposed route, 5, 6 and 7. The lower borderland in the south-western part of the park was also characterized by high concentration of lion and again this could be influenced by prey species availability (**Figure 4-40)**

- **Thomson's gazelle:** This species also tended to be widely distributed in the park but was mainly confined from the middle of the park to the southern region which is traversed by all the 7 proposed routes. The environs of Nagolomon and Hyena dam were also noted to have high aggregations of the species.

- **Wildebeest:** The wildebeest is renowned for its mobility and seasonal migratory tendencies, and this may account for their observed occupation of large swathes of the park. Nonetheless, their population was noted to be mostly concentrated from the mid-zones of the part all the way to the southern sector towards the borderland with sheep and goat, a zone traversed by route 5, 6 and 7.

- **Black rhino:** This is very shy animal and spends a lot its time in concealment especially in vegetation communities with ample browse forage. Although the species was found in different parts of the park, their highest concentration was in the southern park borderland with sheep and goat which provides an important dispersal corridor for black rhinos and other species as well (**Figure 4-41**).

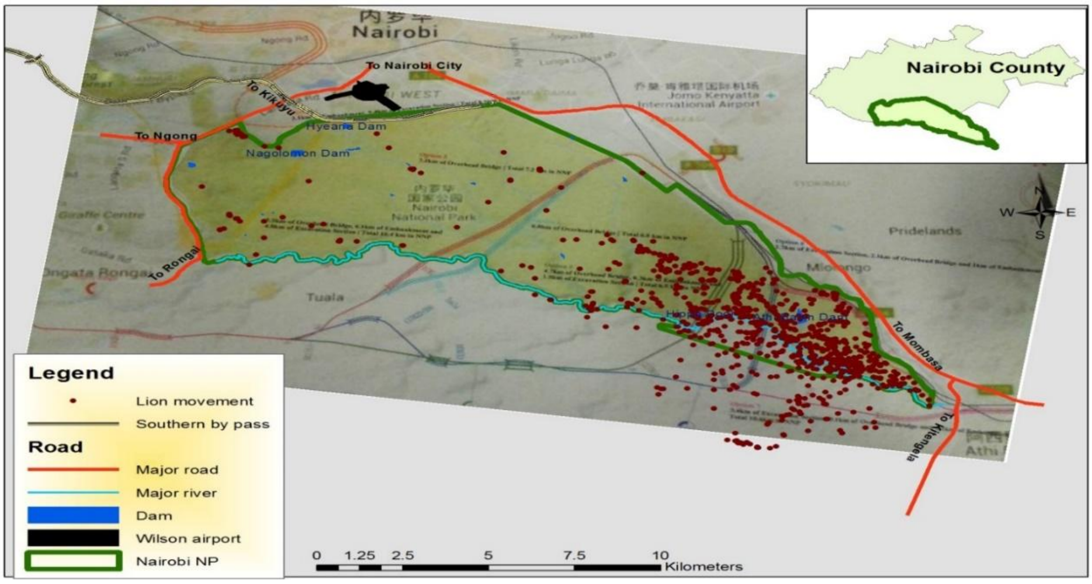


Figure 4- 41: An overlay of lion movement in NNP and the proposed SGR routes

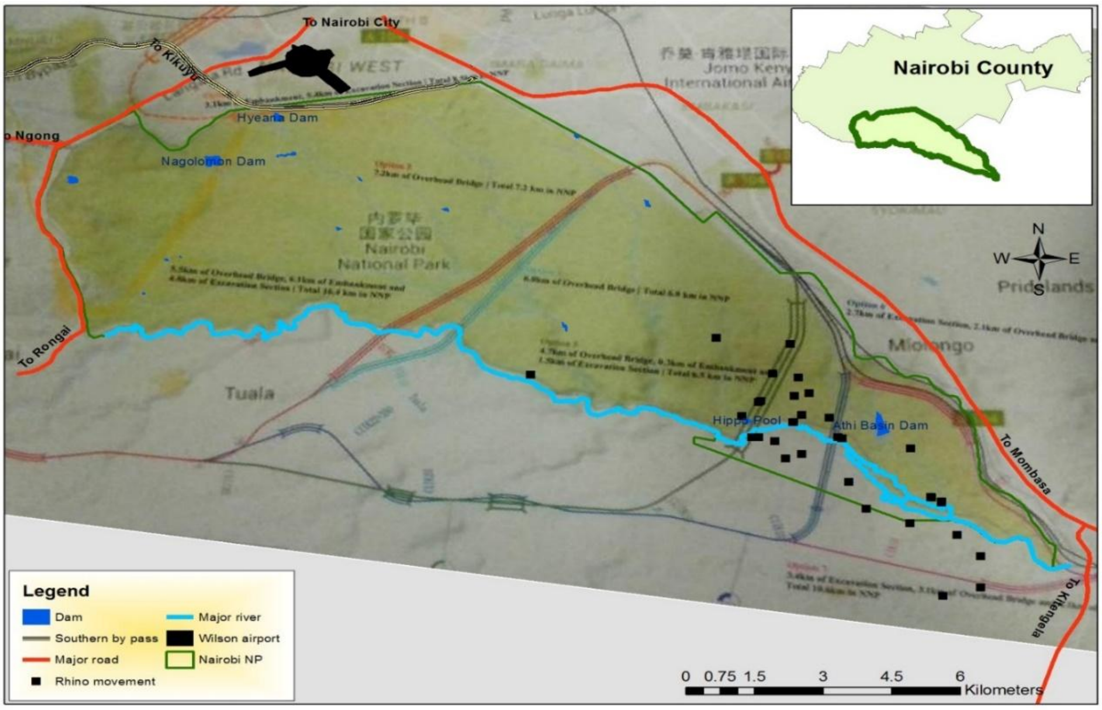
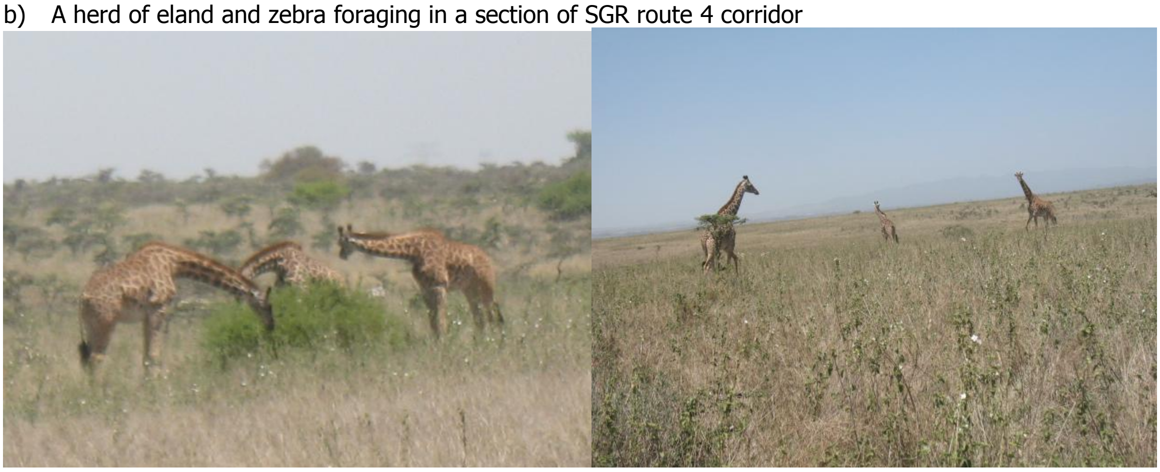


Figure 4- 42: An overlay of black rhino movement in NNP and the proposed SGR routes

The baseline environmental assessment for**Route 4** was jointly undertaken on Thursday 14th October by the Consultant (Habitat Planners) and KWS experts. The findings showed that the route will pass through four vegetation communities or types in the following order starting near East Gate; i) *Acacia drepanolobium* dwarf shrub grassland (**Plate 4.9**), ii) grassland, iii) open low grassland, and, iv) riverine vegetation. Most of the route will pass through the open low shrubland followed by grassland and the least will be riverine vegetation along the Mbagathi River. Due to the open nature of the landscape in the route corridor coupled by an abundance of grass biomass, its used by a variety of key wildlife species especially Impala, Eland, Common zebra, Cape buffalo, Coke's Hartebeest and Grant's gazelle (**Plate 4.9**). Most of these species are prime prey species for Lions and as such the corridor is heavily used by the carnivore which is the largest of all the carnivore species that are found in the park. A variety of low lying shrub species also occur along the corridor and although their abundance is rather low (**Plate 4.9**), they make the landscape attractive to browsers especially the Maasai Giraffe (Plate 4) and Black Rhino. During the route inspection, different species were encountered including; Maasai Ostrich, Maasai Giraffe, Common zebra, Impala, Grant's gazelle, Coke's Hartebeest and Eland supporting existing.

a) Stands of *Acacia drepanolobium* dwarf shrub grassland at the SGR near Nairobi South Station

b) A herd of eland and zebra foraging in a section of SGR route 4 corridor



c) Maasai Giraffes encountered in a section of route 4 corridor

Plate 4-9: Baseline vegetation and wildlife characteristics along Route 4

iii) Tourism revenue trends

Tourism attractions in the NNP include wildlife, landscape experience and the culture of surrounding communities. The park's close proximity to Nairobi City makes the park ideal for conference tourism. Visitor activities in the park include wildlife viewing, picnicking, nature walk, bird watching, filming and bush functions. Visitor facilities in the Park and its immediate vicinity include: picnic sites, hotels and lodges, observation points, a nature trail and a tourist gift shop. **Table 4-14** shows the trend in tourism revenue in the NNP in the 2010-2015 period.

Table 4- 14: NNP visitor numbers and revenues

Year	Citizens	Residents	Non residents	Total	Revenue in KES (millions)
2010	53,000	10,000	23,000	**85,000**	**114**
2011	67,540	14,940	37,200	**120,000**	**191**
2012	93,400	17,150	41,000	**152,000**	**207**
2013	93,000	17,000	41,000	**151,000**	**217**
2014	76,000	16,000	37,000	**130,000**	**228**
2015	77,000	16,000	40,000	**133,000**	**280**
Total	**460,000**	**90,000**	**220,000**	**771,000**	

The experiences from the Hell's Gate National Park (HGNP), Naivasha provide some lessons on the effect of major infrastructural projects on visitor numbers and park revenues**.** For decades, the park has accommodated geothermal exploratory and geothermal electricity production activities side by side with wildlife conservation and management. More wells have been drilled starting with Olkaria 1 then 2, 3 and 4. More electricity generating stations are to be constructed in park including Olkaria 5, 6, 7,8 and 9.**Table 4-15** shows the trend in tourism revenue in the HGNP in the 2010-2015 period. The trend does not indicate any significant decline in tourism revenue as a result of the geothermal development in the area.

Table 4- 15: Hell's Gate National Park visitor numbers and revenue

Year	Citizens	Residents	Non residents	Total	Revenue in KES (millions)
2010	50,000	4,000	12,000	**67,000**	**47**
2011	88,000	6,000	18,000	**113,000**	**81**
2012	63,000	12,000	19,000	**95,000**	**70**
2013	68,000	9,000	21,000	**99,000**	**73**
2014	87,000	15,000	20,000	**122,000**	**94**
2015	97,000	10,000	16,000	**124,000**	**91**
Total	**456,000**	**58,000**	**107,00**	**621,000**	

c) Between Nairobi and CK+120km

The SGR route section between Nairobi and CK+120 is broadly characterized by a wide range of key land uses including the following, agriculture, forestry, livestock production, mining and quarrying, Geothermal energy production, industrial activities, human settlements and conservation.

i. Rainfed and irrigated agriculture

The section in this route between Tuala through Ongata Rongai all the way to the neighbourhood of Ngong hills where the SGR enters a tunnel is characterized by small scale farming throughboth rainfed and irrigated farming. This involves the growing of vegetables and other crops especially maize. Fruit trees such as mangoes (*Mangifera indica*), Pawpaw (*Carica papaya*), Oranges (*Citrinus sinensis*), Bananas (*Musa acuminata*) are also common. Some sections of the route are characterized by agricultural production through the use of green houses to grow tomatoes and other crops for the urban market (**Plate 4-10**). As the line emerges from Ngong hills 3.75km tunnel, the small scale crop growing is replaced by livestock keeping.


Plate 4- 10: Greenhouses along the SGR route

The stretch between Mai-Mahiu to Suswa (Point 75km to 105km respectively), farmlands under agricultural crops occur as isolated pockets of small farms amidst the more expansive livestock production. However, from point 105km, farms under agricultural crops increase. The farms that will be affected are isolated, small and mainly under subsistence farming hence the impact at this zone will range from minimal to moderate. However, at D120km and its neighbourhood, expansive agricultural fields under maize and wheat are common forming mixed farming (livestock and food crop). The presence of hills and depressions at point 120km in Nairekia Enkare and its neighbourhood probably makes the zone to have adequate rains to support large scale crop growing (**Plate 4-10**). The food crops are grown for both subsistence and commercial uses. Along the SGR corridor and its neighborhood, irrigated agriculture occurs in isolated pockets on farmlands and along streams. In areas around D120km, the line will traverse through some of the expansive farms under maize and wheat. However, landholding per household at this zone is big and as a result, the proponent will deal with few farmers.

In the agricultural zone, compensation of the affected land owners will significantly reduce the impact to a bare minimum. It is important for the contractor to restrict earthworks and movement of construction machines and workforce to designated and most efficient routes to minimize the acreage of farms to be affected. Reaching consensus and compensation become easy when dealing with few land owners. The contractor is expected to put in place adequate precautionary measures to minimize disturbances of farms around point 120km since the zone seems to be one among the food baskets for the predominantly pastoral Maasai community.

ii. Forestry

Forestry activities in form of urban and farm forestry are common in the more humid areas where rain-fed agriculture is taking place. Urban and farm forestry are common though most of the route from Tuala onwards. Some cases of isolated plantations and woodlots are also common in some places. The latter are dominated by *Eucalyptus grandis and Grivellea robusta*. However, as the line exits from the Ngong hills and enters the expansive woodland, cases of farm forestry becomes isolated. From Namucha area (75km) to Enoosupukia (120km) farm forestry activities are scarce in the expansive woodland. The only farm forestry activities in this section are practiced on small holder farms and institutions. In Olorowua area in Suswa at D104km, which lies at the tail of Hell's Gate, farm forestry activities sponsored by Kengen are quite common as part of the CSR program. The impact of the proposed line on irrigated farm forestry activities will be minimal since only small sections will be affected directly. However the proposed industrial park and the existing horticultural farms will greatly benefit from the line.

The key indigenous forests along the proposed SGR route include Ngong hills forest and Ololuwa forest. The proposed SGR route will affect sections of the Ngong Hills forest through the construction of railway tunnel in the site shown in **Plate 4-11**. This will involve the drilling of a 3.75km tunnel across sections of the Ngong hills. The tunnel will take up and affect approximately 26.25Ha. Spill-over effects of construction of the tunnel will probably disturb the larger Ngong forest to some extent. It is important to note that Ngong Forest is located approximately 6km from Nairobi's Central Business district and is considered a treasure being one of the city's green space and carbon sinks serving to purify the air of CO^2 and other gases emitted by approximately 700,000 vehicles on the streets of Nairobi and industries (Laventure,2015). It is estimated that approximately 26.25 ha of Ngong Hills Forest and 35km of Ololuwa Forest will be affected by the SGR project particularly through the construction of the railway tunnels.

Plate 4- 11: The Ngong hills area where the tunnel will be constructed

Since the line will pass through a tunnel across the Ngong hills, it is advisable to put mechanism in place to reduce vegetation destruction during construction of the tunnel. The contractor should minimize above ground earthworks and machinery movement during construction of the tunnel. Interference of the root zone within the tunnel corridor should also be avoided. Should blasting be mandatory during construction of the tunnel, then it is advisable that the contractor employs mild blasting and restricts the process to critical and mandatory sections to avoid vegetation disturbances. Revegetation of the disturbed sites after construction of the tunnel will assist the forest to recover from any disturbances that will arise.

Tunneling will involve total vegetation clearance and blasting along the 70m corridor. Construction of the tunnel will make use of heavy machinery thereby causing excessive vegetation disturbance beyond the 70m corridor. Dust generation from construction works will generally settle on vegetation leaves thereby affecting their photosynthetic ability and productivity. Soil compaction at the corridor by heavy machinery as well compacted surfaces of the completed tunnel will hinder natural regeneration of the disturbed sites. Heavy machineries and excessive compaction are known to destroy the soil structure and profile. Vegetation regeneration can only be possible once the soil structure and profile are restored but this can take many years. Key among such measures include: minimization of earth works, restriction of traffic to mandatory and the most efficient routes, control excessive use of heavy machineries, avoid unwarranted vegetation clearance and assist the ecosystem to recover after construction is complete by undertaking enrichment planting of the disturbed areas using native species. Some of the other key environmental concerns to be considered carefully during the tunneling activities are:- a) deep cutting slope protection, b) sub-grade water-proofing and drainage, c) Tunnel drainage, and d) groundwater proofing.

iii. Livestock production

Several small and large scale livestock farms will be affected as the SGR passes through Tuala areas. The effect on livestock will also continue after the line crosses from Kajiado County to Kiambu (Lusigetti, Kamangu and Nachu areas), Nakuru (Maimahiu area) and Narok (Suswa area) Counties. As the SGR emerges from Ngong hills 3.75km tunnel at DK37 (36.630885, 1.455087), it enters expansive rangeland area in Ewaso Kedong where the main landuse is livestock keeping. Dominant livestock in the zone include cattle, sheep, goats, donkeys among others (**Plate 4-12**). The woodland and livestock keeping continues all the way to 75km and up to 120km (Mai-Mahiu to Suswa area). This area has a high population of livestock (livestock ranching). Three expansive ranches, namely Akira, Kedong and Africa Geothermal International characterize the area. Most of the sections of the three ranches have been encroached by the local communities. The local communities claim ownership of sections of the ranches. Cases between the local communities and the ranch owners are in court. Ground checks indicated that most of the ranches owners are absentee landlords thereby increasing the chances of encroachment by the local community and conflict over ownership. Group ranches also exist between 75km-120km. At 75km, small scale livestock farmers dominate. At this zone, the population density is sparse but the population density increases around the roadside market and shopping centres.

Plate 4- 12: Livestock ranching in sections of the savannah woodland

In expansive ranches such as Kedong, Akira and Africa Geothermal International, the 70m SGR corridor will not affect the ranches greatly because of their big landholding. However, in sections of the woodland where land holding per household is small, the impacts of the corridor will range from moderate to high. To minimize the impact, it is expected that the proponent will engage the land owners and compensate them. The SGR line will introduce a physical barrier within ranching areas. Such a barrier will restrict livestock movement from one area to another. Such restrictions will not anchor well with the Maasai who are used to free range livestock keeping. It is strongly recommended that the proponent will put up and increase the frequencies of underpasses that can be used as crossing points for the livestock. Since the line will be raised off the ground by 6 metres, this will minimize possible livestock accidents caused by the trains on transit.

iv. Mining and quarrying

The SGR route after the Kamangu area is characterized by mining and quarrying in some places. This includes the diatomite mines which exist in the area around Gicheru Range. Further down the route is characterized by quarrying areas for construction stones, ballast and sand (**Plate 4-13**). The compact rocks including basalts, trachytes and phonolites are good sources of ballast and foundation while the pyroclastic rocks are good for dimension stone. Volcanic ash deposits are currently being mined as sand for building at areas around CK+104km and thus are of great economic importance.

Plate 4- 13: Quarrying activities in Namuncha area near the SGR corridor

v. Geothermal energy production

The entire railway line section between Nairobi and CK+120km lies in a volcanic terrain. The main economic resource along the vicinity of the line is the geothermal resources whose presence was only evident in the area around CK+104km where the hills on the rift floor were observed to consist of the deep red volcanic ash associated with emanating steam vents. The geothermal resources areas of the region have been mapped in the Longonot and Olkaria area which is a bit removed from the section and are currently being exploited by the government for electricity generation.

vi. Industrial activities

An expansive industrial park has been proposed near the line and Hells gate. A subsidiary line has also been proposed from the Hells gate bridge to the proposed industrial park. In the neighbourhood of Hells gate conservancy, irrigated agriculture occurs in horticultural farms such as Longonot farm, Home grown farm, Kitikoni farm, Oserian farm, Kongoni farm among others. The negative impacts of the proposed line on irrigated agriculture will be minimal since very few farms might be affected directly and the large scale horticultural farms are away from the SGR corridor.

vii. Human settlements

The entire section is characterized by human settlements with the highest density of settlements existing in the Ongata Rongai and Ngong in Kajiado County followed by the Kamangau area which is part of the Karai-Ndeiya zone in the Kikuyu Sub-County of Kikuyu County. The route will pass through a number of towns and urban market centres such as Ongata Rongai, Ngong, Bulbul, Kamangu, Mai-Mahiu, Longonot and Nairekia Enkare. Many of these urban centres will be connected with SGR stations for the transportation of people and cargo.

viii. Key conservation areas

Apart from the Ngong Hills Forest Reserve, the SGR route beyond Mai-Mahiu will pass cross to a number of important conservation areas and wildlife dispersal habitats which include Mt Longonot National Park, Hells Gate National Park, Kedong Ranch and Akira Ranch as well as Suswa Conservancy *(Field Survey, 2015).*

- **Mt. Longonot National Park**

Mt. Longonot National Park (52km^2) was gazetted in 1983. The key wildlife species in the park and generally in the adjacent areas are predominantly plains game. Zebra (*Equus burchelli)*, Kongoni (*Alcephalus buselaphus)* and Thompson's gazelle (*Gazella thomsonii)* are the most common, and in areas like Kedong Ranch they occur in large numbers. Other herbivore species include Buffalo (*Syncerus caffer), Eland, and Impala,* Grant's gazelle (*Gazella granti),* Masai giraffe (*Giraffe camelopardalis),* Warthog (*Phacochoerus aethiopicus),* Klipspringer (*Oreotragus oreotragus),* Steinbuck (*Raphicerus campestris),* Dik *(Rhynchotragus kirkii),* Defassa waterbuck (*Kobus Defassa)* and Bohor reedbuck (*Redunca redunca)*. These animals use the park during the wet season. However, in the dry season, they move out of the park to community areas in search of water. This is because the park has no adequate water resources during the dry season. Once outside the park, the wild animals are a threat to human life (e.g., buffalo) and cause crop raiding (e.g. eland, zebra). They are also under threat from poaching *(KWS, 2010 Unpublished).*

- **Hells Gate National Park**

Hell's Gate National Park (HNP) lies to the south of Lake Naivasha at the bottom of the Eastern arm of the Great Rift Valley. The Park covers an area 68km^2, characterized by diverse topography and geological sceneries *(KWS, 2010 Unpublished).* The park mainly comprises of savannah and cliff ecosystems that host a wide variety of fauna, avifauna and flora. HNP is home to a great diversity of wildlife species including Common Zebra (*Equus burchelli*), Masai giraffe (*Giraffa camelopardalis*), Thomson's gazelle (*Gazella thomsonii*), Leopard (*Panthera pardus*), Klipspringer (*Oreotragus oreotragus*), African buffalo (*Syncerus caffer*) and Common eland (*Taurotragus oryx*) among other wildlife species. The rare klipspringer (*Oreotragus oreotragus*) and Chanler's mountain reedbuck (*Redunca fulvorufula*) inhabit the rocky hills and cliffs. The park hosts over 100 species of birds, which include the near threatened Grey crested helmet shrike (*Prionops poliolophus*), various raptors comprising Rupp ell's vulture (*Gyps rueppellii*), White backed vulture (*Gyps africanus*); birds of prey and swifts which are synonymous with cliff faces of the park. The bush land habitat constitutes of *Tarconanthus camphorates* and *Acacia drepanolobium* which offers browse and cover to animals like giraffes, buffaloes, among other browsers. The grassland habitat which constitutes various grass species like *Digitaria milanjiana* and *Cynodon dactylon* supports numerous grazers in the park, there are a few pockets of this habitat in the park and these sections are marked by high density of invasive plant species due to overgrazing by wildlife. The cliffs offer unique habitat and ecological niches for raptor birds, leopards and rock hyraxes *(KWS, 2010 Unpublished).*

The areas outside both Longonot and Hells Gate National Parks along the SGR project route support a lot of wildlife. Some of the wildlife species sighted outside the NNP during the baseline study in the 10 km long dispersal corridor included; wildebeest, Maasai giraffe, impala, Grant's and Thomson's gazelles, common zebra, Kongoni, Maasai ostrich, eland and olive baboon. Their group sizes ranged from singe (1) individuals to aggregations of up to 10 or more individuals depending on the species. Past studies (e.g. Ogutu et al 2013) have also documented use and presence of these species in this corridor including nocturnal species like the lion and spotted hyena. Many monkeys and Dikdiks were also observed along the project route in Namuncha area. Neighboring the Mt. Longonot and Hell's gate National Parks are many ranches such as Akira ranch and Kedong in Narok area. These ranches are the wildlife dispersal areas that support the protected area ecosystem of Hells gate and Mt Longonot National Parks. The ranches also support large populations of livestock that compete for food and water with wildlife. In view of the importance of maintaining this wildlife dispersal area, KWS has initiated partnerships with the land owners of Kedong, Akira and Kongoni ranches to ensure that land uses in the dispersal area are compatible with wildlife conservation. Kedong, Akira and Kongoni ranches that are adjacent to Hells Gate National Park are important dispersal areas of wildlife from the park.

- **Kedong and Akira Ranches**

All the ranches that form the ecosystem are important wildlife dispersal areas that support the survival and sustenance of wildlife in Hells Gate and Mt. Longonot National Parks. The ranches also support large populations of livestock that compete for food and water with wildlife. In view of the importance of maintaining this wildlife dispersal area, KWS has initiated partnerships with the land owners of Kedong, Akira and Kongoni ranches to ensure that land uses in the dispersal area are compatible with wildlife conservation *(KWS, 2010 Unpublished).* Kedong, Akira and Kongoni ranches that are adjacent to Hells Gate National Park are important dispersal areas for wildlife from the park. However, land use conversion in these ranches ranging from Ranching to horticulture, is negatively affecting wildlife and increasing human-wildlife conflicts *(Sparvs Agency Ltd (2008).*

Kedong Ranch covering an area of 80,000 acres borders Longonot National Park to the west and acts as a dispersal area for wildlife. Amongst the many species of game, which roam freely over these ranches are Eland, Giraffe, Zebra, Impala, Gazelle, Coke's Hartebeest, Hyena and Bat eared fox. There are several nocturnal species such as the African springhare, White tailed mongoose, and the Aardvark *(Sparvs Agency Ltd (2008).* These ranches and other group ranches between 75km-120km have livestock that include cattle, sheep, goats, donkeys and even dogs and these could easily be killed by fast moving train hence the need to build underpasses to provide for wildlife and livestock passage (*Irigia B.K, 2015).*

- **Mt Suswa Conservancy**

Some of the wild animals found in Mt Suswa conservancy include: giraffes, Thomson's gazelle, zebra, Klipspringer, hyenas, Genet cats and Leopards. The caves are full of bats, Rock hyraxes and baboons. The conservancy is a great site for birding (http://www.naturekenya.org). Tourism experiences in the conservancy includes adventure Caving, Mountain Climbing & Wild Camping in caves. The unique geological features of Mt Suswa and potential visitor attractions are the extensive network of accessible lava caves, and stunning sunken 'crater within a crater' with a central island of pristine tropical forest of immeasurable biodiversity and ecological interests *(http://www.ecotourismkenya.org).*

5. POLICY, LEGAL AND REGULATORY FRAMEWORK

At global level there is a growing concern in Kenya that many forms of development activities cause damage to the environment. Themajor national challenge today is to maintain sustainable development without damaging the environment. Today, Kenya is faced with grave environmental problems and challenges amongst these are land degradation, loss of biodiversity and pollution of the environment (air, soil and water). The situation is aggravated by lack of awareness and inadequate information in the public domain on the consequences of their actions on the environment. There is also limited involvement of local communities in the participatory planning and management of their environment and natural resources. The Kenyan Government has put in place a wide range of policy, institutional and legislative arrangements to address the causes of environmental degradation in the country.

Laws governing environmental protection and conservation in Kenya are derived from the constitutional statutes and the ratified international conventions. These laws regulate the establishment and operation of development projects and their associated activities, which may have negative impact on the environment, human health and socio-economic well-being of the people who interact with such projects.

Before the enactment of the Environmental Management and Coordination Act (EMCA) 1999. Kenya did not have a consolidated legislation for the protection and management of the environment. It had about 77 statutes that touched on various aspects of environmental management. Some of the legislative instruments have been in place for many years and are duplicated in other legislations.Environmental protection and sustainable use of natural resources have also been stated in all development plans since independence. The sessional papers and presidential directives have also emphasized the need to conserve the environment and manage the natural resources sustainably. Lack of consolidated legislation offered inadequate protection for the environment due to the absence of legal and institutional framework.

According to the Kenya National Environment Action Plan (NEAP, 1994) the Government recognized the negative impacts on ecosystems emanating from economic and social development programmes that disregarded environmental sustainability. Following this, the establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished or are in the process of development. The NEAP process has introduced environmental assessments in the country culminating into the enactment of Environment and Development policy under the Sessional Paper No. 6 of 1999.

The Kenyan law has made provisions for the establishment of the National Environment Management Authority (NEMA), which has the statutory mandate to supervise and co-ordinate all environmental activities. Policies and legislation highlighting the legal and administrative requirements pertinent to this report are presented below. An ESIA is a legal requirement in Kenya for all development projects. The Environmental Management and Co-ordination Act 1999, is the legislation that governs ESIA studies. This project falls under the Second Schedule that lists the type of projects that are required to undergo ESIA studies in accordance with section 58 (1- 4) of the Act. Projects under the Second Schedule comprise those considered to pose potential negative environmental impacts.ESIA has been prepared to fully comply with environmental legislations for Projects with Impacts and as per various NEMA Regulations. The key environmental benchmark instruments used in the policy, legal and institutional framework for the SGR-IIA Project ESIA are highlighted below.

5.1: National and County requirements

The ESIA for the SGR-IIA is in accordance tothe project alignment with the following environmental regulatory frameworks:-

5.1.1: National environmental policies

a) The Constitution of Kenya
b) Sessional Paper No. 6 of 1999 on Environment and Development)
c) Environment Policy (2013)
d) National Land Policy (2009)
e) National Water Policy (2012 Draft)
f) Draft National Policy on Wetlands Conservation and Management (2013)
g) National Policy for the Sustainable Development of Arid and Semi-Arid Lands of Kenya, 2012 (GoK, 2012)

h) Draft Wildlife Policy (2011)
i) National Policy for Disaster Management, 2009
j) National Gender and Development Policy, 2000
k) Draft National Tourism Policy, 2007
l) National HIV Policy (GoK, 1997)
m) National Environmental Sanitation and Hygiene Policy (2007)
n) Draft National Policy on Peace Building and Conflict Management (2006)

5.1.2: National Legal frameworks

a) Environmental Management and Coordination Act (EMCA) No. 8 of 1999
b) Relevant EMCA Regulations
    - Environmental Management and Coordination (Impact assessment and audit) Regulations, 2003
    - Environment Management and Co-ordination (Noise and excessive vibration PollutionControl) Regulations, 2009
    - Environmental Management and Coordination (Wetlands, riverbanks, lakeshores, and seashores management) Regulations 2009
    - Environmental Management and Coordination (Water quality) Regulations, 2006 (Legal Notice 121)
    - Environmental Management and Coordination (Controlled substances) Regulations, 2007
    - Environmental Management and Coordination (Conservation of biological diversity and resources, and access to genetic resources and benefits sharing) Regulations, 2006
    - Environmental Management and Coordination (Air quality) Regulations, 2009
    - Environmental Management and Coordination (Waste management) Regulations, 2006
c) Physical Planning Act, Cap 286, of 1998
d) Water Act, Cap 372 of 2002
e) Wildlife (Conservation and Management) Act Cap 376 of 1976, 1989 & Bill, 2013
f) Public Health Act, Cap 242
g) Employment Act
h) Work Injury Benefits Act
i) Municipal By-Laws

5.1.3: National Plans and Strategies

a) Vision 2030 – Second Medium Term Plan (2013-2017)
b) National Environment Action Plan (2009-2013)
c) National Biodiversity Strategy and Action Plan (2000)
d) National Climate Change Response Strategy (2009)
e) Nairobi County Integrated Development Plan (2013-2017)
f) Kajiado County Integrated Development Plan (2013-2017)
g) Kiambu County Integrated Development Plan (2013-2017)
h) Nakuru County Integrated Development Plan (2013-2017)
i) Narok County Integrated Development Plan (2013-2017)

5.1.4: Regional and international multinational environmental agreements

a) East African Community (EAC) Protocol on Environment and Natural Resources (EAC, 1999)
b) EAC Climate Change Policy (EACCCP) (EAC, 2011)
c) EAC Trans-boundary Ecosystems Management Bill, 2010 (EAC, 2010)
d) Convention on Biological Diversity (CBD Secretariat, 1992)
e) United Nations Framework on Combating Climate Change (UN, 1992)
f) Ramsar Convention (UN, 1971)
g) Convention on Migratory Species (UN, 1979)
h) African Convention on the Conservation of Nature and Natural Resources (AU, 1968)

5.1.5: Environmental safeguards for funding agencies

a) World Bank/IFC environmental safeguard policies

The analysis of the above frameworks in relation to the ESIA for the SGR-IIA project is tabulated below.

Table 5- 1: Summary of the policy, legal and institutional framework

1. Policies

Policy	Relevant environmental obligations	Linkages with the SGR-IIA project
1. The Constitution of Kenya (GoK 2010c)	**Article 42 –** Supporting public involvement in ensuringthe rights to a clean and healthy environment. **Article 43 –** Supporting public involvement in ensuringthe need for every person to have access to clean and safe water in adequate quantities, **Article 69 - Environment and natural resources** **(1)** (d) Encouraging public participation in the management, protection and conservation of the environment (f) Supporting environmental impact assessment, environmental audit and monitoring of the environment (g) Eliminating processes and activities that are likely to endanger the environment; and **Article 66 –** Regulating use of any land or any interest or right over any land, in the interest of public health or public planning **Article 185:** **22 -** Protection of the environment and natural resources with a view to establishing a durable and sustainable system of development	• Stakeholder engagement was undertaken during the pre-project implementation stage of the SGR-IIA project • The SGR-IIA project will contribute to social and economic development at national level and also in the Nairobi, Kajiado, Kiambu, Nakuru and Narok Counties • The SGR-IIA project will ensure the sustainable use of natural resources during construction and operational stages including the protection of valued conservation areas
2. Sessional Paper No. 6 of 1999 on Environment and Development (GoK, 1999d)	**Human settlements** • Regulating urban development to only those areas which are suitable, avoiding ecologically fragile areas **Other policy goals** • Encouraging sustainable use of resources and ecosystems • Undertaking EIA for all private and public projects • Increase public awareness on environment	• Stakeholder engagement was undertaken during the pre-project implementation stage of the SGR-IIA project • Environmental awareness was undertaken during the stakeholder engagement process
3. Draft Environment Policy (2012) (GoK, 2012c)	• Adopting measures, incentives and disincentives to promote the re-use, recycling and reclamation of re-usable packaging material and combat pollution of the environment • Promoting application of sound environmental management tools, in particular; strategic environmental assessment, EIA, environmental audits, environmental management systems, risk assessment/management and environmental reporting • Working with private sector, NGOs and CBOs to enhance corporate social responsibility and accountability	• Efforts will be made to minimize the solid waste generation by the SGR-IIA project • Stakeholder engagement was undertaken during the pre-project implementation stage of the SGR-IIA project

4. National Land Policy (2009) (GoK, 2009d)	2(a) Supporting community land management and dispute resolution 5. Supporting the implementation of environmental assessments and audits **Other policy goals:** Ensuring sustainable utilization and management of land and its resource	• Stakeholder engagement during the SGR-IIA ESIA ensured that any public concerns associated with the project are captured and considered • SGR-IIA route survey will ensure proper identification of land owners who might be affected by the SGR-IIA and ensuring acceptable compensation where necessary
5. National Water Policy (2012 Draft) (GoK, 2012f)	d) Enhancing storm water management and rainwater harvesting f) Enhancing pollution control	• The SGR-IIA project implementation will ensure adequate rainwater harvesting in the railway stations and other infrastructure where possible • The SGR-IIA project implementation will ensure that water pollution will not occur at any site during construction and operational phases
6. Draft National Policy on Wetlands Conservation and Management (2013) (GoK,2013)	**2.0: Wetland conservation and management** **Policy Statement 2:** Ensuring that any alteration of a wetland for public interest will be subject to Environmental Impact Assessment (EIA), cost benefit analysis, and wide stakeholder consultations	• The SGR-IIA project proponent will ensure that the implementation does not affect the state of wetlands during construction and operational phases
7. Draft Wildlife Policy (2011) (GoK, 2011)	**8.5.3:Wildlife Security** *1.*Strengthening wildlife security in wildlife conservation areas **Other policy goals** • Decentralization of wildlife planning to constituency level • Educating the public and raising awareness on the critical role of wetlands, rivers and lake ecosystems • Ensuring good governance in the management of wildlife conservation areas and sanctuaries • Incorporating or domesticating the provisions of the relevant wildlife related Multi-lateral Environment Agreements (MEAs) to which Kenya is Party to • Putting in place mechanisms to identify, control and eradicate invasive alien species in wildlife conservation areas in collaboration with relevant lead agencies. • Supporting the conservation and management of wetlands	• Measures will be undertaken to ensure construction and operations of SGR-IIA will not increase the risk of wildlife poaching and spread of invasive species in conservation areas • Stakeholder engagement in the SGR-IIA ESIA was undertaken in order to promote the level of environmental awareness • In the final ESIA report, the ESMP will serve as a tool for good environmental governance in key wildlife conservation areas such as the Nairobi National Park, Longonot National Park, Hells Gate National Park and Mt. Suswa Conservancy
8. National Policy for Disaster Management, 2009	**2.1**: Promoting the mainstreaming of disaster management and climate change into development planning and management for sustainability **3.1:** Providing for well-structured participation of society in disaster	The proponent will ensure that the SGR-IIA project will not install railway infrastructure which can lead to environmental disasters such as floods due to

(GoK, 2009e)	management by integrating traditional coping strategies into the DM systems **Other policy goals:** Supporting climate change disaster risk reduction initiatives	the future impacts of climate change
2. National Policy for the Sustainable Development of Arid and Semi-Arid Lands of Kenya, 2012 (GoK, 2012)	**3.4.2 Natural resource management** Promoting low-maintenance water technologies, with an emphasis on water harvesting	The SGR-IIA project implementation will ensure adequate rainwater harvesting in the railway stations and other infrastructure where possible
9. National Gender and Development Policy, 2000 (GoK, 2000)	• Considering the needs and aspirations of all Kenyan men, women, boys and girls across economic, social and cultural lines • Ensuring the empowerment of women	The project will create employment and business opportunities for all people including women within the project area especially within Nairobi, Kajiado, Kiambu, Nakuru and Narok Counties
10. National HIV Policy (GoK, 1997)	• Ensuring that new development projects especially in the rural areas encourage preventive and responsible behaviour both for the workers involved in such projects and also the local people within which projects are taking place as a goal towards curtailing the spread of the disease	Efforts will be made to ensure that the project especially during the construction stage will not escalate the risk of HIV transmission due to the involvement of workers from other areas
10. National Environmental Sanitation and Hygiene Policy (2007) (GoK, 2007)	**4.3: Sanitation and the environment** • Protection of the environment from pollution and its negative effect on human health • Ensuring use of technologies that uphold the right of present and future generations to a healthy and pollution-free environment. • Ensuring the use of sanitation systems that are environmentally sound • Preventing environmental pollution from liquid and solid waste **Other policy goals** • Setting of clear standards and guidelines for environmental sanitation • Increasing environmental sanitation awareness across the country	The proponent will ensure that the SGR-IIA project especially during the operational phase will maintain high standards of sanitation and environmental hygiene especially in all the railway stations
11. Draft National Tourism Policy (2007) (GoK, 2007b)	• Promoting the KenyaTourism industry to be a leader in responsible and sustainable environmental practices	The project will improve the tourism industry by providing better transportation for visitors

2. Legal Frameworks

Legal Framework	Relevant environmental obligations	Linkages with SGR-IIA project
1. Kenya Railways Corporation Act (Cap. 397), 1979	The overall mandate of the Corporation is to provide a coordinated and integrated system within Kenya for rail and inland waterways transport services and inland port facilities.	The KRC as the proponent will ensure that the alignment starts from the western end of the Nairobi South Station Hub and runs on embracement straight on in a north-east direction for approximately 2 km outside the NNP in a corridor to be acquired before making a bend in the south-western direction and entering the NNP near the East Gate. It will then cross the park through the savannah region in an almost straight line through a 6.0 km width of the NNP in a Single Track along a 7.6km viaduct in a super bridge consisting of precast T frame girders of average height 18 m. The SGR will exit the park to the east of the Massai Gate after which it will pass through Tuala Market and then turn westwards and run in the outskirts of the Ongata Rongai Town and head towards Ngong town. Therefore, between DK31- DK36 the line will pass through a tunnel on the Eastern side of Ngong Hills and then run northwards to meet option 1 above around Kamangu Area DK 50 and then proceeds to DK 120
***2.* Standard Gauge Railway Protocol, 2014**	**Article 2** - Stipulates the overall objective of the SGR which is to jointly develop and operate a modem, fast, reliable, efficient and high capacity railway transport system as a seamless single railway operation among the Parties with the specific objectives of the SGR project	The proponent shall adhere to the provisions of this protocol
3. Environmental Management and Coordination Act (EMCA) No. 8 of 1999 (GoK, 1999b)	**Section 42** – Supporting the protection of rivers and wetlands **Section 50** – Supporting the conservation of biological diversity **Section 51** – Supporting the conservation of biological resources *in situ* **Specific compliance obligations** • Prohibiting and controlling the introduction of alien species into natural habitats • Controlling and prevention of environmental pollution • Carrying out EIA for all proposed projects with a potential for adverse impacts • Carrying out environmental audit and monitoring of all activities that are	• The proponent will ensure that the SGR-IIA project does affect valued environments along the way leave including national parks, wetlands and forests thereby disturbing valued biodiversity including wildlife and birdlife • The project should not increase the risk of invasive species in valued environments along the way leave including national parks, wetlands and rangelands • The SGR-IIA project implementation will ensure

	likely to have significant effect on the environment • Ensuring compliance with all other relevant EMCA (1999) Regulations including the following:- • Environmental Impact Assessment and Audit Regulations, 2003 ○ The Environmental management and coordination (Noise And Excessive vibration Pollution Control) Regulation, 2008 ○ Water Quality Regulations, 2006 (Legal Notice No. 121) ○ Waste Management Regulations, 2006 (Legal Notice No.121) ○ Air Quality, Regulations, 2008 ○ Controlled Substances Regulations, 2007 (Legal Notice No.73 of 2007) ○ Fossil Fuel Emission Control Regulations (2006) ○ Conservation of Biodiversity Regulations 2006 ○ Wetlands, River Banks, Lake Shores and Sea Shore Management Regulation, 2009	that water pollution will not occur at any site during construction and operational phases • The proponent will use proper technology and strategies to ensure minimum noise and vibration as well as low carbon emission levels both during construction and operational stages • The SGR-IIA project will avoid the use of chemical materials or substances that deplete or have the potential to deplete the ozone layer. • The proponent will undertake the obligatory environmental monitoring audits throughout the life cycle of the project • The Project proponent will meet all the costs pays for the entire EIA process including the NEMA fee at 0.1% of the project cost
4. **Wildlife (Conservation and Management) Act Cap 376 of 1976, 1989 & Bill, 2013 (GoK, 2013)**	**33 (c)**: Supporting the establishment of wildlife Development Fund for development of conservation areas **68:(4)**: Preventing development in a National Park without approved management plans **Section 30 of part VI:** Prevention of adverse effects on the environment, including the seepage of toxic waste into streams, rivers, lakes and wetlands.	• The proponent of the proposed project will ensure that the provisions of this Act are complied to minimize negative impacts of the project in protected and dispersal areas for wildlife. • The proponent will identify and implement suitable CSR strategies for wildlife conservation stakeholders in areas where the SGR-IIA is crossing through valued conservation areas • The proponent will ensure the application of environmentally sustainable activities within national parks including the use of suitable mitigation to alleviate and/or minimize negative impacts
5. Way Leaves Act (Cap. 292)	6. The Act provides for certain undertakings to be constructed e.g. rail lines transmission lines, pipelines, canals, pathways etc., though, over or under any lands **Section 3**: Allows the Government may carry any works through, over or under any land whatsoever provided it shall not interfere with any existing building or structures of an ongoing activity	• The Government will give notice before carrying out works with full description of the intended works and targeted place for inspection. • Any damages caused by the works would then be compensated

6. Trust Lands Act, 2012(Cap. 288)	**Section 38**:, Way leave license may be granted to any person empowering him and his servants and agents to enter upon Trust land vested in the Council and to lay pipes, make canals, aqueducts, weirs and dams and execute any other works required for the supply and use of water, to set up electric power or telephone lines, cables or aerial ropeways and erect poles and pylons therefore, and to make such excavations as may be necessary	• Compensation for loss of the use of land in any case where the usefulness of the land for agricultural purposes is impaired must be made before the license is awarded
7. Physical Planning Act, Cap 286, of 1998 (GoK, 1998)	**Section 29**: Ensuring that developers to ensure proper execution and implementation of approved physical development plans **Other legal obligations:** • Ensuring that subsidiary area plans are recognized and integrated in the Regional Physical Development Plans • The local authority concerned shall require the developer to restore the land on which such development has taken place to its original condition within a period of not more than ninety days.	• The construction of SGR-IIA should not contradict the overall goals of physical planning in the implementation areas • The proponent will ensure quick restoration of all the disturbed environments after the construction phase
8. Land Act, 2012	**Part viii:** Provides procedures for compulsory acquisition of interests in land. **Section 111 (1)**: States that if land is acquired compulsorily under this Act, just compensation shall be paid promptly in full to all persons whose interests in the land have been determined. o The Act also provides for settlement programmes.	• The proponent will acquire land for the proposed project in accordance with this Act
9. Land Adjudication Act, 2010	Act applies to any area of Trust land where the County Council in whom the land is vested so requests; and the Minister considers it expedient that the rights and interests of persons in the land should be ascertained and registered	• The Proponent will undertake a survey with extensive public consultations in the affected project area and commission a Resettlement Action Plan (RAP) study to comply with the provisions of the Act
10. Forest Act, 2005	Highlights the integration of the community on the management, utilization and conservation of forests and its resources. It prohibits wanton destruction of the forests.	• The railway construction and operation will preserve valued forests such as Ngong Hills Forest reserve, and Ololua Forest
11. Water Act, Cap 372 of 2002 (GoK, 2002)	**Article 20.** (1) Ensuring that state schemes shall take precedence over all other schemes for the use of water or the drainage of land **Part IV**: Addresses the issues of water supply and sewerage **Other legal obligations** • Promoting the conservation and proper use of water resources • Protection of any water resource, its source or catchment	• The project will not consume and utilize huge quantities of water during the construction stage to avoidunnecessary wastage
12. Public Health Act, Cap 242 (GoK, 1986)	**Article 129:** Supporting the protection of public water supplies **Article 117:** Supporting the prevention or remedy danger to health from unsuitable activities including dust and noise	• The proposed SGR-IIA should not interfere with public water supply systems both during construction and operational phase

		• Construction activities near public institutions such as schools, churches, hospitals, and prisons will minimize the occurrence of environmental hazards such as dust, noise and waste generation
13. Occupational Safety and Health Act, 2007	This Act applies to all workplaces where any person is at work, whether temporarily or permanently. The purpose of this Act is to secure the safety, health and welfare of persons at work, and protect persons other than persons at work against risks to safety and health arising out of, or in connection with, the activities of persons at work	• Failure to comply with the OSHA, 2007 attracts penalties of up to KES 300,000 or 3 months jail term or both or penalties of KES 1,000,000 or 12 months jail term or both for cases where death occurs and is in consequence of the employer
14. Agriculture, Fisheries and Food Authority (AFFA) Act, 2013	• Control over soil conservation, land preservation and land development are mainly controlled within this Act, and many of the provisions can be generally applied beyond those lands suitable for agriculture	• The project should not initiate or accelerate soil erosion and land degradation within agricultural areas
15. Antiquities and Monuments Act, 1983, Cap 215	The Act aims to preserve Kenya's national heritage. Kenya is rich in its antiquities, monuments and cultural and natural sites which are spread all over the country. The National Museums of Kenya is the custodian of the country's cultural heritage	• The proponent will ensure the cultural sites near or along the proposed railway line are preserved
16. Mining and Minerals Act, Cap 3016	The Mining and Minerals Act administered by the Department of Mines and Geology in the Ministry of Mining requires that the resulting open pits be rehabilitated appropriately, so that the natural environment is protected	• The proposed SGR will have several quarry sites, borrow pits and sand harvesting sites which will be carried out and established under the Mining Act. Separate EIAs for the same will also be conducted as per the EMCA, 1999 (Amendment Act, 2015)
17. Explosives Act Cap 115	**Section 7(1)** - Stipulates that No person shall keep, store or be in possession of any unauthorized explosive in or on any premises except in an explosives factory or explosives magazine or unless the explosive is kept for private use, and not for sale or other disposal, and in accordance with rules or unless the explosive is kept for use in the construction of railway, road or other public work, in quantities not exceeding two thousand five hundred kilograms in weight and is stored in a temporary magazine approved by an inspector and under conditions specified in writing by an inspector **7(2) -** Stipulates that any person who contravenes the provisions of this section or any condition imposed or prescribed thereunder or mentioned therein shall be guilty of an offence and liable to a fine not exceeding three thousand shillings or in default of payment to imprisonment for a term not	• Since this project will have a storage facility for the explosives to be used in the blasting processes during construction phase of the SGR, the above Act will be adhered to. There will be a separate EIA done for the magazines to ensure that the project complies with specifications of this Act

	exceeding one year	

18. Use of Poisonous Substances Act Rev. 1983, Cap 247	Sections 3,4,6,8 imposes restrictions and conditions on the use of poisonous substances and requires that persons concerned with storage, transportation and disposal or use of poisonous substances be registered or licensed	The proponent shall adhere to the provisions especially during the operation stage
19. The Standards Act Cap 496	The Act is meant to promote the standardization of the specification of commodities, and to provide for the standardization of commodities and codes of practice; to establish a Kenya Bureau of Standards, to define its functions and provide for its management and control.	The Proponent shall ensure that commodities and codes of practice utilized in the project adhere to the provisions of this Act
20. National Land Commission Act, 2012 (No. 5 of 2012)	**Section 5**: Mandates the Commission to:- *a)* Initiate investigations, on its own initiative .or on a complaint, into present or historical land injustices, and recommend appropriate redress; b) Encourage the application of traditional dispute resolution mechanisms in land conflicts; c) Assess tax on land and premiums on immovable property in any area designated by law	The proponent will liaise with the NLC in order to ensure agreeable resolution of all the affected land issues including compensation
21. The Kenya Civil Aviation Act, Cap 394	The Act mandates the KCAA to authorize and approve the usage of the flight for the purpose of ensuring the safety of flying aircraft over the proposed project area.	The Proponent shall comply with the provisions of the Act in seeking authorization from KCAA especially where the line passes in the vicinity of the Jomo Kenyatta International Airport landing airway and Wilson Airport take-off route
22. Building Code 1997	The Act mandates the Municipalities or County Governments the powers to approve building plans.	This act will apply to the terminals and stations to be established along the proposed standard gauge line which will also have some staff housing facilities
23. Penal Code Cap 63	**Section 191** - States that if any person or institution that voluntarily corrupts or foils water from public springs or reservoirs, rendering it less fit for its ordinary use is guilty of an offence **Section 192** – States that a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons /institution, dwelling or business premises in the neighbourhood or those passing along public way, commit an offence.	The Proponent shall observe the guidelines set out in the environmental management and monitoring plan stipulated in thereport as well as the recommendation provided for mitigation/ minimization/ avoidance of adverse impacts arising from the project activities
24. Masaai Customary Law	The Maasais are governed by strict customary laws. Under `customary law,' rights over land tend to be inclusive (many people `included' as right holders), ambiguous (different rights overlap), and negotiable (rights specified through the agency of social process). But customary land tenure, in all its flexibility, seems to lack the certainty brought about by formal land registration. Maasai,	The Proponent shall observe the Maasai Customary Law in the areas where it might apply along the SGR-IIA route

	for instance, have a clear notion of *e-rishata* or division or separation that constitutes a boundary, but their borders are zones more than lines. Individuals and families, whose rights are derived from the community, mingle together as they use land in common, with access being subject to negotiation and potential conflict. One would expect then, that titling Maasai land would have reduced uncertainty of tenure and social conflict, but in fact, instances of uncertainty and conflict have risen.	

5.2: Licenses and Permits

Several of the legislations above require issuance of licenses or permits whenever the conditions of the legislation are met as highlighted in the table below.

LEGISLATION	REQUIRED LICENCES AND PERMITS
National Environmental Management and Coordination Act (EMCA of 1999)	• Emission licenses • Effluent discharge • Operation of waste disposal • License to generate hazardous waste
Geothermal resources Act of 1982	• Geothermal resources Authority and License
Radiation Protection Act 1985	• License for owning, purchasing, acquiring, importing, manufacturing, selling or dealing in or stores, uses, disposes of or exports any kind of irradiating device or radioactive material or any other sources of ionizing radiation
Water Act 2002	• WRMA licenses water abstraction from rivers and ground water • Ware Resource User Association (WRUAs) is established to manage and conserve water at the lowest level
Standard Act, Cap 496	• Permit us of standardization
Public Health Act, Cap 242	• Licenses eating places such as restaurants and kiosks
Occupational Health and Safety Act of 2007	• Workplace health and safety standards • Inspects and registers workplace
Use of Poisonous Substances Act Cap 247, (rev. 198)	• License for disposal/ storage of poisonous substances
Physical Planning Act, Cap 286	• Development application
Traffic Act, Cap 403	• Licensing for public service or operating a vehicle
Transport Licensing Board Act, Cap 404	• Licensing for public service vehicles (PSVs)
Scrap Metal Act 1972,	• Licenser for removal and sale of scrap metal

3. National Strategic Plans

Policy, Plan or Strategy	Relevant environmental obligations	Linkages with the SGR-IIA project
1. Vision 2030 (GoK, 2008b)	**The SGR-IIA urban development interventions are expected to support the following national environmental flagship activities:-** • Supporting the control of the spread of invasive species • Supporting water harvesting and storage • Supporting security in protected areas • Supporting the reclaiming of wildlife corridors and migratory routes	• The proponent will ensure that SGR-IIA project implementation will not escalate the spread of invasive species in the railway corridor and adjacent environments • The SGR-IIA project implementation will ensure adequate rainwater harvesting in the railway stations and other infrastructure where possible • The construction and operation of the SGR should not jeopardize security in protected areas • The construction and operation of the SGR should not violate the goal of reclaiming wildlife corridors and migratory routes
2. National Environment Action Plan (2009-2013) (GoK, 2009b)	**The SGR-IIA urban development interventions are expected to support the following national environmental activities:-** *a)* Enhancing the protection of wildlife resources *b)* Protection of flora & fauna c) Supporting soil erosion and siltation control d) Management of invasive alien species	• Project activities during construction, and operational and maintenance should not escalate the spread of invasive species the spread of invasive species within the railway corridor and adjacent environments • The SGR-IIA project should not increase the risk of soil erosion and siltation in rivers and water bodies
3. National Biodiversity Strategy and Action Plan (2000) (GoK, 2000b)	**The SGR-IIA urban development interventions are expected to support the following national environmental strategic actions:-** **4.3.2**: Protection of sites of high biological diversity outside the protected area system because they may be habitats for unique endemics. **Other activities** • Adopting best practices in conservation and management of natural resources	The project should not disturb the long term security of valued biodiversity in Kenya
4. National Climate Change Response Strategy (2009)	**The SGR-IIA urban development interventions are expected to support the following national strategic actions** ***a)* Water resources** • Improving municipal water recycling facilities **b) Physical Infrastructure including transportation and telecommunication networks**	The infrastructure in the SGR-IIA such as drainage channels and bridges should be properly designed to withstand the impacts of climate change

	Ensuring that all new infrastructureis climate-proof over its lifespan	

5. Economic Recovery Strategy for Wealth and Employment Creation (2003)	The Strategy includes Macro-economic objectives for economic growth, objectives relating to governance, public sector reform, infrastructure, productive sectors and equity.	SGR-IIA will have an impact in the socioeconomic environment in the project area.
6. Poverty Reduction Strategy Paper Second Medium Term Plan (2013-2017)	**1.** The poverty reduction initiatives are necessary for the implementation of Vision 2030's equity and poverty reduction objectives (within the Social Pillar). **2.** The objectives include high growth, job creation, poverty reduction, improved income distribution and gender equity.	The SGR-IIA interventions should have a positive impact in the socioeconomic environment in the area of implemenation.

5.3: Multilateral Environmental Agreements (MEAs)

The SGR-IIA ESIA was conducted by considering the project alignment with the following regional and international frameworks:-

5.3.1: Regional environmental agreements

1. EAC Climate Change Policy (EACCCP) (EAC, 2011)

Table 5-2 provides a summary of environmental obligations in the regional framework, which were considered as relevant to SGR-IIA ESIA.

5.3.2: International environmental agreements

1. Convention on International Civil Aviation Organization (ICAO),
2. Convention on Biological Diversity (CBD Secretariat, 1992)
3. United Nations Framework on Combating Climate Change (UN, 1992)
4. Ramsar Convention (UN, 1971)

Table 5-3 provides a summary of environmental obligations in the regional framework which were considered as relevant for the SGR-IIA ESIA.

Table 5- 2: Summary of the relevant environmental obligations in the regional frameworks

MEA	Relevant environmental obligations	Potential Interaction with the SGR-IIA interventions
1. EAC Climate Change Policy (EACCCP) (EAC, 2011)	**Section 3.1.3 Climate change adaptation** **Relevant sectorial obligations:** **c) Infrastructure** (i) Promoting climate change integration in all planning and design of infrastructure	The infrastructure in the SGR-IIA urban development interventions such as drainage channels and bridges shouldbe properly designed to withstand the impacts of climate change

Table 5- 3: Summary of the relevant environmental obligations in the international frameworks

MEA	Relevant environmental obligations	Potential Interaction with the SGR-IIA interventions
1. Convention on International Civil Aviation Organization (ICAO),	• Contracting State shall ensure that the access to airside areas at airports serving civil aviation is controlled in order to prevent unauthorized entry. • Contracting State shall ensure that security restricted areas are established at each airport serving civil aviation designated by the State based upon a security risk assessment carried out by the relevant national authorities.	The proponent will comply with the provisions both during the construction and operation of the SGR within the vicinity of the airports
2. Convention on Biological Diversity (CBD Secretariat, 1992)	**Article 8 - In-situ conservation** (d) Promoting protection of ecosystems, natural habitats and maintenance of viable populations of species in natural surroundings (j) Respecting, preserving and maintaining knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application **Article 13 - Public education and awareness** Promoting and encouraging understanding on the importance of and the measures required for, the conservation of biological diversity, as well as its propagation andCooperating, as appropriate, with other States and international organizations in developing educational and public awareness programmes, with respect to conservation and sustainable use of biological diversity	• The SGR-IIA should have minimal negative impacts on valued ecosystems and natural habitats during the construction and operation stages • The implementation of the project should ensure the preservation of valued cultural heritage including local cultural practices • Environmental awareness will be undertaken during the stakeholder engagement process in ESIA
3. United Nations Framework on Combating Climate Change (UN, 1992)	**Article 6**: Education, training and public awareness A(i) Development and implementation of educational and public awareness programmes on climate change and its effects	The infrastructure in the SGR-IIA urban development interventions such as drainage channels and bridges should be properly designed to withstand the impacts of climate change
4. Ramsar Convention (UN, 1971)	**Article 3** *a)* Formulating and implementing wetland planning so as to promote the conservation of wetlands	The project interventions should not affect the regional and international efforts towards the conservation of valued wetland ecosystems

5.4: Environmental Safeguards for Funding Agencies

The ESIA was conducted with consideration of the environmental requirements ofWorld Bank and International Finance Corporation (IFC)Environmental and Social Performance Standards outlined below (IFC, 2012) (*www.ifc.org*). This was necessary because the project will partly be financed by Government of Kenya public funds.

5.4.1: World Bank/IFC Environmental and Social Performance Standards

The World Bank (WB) has 10-major Social and Environmental Safeguards that are applicable in development of projects. The World Bank considers these safeguards to be the cornerstone of its support to sustainable poverty reduction. The objective of these safeguards is to prevent and mitigate undue harm to people and their environment in the development process. The following Performance Standards are relevant for the SGR-IIA.

- *Performance Standard 1:* Assessment and Management of Environmental and Social Risks and Impacts
- *Performance Standard 2:* Labor and Working Conditions
- *Performance Standard 3:* Resource Efficiency and Pollution Prevention
- *Performance Standard 4:* Community Health, Safety, and Security
- *Performance Standard 5:* Land Acquisition and Involuntary Resettlement
    - *OB/BP 4.12 –* Resettlement Action Plan has to be prepared
- *Performance Standard 6:* Biodiversity Conservation and Sustainable Management of Living
    - OP/BP4.04 - Natural habitat
        - Alignment alternatives, use of tunnels and viaducts to void and minimize impacts on natural habitats
        - Adequate assessment of impacted protected areas and mitigation measures incorporated in EMP
- *Performance Standard 7*: Indigenous Peoples
- *Performance Standard 8:* Cultural Heritage

Performance Standard 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the project proponent's management of environmental and social performance throughout the life of the project.

Performance Standards 2 through 8 established objectives and requirements to avoid, minimize, and where residual impacts remain, to compensate/offset for risks and impacts to workers, affected communities, and the environment. While all relevant environmental and social risks and potential impacts should be considered as part of the assessment, Performance Standards 2 through 8 describes potential environmental and social risks and impacts that require particular attention during project implementation.

5.5: Institutional Framework

There are 21 institutions, which deal with environmental issues in Kenya. Some of the key institutions include National Environmental Management Authority (NEMA), the Department of Resource Surveys and Remote sensing (DRSRS), the Water Department, The Kenya Forest Service (KFS), the Kenya Wildlife Service (KWS) the Kenya Forestry Research Institute (KEFRI), the National Museums of Kenya (NMK), the Kenya Marine and Fisheries Research Institute (KEMFRI), the Kenya Agricultural and Livestock Research Organization (KALRO)among others. There are also local and international NGOs involved in environmental issues in the country. Figure 5-1 shows the institutional framework for the Environmental Management and Coordination Act (EMCA, 1999 and Review 2015 Cap 387) which is the umbrella framework within which all the environmental issues concerning the SGR-IIA will be implemented.

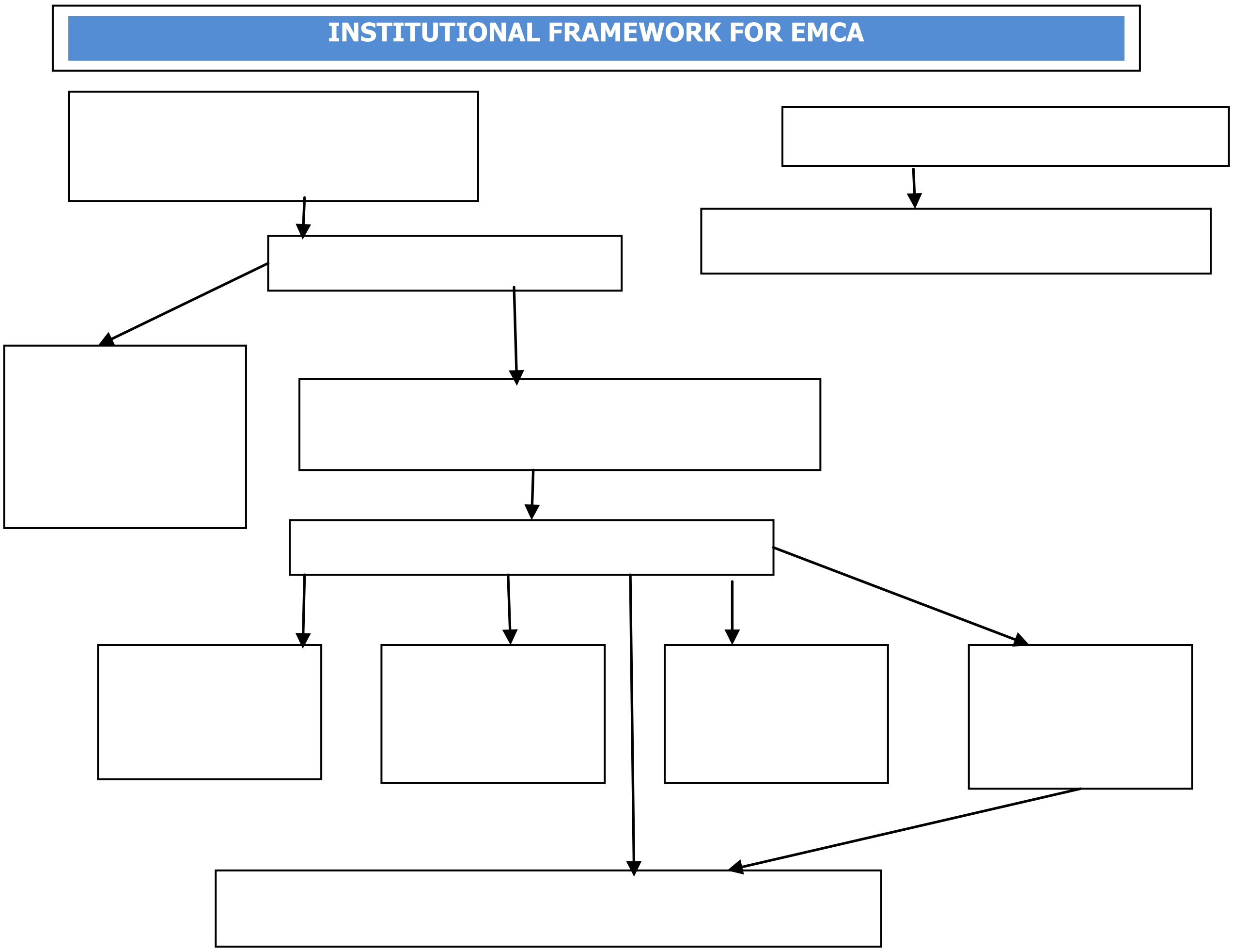


Figure 5- 1: EMCA (Amendment Act), 2015 Institutional Framework

5.5.1: National Environmental Management Authority (NEMA)

The object and purpose for which NEMA wasestablished is to exercise general supervision and co-ordinate over all matters relating to the environment and to be the principal instrument of the government in the implementation of all policies relating to the environment.Director General appointed by the president heads NEMA. The Authority shall:

- Co-ordinate the various environmental management activities being undertaken by the lead agencies and promote the integration of environmental considerations into development policies, plan, programmes and projects with a view of ensuring the proper management and rational utilization of the environmental resources on a sustainable yield basis for the improvement of the quality of human life in Kenya.
- Take stock of the natural resources in Kenya and their utilization’s and consultation, with the relevant lead agencies, land use guidelines.
- Examine land use patterns to determine their impact on the quality and quantity of the natural resources.
- Carry out surveys, which will assist proper management and conservation of the environment.
- Advise the government on legislative and other measures for the management of the environment or implementation of relevant international conservation treaties and agreements in the field of environment as the case may be.
- Advise the government on regional and international environmental convention treaties and agreements to which Kenya should be a party and follow up the implementation of such agreements where Kenya is a party member.
- Undertake and co-ordinate research, investigation and surveys in the field of environment and collect and disseminate information about the findings of such research, investigation or survey.

- Mobilize and monitor the use of financial and human resources for environmental management.
- Identify projects and programmes or types of projects and programmes, plans and policies for which environmental audit or environmental monitoring must be conducted under EMCA.
- Initiate and evolve procedures and safeguards for the prevention of accidents, which may cause environmental degradation and evolve remedial measures where accidents occur.
- Monitor and assess activities, including activities being carried out by relevant lead agencies in order to ensure that the environment is not degraded by such activities, environmental management objectives are adhered to and adequate early warning on impeding environmental emergencies is given.
- Undertake, in co-operation with relevant lead agencies programmes intended to enhance environmental education and public awareness about the need for sound environmental management as well as for enlisting public support and encouraging the effort made by other entities in that regard.
- Publish and disseminate manuals, codes or guidelines relating to environmental management and prevention or abatement of environmental degradation.
- Render advice and technical support, where possible to entities engaged in natural resources management and environmental protection so as to enable them to carry out their responsibilities satisfactorily.
- Prepare and issue an annual report on the state of the environment in Kenya and in this regard may direct any lead agency to prepare and submit to it a report on the state of the sector of the environment under the administration of that lead agency and,
- Perform such other functions as government may assign to the Authority or as are incidental or conducive to the exercise by the authority of any or all of the functions provided under EMCA.
- However, NEMA mandate is designated to the following committees:

5.5.2: County Environment Committees

According to the Environmental Management and Co-ordination (Amendment) Act, 2015, the Governor shall by notice in the gazette constitute a County Environment Committees of the County.

County Environment Committee: County Environment Committee is responsible for the proper management of the environment within the County for which it is appointed. They should also perform such additional functions as prescribed by the Act or as may, from time to time be assigned by the Governor by notice in the gazette. The decisions of these committees are legal and it is an offence not to implement them. For this project, the comments of the County Environment Committees of Nairobi, Machakos, Kajiado, Kiambu, Nakuru and Narok will be very crucial in the decision making process. The comments of relevant NEMA County Directors based in the six (6) Counties: Nairobi, Machakos, Kajiado, Kiambu, Nakuru and Narok will also be very useful in decision making process of the project.

5.5.3: National Environmental Complaints Committee

The National Environmental Complaints Committee performs the following functions:

- Investigate any allegations or complaints against any person or against the authority in relation to the condition of the environment in Kenya and on its own motion, any suspected case of environmental degradation and to make a report of its findings together with its recommendations thereon to the Council.
- Prepare and submit to the Council periodic reports of its activities which shall form part of the annual report on the state of the environment under section 9 (3) and
- To undertake public interest litigation on behalf of the citizens in environmental matters.

5.5.4: National Environment Action Plan Committee

The Authority is responsible for the development of a 6-year National Environment Action plan and shall ensure that it has undertaken public participation before the adoption of the plan. The National Environment Action Plan shall:

- Contain analysis of the Natural Resources of Kenya with an indication as to any pattern of change in their distribution and quantity over time.
- Contain analytical profile of the various uses and value of the natural resources incorporating considerations of intergenerational and intra-generational equity.

- Recommend appropriate legal and fiscal incentives that may be used to encourage the business community to incorporate environmental requirements into their planning and operational processes.
- Recommend methods for building national awareness through environmental education on the importance of sustainable use of the environment and natural resources for national development.
- Set out operational guidelines for the planning and management of the environment and natural resources.
- Identify actual or likely problems that may affect the natural resources and the broader environment context in which they exist.
- Identify and appraise trends in the development of urban and rural settlements, their impact on the environment, and strategies for the amelioration of their negative impacts.
- Propose guidelines for the integration of standards of environmental protection into development planning and management.
- Identify and recommend policy and legislative approaches for preventing, controlling or mitigating specific as well as general diverse impacts on the environment.
- Prioritize areas of environmental research and outline methods of using such research findings.
- Without prejudice to the foregoing, be reviewed and modified from time to time to incorporate emerging knowledge and realities and;
- Be binding on all persons and all government departments, agencies, States Corporation or other organ of government upon adoption by the national assembly.

5.5.5: National Environmental Tribunal

This tribunal guides the handling of cases related to environmental offences in the Republic of Kenya. If disputes related to environmental matters arise during the implementation of the project, the matter should be presented for hearing and legal direction to the tribunal.

6. PUBLIC PARTICIPATION

6.1: Introduction

The Stakeholder Engagement and Public Participation process is a policy requirement by the Government of Kenya and a mandatory procedure as stipulated in the National Constitution and also by EMCA 1999 and EMCA (amendment), 2015 section 58, on Environmental and Social Impact Assessment (ESIA) for the purpose of achieving the fundamental principles of sustainable development. This chapter describes the process of the consultation and public participation followed to identify the key issues and impacts of the proposed railway project from the public and key project stakeholders in both public and private sectors. Views from the local residents, local leaders, surrounding institutions and development partners for the proposed SGR, who in one way or another, directly and/or indirectly, would be affected or have interest in the proposed project were sought through interviews, technical consultative forums and public meetings as stipulated in the Environment Management and Coordination Act, 1999 and EMCA (amendment), 2015 (Cap 387).

6.2: Objectives of the Stakeholder Engagement and Public Participation(SEPP)

The objective of the consultation and public participation was to:

- Disseminate and inform the stakeholders about the details of project with special reference to its key components and location.
- Create awareness among the public on the need for the ESIA for the proposed railway project.
- Gather comments, suggestions and concerns of the interested and affected parties.
- Incorporate the information collected in the final ESIA study report.

In addition, the process enabled the establishment of a communication channel between the general public and the team of consultants, the project proponents and the Government; and the concerns of the stakeholders to be known to the decision-making bodies at an early phase of project development.

6.3: Methodology used in the SEPP

The project's Environmental and Social Impact Assessment's Consultation and Public Participation exercise was conducted between the months of September 2015 and October 2016 by a team of experienced registered environmental experts in three ways namely; (i) Key informant interviews and discussion, (ii) Focus group discussions and (iii) Impromptu field observations and informal chats, (iv) Technical consultative forums and dialogue meetings (iv) Public consultation meetings (PMCs).

In general, the following steps were followed in carrying out the entire Stakeholder Engagement and Public Consultation process:-

- Comprehensive stakeholder mapping in the entire SGR route from Nairobi South Station to Enosupukia (DK120).
- Identification of institutions and individuals interested in the process and compiling a database of the interested and affected parties.
- Administration of questionnaires to different target groups and local community members along the proposed project corridor.
- Public/Technical Meetings at various levels and with different target groups.

6.3.1: Interested and Affected Parties Consulted

The following list outlines the parties consulted, that will likely be affected or have interest in the proposed railway corridor. (See **ESIAVol II -Annex Schedule II** for the full list of the Stakeholders and stakeholders' questionnaire).

- Government Institutions officials including, Kenya Pipeline Company (KPC), Kenya Civil Aviation Authority (KCAA), Kenya Power Company, Kenya Airports Authority (KAA), Kenya Wildlife Service (KWS), Kenya Ports Authority (KPA), Kenya Railway Corporation (KRC), Kenya Highways Authority (KENHA), Kenya Urban Roads Authority (KURA), Kenya Rural Roads Authority (KeRRA), Kenya Electricity Generating Company (KenGen), Kenya Electricity Transimmission Company (KETRACO), Kenya Forest Service (KFS), Bomas of Kenya (BoK), Water Resource Management Authority (WRMA), Ministry of Mining, Relevant ministries in the County governments of Nairobi, Kajiado, Kiambu, Nakuru, Narok such as Environment, Transport, National Transport Safety Authority (NTSA), National lands Commission (NLC), Academia, Youth among others.

- Long Distance Truck Drivers Union
- Kenya Association of Transporters
- Kenya Association of Manufacturers (KAM)
- Kenya Association of Tour Operators
- Kenya Chamber of Commerce
- Local community representatives (Local political and Community leaders)
- Local community members along the proposed railway line
- Business operators – Hotel owners, shop owners, service stations, freight terminal owners, truck owners among others.
- Truck drivers, turn boys, mechanics, puncture repairers
- Residents Associations along the proposed alignment – KLDA, Orosirikon, Nkoroi, Ongata Rongai
- Conservation NGOs – Conservation alliance, Nature Kenya, IFAW, WWF, AWF, ACC, FONNAP
- Local administration in the SGR route for the five counties – Nairobi, Kajiado, Kiambu, Nakuru and Narok

6.3.2: Key informant interviews

About 2,000 people residing and those owning business properties along the proposed standard gauge railway line were consulted during the public meetings for the proposed SGR.The purpose for the interviews was to identify the potential positive and negative impacts and subsequently recommend the best practices to be adopted to mitigate the negative impacts while optimizing the positive impacts. The exercise was being conducted by registered and ESIA experienced experts through interviews under the guidance of questionnaires (See **ESIAVol II -Annex Schedule II**) developed to capture their concerns, comments and issues comprehensively. The completion of such questionnaires subsequently allowed for the synthesis and analysis of issues that arose. This provided basis upon which the environmental, economic and social aspects of the ESIA were undertaken. Through interviews, other miscellaneous issues with potential conflicts in event of project implementation were also identified for mitigation and/or adequately mitigated.

6.3.3: Stakeholders Public Meetings

Consultative experts' meetings were continuously held during the field exercise to consolidate the issues affecting the project as well as capturing issues raised by the project affected persons. Nine (9) comprehensive public meetings and technical meetings were held on various dates from December 2015 to April 2016, with the local residents, Chiefs, Village elders, local administrative leaders and relevant line ministries from the County governments along the proposed route invited to attend. (See Appendix H for a sample public notice).

The summary of the number of participants at public/technical meetings/ community interviews for the project are listed in the two tables below. See also **ESIAVol II -Annex Schedule II**for the minutes and attendance lists of public meeting respectively also appendix N for the National Stakeholders Meeting for the initial option.

Table 6- 1: Number of Participants in Public Consultation meetings

No.	Public/Technical Meeting/ Consultations	Venue	Date of Meeting	No. of Participants
1.	Public meeting at Embakasi area	Open Ground next to the existing Embakasi railway station	04/12/2015	315
2.	Enoosupukia/Nairagie North town public meeting at Enariboo market	Open Ground in Enariboo Market	08/12/2015	284
3.	Suswa town public meeting at Olorowua village, Suswa ward, Narok County	Olorouwa Village near the community water tank	08/12/2015	393
4.	Public meeting in Naivasha Constituency, Nakuru County	Namuncha Primary School	11/12/2015	493
5.	Public meeting in Mai-Mahiu town	Karima Primary School	15/12/2015	186

	Naivasha Constituency, Nakuru County			
6.	Nachu, Karai Location, Kikuyu Sub-County, Kiambu County	Chief's Camp	22-09-2016	78
7.	Ewaso Kedong, Ewaso Location, Kajiado County	Ewaso Kedong Catholic Church	22-09-2016	95
8.	Nachu, Karai Location, Kikuyu-County, Kiambu County	Ngacha Market	26-09-2016	286
9.	Ongata Rongai, Ngong Sub County, Kajiado County	St. Charles Lwanga and Our Lady of Mt. Carmel Catholic Church Nkoroi	27-09-2016	248
10.	Embulbul, Ngong Sub County, Kajiado County	Deliverance Church, Embulbul	28-09-2016	303
11.	Kimuka, Ewaso Location, Kajiado County	Kimuka PCEA Church	04-10-2016	62
12.	Duka Moja, Narok County	Olaisiti AIC Church	30-09-2016	61
13.	Suswa Market Centre, Narok County	Suswa KAG Sanctuary Church	30-09-2016	55
14.	Tuala Market Centre, Kajiado county	Tuala Chief's Camp	05-10-2016	145
15.	KWS Technical Meeting	KWS Hqs	10-10-2016	20
16.	National Stakeholder's Consultation Meeting	Catholic University of Eastern Africa	12-10-2016	76
Total				**1429**

Table 6- 2: Number of Participants interviewed along the SGR Route

No.	Public/Technical Meeting/ Consultations	No. of Participants Interviewed
1.	Embakasi section	**40**
2.	Athi river to Ngong hills (Kajiado) section	**63**
3.	Suswa town and Enoosupukia section	**222**
4.	Namuncha and Maimahiu town section	**299**
5.	Nachu	**43**
6.	Ewaso Kedong	**36**
7.	Nachu	**52**
8.	Ongata Rongai	**78**
9.	Embulbul	**92**
10.	Kimuka	**3**
11.	Suswa	**6**
12.	Duka Moja	**6**
13.	Tuala	**0**
14.	KWS Technical Meeting	**-**
15.	CUEA National Stakeholder Meeting	**-**

Total	940

Plate 6- 1: A participant giving views on the proposed SGR in the public meeting held at Embakasi Open ground on 4th December, 2015

Plate 6- 2: Public meeting at Embakasi area (Open ground next to the Existing Embakasi station, Nairobi held on 4th December, 2015

Plate 6- 3: Lead Expert describing the project route during the Public meeting at Enoosupukia, Enariboo market held on 8th December, 2015

Plate 6- 4: Public meeting at Enoosupukia/Nairagie North town public meeting at Enariboo market held on 8th December, 2015

Plate 6- 5: Public meeting at Suswa town held at Olorowua village, Suswa ward, Narok County on 8th December, 2015

Plate 6- 6: Village elder giving views on the proposed SGR at Namuncha Public Meeting on 11th December, 2015

Plate 6- 7: Public meeting held at Namuncha Village on 11th December, 2015

Plate 6- 8: Public meeting Karima Primary School on 15th December, 2015

Plate 6- 9: Public meeting at Nachu Chief's Camp in Karai Location, Kikuyu Sub-County, Kiambu County held on 22-09-2016

Plate 6- 10: Public meeting at Ngacha Market in Nachu area, Karai Location, Kikuyu Sub-County, Kiambu County held on 26-09-2016

Plate 6- 11: Public meeting at Ewaso Kedong Catholic Church in Ewaso Location, Kajiado County held on 22-09-2016

Plate 6- 12: Public meeting at St. Charles Lwanga and Our Lady of Mt. Carmel Catholic Church Nkoroi Ongata Rongai, Ngong Sub County, Kajiado County held on 27-09-2016

Plate 6- 13: Public meeting at Embulbul Deliverance Church, Embulbul, Ngong Sub County, Kajiado County held on 28-09-2016

Plate 6- 14: Public meeting at Kimuka PCEA Church, Ewaso Location, Kajiado County held on 04-10-2016

Plate 6- 15: Public meeting at Olaisiti AIC Church in Duka Moja, Narok County, held on 30-09-2016

Plate 6- 16: Public meeting at Suswa KAG Sanctuary Church Suswa Market Centre, Narok County held on 30-09-2016

Plate 6- 17: Public meeting at Tuala Chief's Camp in Tuala Market Centre, Kajiado County, held on 05-10-2016

Plate 6- 18: KWS Technical Meeting at KWS Hqs held on 10-10-2016

Plate 6- 19: National Stakeholders Consultation Meeting at Catholic University of Eastern Africa held on 12-10-2016

From the field work and the views collected from public and technical consultative meetings, it was apparent that the majority of the stakeholders were not aware of the proposed project, therefore the consultant and proponent explained to the public and relevant stakeholders that the proposed development would involve construction of a Standard Gauge Railway line from Nairobi South railway station to Enoosupukia, to be used by high speed trains (80Km/hr for freight and 120km/hr for passengers). The consultant (Habitat Planners), contractor (China Communications Construction Company) and proponent (Kenya Railways Corporation) also responded to the queries that the public sought to know about the project. The proposed project was nevertheless received with mixed reactions by the community as they anticipated numerous impacts, both negative and positive. The local communities and major stakeholders independently gave their views, opinions, and suggestions in their best interest, bringing out the factors that affected the circumstances, influences, and conditions under which their organizations exist.

The stakeholder technical consultative meetings and public meetings captured the concerns of the people both those directly and indirectly affected by the project. The issues raised during the public meeting enabled the identification of the specific issues from the stakeholders' views and suggestions which provided one of the basis upon which ESIA study was undertaken. The consultant particularly gave close attention to affected persons both within and in proximity to the proposed railway corridor. The views of these stakeholders were considered and their names and their contacts recorded for future references as required by NEMA (*See* **ESIAVol II -Annex Schedule II***for the list of participants in the Public Participation and Consultation)*.

The environmental issues will be mitigated exhaustively as addressed in chapter seven of this report. Other issues surrounding the project were successfully settled during the public meetings since representatives of the proponent were in attendance and responded to the issues which were unclear to the public. Minutes for all the public meetings conducted are attached to this report as Appendix I. The summary of stakeholder contributions and views in selected public consultation and technical meetings is provided below.

a) Meeting at Nachu Chief's Camp, Kiambu County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, participants raised the following issues and concerns:

- The SGR will displace animals in the Nairobi National Park. As a result, animals like primates will end up being a problem to them.
- There is too much dust being produced as a result of construction heavy trucks using the roads to and from the SGR construction sites. The dust is adversely affecting the health of people and livestock.
- There are no sanitation facilities for workers at Nachu Camp. The Constructor has not provided workers with toilets.
- The way the constructor transports workers to and from the construction sites was considered to be inhuman. Workers are packed like animals in construction trucks.
- The possibility of SGR splitting land owned by one person to the extent that one piece may become too small for the benefit of that person is troubling to some land owners
- The Constructor should consider improving feeder roads for use by Constructor's trucks. Many sections of the roads are already damaged and require repairing
- The constructor should employ local people as much as possible during construction of SGR in Kiambu area instead of coming with workers from elsewhere
- Being a semi arid area, Nachu has insufficient water supplies. The water available will not be sufficient for use by the constructor and the community. Therefore, the constructor should consider developing boreholes in the area to supply water for construction work
- As a matter of corporate social responsibility, KRC was requested to support the local schools

Overall Decision: by show of hands all participants present approved the project.

b) Meeting at Ewaso Kedong, Kajiado County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, participants raised the following concerns and issues:

- The Constructor should consider giving tender to supply local construction materials to the local people.
- Kenya Railways Corporation should consider building a passenger station with livestock loading bay at Namunja, Ewaso Kedong. The community felt that Nachu and Suswa stations were too far away from them.
- The constructor should consider repairing the local roads before using them during construction of the SGR.
- Since SGR will be tranversing the rangeland which is used by people and animals, KRC should provide pass ways for livestock, wild animals and people to access both sides of the rangeland. Short distances between the pass ways were recommended.
- The Constructor should consider sub-contracting provision of transport services to the local people. The local people have vehicles that the Constructor can hire for use during construction of the rail line
- Since Ewaso Kedong is a water scarce area, the Constructor should consider sinking boreholes to supply water for construction work
- The Constructor was cautioned against importing construction workers from other areas to the Ewaso Kedong area to construct the rail line. The constructor was advised to employ the local people as much as possible in the construction work.
- The stakeholders wanted information on how compensation for land was going to be undertaken.
- The community expressed strong desire to negotiate with the management of Nachu Construction Camp. The community felt that many things were not right there.

Overall Decision: by show of hands, the project was unanimously approved by participants.

c) Meeting at Nachu Trading Center, Kiambu County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, participants raised the following concerns and issues:

- Considering that Nachu area is down ward sloping and has water shortage, any underground water abstraction should be done carefully in both the higher and lower parts so that underground water flow in either part is not adversely affected.
- Construction trucks using the local roads are producing a lot of dust. The dust is harmful to the people and livestock.
- Since the feeder roads were already badly damaged, the constructor was asked to consider repairing before using them during the construction phase of the SGR
- Drainage for storm water should not be directed towards people's homes. If need be, such water should be harvested for use by the constructor during the SGR construction phase and, later by the community.
- Constructor was cautioned against using clean drinking water for construction work. Using such water would exacerbate shortage of drinking water problem in the area.
- The Constructor was asked to employ the local people once the SGR construction phase reaches Nachu. There were many unemployed but hard working people around.
- Nachu Construction Camp did not have proper sanitary facilities. Workers there were using the bush as toilets.
- Compulsory of acquisition of land by Kenya Pipeline Corporation was a bad experience in the area. Many people were not adequately compensated for their land. The same should not happen when it comes to acquisition and compensation for land for SGR.
- After construction of the SGR, the Constructor should not demolish the camp site at Nachu. Instead, the buildings and structures should be handed to the community for use
- The way construction workers were transported by the constructor was not good. It was degrading and inhuman. Why can't the constructor hire better vehicles from the community to be transporting workers?
- Train vibrations can cause damages to properties next to the rail line. How will owners of such properties be compensated?

Overall decision: by show of hands all participants approved the project.

d) Meeting at Ongata Rongai, Kajiado County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, participants raised the following concerns:

- It was observed that Kenya Railways Corporation identified the route for the SGR without engaging the people. The case in point is the route through Nairobi National Park. Such action does not only augur well with the people but offends the Constitution that requires public participation in the decision making of public development projects.
- Many people are concerned with what will happen to the wildlife in the Nairobi National Park once the SGR project takes off. Already, human-wildlife conflict around the park has escalated.
- Was the SGR route fixed? Can it be changed? Is there room for negotiation with KRC on the SGR re-routing? These questions were asked by property owners affected by the SGR routing.
- Some people had their land divided by the SGR and wanted to know whether there were provisions in the SGR plans for land owners to easily access parts cut-off by the SGR.
- The SGR route shows a single line, is there a provision for double lines in future? Why is that not shown in the KRC plans?
- From the media, there are seven possible routes around the Nairobi National Park; how did KRC arrive at one a) without consulting the people b) how long will construction of the chosen route through the park take?
- In view of the decision by the NEMA Tribunal to suspend construction of the SGR, participants wanted to know whether there will be another opportunity for KRC to consult people again.
- Trains vibrations will affect buildings and structures next to the rail line. What is the position of KRC and the Government on this matter? How will property owners of such properties be compensated?
- Noise from the trains is bound to affect homes, schools and health facilties, how is KRC going to address this problem? What kind of trains are going to be operated by KRC?

- The proposed railway station at Ongata Rongai was not appropriately located. It should be located at the entry to Magadi Road where most people could easily access it. Kenya Railway Corporation was asked to consult the people on this matter before construction commences
- The Nairobi-Ongota Rongai Road is congested with traffic especially in the mornings and evenings, will the Government consider expanding it?
- From the SGR routing it means passengers to and from Ongata Rongai going would have to pass through the Nairobi Southern Station, which is unnecessary and a waste time- are there provisions to have a direct rail link between Nairobi and Ongota Rongai?
- The average distance between rail stations is 11 km- why not reduce the distances so that there can be more stations to serve more people?
- The SGR has commenced: the evidence is there at Embulbul yet the ESIA is being undertaken. Is this not rubber stamping what already has been decided by the Government and Kenya Railways Corporation? Is this not contravening the EMCA Law?

Overall decision: by show of hands the majority voted is support of SGR project. Nine people voted to the contrary

e) Meeting at Embulbul, Ngong, Kajiado County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, the participants raised the following issues and concerns:

- The coming of SGR will attract more people in the surrounding areas. This will cause traffic congestion. Are there plans to expand the existing road network? Ngong town has no proper sewerage system-will there be one now?
- Landowners were shocked to see Chinese people pegging their land without their permission. This did not only amount to an affront to their Constitutional Rights of quiet enjoyment of their property but also amounted to trespass punishable by law. If they were not strained by the chiefs, the Chinese constructors would have been in real danger.
- Since the Chinese could neither speak Kiswahili or English, communication between them and the people was extremely difficult. The situation would have been much better if the Chinese constructors were accompanied by the KRC officials to explain to them what was going on.
- It was only after pegging their land that there were rumours that SGR was going to pass through their land. To date, neither KRC nor the Constructor has confirmed to them that, that will be the case. Meanwhile, landowners do not know whether to continue or not with their planned developments on their land. This state of suspense is hurting their investment decision-making.
- People living on top of the SGR tunnel are concerned about the noise by the trains and possibility of not getting underground water when they want. Because of the tunnel, underground water will either be diverted to drain elsewhere or lower the water table hence deny them the water they so much desire to have.
- From what the people had seen and heard in the recent past, SGR project had already began being implemented. Unfortunately, this was happening before the ESIA was conducted. Why was the ESIA asking them to rubber stamp a project already being implemented? Why is project being implemented even when the NEMA Tribunal has suspended its implementation? They felt cheated by the Government, KRC and the ESIA process.
- Implementation of a project of the magnitude of SGR requires that some awareness among the affected people would be created. Unfortunately, KRC who are the project proponent have to date not done so. Most affected people do not know that they are affected by SGR project.
- Since the SGR is going to pass through the Nairobi National Park, some people wanted assurance that the Park would not die. The main concern here was that there was a possibility of corrupt people subdividing the park for their own benefit
- It was observed that Chinese Constructors hardly transfer sufficient technologies to Africans. That way, they want Kenyans to be depending on them for almost everything after the SGR construction is completed. Kenya should not allow such a situation to occur.
- Now that SGR is going to pass through Ngong, there was need for a liaison office in the area. The Office will link the people affected by the SGR with KRC.

- As a matter of transparency and accountability, KRC was requested to post the SGR route map on a website so that people can access the information about the SGR project easily.
- Chinese Constructors should be advised to negotiate with local committees and not individuals on matters of employment.
- There should be another rail station between Ongata Rongai and Ngong. SGR should help solve the road traffic congestion problem. Another station at Mericho was recommended.
- SGR should minimize interfering with public utilities such as schools and hospitals. This is because it is expensive relocating such utilities. Land availability is not only a problem but its cost is prohibitively high, which will burden the local people.
- Compensation for land and other properties should target the true owners. KRC should be weary of running conflicts over property ownership and running litigations.
- What will happen if the nearby Ndire swamp is disturbed by the tunnel construction? Will it dry
  or continue to be there after construction work is completed?

Overall decision: Overwhelming majority voted to approve the SGR project

f) Meeting at Duka Moja, Narok County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, participants raised the following issues and concerns:

- Nobody in the community knew that the Camp at Duka Moja was established to construct SGR. People were surprised to learn that, that was the case. They wanted to know why construction of SGR had been kept a secret all along since the camp was established. Why is information about SGR being passed on the people when construction work is progress?
- During the initial survey of the SGR route, the Chinese constractors trespassed local peoples' land and cut down trees without reference to the landowners. Up to day, they have not compensated the people for the trees.
- Since the Chinese could not speak English or Kiswahili, it was difficult for them to communicate with the local people regarding what they were doing in the area.
- Because of the difficulties in communication with the Chinese constructors and lack information from KRC about what the Chinese were doing in the area, conflict between them and the Chinese arose.
- It is possible for a landowner to object to SGR passing his land?
- The construction Camp at Duka Moja was built before proper negotiations with the bono fide landowner were completed. The landowner felt that the leasehold fee the Camp Management is paying him is too small.
- The construction camp at Duka Moja does not take care of wastes generated. Some of waste water is spilling onto neighbouring land. Complaints raised with Camp Management have not been heeded.
- SGR should not be an obstacle to movement of people and livestock in the rangeland
- People have not understood who is supposed to compensate for land required for SGR and for electricity wayleaf in the area. Is it SGR or Kenya Power or Lighting Company or KETRACO

Overall decision: the project was approved by a majority vote.

g) Meeting at Suswa, Narok County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, participants raised the following concerns and issues:

- Some access roads in the area were blocked by the Contractor without consulting the people. This was greatly inconveniencing because residents were now forced to use bad and longer roads to reach their destinations.
- The Chinese contractors had no respect for the local workers. Cases of Chinese slapping workers were very annoying. If such cases are not stopped immediately, the local people would be forced to act against humiliation of their people by the Chinese contractors.
- The construction camp at Suswa had no sanitation facilities and bathrooms for the workers.
- A lot of solid waste, especially packaging materials (polythene) is found near the camp.

- Because of the loose soils, construction trucks using the access roads in the area were producing a lot of dust which was affecting people, animals and roofs of houses.
- Because of SGR project, many land brokers have come to the area. Their intention is to make money by cheating the local landowners. KRC should educate people when and how land compensation will be undertaken.
- The local people are suspicious about giving up land for the SGR project to be implemented. They still remember how their Chief, Ole lenana, sold Maasai land to the colonialists for inconsequential benefits. They do not want the same to happen today.
- Land compensation should consider the monetary value of trees, shrubs, grass. Compensation should be adequate, fair and just. No games. No cheating
- Because of SGR, many people from outside will come to the area. What plans are there to ensure that social services in the area are expanded and improved? What measures are there, to protect the local people from socially transmitted diseases?
- KRC was cautioned not to allow SGR project interfere with burial sites. Maasais don't exhume remains of the dead. They are against the practice.
- Sand and rock harvesting are occurring in the area without reference to the bona fide land owners. This habit should be stopped because it is bound to bring conflict.
- Employment of local people on SGR project and erecting electricity pylons in the area should be transparent. At the moment, the process is not.

Overall decision: the project was approved by a majority vote.

h) Meeting at Kimuka, Kajiado County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, participants raised the following concerns and issues;

- The roads in the areas were being destroyed by the contractors' trucks
- Dust emitted on the roads is threatening the health of the people and animals
- There are accident risks posed by trucks over speeding
- The construction camp lacks sanitation facilities for workers
- SGR project was started without consulting the local people. People lack information about the project.
- Trees have been cut down and the holes dug for electricity poles which are a danger to the livestock since they are left open.
- What corporate social responsibility programme is there for the community?
- Chinese workers disrespect the local people. This kind attitude must stop otherwise the local people will be forced to teach them a lesson. They bad to be disrespected by foreigners in their homeland.
- Landowners were not consulted prior to surveying the SGR route. Chinese contractors entered their land and homes without consultating them. People found the intrusion as rude and despising.
- Local people demand to be employed during construction of the project in their area. The contractor should be giving written contracts to workers
- Local suppliers to camp are not paid promptly.
- There should be a tunnel for people and livestock to cross the railway.
- The impact of the tunnel at Embulbul to those who live above it and the impact of the tunnel on the hydrology of the area
- There was need for KRC to establish a laison office in the area to bring better understanding between the people and constractors

i) Meeting at Tuala, Kajiado County

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, participants raised the following concerns and issues

- Questions asked during the last meeting between the KRC and the local people needed to be answered. For example, most people did not know the exact route of SGR. Which properties would be affected?
- Considering that the NEMA Tribunal had suspended construction of SGR project until certain issues were sorted out, the legality of the consultative meeting was questioned.

- Participants wanted free access and not by invitation to attend the national stakeholders meeting scheduled for October 12, 2016 at the Catholic University of eastern Africa
- The access road to Tuala is in bad conditions. It needs up-grading before the Contractor can start using it during SGR construction phase. Using it before it is repaired would make the road impassable.
- Constructor should consider addressing the problem of dust when trucks start using the roads in the area.
- Local entrepreneurs should be sub-contracted to supply construction materials
- House owners are worried about the effect of rock blasting in the area on their houses
- People affected by SGR should be compensated adequately and on time. Thereafter, they should be given ample time to move out. Graves, too, should be compensated.
- It was observed that KRC had a problem of fulfilling its commitments. In SGR phase 1, bridges and tunnels were not completed yet the construction was almost coming to an end and some of the land not acquired by the project was being destroyed by construction machines without compensation.
- Elaborate measures should be to put in place in Nairobi National Park to address the human-wildlife conflict during construction
- Roads crossing the SGR should not be blocked during and after construction of the project
- The existing bridge to the construction camp site is old and weak. The contractor should fix it before using it.
- There are no sanitation facilities at the construction camp
- The contractor should consider employing the local people during the construction phase of the project instead of bringing workers to the area from elsewhere. A liaison officer should be appointed to deal with this issue.
- KCR should let people know the corporate social responsibility programme it has for the area
- Details of Tuala Railway Station were required. What facilities will be there?
- Strong sentiments about the effect of SGR on the Nairobi National Park were expressed. Why can't SGR be re-routed outside the park? Why ruin the oldest and only urban park in the country? Why should we allow SGR to hurt tourism in the park? Why are we destroying our heritage?

j) Technical meeting at Kenya Wildlife Service

After Habitat Planners explained the technical details of the SGR in the Nairobi National Park, KWS expressed the following concerns:

- The number of workers who would be at the construction site at any time
- Protection of the construction site from animals
- Containing of animals within the park once construction starts.
- Safety of workers while at the construction site and in the park
- Adherence to park rules by the contractor and workers while in the park
- Workers overstaying in the park after 6 pm or working at night (not permitted, yet there may be need)
- Excavations within the park (allowed only where holes for the pillars be erected)
- Impact of heavy machinery and equipment on vegetation at the construction sites
- Access roads to the construction sites
- The cost of relocating Rhino bases within the NNP
- Sensitization of security personnel and KWS workers who will be involved in some of the work imposed on them by the SGR project
- Movement of construction materials without damaging the park roads, gates and bridges
- Closure of some roads and disruption of tourist circuits during construction phase
- Loss of park revenues due to visual impact of the sites during construction and of SGR railway once SGR is operational.
- Bringing murrum and rocks from outside that could introduce invasive species in the park
- Restoration of vegetation after construction work is complete
- Restocking of wildlife that will leave the park completely
- Access to the railway line for routine maintenance once SGR is operational
- Mitigation of noise levels from the train in addition to noise from aircrafts along the Jomo Kenyatta International Airport and Wilson Airport flight paths

- Financial and technical agreements to manage the area around the Eastern Gate. KWS has easement agreements with KETRACO, Pipeline and underground Cables. KRC needs to be accommodated since the SGR over bridge will also start in this area.
- Joint management of the SGR corridor between KWS and KRC during the operation phase of the project
- Possibility of acquiring land in the park neighbourhood to compensate for land lost due to implementing SGR or adding more land to increase the size of the park.
- Dispute resolution mechanisms between KWS and KRC
- Need for clear conditions to the constructor to follow during construction phase. Experience has shown that if not controlled, Chinese contractors have a tendency of doing things their own way

k) National Stakeholder meeting at Catholic University of Eastern Africa

After the proponent, Kenya Railways Corporation gave the history of Kenya Railways and the background, description of SGR project (including a map the route) and the envisaged benefits of the project to the meeting, Habitat planners presented the ESIA draft report. Thereafter participants raised the following issues and concerns

- Route 4 which has chosen by KRC is traversing heavily populated areas, why can't the SGR be re-routed to less densely populated areas like south of the proposed Konza? Or in Isinya?
- There is need for the ESIA to consider animal numbers outside Nairobi National Park in the assessment of impact of SGR on wildlife
- The impact of SGR on tourism should not be based on the number times the tourist encounters the SGR structure, but rather on the preferred routes by the tourists while in the park
- .The ESIA should consider the financial loss KWS will suffer when construction of SGR starts in NNP.
- There are many intuitions affected by the SGR using route 4. More should be added in the route social impact analysis.
- The impact of SGR on the hydrology should be based on the depth of depressions within the park rather than on number of river crossings
- Why can't the analysis of routes consider the eighth option?
- How will animals be restocked in an environment that will be continually disturbed by the operation of the SGR?
- Analysis of routes was based on costs of each route: costs in comparison to what? Are route costs compared with the value of genetic materials in the park? What is the value of ecosystem services that will be lost?
- Will KRC compensate KWS for land lost as a result of SGR project? What is the economic value land in the park?
- Public consultations for SGR were based on quantity rather than the quality. If that is the case, does the ESIA consultant get the quality inputs for the ESIA report?
- There are clear procedures for developing management plans for protected areas. The NNP management plan for NNP is not gazetted. How come SGR project is being implemented in the NNP without a gazetted management plan?
- Nairobi National Park has been losing land to development, how can people trust the government that it is not going to turn the park into development area?
- The ESIA report had heavy details that require participants to read and digest. Will the draft report be disseminated or shared out?
- Since SGR will be handling petroleum products, what safeguards are there against accidents for people living along the line?
- People lack information about the SGR project. Why is KRC withholding information that the public badly needs?
- Social economic analysis should not only consider big establishments, but should also go down up to household level.
- It appears the SGR will be for rich and not the poor.
- NNP is a unique national heritage- why are we disturbing it? Why are we building a traumatic situation to the animals?
- Considering that Uganda and Rwanda can use the Tanzania Route to the Sea and Southern Sudan can use Sudan route to the sea, how are we sure of optimum utilization of SGR in future?

- Data on birds in the park should be given in the ESIA report
- NNP is carbon sink. There is need to quantify carbon absorbed by the park.
- There is need to indicate revenue loss projections as a result of implementing SGR project in the NNP
- Considering the animal numbers in the NNP and Kapiti Plains have been going down, won't the SGR accelerate the loss of animals?
- Deliberation on route 7 was not sufficiently done. There is need for KRC to consult more with stakeholders on this route.
- The ESIA presentation emphasized route analysis in the NNP at the expense of other sections of 120 km route. Community issues in those parts were not sufficiently brought out.
- Why is the ESIA going on when there is a court order to stop implementation of the SGR project?
- Will the government compensate people living above the tunnel at Embulbul?
- Why was the meeting asking people to rubber stamp a decision already made by the government? Construction of SGR is on-going yet ESIA is being undertaken late.

6.4: Positive concerns raised by the public

The following are the positive views about the proposed project given by those interviewed and attendants of the meetings:

- **Employment opportunities**

The respondents interviewed/consulted were optimistic that the project will create numerous employment opportunities for both skilled and unskilled labor alike during the construction and operational phases. Despite the fact that the project will at greater extent need skilled labour force during operation, the people interviewed in Tuala, Ongata Rongai town, Nkoroi, Ebulbul, Ngong town, Lusigetti, (DK46+490), Kamangu, (DK53+600), Nachu, Kimuka, Ewaso Kedong, Mai-Mahiu, Suswa, Duka Moja, Enosupukia areas expressed hope that they will be able to access employment once the project commences mostly as casual workers. The respondents were also optimistic that they will be trained to take up jobs during operation stage. Job opportunities will arise at the terminals, in the trains and maintenance workshops. This will be a major source of income for several individuals and households and hence expected to boost the GDP and improve the living standards of Kenyans at large. Apart from direct employment opportunities, the project will also create indirect job opportunities such as in quarries, lodgings, hotels etc.

- **Increased business opportunities**

The respondents and participants were optimistic that a number of project-related business opportunities will arise during construction of the new Standard Gauge Railway project. Small scale business people such as food vendors in Tuala, Ongata Rongai town, Nkoroi, Ebulbul, Ngong town, Lusigetti, (DK46+490), Kamangu, (DK53+600), Nachu, Kimuka, Ewaso Kedong, Mai-Mahiu, Suswa, Duka Moja, Enosupukia, home, rental apartments, kiosk owners, entertainment joints will benefit greatly during construction period. On the other hand, once the construction of the railway line is complete, new market centres will be created along the route such as in Nachu and Kamangu areas of Kiambu County and Kimuka, Ewaso Kedong, Duka Moja, Enosupukia in Kajiado and Narok Counties. There will be new terminals created which will lead to creation of new or renewal/revitalization of existing old towns or dormant towns along the corridor leading to new business opportunities. Mining of rail construction materials will greatly create and improve opportunities due to the proximity, cheap and affordable transport to various construction sites along the proposed corridor.

- **Increased value of land and land compensation**

Most people interviewed along the railway corridor such as in Tuala, Namuncha and Mai-Mahiu areas were optimistic that the proposed development of the SGR would lead to appreciation of the land value thus an advantage to the land owners. Some people especially in Ongata Rongai, Nachu and Ewaso Kedong were keen to secure compensation for the use of their land by the CSR

- **Provision of a cheaper and faster means of transport**

The respondents and participants at public meetings were positive that the proposed standard gauge railway line will provide a faster and cheaper means of transport of freight and passengers from and to Mombasa, Nairobi, Kikuyu, Mai-mahiu-Narok and beyond. This will be the best means of transport compared to the air transport which is very expensive to ordinary people. This is influenced by SGR's tracks which will have a speed of 120 km/hr for passengers and 80 km/hr for freight.

- **Ease of traffic and congestion along the Nairobi - Nakuru Highway**

The participants also stated that the new railway system will help to ease traffic and congestion caused by long distance trucks along the main Nairobi -Nakuru-Eldoret-Malaba Highway. After completion of the proposed railway system, most of the cargo currently transported by road will be switched to transportation by rail system. This will lead to elimination of significant amount of cargo trucks and passenger vehicles on the Highway therefore leading to ease of traffic and de-congestion.

- **Improved Road Safety**

The public expects road safety from Nairobi-Nakuru-Eldoret-Kisumu-Malaba highway to improve since most long-distance trucks will be removed. This will considerably improve the safety of public road users and reduce the number of road accidents along the busy highway in the long run.

- **Improved Agricultural Production**

The public indicated that their agricultural produce will be able to reach the market easily, hence improved rural incomes. The new railway will greatly open most remote areas especially in areas from Kamangu-Ewaso Kedong-Mai Mahiu to Enoosupukia. They indicated that cultivation of maize, flowers, fruits and other horticultural crops in ASAL areas will greatly be improved. This will be enhanced by availability of water through the boreholes and rain water harvesting tanks that will be put up to support the proposed project.

- **Opening up town centers and villages to investment and development**

People interviewed in Mai-Mahiu area were positive about the proposed SGR development since it will open up Mai-Mahiu as a hub of business opportunities like hotels, increased development of residential houses, in the area, industrial development among other developments and this will lead to economic growth of the town. Residents of Namucha and Nachu villages were also positive about the proposed development and were opportunistic that it will lead to development of other infrastructures in the village such as schools, roads, hospitals and drinking water access points.

- **Iconic landmark**

The project is an iconic and once complete, it will be a landmark in Kenya hence adding value to the local and international revenue in the tourism sector.

- **Improved security**

There will be improved security in and around the areas where the train stations will be constructed. This is due to the availability of security personnel who will be employed there, security lighting and presence of CCTV surveillance system in the new railway stations.

- **KRC CSR programme**

The stakeholders in some of the SGR route sections especially Karai-Ndeiya in Kikuyu sub-county and Ewaso Kedong had positive expectations that the SGR construction and operation in their area will bring a number of CSR interventions including the following: improved water supply through borehole drilling, improved education facilities through support for construction of additional class rooms in schools, improved healthcare through establishment of dispensaries to deal with SGR related health problems, and improved sanitation.

6.5: Negative concerns /issues raised by the public

The following are the negative views about the proposed project given by those interviewed and attendants of the meetings;

- **Noise and vibrations**

There was concern by stakeholders especially in Tuala, Ongata Rongai town, Nkoroi, Ebulbul and Ngong town over the possibility of high noise and vibration levels along proposed corridor and its associated facilities as a result of excavation, construction and demolition works and operation stage.

The source of noise pollution during construction phase will include; transport vehicles, construction machinery, metal grinding and cutting equipment. Excavations will cause vibrations; however, the contractor will take appropriate steps to minimize noise impacts including provision of appropriate protective equipment to construction workers, planning and minimizing the frequency of materials transported, ensuring that all equipment are well maintained and ensuring liaison with the adjacent communities during blasting. The public also feared that there would be noise and vibrations during operation stage of the project that will emanate from the rolling stock and locomotives that would be introduced to the new railway line. Noise and vibrations during operation stage will be mitigated by minimum distance from the railway line and use of modern locomotives that have minimal noise and vibration effect.

- **Dust generation**

The participants along the proposed SGR corridor but especially in Tuala, Ongata Rongai town, Nkoroi, Ebulbul, Ngong town, Lusigetti, (DK46+490), Kamangu, (DK53+600), Nachu, Kimuka, Ewaso Kedong, Mai-Mahiu, Suswa, Duka Moja and Enosupukiaexpressed concern over possibility of generation of large amounts of dust within the project site and surrounding areas as a result of demolition, excavation works and transportation of building materials. The contractor will ensure that dust levels along the corridor and associated sites are isolated and minimized through sprinkling water and using dust nets where possible especially in areas being excavated and along the tracks used by the transport trucks within the site. Additional mitigation measures are presented in the section of mitigation measures (Section 8) of this report and if fully implemented, they will minimize the impacts of dust generation.

- **Waste disposal**

The stakeholders along the proposed SGR route expressed concern over possibility of generation of large volumes of waste during the construction phase. The proponent should ensure that the waste is collected at all times and disposed in an appropriate manner to ensure a clean and healthy environment for all under the management of project Environment, Health and Safety officers at various sections.

- **Tunnel impacts on water supply**

The stakeholders within the proposed SGR tunnels inEbulbul, Ngong town, Lusigetti, and Kamangu expressed their fears on the potential impacts of tunnel construction on the hydrogeology and the likely impacts on water supply bth in terms of quality and quantity.

- **Tunnel noise, vibration and safety**

The stakeholders within the proposed SGR tunnels inEbulbul, Ngong town, Lusigetti, and Kamangu expressed their fears on the potential long term impacts of tunnel on the people residing above the corridor especially in terms of noise, vibration and safety.

- **Loss of vegetation and agricultural Crops**

Some vegetation cover will be cleared to pave way for the proposed development thus creating negative impacts to the environment. Those who benefit from the current ecological value of these forests will be negatively affected for example those who practice small scale farming along the railway line corridor in Kamangu, Nachu and Mai-Mahiu, Kimuka, Ewaso Kedong areas. Most of the respondents proposed that a major rehabilitation and restoration through landscaping and tree planting should be done in such areas.

Some residents, especially from the Maasai community attached a great medicinal dependence on the indigenous trees in their community and proposed minimal disturbance of this trees and replanting of the cut down trees. The consultant, constractor and project proponent expressed his confidence that, the public views will have an impact on the final designs and stated that a botanist expert is on board to study in detail the tree profile all along the corridor.

- **Displacement of people and loss of property**

The participants were worried that the proposed project may demand more land acquisitions to give room to actualize the proposed right of way of 70 metres for the corridor and 250m to 350 m for the railway stations. This will lead to a likely displacement of persons and loss of property along the corridor.

It was proposed that Project Affected Persons be informed in good time and compensations should be done fairly, using the existing local legislation and international standards law and best practices. Residents were worried that they would lose their homes, land and businesses since the proposed railway corridor will require a huge way leave. The residents were however informed that through the views collected from public meetings and consultative technical meetings will the final designs will be realigned to ensure that unnecessary displacements are minimized.

Most members of the public indicated that if they have to relocate they will do so as long as they are compensated fairly and a Resettlement Action Plan is professionally done and implemented using an inclusive and all-stakeholder participatory process.

- **Displacement of institutions**

Others were concerned about displacement of institutions such as schools, churches, hospitals among others and whether compensation and relocation will be done the same way as for individual properties. They suggested that such institutions be rebuilt by the contractor in good time so that livelihoods are not so much disrupted. In other areas, they should consider rebuilding health centres for local communities. Final designs will be realigned to ensure that displacements of any nature are minimized. The public were informed that in the case of public assets the community elders will be involved in deciding areas for reallocation in event of their displacement.

- **Loss of jobs**

Since the cargo trains will transport containers and other goods from the port to various destinations, the community felt that the number of long distance trucks plying the Nairobi-Nakuru-Eldoret-Malaba highway will reduce in the long-term hence loss of jobs for truck drivers, reduced revenue for truck owners and mechanics. Other people that will lose jobs are those working in hotels and other forms of businesses that depend on the long-distance trucks.

- **Railway accidents**

The residents along the proposed line also feared that since the proposed railway will be used by high speed trains, there would be more accidents to humans and livestock crossing the rail track. However, this will not be a problem since the proposed line will have bridges and tunnels built all the way from Nairobi to Narok. On the other hand, underpasses and over-passes will be provided for people and animals to cross. There will be no level crossings in the proposed rail project.

- **Inaccessibility and sub-division of communities**

The residents expressed their fear of losing contact with their neighbors on either side of the railway line due to a barrier created by the fenced-out corridor. The consultant assured them that the designs of the rail provides for underpasses, overpasses and foot bridges to access both sides of the railway corridor hence contact with their neighbors will be maintained.

- **Increased chances of conflicts between neighboring communities in Mai-Mahiu and Narok**

Residents interviewed in Mai Mahiu expressed their fear that the proposed development may lead to conflicts especially between the communities in Maimahiu in Nakuru County and Maasai community in Narok County. They said that this is likely to happen especially during employment period of the proposed development and requested that equal opportunities be given to both communities in terms of employment.

- **Emergence of diseases**

The residents along the proposed line feared that there would be emergence or an increase of disease incidences such as HIV/AIDS especially during construction of the railway line since there will be an influx of many people working at the site and a possibility of increased moral decadence and prostitution. The contractor is however expected to put in place an HIV/AIDs control programme during the construction phase of the project which shall include relevant training and sensitization on sexual health, HIV/AIDs and issuance of condoms to the railway workers and the community where possible.

- **Alignment of the of the proposed railway line**

The public mostly sought to know the exact alignment of the railway line through the protected areas, ecologically sensitive areas, and towns so that they could be aware if they would be affected by the proposed railway or not. They also stated that the rail may affect the Nairobi National Park.The Consultant informed the public that other routing options had been considered (refer to Section 3 on alternatives analysis) and the most environmentally feasible option of all four proposed routes was selected.

- **Interference of other infrastructure**

The public was concerned that the proposed project would interfere with other infrastructure and utility lines already existing such as the pipeline, water pipes, power lines, roads, electric fences, etc. This, they said, is likely to happen since there has never been an integrated system of planning for infrastructure within the proposed corridor. The proposed railway is likely to run over the KPC pipeline in Namuncha area or water systems hence cause damage to these structures which may then need to be relocated. They suggested that the final designs be done in consultation with affected parties like KWS, KENHA, KURA, KERRA, KPC, KETRACO, etc. who have utility lines along the corridor.

- **Livestock and human Crossings**

The residents along the SGR corridor were concerned about access to either side of the railway. They suggested that the railway be designed in a way to provide crossings (underpasses/overpasses) at short intervals for convenience and avoid accidents. The consultant, constractor and project proponent informed the meeting that at design stage the project has accorded more than 47 bridges, 255 culverts and underpasses for animal and human crossing. Other more structures will be put up on need basis by the contractor.

- **Animal(wildlife)crossings**

The members wanted to know how many animal crossings (underpasses/overpasses) will be provided and at what interval/distance. They stated that since the animal migration corridors are known, crossings should be provided at these particular areas and at short distance intervals in consultation with local community leaders, KWS and livestock group ranches.

- **Disturbance to wildlife migratory corridor**

There was also concern that wildlife will be disturbed considering they will not have freedom of movement from one side to the other side of the rail since they will only be forced to use the underpasses. A well-designed funnel-like fence near animal corridors was suggested to easily direct the animals during crossing. This had been tried elsewhere like Lewa conservancy in Rift Valley and it has been found out to be the best practice (**Plate 6-20**).

Plate 6- 20: Structure of a wildlife and livestock underpass culvert in the SGR Phase I project

- **Efficiency of transport of cargo**

Community members were curious to know if the proposed railway will be able to attain its goal of transporting the increasing bulk capacity of cargo from the port of Mombasa and Internal Container Depot near the Nairobi South Station. They stated that for this to be achieved, trains to be used for transportation on the rail will have to be very long. The consultant indicated that the short and long term designs have taken into consideration and models on the amount of exports and imports done to ensure efficiency, reliability and sustainability.

- **Fate of existing railway**

The participants were curious to know what will happen to the existing railway when the SGR one is complete. They suggested that it should be retained for local operations. Some members were also of the opinion that the existing rail be removed and replaced by the new proposed SGR line so as to minimize negative impacts of relocation of people. The public were informed by the Lead ESIA Expert that the KRC and RVR concession has a life-span of about 25 years and more rehabilitation is planned on the existing railway facilities by the RVR. It was also explained that MGR does not meet the engineering standards of the SGR.

- **Use of the Railway wayleave**

The locals also wanted to know if they would be allowed to use the rail wayleave for agricultural purposes and livestock grazing. The consultant responded that this would be impossible since the entire way leave will be fenced off and only underpasses will be provided for the animals to access both sides of the rail. However, locals may be contacted to clear various sections to ensure safety from fires.

- **Resettlement of Project Affected Persons**

The participants stated that they would have no objection if they were to be displaced; however, they claimed that they would not have other places to move to. The consultant responded stating that according to the constitution, the government has a right of compulsory acquisition of land, and the acquisition will be done according to the law, ensuring that all affected persons are resettled. The people will have freedom to choose between cash or alternative land compensation or both depending on the local livelihood conditions and land availability.

- **Source of Construction materials**

Some of the participants wanted to know if the Proponent would consider sourcing construction materials from within the communities living along the proposed corridor. The consultant responded by stating that if this is to be done then all legal procedures will have to be followed as per the laws of Kenya and the material to be sourced has to undergo material lab tests to ascertain that they meet the required engineering standards.

- **Availability of final and detailedpProject designs**

Key project stakeholders such as KWS requested for detailed designs before they give their approvals or comments on the project. While these stakeholders were given preliminary designs to make comments which will shape the final designs, some lacked understanding of the ESIA process as a tool that shapes the final detailed designs for approval. However, they will still have the opportunity to access the materials when the ESIA study report will be advertised in local dailies for public comments.

- **Loss of pasture**

Residents in pastoral areas in Tuala, Nachu, Kimuka, Ewaso Kedong, Mai-Mahiu, Suswa, Duka Moja, Enosupukiaareas were afraid of the potential loss of their pasture due to the proposed project. The consultant however indicated that due compensation will be done by the government for any property and vegetation lost. The ESIA report shall also incorporate comprehensive recommendations to cushion the public from anticipated impacts such recommendation will include resettlement, reforestation, installation of enough bridges, culverts to ensure pastoralists are still able to access either sides of the corridor and creation of water pans in the community.

- **Erosion of historical and cultural norms**

The project will result in the interaction of people from diverse cultural backgrounds. This may result in intermarriages which will cause dissolution of the indigenous cultural norms.

- **Improper transportation of SGR workers**

Some stakeholders were concerned about the risk of improper transportation of SGR workers during the construction stage. They recommended that the workers should be transported in buses instead of being crammed in open trucks which is very tiring and dusty.

- **Additional railway stations**

The stakeholders in Ewaso Kedong were concerned about the lack of a railway station in their area for the transportation of people and goods. They voiced concern about the location of the nearest station in Mai-Mahiu which is quite far.

- **Location of SGR railway station**

The stakeholders in Ongata Rongai indicated the need for the SGR railway station in the area to be aligned according to the population distribution in order to ensure easy access to majority of the people in the area. They were also concerned about the long intervals between the stations which could reduce the benefit of the project within highly populated urban areas.

- **Access to the ESIA report**

The stakeholders in Ewaso Kedong expressed fear that they may never get a chance to cross-check the final ESIA report if it is circulated by NEMA through the usual internet platform which is out of reach for most of the local people in remote areas.

- **Property ownership transfer after decommissioning**

The stakeholders in Nachu area in Karai location of Kikuyu Sub-County were concerned that the ownership of the SGR construction installationssuch as construction camps and boreholes might go to private individuals through corruption rather than being reserved for public uses such as schools and health facilities.

- **Environmental protection**

The stakeholders in Ongata Rongai were concerned about the potential adverse environmental impacts by the SGR on critical ecosystems and buffer zones especially forests such as the Ngong Forest. They also indicated concern about the official KWS position with regard to the project approval.

6.6: Recommendations made by the participants

The following suggestions were made during the consultations and house-to-house interviews: -

- The proponent should consider employing locals as formal and casual employees during construction and operation activities.
- The environment and health of the public should be protected from degradation.
- Schools for children to be constructed and be provided with water, electricity and sanitary facilities, especially for affected/ displaced communities.

The consultant also informed the public that the local leaders will have opinion in selection of viable projects within their areas as corporate social responsibility from the government and contractor: such projects cut across the project sections and may include water dams, boreholes, schools, etc.

The ESIAconsultant also indicated that there will be other SGR related infrastructure whose benefits will trickle down to the community such as:

a) Electricity: The SGR shall make use of electricity in the entire corridor for automation reasons. This power can also be used by the public in areas that are devoid of electricity as at now.
b) Utility Roads: During construction of the SGR, utility roads will be put up parallel to the track. These roads can be improved and used by the public by the end of the project construction.

- Many foot bridges and underpasses should be constructed to enable convenient accessibility to either side of the railway line. The design of the proposed railway should have several underpasses at intervals where the animals and humans can easily find them and access either side of the railway line.

- Proper drainage facilities should be constructed along the line.
- The proponent should provide education and awareness to the local community to clear issues that concern them.
- The proponent should ensure fair compensation of all displaced persons.
- The proponent should involve KWS scientists and engineers and other key stakeholders at all stages of the project including design stage to ensure that the impacts to the protected and other wildlife areas are minimal.

- The proponent should consider wildlife corridors and the community around the Mt. Longonot and Hell's gate National Park and Mt. Suswa conservancy by ensuring that the wildlife migration corridors are less interfered with and that lives of people living around the park are improved by providing services such as water through earth dams/ water pans, boreholes, etc.

- The proponent should ensure that all the stakeholders (including community members,KWS, WRMA, Kenya Roads Board, Kenya Pipeline Corporation, Kenya Power, KETRACO), are thoroughly consulted especially from the design stage of the proposed rail to ensure that other infrastructures are considered to minimize disruption. This can be done to ensure integrated planning of infrastructure.

- The design of the project should be able to give provision for further expansion or future plans without its destruction, ensuring full sustainability of the project.

- Hydrologists to survey potential borehole sites within the protected and non-protected areas to allow access to water for construction.

- Security of the wildlife should be ensured in order to protect them from poaching especially during the construction period as many people are expected to move to the area to work on construction of the rail.

- Measures should be put in place in order to encourage wildlife to use the underpasses that will be provided.

- Some communities requested to have railway stations built within their areas in order to boost their business transactions and open their areas to investors. The consultant responded this by explaining to them that planning for a railway station solely depends upon the international engineering standards of construction of the standard gauge railway. The engineering standards play a big role in the selection of the areas best suited for setting of railway stations but the consultant informed the public that he shall recommend for a parallel road to the railway that shall act as feeder and connection between the communities to the nearest station.

- Communities requested for a requisition of a community liaison officers between the communities and the project. In response to this the consultantaffirmed the request for a liaison officer indicating that the office is essential for such a kind of a project. He indicated that a liaison officer with a Bachelor's Degree as minimum qualification and with deep knowledge and ability to speak with the community will be sought for.

- Some communities requested their relevant county departments to facilitate quick requisition of National Identity Cards unto the youth to aid in job application, job allocation and business tendering with the SGR contractor (s).

- The public indicated that land disputes exist between the local communities and the Akira, Kedong and Africa Geothermal Development Limited Ranches. The dispute is in court hence further consultations on this were needed.

- Due to the presence of hot springs/geothermal effects in Naivasha, detailed geotechnical sensitivity reports need to be availed by the contractor geological subsidence has been recorded in the past.

- The public inquired of how feasible it would be to make use of the existing Meter Gauge rail corridor. It was however indicated, by the Lead Expert that the existing corridor will not accommodate the speed of 120km/hr since it has so many so many corners which may not accommodate the Standard Gauge Railway and that the required international standards between the two corridors are completely different.
- The public sought to know the impacts on agricultural land. It was indicated to them that a comprehensive assessment of the value of all land that will be affected will be done, and the National Land Commission will be in charge of compensation and valuation of identified property. There are basically two types of land that will be affected i.e. titled and non-titled for titled land compensation will be easy because the owner is known to the government while for non-titled land verification procedures will be followed by National Land Commission.

- The public inquired of the acoustic impact of constructing tunnels. The consultantindicated that Department of mines and geology has standards on the minimum distance which must be kept from the people in the surrounding (50m-500m) depending on the explosives used and the amount of blast used. For the proposed corridor, new technology of blasting using chemicals will be used hence no vibrations will be experienced. He also indicated that the advantage of having a tunnel is that it will remain stable for a long time.

- The Public requested that enough information supported by maps be provided to the public for effective public participation. It was indicated to them that Kenya Railway Corporation will upload the maps on their website to enhance public access. He encouraged interested public members to make formal request of maps to KRC via emails or formal letters.

- The public requested follow up to be made by NEMA on the project for compliance. The consultant explained that he will capture that in the report and NEMA or other agencies will be compelled to do follow ups on the project for compliance purposes.

- The Mai Mahiu Community appealed for a substation in Mai Mahiu and the formation of a committee to advise the proponent to save the town from extinction due to massive transfer of tracks from road to rail. The consultantassured residents that Mai Mahiu as a town will remain with its usual activities and not all tracks will be removed from the road because some will serve the other areas from one of the stations. He explained that planning for a railway station solely depends upon the international engineering standards of construction of the standard gauge railway.

- The engineering standards play a big role in the selection of the area best suited for setting of railway stations. The consultant them of feeder roads for connection between the communities to the nearest station. On formation of committees, he informed then that local administration will handle that when the right time comes.

7. POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

ESIA is a tool used to guide environmentally sustainable decisions especially through the identification of potential impacts of the proposed project. The primary function of an ESIA study is to identify, predict and quantify where possible the magnitude of impacts, and also evaluate and assess the importance of the identified changes and formulate plans to monitor and mitigate actual changes. The construction of the proposed Nairobi South Railway Station-Naivasha Industrial Park-Enoosupukia SGR-IIA project is envisaged to generate environmental impacts which could be positive or negative, direct or indirect, local, regional or global, reversible or irreversible hence there was need to subject this project to full ESIA process.

This chapter focuses on the positive and negative impacts that are likely to occur as a result of the proposed construction and operation of the Railway project. These were identified according to the proposed project phases namely: **Construction, Operational, and Decommissioning Phases*.*** While, most of the positive benefits would be during the operation phase of the proposed railway project, most of the negative impacts would take place during construction activities of the project.

7.1: Positive environmental and social impacts during construction phase

The following are the positive impacts during construction phase of the proposed railway:

- **Employment opportunities**

One of the main positive impacts during projects construction phase is the availability of employment opportunities along the SGR route especially to casual workers and several other skilled workers such as building and construction engineers. Employment opportunities are of benefit both economically and socially. Several workers including casual labourers, masons, carpenters, joiners, electricians, and plumbers are expected to work along the railway alignment site during the construction phase. Apart from casual labour, semi-skilled, unskilled labour and formal employees are also expected to obtain gainful employment during the period of construction. Generally, employment during the construction phase will lead to multidimensional development in the project area such as Tuala, Ongata Rongai town, Nkoroi, Ebulbul, Ngong town, Lusigetti, (DK46+490), Kamangu, (DK53+600), Nachu, Kimuka, Ewaso Kedong, Mai-Mahiu, Suswa, Duka Moja, Enosupukiaamong others hence improve several people's living standards.

- **Economic growth**

Through the use of locally available materials during the construction phase for example cement, steel metals and others; the project will contribute towards growth of the country's economy by contributing to the gross domestic product. The consumption of these materials, oil, fuel and others will attract taxes including VAT which will be payable to the government hence increasing government revenue while the cost of these raw materials will be payable directly to the producers.

- **Reduced Transport Cost of Goods**

According to available statistics, currently the transport expenses of import & export trades in East Africa account for 40% of total cargo costs, and among deferred import freights, 24% suffers from backward traffic infrastructure. This has negatively impacted the regional and international trade. The current railway being operated by Rift Valley Railways (RVR) can only handle about 6% of the cargo from the Mombasa Port (which is currently approximately 13 mt per year). The rest (94%) or 12.22mt/yr has to be hauled by road which is unsustainable in the long run as the cargo volumes increase. The transport costs of goods like petroleum products, building materials, cereals and food stuffs, minerals among othersare expected to drop. This will greatly improve regional trade by making the country's goods and services competitive with other Ports in the world.

- **Increased local incomes**

The local community may get extra income from the sale of construction materials from their firms and also renting spaces for camp sites, borrow pits, quarries, dumping sites, lease of ground for yards and temporary passage to pick materials. There exist several quarrying sites along the project route as observed in Kamangu-Ndeiya, Ewaso Kedong and Mai-Mahiu areas which may increase local incomes for the local communities.

- **Reclamation of disturbed land**

Where borrow pits, and unproductive grounds may serve as dumping space for good top soil excavated from construction activities. The developer will need to rehabilitate disturbed sites in the process of construction. Since rehabilitation and catchment protection will go beyond the corridor, the developer will have to supply seedlings to state agencies and local communities along the proposed alignment to aid the process.

- **Optimal use of land resources**

The proposed line will traverse expansive areas whose main land uses are livestock keeping and wildlife conservation such as in Nairobi National Park, Ewaso Kedong area, Akira, Hells Gate, Mt. Suswa and Mt. Longonot dispersal areas. Some of these areas are sparsely populated in terms of people, livestock and wildlife. As such the land is underutilized. The completion and operation of this project is expected to put the land into optimal use for the benefit of the local and national economy.

- **Provision of more water points**

Apart from replacing affected water points, the developer will also put up more water points such as boreholes for the construction works and at all Railway Terminals. After completion of the work, some of these water points will serve the local communities.

- **Landscaping and improvement of aesthetic values**

As the construction works progresses, the developer will also be carrying out landscaping activities not only at the corridor but also on areas to be occupied by station offices and staff houses. This will add aesthetic value especially in currently degraded areas.

- **Provision of market for supply of construction materials**

The project will require supply of large quantities of construction materials most of which will be sourced locally within the project surrounding areas. This will provide ready market to the suppliers such as companies and individuals with such materials.

7.2: Negative environmental and social impacts during construction phase

- **Land acquisition**

Land will be required for construction of the new railway project. This will affect the income,and livelihood as well as social integrity.A high negative impact due to land acquisition and resettlement will be experienced especially in high population density areas in Tuala, Kindisi, Ongata Rongai, Nkoroi. However, there will also be a high positive impact since all theaffected people will be compensated through the NLC.This will require acquisition of public, community and private lands, and will involve social issues such as resettlement of quite a number of families especially in urban areas such as Tuala, Kindisi, Ongata Rongai Nkoroi, Ebulbul, and Ngong. Rural private and communal land in areas such as Kamangu, Nachu, Kimuka, Ewaso Kedong, Mai-Mahiu, Suswa and Enosupukia may also be affected by the land acquisition process. The project is likely to affect various households, business enterprises among others. Moreover there is possibility of adverse effects on the quality of life of affected community members. There will be loss of land and crops as well as houses and other properties such as businesses, churches, institutions among others. The land will be acquired and the properties destroyed to pave way for construction of the railway line and the respective stations. The identified line route (Nairobi South Station-Naivasha Industrial Park - Enoosupukia) will lead to physical displacement of people, loss of shelter, assets, income sources and livelihood, and restriction of access to economic resources. Land Acquisition and Resettlement

- **Land ownership disputes risk to the project**

The proposed SGR route has some land ownership disputes between private owners and the local Maasai communities. The main areas with disputes include Akira Ranch (owned by Kedong Ranch Ltd (Title No.LR.8396)).The project proponent will require legal due diligence and community negotiations for access and acquisition. There will also be need to hold consultations on the disputes with the National Land Commission (NLC).

- **Involuntary displacement and resettlement of persons**

The proposed SGR will start from the western end of the Nairobi South Station (DK0+00) and runs on embracement straight on in a north-east direction for approximately two (2) kilometres outside the NNP before making a bend in the south-western direction and entering the NNP near the East Gate. The SGR will exit the NNP near the Maasai gate, then turn west past Tuala and Ongata Rongai Towns then cross Magadi Road next to the Adventist University of Africa and then continue north-west towards Ngong Road at Ebulbul before heading to to a a tunnel near Ebulbul in Ngong (DK32+320), then the Lusigetti tunnel (DK46+490) and Kamangu tunnel (DK53+600). From there it proceeds north-west to Kamangu area and then drops into the rift valley and head to the proposed Naivasha Industrial Park near Suswa after Mai Mahiu and crosses B3 at Duka Moja to Enosupukia in Narok County. Several areas will be impacted on by the line such as Tuala, Kindisi, Ongata Rongai town, Nkoroi, Ngong area, Lusigeti, Kamangu, Ewaso Kedong and Mai-Mahiu, Suswa and Enosupukia,among others. The alignment of the proposed line will eat into Government and private land and properties is as explained in detail below, but it is expected that a RAP study will give finer details.

Nairobi County: The proposed project will start from the Nairobi South Station in Nairobi County, which is the terminating station for the Mombasa-Nairobi SGR portion of the railway. Human settlements in these areas are mainly a mixture of industrial, commercial with both temporary and semi-permanent structures with a few permanent ones.The SGR will crosses over the through the savannah regionof the Nairobi National Park in an almost straight line along a 6km viaduct consisting of precast T frame girders of an average height of 18m on a 15m way-leave Single Track. The viaduct is super bridge flyover with free underpass for wildlife movements. On completion after about 18 months, the impacted corridor in the park will undergo both natural healing and supported restoration. Eventually, it is expected that only the 187 viaduct pillars will leave a permanent footprint on the ground surface.

Kajiado County:After exisiting the Nairobi National Park near the Masaai Gate, the SGR will pass through Tuala Station (DK12=150) before proceeding to Ongata Rongai and Ngong. There will be five (5) stations in Kajiado County, namely Tuala Station (DK12=150, Ongata Rongai Station (DK20+800), Ngong South Station(DK31+900) and Ngong West Station(DK41+550).Various settlements in Twala market, Kindisi, Ongata Rongai, Nkoroi, Ebulbul and Ngong area will be impacted on by the proposed development negatively.

Kiambu County: Between DK31-DK36 the line will pass through a tunnel on the Eastern side of Ngong Hills and then northwards to Kamangu area (DK50) in Kiambu County. The proposed SGR will leave the Ngong station through a tunnel to Nanju Station (DK51+850) in Kamangu area, the only one in Kiambu County. Several farmlands that will be affected by the proposed railway line include Kiambu western grazing area and Marella farm. Several human settlements will also be adversely affected by the proposed development in Kamangu area during the construction of the Nanju Station as well as the Lusigetti and Kamangu tunnels.

Nakuru County: From Nanju Station (DK51+850) in Kamangu area of Kiambu County, the alignment will proceed briefly back to Kajiado County and pass through Ewaso Station (DK64+700) and then enter Nakuru County at Mai Mahiu Station (DK74+600) and then the Mai-Mahiu West intermediate station (DK86+500) both in Nakuru County. Nakuru County will have a total of two SGR stations exclduding the Naivsha Industrial Park. Human settlements here are sparse such as in Namucha village with some part of the land belonging to the government. Human settlements in these areas mainly consist of temporary structures to whom these areas are their ancestral land and those who have purchased land from original owners and have put up or are in the process of putting up homes. The magnitude of impacts on infrastructure in this region ranges from medium to low due to the sparse human settlements along the SGR corridor such as in Namuncha area.

Narok County: From Mai-Mahiu West Station (DK86+500) in Nakuru County, the SGR will proceed to the Suswa Station (DK99+400) and after crossing the Mai-Mahiu-Narok road (B3) after DK90. It will then head to Oloshaiki Station (DK110+500) and the cross the Mai-Mahiu-Narok road (B3) after DK110 and terminate at Enosupukia Station (DK110+500). Narok County will have three railway stations upto Enosupukia alone.The proposed railway line will pass through farmlands, human settlements, and livestock grazing areas as well as private ranches such as Akira and Kedong ranches. This will cause adverse negative impacts on social and economic activities of the Maasai communities living a long this route which may also lead to change in livelihoods such as in Olorouwa and Enariboo villages of Suswa ward.

- **Loss of property and assets**

Apart from land, a number of other properties and assets will be affected along the proposed railway line because of several reasons, which include;

- Encroachment on railway reserves for both human settlement and commercial purposes
- Private developers with property on or close to the rail corridor. For example in Nairobi, several properties will be affected.

- **Traffic diversions**

The construction of the SGR through Route Option 4 will affect anumber of key utility roads during construction including:- a) Magadi Road at Ongata Rongai which connects Ongata Rongai to Kiserian and Magadi town in the South Rift, b) Ngong Road at Ebulbul which connects Nairobi to Ngong, Matasia Kiserian and Kajiado Town through Isinya. During construction, traffic diversions on these key roads and other minor ones will be required more so at locations where the line traverses the roads. Advance information on communication systems will be an advantage to users of any particular road. Traffic circulation will change due to this action and it will inconvenience people or even make people lose property and business. Road signs will be used and personnel will be stationed on strategic points to assist motorists during the diversions.

- **Destruction of indigenous forests and grasslands**

The clearance of some parts of the Ngong Hill forest and Ololua forest will be done hence permanent loss to indigenous vegetation. The use of the Ngong forest area will include the construction of SGR tunnels which might not interefere with the surface above the ground in a very big way. The forest are important habitats vervet and colobus monkey, baboon, duiker, bush pig, water buck and leopard (the latter found mostly in the remnants of indigenous forest along the river valleys). The disturbance of the forest will affect the status of the forest in terms of forest structure, species composition and diversity. Naturally, if the disturbances occur within short intervals, the forest can flip off to an alternative state to the detriment of the all the biota in habitation. As such, the magnitude of clearance during construction phase should be minimized.

- **Disturbances to rivers and wetlands**

The water resources along the proposed line iare mainly associated with the Athi Basin, including several of its tributaries such as Ngong, Kiserian, Mbagathi and Nairobi rivers, which flow through Nairobi City before draining into the Indian Ocean. The proposed SGR line also passes through the upper catchment of Kiserian River which originates from the Ngong Hills. While ensuring the riverine environment and associated wetlands are not critically affected, the engineering works will have to ensure that soils within the site are well stabilized. However, for long term stability of the site, stabilization and protection of the upper catchment will be pivotal through: enrichment tree planting and establishment of soil erosion control structures (terraces and cut-off drains). Complete eradication of cultivation and grazing will conserve the wet land. Sensitization of the local communities undertaking the farming activities is required.

- **Loss of pasture for livestock and wildlife**

The excavation and construction of the new railway corridor will result in removal of some vegetation and pasture for livestock and wildlife along the SGR corridor. The impacts will be high livestock and wildlife density sections of the corridor such as , Lusigetti, Kamangu, Nachu, Kimuka, Ewaso Kedong, Mai-Mahiu, Suswa, Duka Moja and Enosupukia.The excavation of various sites for collection of construction material will result in a permanent loss if the areas are not refilled and the tree and grass cover re-established. The corridor will also not be accessed by animals for grazing compared to power transmission corridors, which allow livestock and animals to graze freely within the way leave.

- **Occupational health and safety issues**

During the construction of the proposed project, it is expected that construction workers are likely to have accidental injuries and hazards as a result of accidental occurrences, handling hazardous waste, lack or neglect of the use of protective gearsamong others. All necessary health and safety guidelines will be adhered to so as to avoid such circumstances.Workers are also likely to be exposed to diseases from contact with potentially harmful building materials. It is therefore recommended that before the construction activities, there is need for the materials to be well inspected and harmonized to the occupational health and safety standards.

- **Health, safety and hygiene**

Large immigrant work force could be engaged during construction works and their camp sites are hot spots for health,safety and hygiene.

- **Oil spillage**

Oil spillages are likely to occur as a result of leaks from petroleum products, coupled with the normal leaking and dripping of oil, grease and solvents from the construction equipment and vehicles transporting materials to the construction sites. Oil spills are hazardous to the environment as they contaminate the soil and water sources such as rivers though it's less severe on running water resources. Spillages of liquids stored on site, such as oil, diesel and solvents could result in interference of water quality if they get into contact with surrounding water bodies therefore contaminating wildlife conservation areas. Oil spills of petroleum-based components may introduce hydrocarbons in water bodies and soil thus exposing some species that are susceptible to the toxic effects of inhaled oil. Oil vapors can cause damage to an animal's central nervous system, liver, and lungs. Animals are also at risk from ingesting oil, which can reduce the animal's ability to eat or digest its food by damaging cells in the intestinal tract. Some studies show that there can be long-term reproductive problems in animals that have been exposed to oil. The contractor must ensure that oil spill containment measures are in place.

- **Increase in HIV/AIDs infection incidence**

According to the latest UNAIDS estimates, HIV prevalence rates in East African countries/Great Lakes Region is very high: between 4% and 7% in adult population. In Burundi, Democratic Republic of Congo (DRC), Kenya, Rwanda, Tanzania and Uganda, there are more than 4 million persons living with HIV and AIDS, and 3 million AIDS orphans. Due to influx of rail construction workers in communities where the proposed railway line will pass there is a likelihood of increase of HIV/AIDS incidence. This will be as a result of workers socialization with the local residents.

- **Increased crime rates/ culture erosion**

Social crime rate in the construction areas is expected to rise with the beginning of the SGR construction as local youths may target project construction workers. There will be culturalexchange between residents, local workers and foreigners who will be involved in the construction work. The influx of construction and rail workers in communities where the proposed railway line will cut through might lead to cultural erosion considering some of these communities are rural communities with some traditional values and believes.

- **Increased water demand and changes in water quality**

Both the workers and the construction works will create an increased demand for water in addition to the existing demand along the railway line. Most of the areas where the line passes are dry areas, where water sources are very scarce. Construction of the SGR will put a strain on the quantity of water in a region already under acute water shortage. Construction across some rivers will also affect the quality of the water at certain points in the short term. For example, the proposed rail will pass through some sections of Athi River which may compromise the quality of the water during the bridge construction period thus affecting the town and downstream population. Other water resources whose water quality will be affected during construction include Ewaso Kedong River in Namuncha area, Nakuru County. Boreholes might also be sunk to supplement the existing water sources which might have an impact on the underground water reservoirs i.e. quantity of water might be reduced.

- **Disposal of excavation materials and equipment**

Some of the excavation tools and equipment once used will have to be disposed off. This will also applly to some of the soil/ rocks, which may not be reusable after excavation processes are complete. In addition, site excavations shall be done to the satisfaction of standard specifications hence some materials shall be rejected as waste for disposal. Improper disposal of this category of waste may have adverse impacts on the receiving environment. All these materials need to be collected, transported and recycled or disposed off appropriately in approved designated areas. It is encouraged that other alternative uses of these materials should be found so that they can be turned into economic value and use.

- **Soil erosion**

Riverbanks in the Project area, especially Mbagathi River and Ewaso Kedong River are very unstable and susceptible toseverebank erosion. Construction of the SGR including super-bridges may induce changes in the erosionand scour. Soil erosion from small streams along the SGR corridor may lead to subsequent siltation in downstream rivers and users. The excavation and construction activities are likely to loosen the soil particles making them prone to soil erosion. Such problems become serious when the topsoil is left bare and agents of erosion become active. There is also the possibility of open quarries on sites of building material extraction. Run off from unprotected excavated areas lead to excessive soil erosion, especially when the erodability of soil is high. Lost soil will be deposited somewhere, and the location of the deposition could alter downstream hydrology thereby posing a water quality issue directly as a result of siltation and indirectly from contaminants carried with or attached to soil particles.

- **Slope destabilization**

Excavations on landscape and hillsides when constructing the rail track will destabilize slopes. Provision of adequate slope to cuttings and protecting the slope, both in the natural way or artificially will minimize this effect. The construction will have a destabilization effect on slopes where the line crosses hilly area in Nakuru County-Mai Mahiu area (Namuncha village) and Narok County (Suswa area) on the cliffs of Hells Gate National Park and also in Enariboo village thus resulting in increased erosion and possibility of slope failures. This is based on the fact that most of the landslides that have occurred in the past in these areas have been warranted by the existence of steep slopes, heavy rainfall and response of high clay soils with high absorption capacity and well-jointed fractured metamorphic rocks.

- **Existence of fracture zones**

The SGR crosses through the fracture zones where surface dislocation is liable to being generated during an earthquake or by aseismic creep due to crustal movement, which may lead to building damage and thus potential safety issues. The route selection of the railway shall avoid the areas intensively distributed with active fracture zone and shall be constructed by subgrade. In areas where bridges and culverts will be constructed proper engineering measures and supervision methods shall be taken to ensure the operation safety of the railway.

- **Generation of exhaust emissions**

Exhaust emissions are likely to be generated during the construction period by the various construction machinery and equipment. Motor vehicles used to mobilize the work force and materials for construction would cause a potentially significant air quality impact by emitting pollutants through gaseous exhaust emissions. However, this will only be on a temporally basis.

- **Dust emissions to air**

Air pollution will occur mainly due to fugitive emissions/dust generation from various construction activities. Particulate matter pollution is likely to occur during the site clearance, demolitions, excavation, loading and transportation construction materials and excavations. This dust will emanate from diversion roads, construction sites and blasting sites. Suspended Particulate Matter (SPM) is expected to be the main pollutant associated with the earthwork activities and material handling.

- **Effects of quarrying, sand harvesting, borrow pits and explosive magazine**

The explosives will be utilized to extract rock materials from licensed quarry sites to be used in constructing the SGR and in some cases the explosives will also be used to facilitate rock extraction in rocky areas where the railway line and other structures are to be constructed. If not stored properly the explosives may lead to possible negative impacts if accessed by unauthorized persons hence the Explosives Act should be adhered to so as to mitigate this.Quarrying activities on the other hand result in significant degradation of the environment as vegetation is cleared to pave way. It leaves behind open depressions which are prone to soil erosion and ponds during rainy seasons. These ponds interfere with drainage and offer breeding grounds for mosquitoes. Soil piling, buildings, stockpiles and quarry waste piling all have a negative effect on landscape by causing visual intrusion.Sand harvesting will also be carried out on various sites along the SGR corridor and this may lead to conflicts in areas where the resource occurs as well as increased erosion of the river banks.

- **Hydrology and water quality degradation**

Project related excavation operations could lead to ground water quality degradation. Contaminated soil or ground water in the path of the project could be disturbed by excavation resulting in a potential transfer of the contamination to such waters. The excavated area, if linear could act as a conduit to extend groundwater contamination to new areas. Spills of hazardous materials in excavated areas during construction could introduce contaminants to ground water.

- **Solid waste weneration**

A lot of solid waste will be generated from soil excavations and construction material remains as well as their packaging materials. Domestic waste from labor camps can lead to land pollution. Pollution risks may arise from dumping of these waste materials which in turn may lead to surface and ground water pollution. The contractor should ensure full compliance with the EMCA Waste Management Regulations of 2006 as well as the following measures:-

  - Use an integrated solid waste management system through the following options: i) waste source reduction, ii) material reuse and recycling, and, iii) combustion
  - Dispose waste more responsibly in appropriate designated dumping sites
  - Use building materials that have minimal or no packaging to avoid the generation of excessive packaging waste
  - Provide waste collection sites and facilities within the site

- **Noise and Vibrations**

Increased noise levels will be experienced from the construction equipment, blasting and quarrying activities. High noise levels may be experienced near the residential areas or institutions when diversions of roads are made for motorist use. Increased vibrations during construction by equipment movement, excavations and quarrying may have a negative effect on the surrounding buildings and other structures that may be destabilized, cracked or damaged.

- **Noise during project construction phase**

Noise during the project construction will mainly be caused by construction machinery, such as bulldozers, excavators, pile drivers and other stationary sources. Concrete mixer truck, road roller, transport vehicles and other mobile sources can also exert a noise impact.10 m away from the source, the noise intensity of common construction machinery, transport machinery and vehicles at each construction stage is 76-92 dB (A) in earth and stone stage, 90-109 dB (A) in piling stage, 70-90 dB (A) in structural construction stage, and 85-95 dB (A) in decoration stage, respectively.

- **Vibrations during project construction phase**

The vibration effect during the construction period will mainly result from the operation of machinery and equipment. 10 m away from the source, the noise intensity of main construction machinery at each construction stage is 78-85 dB in earth and stone stage, 93-99dB in piling stage and 74-76dB in transport stage, respectively. Among the construction machinery, the vibration intensity generated by the pile driver is the largest. Vibration generated by construction machinery decreases as the distance increases. Increased vibrations are likely to cause disturbance to the surrounding people and also cause damages to infrastructure due to cracking of houses near the proposed SGR way leave.

- **Removal of nonrenewable resource**

The proposed SGR from Nairobi South Railway Station-Naivasha Industrail Park -Enoosupukia will have a total of 8 tunnels along the route, the longest tunnel being in the Ngong Hill forest (3790m).The construction of the tunnels will result in removal of rocks and soils in some sections where it will pass through tunnels such as Ngong, Lusigetti and Kamangu areas. This will result in the loss of large volumes of rocks and soils in some areas. This will also result in the weakening of the support on the overlying areas.

Recommended measures include:

- Compensate adequately owners of land where material is extracted
- Where feasible, refill the exaction sites with extracted soil along railway
- Regreen excavation sites for aesthetic value addition

7.3: Positive environmental and social impacts during operation phase

This section outlines potential **positive** environmental and social impacts likely to occur during the operation stage, i.e. when the trains will start operating on the new standard gauge rail as from 2018/19.

- **Emergence of new towns and urban development**

Growth of businesses, estates, market centres and other essential services will be experienced at the new stations and along the new railway line from Nairobi South Station-Naivasha Industrail Park - Enoosupukia, Narok.

- **Growth of businesses and market centres**

There will be growth of towns, businesses and market centres leading to growth of the local economy along the proposed alignment such as in Tuala Railway Station, Ongata Rongai town, Ebulbul and Ngong town. Economic activities will increase around the corridor, as enhanced transportation by new railway will attract industries, enterprises to serve the workforce and also sale to easily accessible cities of Mombasa and Nairobi. New businesses are also likely to emerge around the Embakasi Internal Container Depot, which will later connect to Nairobi Metropolitan Commuter railway network. In Narok and Nakuru counties, Mai-Mahiu and Suswa terminals will enhance growth of towns where they are located.

- **Reduced Road Accidents**

Accidents on the roads will be reduced due to decreased traffic flow on the Nairobi-Mombasa-Nakuru-Malaba highway as freight trucks will be fewer on the roads. The fact that the railway corridor will be fenced and the railway line will be inaccessible from either side will lead to decrease in accidents since residents will have to utilize foot bridges. It is expected that the number of motor vehicles on the Nairobi – Mombasa - Nakuru-Malaba highway will decrease as people take advantage of the more efficient railway line. As the railway corridor will be fenced off the number of wildlife and livestock deaths will also be drastically reduce. Similarly, fewer road accidents will occur as the road will be decongested.

- **Reduction in freight haulage and transportation time**

Freight haulage through the roadways will minimize the necessity to expand roads in sensitive ecosystems. Rail systems require limited right of way compared to road ways. At the moment, it takes about 2-3 days to transport freight from Mombasa to Nairobi and 3-4 days to Malaba, the new project will reduce the time to less than six hours for express trains because of limited obstructions normally experienced on roads. This will be an important aspect of resource management since the current road transport is slow because of heavy traffic. Efficient movement of people will translate to effective human resource management. Access to remote areas will be improved especially where the line is passing and where raw materials/goods will be sourced.

- **Reduced air pollution along the highway**

Rail transport has significant low exhaust gas emissions compared to road transport hence reliable rail transport will attract high passenger numbers translating to low traffic volume on the Mombasa-Nairobi-Nakuru-Malaba highway. Therefore e the number of vehicles will be reduced which will in turn reducee gas emission levels. This will improve the human health especially those with residential houses near the road (highway) and its satellite towns along the road.

- **Improved tourism opportunities**

The regions along the line are rich in tourism resources such as Lake Naivasha, a famous water resource and flower base, which will greatly benefit from the SGR construction. The proposed railway will run through the Great Rift Valley, which is the largest continental fault zone in the world. Its grandness, impressiveness and spectacular views attract a huge number of tourists and explorers around the world annually.

The Nairobi National Park, Mt. Longonot and Hells Gate National Parks are popular tourist destinations, receiving both local (citizens and residents) and foreign (non-residents) visitors throughout the year. The main mode of transport used by visitors is by road and a small number use chartered aircrafts. Currently, there are no records of visitors to the protected areas using rail transport system. It is however, anticipated that with the construction of the proposed standard gauge rail line, which promises to be faster and reliable, rail transport will become popular for all categories of tourists. This in itself is likely to increase the number of visitors visiting the parks annually. This will arise from low costs of transport, comfort and reliability provided by the rail system. This anticipated preference for rail transport is likely to have a major ripple effect on the economic growth in towns like Maimahiu and Enoosupukia, which will be terminals on the proposed new rail line. More tourists will also prefer rail transport for purposes of site seeing along the railway corridor.

The tourism industry will continue to be an important pillar in Kenya's national economy. The completion of the railway will improve the tourism resources along the line, establishing a safe, rapid and comfortable traveling channel, raising the tourism service level as well as promoting the rapid development of the tourism industry in the region and along the line.

- **Increase in property value**

Residents who own property in towns and areas along the railway line and next to the railway stations will experience a tremendous increase in the value of their properties due to infrastructural development and emergence of new businesses that will require new space. This impact is most likely in all the 6 railway stations planned along the Nairobi South Railway Station-Naivasha Industrial Park -Enoosupukia, Narok SGR line.

- **Economic growth**

The project is anticipated to generate revenue through rail transporters payment of relevant taxes and fees. The traffic volumes offered by the trains during the project operation will require locomotive operators as well as maintenance services, which will be provided by personnel employed, paying relevant taxes. The consumption of oil and other fuel will also attract taxes including VAT which will be payable to the government hence increasing government revenue. The efficiency of railway operation will increase port efficiency, increase export and import volumes and improve foreign trade, tourism, agriculture, hence increase in the national economy.

- **Regional economic growth**

The railway line will improve the inter-country transportation status in East Africa, forming a modern railways network covering most countries in Eastern Africa. The project implementation will promote the regional economic and trade development, support the national economic development in Kenya and facilitate the regional economy to better and faster development of Sudan, Uganda, Ethiopia, Rwanda, DRC Congo and Burundi. The efficiency of railway system will improve foreign trade, tourism, and agriculture in the region leading to an increase in the economic growth.

- **Reduction of road maintenance costs**

Due to the current inefficient railway network most industrial inputs and agricultural produce, Livestock and livestock products are transported by road. The completion of the new railway line will result to diversion of the road transportation to the railway line. Which in turn will reduce the number of heavy trucks on the road resulting to a drastic reduction of the maintenance costs.

- **Reduction in HIV/AIDs infection incidence**

According to the latest UNAIDS estimates, HIV prevalence rates in East African countries / great Lakes are very high: between 4% and 7% in adult population. In Burundi, Democratic Republic of Congo (DRC), Kenya, Rwanda, Tanzania and Uganda, there are more than 4 million persons living with HIV and AIDS, and 3 million AIDS orphans. The rate is as high as 27% among long-distance truck drivers. Such drivers are of particular concern to HIV prevention and care programs because they travel frequently, often to areas with high levels of HIV, and are away from home for long periods of time. Commercial and casual sex is available at truck stops, border crossing points and major transportation hubs. Truck drivers may contract HIV infection in these environments, spread it along their route, and infect their sexual partners back at home. With the rail project, the prevalence rates are expected to drop drastically along the transport corridor among the local populations and truck drivers.

- **Revitalization of the agricultural production in rural areas**

Transportation is a tremendous challenge in rural areas along the proposed railway line. The reason being roads are rough, mostly unpaved and often rendered barely passable by potholes, erosion, ruts, and axle-deep mud. Introduction of the railway line in such areas will motivate residence to engage in agricultural production thereby reviving the agricultural activities in these areas.

To be more specific, the project will make movement of these farm products to distance markets fast and cheap, especially Maize which characterizes farming activities in some parts of Kiambu, Nakuru and Narok regions. Also other horticultural products such as flowers can be harvested from Naivasha in the expansive area and transported to various markets cheaply and fast. Ranches along the proposed route such as Akira, Mai-Mahiu and Kedong Ranches are also advantaged since transportation of livestock products will be made easier and cheapier. The proposed new railway line will provide a faster and cheaper means of transport when completed compared to the current railway line. This will stimulate growth of the livestock and generally the agricultural industry. Livestock transportation and inputs for the industry will be more cheaply transported. Losses incurred through death when livestock are transported on foot or by road will be minimized.

7.4: Negative environmental and social impacts during operation phase

This section outlines possible **negative** environmental and social impacts likely to occur during the operation stage, i.e. when the trains will start operating on the new standard gauge rail as from 2018/19.

- **Collapse of towns and market centres and economic downfall**

Towns and market centres which depend on the long distance trucks for business opportunities will experience economic downfall. Such towns and urban centres include: Ongata Rongai, Kiserian, Ngong town, Mai-Mahiu town, Naivasha town, Nakuru town and Narok town. These towns and centres act as stop-overs for long distance trucks transporting containers and goods from the port of Mombasa to Nairobi and to their various destinations outside the city. Some tracks using the Southern Bypass to Mombasa road are also likely to be affected which may lead to the collapse of businesses in Kikuyu town. When the new railway line whose main aim is to decongest the Mombasa-Nairobi-Nakuru-Malaba highway of these long distance transport trucks starts operating, the economy of these towns which are largely dependent on the transportation trucks will be affected adversely. Business enterprises such as hotel, restaurant, lodging and garage businesses that are vibrant in these towns because of the long distance trucks will also almost collapse.

- **Disruption and change of local livelihoods/ outward migrations**

The project is expected to lead to major disruption and change of local livelihoods of people directly or indirectly depending on long-distance trucks. This will include drivers, mechanics, turn-boys, truck owners, other related/ supportive business owners, Commercial Sex Workers, vendorsamong others. When operations will start these group of people are expected to either change their main source of dependence/ livelihood or migrate to other towns/ regions where the trucks will be operating and even to other countries in the East African Region. Some workers may have to change their skill to suit the new opportunities that will arise. This will require time and resources to re-train.

- **Loss of Employment Opportunities**

The proposed railway line will be a passenger- freight line with a branch line emanating from the main port in Mombasa. The cargo train will therefore transport containers and other goods from the port to their various destinations. This will in turn reduce the number of long distance trucks plying the Mombasa-Nairobi-Nakuru-Malaba highway in the long-term hence loss of jobs for truck drivers, reduced revenue for truck owners and mechanics. The approximate number of drivers and turn boys who will be affected was estimated by the Kenyan registered trucks which are currently about 125,773. However, the Kenyan trucks operating along the Mombasa-Nairobi-Malaba highway are estimated to be about 25,000. The norm is that a truck needs to have a driver and an assistant driver commonly known as "turn-boys". Therefore over 50,000 drivers and turn boys might be adversely affected once the proposed railway starts operating. Workers in related businesses like mechanics, oil recyclers, etc. in major towns along the main road will also be affected adversely.

At the regional level, about 18,000 drivers and turn boys using an estimated 9,000 trucks that deal with transit cargo will also be adversely affected. They will have to change their routes or migrate to other areas or change jobs. Most travelers using road transport will also find it faster, convenient and safe to travel by train rather than public buses. This means that bus companies that operate between Mombasa and Nairobi will have fewer passengers. They will have to improve their services in order to compete with high quality train services that will be offered. Some bus and truck owners may have to shift their business interests to the new railway in order to survive.

- **Interference with cultural-set up of communities**

Interference with cultural set-up of communities will be experienced. Similarly, loss of graves will also be an issue in areas where the railway line passes through ancestral lands. Areas like in Namucha and Enariboo villages might have grave yards within the proposed railway corridor.

- **Increased crime rates/culture erosion**

Business enterprises along the proposed track alignment will be affected thereby disrupting sources of income and livelihood of residents. As a result, social crime rate in the area is expected to rise with the beginning of the operations as people who have experienced job loss might resolve to go into crime to earn their daily livelihood. Local residents will interact with other cultures especially during operation, due to increased number of tourists in some towns. The influx of rail workers in communities where the proposed railway line will cut through might lead to cultural erosion considering some of these communities are rural communities.

- **Loss of Vegetation during way leave maintenance**

Regular maintenance of vegetation within rail track alignment is necessary to avoid interference with train operations and track maintenance. Unchecked growth of trees and plants can disrupt signals, fall onto the tracks and overhead power lines, and prevent workers from getting to places of safety when trains are passing. Regular maintenance of the way leave to control vegetation may involve the use of mechanical methods (for example mowing), manual methods (such as hand pruning), and use of herbicides. Vegetation maintenance beyond that which is necessary for safety may remove unnecessary amounts of vegetation, resulting in the continual replacement of successional species and an increased likelihood of the establishment of invasive species.

- **Ecological impacts to wildlife during operation stage**

The proposed SGR route passes through wildlife dispersal areas leading to introduction of underpasses which may change the movement and general behavior of wildlife. This impact is likely to occur in Nairobi National Park, Hell's gate National Park, Mt. Suswa conservancy and in open ranches all the way from Nairobi to Narok. Various impacts are likely to occur during the operation phase of the SGR will include;

i) Changes in animal behavior and social organization: Some animals avoid railway infrastructure due to the magnitude and disturbance created by noise pollution (Brody & Pelton 1989, Thurber *et al* 1994, Lovallo & Anderson 1996). In some cases, some species Such as the zebra get attracted to the infrastructure to forage on high quality and lush vegetation growing along the railway line system (**Plate 7.1**). Some are attracted to forage that leaks from transport goods such as grains (Yin *et al* 2006). Some, particularly predators, may be attracted to the infrastructure to as a prime area for hunting prey. In some instances, the railway infrastructure disrupts the social organization of some species thereby interfering with their survival and overall population performance (Mansergh & Scott 1989, Gibeau and Heuer 1996).

Plate 7- 1: Zebras in the vicinity of the SGR Phase I

In some situations, wild animals do not regard trains on the railway tracks as their natural enemies; they get used to the noise produced (Dorsey *et al*. 2015). However, the proposed SGR train speed of around 80-120 km per hour, exceed the speeds that these animals have become familiar with during their natural existence in their habitats. The time to react, to escape is too short for an animal to give it a chance to survive an encounter with a train. There are no records which indicate high train-wildlife-collisions in the Tsavo National Park where the narrow gauge railway has existwsed for over 60 years.

ii) Effects of noise and vibration on wildlife: Noise from high-speed train in wildlife inhabited landscapes may have significant impacts on wildlife thereby compromising their survival and population performance. Concerns have been raised by environmentalists who suggest high noise levels adjacent to a rail corridor can cause impact such as interference with communication, mating, predation, startle (shock, frighten, scare) and fright (Federico *et al* 2014). The SGR line over the Nairobi National Park will be fitted with a noise deflector along the 6km stretch which will minimize the noise levels by upto 10dBAs. The viaduct pillars within the national park will be installed at an approximate depth of 30m in order to minimize vibrations during train movement.

- **Emissions**

Locomotive engines may be significant contributors to air pollution in urban areas, especially in the vicinity of rail yards. Worldwide, approximately 60% of passenger trains and 80% of freight trains are powered by diesel locomotives which emit combustion products, including nitrogen oxides (NO_X) and particulate matter (PM), both of which contribute to public health problems, and carbon dioxide (CO_2), a greenhouse gas. Transportation and transfer of dry granular materials (for example minerals and grain) may result in dust emissions, while the storage and transfer of fuels or volatile chemicals may result in fugitive emissions. It is recommened that the proponent (KRC) should ensure the acquisition of modern technology low-carbon emission engines.

- **Air pollution due to transportation of goods**

On time delivery of products such as cement, coal, phosphate and petroleum by the SGR to the neighboring countries and various destinations in Kenya sites is critical. However, the transporting of these products will have adverse social and environmental impacts including: Use of fossil fuels, Carbon dioxide (CO_2) emissions and nuisance to local residents. After completion of the SGR, cement in Athi River is expected to be delivered to Kenyan surrounding countries through the Standard Gauge railway. The transport volumes of cement in this railway are respectively 280,000t, 350,000t and 550,000t in the initial stage, in the short term and in the long term. The proposed SGR is also predicted to transport 1,200,000t, 1,700,000t and 2,500,000t of coal respectively in the initial stage, in the short term and in the long term after its completion. Other products to be transported include phosphate and petroleum. The transportation of these products is likely to lead to increased emissions of carbon dioxide which is a greenhouse gas and hence air pollution.

- **Waste management**

Depending on the number of passengers handled and the services provided, trains and passenger train terminals may generate solid, non-hazardous, food waste from food establishments, in addition to packaging materials from retail facilities, and paper, newspaper, and a variety of disposable food containers from trains and common passenger areas. The maintenance and upgrade of rail infrastructure may also result in the generation of non-hazardous and hazardous waste including lubricants from field maintenance equipment and steel and wood from rails and rail ties.

Most wastes from railway operations are generated as a result of maintenance and refurbishment of locomotives and rolling stock and, to a lesser extent, from track maintenance. These wastes typically include solids from mechanical cleaning of rail cars; paint chips and sandblast grit; waste paint; spent solvent and solvent sludges (from painting and cleaning); sludge from cleaning and wastewater treatment; waste oil, hydraulic fluid, and other petroleum-based fluids; petroleum-contaminated solids (e.g. oil filters and saturated spill absorbent material); spent coolant; metal filings and scrap; spent locomotive and signal batteries; and spent brake shoes.

The refuse from railway station includes; garbage, rubbish, and floor sweepings. The collection and removal of refuse in a sanitary manner from the station is of importance for effective vector control, aesthetic improvement, and nuisance and pollution abatement. Major activities at the stations will be carried out through electronic medium and, minimal use of paper is expected, which makes the major part of solid waste during operation. For the maintenance of adequate sanitary facilities, containers/collection bins will be appropriately designed and installed at all railway facilities. There is also potential for increased littering in the protected areas, hence loss of protected area aesthetic value from increased littering by rail-line users

- **Fuel management**

Rail operations with diesel locomotive engines depend on fueling stations strategically situated along the rail network. Fueling stations typically include aboveground storage tanks, piping, and filling equipment with the potential for soil and ground water resource contamination due to leaks and spills.

- **Wastewater management**

Rail operations may generate sanitary wastewater primarily from passenger terminals and from passenger rail service. Rail cabin/carriage maintenance and refurbishment typically involves a high-pressure water wash which may contain residues from transported materials, paint, oil and grease, and other contaminants. Caustic solutions are often used to remove grease and dirt from axles and other metal parts. Acids and caustics may also be used for rust removal. Locomotive coolants are usually water-based with corrosion inhibitor additives. Passenger trains also generate domestic wastewater, which is sometimes discharged directly to the land surface.

- **Hazardous materials**

Hazardous materials, including solvents, coolants, acids, and alkalis, may be used in locomotives and rolling stock maintenance operations. Polychlorinated biphenyls (PCB) may be found in older electrical equipment (e.g. transformers and capacitors), and asbestos may be present in older parts such as wheel bearings and seals for steam engines.

- **Oil pollution/spillage**

Oil spillage during change of lubricants, cleaning and repair processes, in the maintenance of rolling stock, is very common. Oil spillage is also likely to occur by leaks of these petroleum products, coupled with the normal leaking and dripping of oil, grease and solvents from locomotives especially at the yards. Oil spills are hazardous to the environment as they contaminate the soil. Water from the rail yards may flow into farms and wildlife conservation areas, which has the potential for contamination from any spills, leaks or natural dripping of petroleum products and solvents in the rail yard. Storm water falling on fueling areas and secondary containment systems may contain oil residues from incidental releases. Oil spill containment measures must be ensured by the operators. The spilled oil should be trapped in grit chamber for settling of suspended matter. The collected oil should either be auctioned or incinerated, so as to avoid any underground water contamination.

- **Pollution on vegetation**

The trains are expected to produce exhaust gases and smoke. Once the smoke settle on vegetation leaves, it interferes with the process of photosynthesis thus compromising the plant growth. Exhaust gases results to acid rain that impacts negatively on vegetation growth. The project will put up measures to ensure that there is reduction in emission of exhaust gases and smoke.

- **Separation of communities as well as inaccessibility to market centres and other social amenities/services**

Fencing of the rail corridor will lead to a possible separation of communities in the project areas. Some people will also find it difficult to access some shopping/ market areas/schools/churches/Baraza areas/ Cattle dips, etc. even no proper planning for access routes/facilities are developed. The project can give provisions for foot bridges and flyovers in areas where the railway line cuts through communities to aid in access to amenities on either side of the railway line

- **Blockage of wildlife, livestock and human corridors**

Livestock and wildlife cross the current railway line freely and move from East to West in search of pasture. To ensure this movement is not hampered, provision of underpasses should be provided at strategic points to enable wildlife and livestock to cross the rail system without accidents occurrence. Some water points may have to be established for the wildlife to ensure that they are drawn to the underpasses, and with time become acclimatized.

- **Noise pollution during operation phase**

Sources for noise pollution will include rolling noise generated by the contact between wheel and rail during normal movement and braking; aerodynamic noise generated by the train pushing air (particularly for high speed trains); and traction noise generated by the engine and cooling fans.

Specifically during the operation phase, main noise sources along the railway, exerting certain impact on acoustic environment of the area within 200m to both sides of the railway line, are train running and whistling, shunting at stations, departing, arriving and locomotive servicing work. The shelters are locationed at 30m away from the central line of the outer rail. Without considering other factors such as sound attenuation, the equivalent noise levels in the day and night time for different lines are predicted as shown in **Table 7-1**.

Table 7- 1: Predicted Values of Noise Levels in Day and Night at Non-Sheltered Locations 30m Away from the Central Line of Outer Rail

Iten / Section	Study years	Number of Train Pairs (pairs/day)		Predicted Vibration Value (VLz/dB)					
				30m		45m		60m	
		Passenger train	Freight train	Bridge	Embark ment	Bridge	Embark ment	Bridge	Embark ment
Nairobi South-Nairegie North	Short term	2+1/7	13	75.1	77.9	71.6	74.4	69.1	71.9

The predicted noise levels due to the railway operation will depend on the train speed and distance to the receptors (people and wildlife) as shown in **Table 7.2**.

Table 7- 2: Predicted SGR noise levels

Train speed (km/hr)	L_{eq}(1hr) (dBA)				
	Receptor distance (m)				
	25	50	75	100	200
80	63.4	60.4	58.7	57.4	54.4
100	64.2	61.2	59.4	58.2	55.2
120	65.4	62.4	60.6	59.4	56.4

During the operation period, the main vibration source at sensitive regions along the line is the vibration in train operation, and it is mainly caused by the impact between wheels and rail during the train traveling. The vibration source strength is directly related to track structure, running speed of train, train type, and axle load. See **Table 7-3** for the predicted value of vibration strength from different distance in each section.

Table 7- 3: Predicted Values of Vibration Strength in Each Section (Unit: VLz/dB)

Iten Section	Study years	Number of Train Pairs (pairs/day)		Predicted Vibration Value (VLz/dB)					
				30m		45m		60m	
		Passenger train	Freight train	Bridge	Embark ment	Bridge	Embark ment	Bridge	Embark ment
Nairobi South-Nairegie North	Short term	2+1/7	13	75.1	77.9	71.6	74.4	69.1	71.9

Vibrations due to the operation of trains were predicted using the EMCA *Noise* and Excessive Vibration Control *Regulations*, 2009. The predicted vibration levels due to the railway operation will depend on the train speed and distance to the receptors along the approach SGR corridor (people and wildlife) as shown in **Table 7.4**.

Table 7- 4: Predicted vibration level along the approach railway corridor

Train speed (km/hr)	Vibration (VdB re 5X10^{-8} m/s)				
	Receptor distance (m)				
	25	50	75	100	200
80	64.3	57.5	52.9	49.2	38.7
100	66.2	59.4	54.8	51.1	40.6
120	68.1	61.4	56.7	53.1	42.5

- **Climate change impacts on the SGR**

The likelihood of the occurrence of more extreme weather events such as storms and floods due to climate change can affect SGR infrastructure such as bridges and culverts in the future. The climate change related hazards can cause serious damages to the SGR resulting to safety hazards and huge socio-economic loses.The lifespan estimate of the SGR is estimated at over 100 years which necessitates considerations of the impacts of climate change on the project. The key consideration is the likelihood of severe storms and floods in accordance with the National Climate Change Response Strategy (2009)

- **Risk of train accidents**

The most significant safety issues for any railway operation are derailments, collisions, fires andexplosions (including sabotage/terrorism), falls from the trains, collision with road transport and peopleat level-crossings, the risks associated with stationary sources of pollution (like fuelling stations) and so on.

7.5: Positive impacts during decommissioning phase

- **Rehabilitation of the environment**

It is envisaged that the railway services will be provided throughout but upon decommissioning of the proposed project, rehabilitation of the project site will be carried out to restore the site to its original status or to a better state than it was originally. This will include replacement of topsoil and re-vegetation, which will lead to improved visual quality of the area.

- **Employment opportunities**

Temporary employment opportunities will be created for the demolition staff during the demolition phase of the proposed project.

- **Reduced environmental pollution**

Decommissioning will obviously lead to reduced air, water, soil and general environmental pollution that is experienced during operations.

- **Reduced negative environmental impacts of operation**

All other negative impacts listed under the operations section will drastically reduce when the decommissioning will take place.

7.6: Negative impacts during decommissioning phase

- **Noise and Vibration**

The demolition works will lead to significant deterioration of the acoustic environment within the project site and the surrounding areas. This will be because of the noise and vibration that will be experienced as a result of demolishing the proposed project.

- **Solid Waste Generation**

Demolition of the stations buildings and related infrastructure will result in large quantities of solid waste. The waste will contain the materials used in construction including concrete, metal, drywall, wood, glass, paints, adhesives, sealants and fasteners. Although demolition waste is generally considered as less harmful to the environment since they are composed of inert materials, there is growing evidence that large quantities of such waste may lead to release of certain hazardous chemicals into the environment. In addition, even the generally non-toxic chemicals such as chloride, sodium, sulphate and ammonia, which may be released because of leaching of demolition waste, are known to lead to degradation of groundwater quality.

Optimize waste disposal probably using it to fill up excavation sites for materials used in construction of the line.

- **Dust**

Large quantities of dust will be generated during demolition works. This will affect demolition workers as well as the neighboring residents.

- **Reduced/ loss of positive impacts to the project**

All positive impacts of project operation listed in this report will be lost unless alternative means of transport will be established, especially the electric rail system.

7.7: Environmental and social risks to the project

In any business, there are risks associated with it during the project cycle. For the proposed rail project, the following environmental risks were identified and some recommendations to reduce their occurrence are outlined.

7.7.1: Forest fires

If vegetation growth is left unchecked or slash from routine maintenance is left to accumulate within the right-of-way, sufficient fuel can accumulate that may promote forest fires. Recommended measures to prevent and control risk of forest fire include:

- Monitoring of right-of-way vegetation according to fire risk;
- Removal of blow down and other high-hazard fuel accumulations;
- Timing of thinning, slashing, and other maintenance activities to avoid seasons when the risk of forest fires is high;
- Removal of maintenance slash or management by controlled burning. Controlled burning should adhere to applicable burning regulations, fire suppression equipment requirements, and typically should be monitored by a fire watcher;
- Planting and management of fire-resistant species (e.g. hardwoods) within, and adjacent to, rights-of-way.

7.7.2: Disposal of earth waste and opening of excavation sites

The construction will result in a great level of excavation thus creating large quantities of waste and open quarries. This will offer challenges to the residents adjacent to such sites and also to the construction activities. The excavation sites act as water stagnation points which may harbour disease-causing organisms thus causing a negative impact to both workers and the communities especially during the rainy season. This will be a great challenge especially in areas with vertisols such as in Embakasi area.Therefore, the following measures are recommended to eliminate or to reduce impacts of waste earth materials and excavation sites:

- Use rehabilitation methods in the reclamation of excavated sites
- Optimize waste disposal probably using it to fill up excavation sites for materials used in construction of the line.

7.7.3: Run off and mud slides

Landslides are caused by disturbances in the natural stability of a slope. They can accompany heavy rains or follow droughts, earthquakes, or volcanic eruptions. Mudslides develop when water rapidly accumulates in the ground and results in a surge of water-saturated rock, earth, and debris. Mudslides usually start on steep slopes and can be activated by natural disasters. Areas where wildfires or human modification of the land have destroyed vegetation on slopes are particularly vulnerable to landslides during and after heavy rains. Mudslides are likely to occur in areas where proposed railway will cut through steep slopes such as the Ngong hills thereby destabilizing the slope. This will disrupt the operation of the railway. Soil erosion and sedimentation of silt below underpasses make some impassible. All these risks can be mitigated by using environmental catchment protection and mechanical soil erosion methods.

7.7.4: General rail operational safety

The most significant safety issue potentially affecting both crew and passengers is the threat of serious injury or the potential loss of life due to train collisions with other trains or accidents as well as the possibility of derailment and any other operational causes. Recommended management actions include:

- Implementation of rail operational safety procedures aimed at reducing the likelihood of train collisions such as a positive train control (PTC) system. If a full PTC system is not practical, automatic rail switches should be installed or, where manual switches remain, documenting when a manually operated switch in non-signaled territory is changed from the main track to a siding, and returned back to the normal position for main track movements. This information should be communicated to all crew members and the train dispatcher;

- Regular inspection and maintenance of the rail lines and facilities to ensure track stability and integrity in accordance with national and international track safety standards;
- Implementation of an overall safety management program that is equivalent to internationally recognized railway safety programs.

7.7.5: Transport of dangerous Goods

Dangerous goods are frequently transported in bulk or packaged form by rail, representing a potential risk of release to the environment in the event of accidents on a number of other causes. Examples include valve leakage or safety valve releases in pressurized and general-service tank cars or other hazardous material containers (e.g. covered hoppers, intermodal trailers and containers, or portable tanks). In intermodal containers, spills and leaks may result from improper packing and resultant load shifting during transport. Additionally, there is a potential for the release of diesel during fuelling operations.

The recommended measures to prevent minimize, and control releases of hazardous materials during rail transportation and use include the following:

- Implementation of a system for the proper screening, acceptance, and transport of dangerous goods. Since these materials may be provided by third parties, the screening and acceptance process should confirm accordance with international standards applicable to packaging, marking, and labelling of containers;
- Use of tank cars and other rolling stock that meet national and international standards (e.g. thermal protection and puncture resistance) appropriate for the cargo being carried, and implementing a preventive maintenance program;
- Preparation of spill prevention and control, and emergency preparedness and response plans, based on an analysis of hazards, including the nature, consequence, and probability of accidents.

Based on result of the hazard analysis, implementation of prevention and control measures which may include: -

- Routing and timing of hazardous materials transport to minimize risk to the community (e.g. restricting transport of hazardous materials on some routes)
- Limiting train speed in developed areas
- Construction of protective barriers and other technical measures (e.g. drainage / receptacle provisions) at sensitive locations (e.g. water resources and settlements)
- Dissemination of emergency preparedness and response information to the potentially affected communities (e.g. emergency notification systems and evacuation procedures);
- Implementation of a hazardous material security plan and security awareness training, including provisions for personnel security, prevention of unauthorized access, and measures to reduce risks during storage and transport of hazardous materials;
- Use of standardized fuel spill prevention system for locomotive fueling, including automatic shut-off systems.

7.7.6: Earthquakes and volcanic eruptions

One of the main unfavorable geological troubles along the Line is the existence of earthquake areas. The starting point of the Line is in Nairobi through Kajiado, Kiambu, back to Kajiado then to Nakuru and Narok. This route is on the east boundary of the Great Rift Valley, where the basic seismic intensity is Ⅶ, and the seismic peak ground acceleration is 0.15g. This risk will have a big influence on the Project design. The selection of pier and abutment to be used and steel-bar surface protection will be set in abutment body according to geological, topographic and earthquake intensity conditions. Since the seismic intensity along this line is 5-7 for different line sections, the shockproof girder falling measures will be prepared in pier top according to corresponding earthquake magnitude. The shockproof girder falling measures will also be prepared according to corresponding earthquake magnitude for the bridges in seismic areas.

7.7.7: Land Ownership disputes and conflicts

The proposed SGR route has some land ownership disputes between private owners and the local Maasai communities. The main areas with disputes include Empakasi area (Sheep and Goat project area) in Athi River Township and Akira Ranch (owned by Kedong Ranch Ltd (Title No. LR. 8396)).The project proponent will require legal due diligence and community negotiations for access and acquisition. There will also be need to hold consultations on the disputes with the National Land Commission (NLC).

8. MITIGATION MEASURES AND MONITORING PROGRAMMES

The proponent acknowledges the fact that the proposed project activities will have some impacts on the biophysical environment, health and safety of its employees and members of the public, and socio economic wellbeing of the local residents. Thus, the main focus will be on reducing the negative impacts and maximizing the positive impacts associated with the project activities through a programme of continuous improvement.

An environmental management plan will be developed to assist the proponent in mitigating and managing environmental impacts associated with the life cycle of the project. This chapter focuses on measures that can be incorporated into the design, and taken during the improvement works and operation stages of the project in order to mitigate the negative environmental impacts and enhance the positive ones described in Section 7. The potential key negative impacts and the possible mitigation measures have herein been analysed under two categories: construction and operational.

8.1: Mitigation measures within Nairobi National Park

1. Inadequate education and awareness of SGR workers and construction site managers on code of practice within national parks		**Mitigation**
Pre-construction	The project proponent in collaboration with KWS will undertake a comprehensive education and awareness training to the SGR workers and construction site managers on the acceptable terms, conditions and protocol to be used during the construction work within the Nairobi National Park in order to minimize environmental impact and avoid illegal practices in the park environment	The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park
Construction	Construction sites shall be inspected by the relevant KWS specialist on a regular basis	• No construction camps will be established inside the park • The contractor will minimize the number of workers operating inside the park in any single day • No fuel-wood collection and use in the park will be permitted • No collection and removal of any material (e.g. excavated soil, murram, plants and animals) will be allowed from the park without approval by KWS • All the construction materials entering the national park will be inspected by KWS personnel to avoid introduction of invasive species or hazardous materials • KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities
Operation & maintenance	Operations of the SGR inside he park shall be inspected by the relevant KWS specialist(s) on a regular basis	KWS personnel will continuously monitor the SGR operations & maintenance activities

2. Inadequate awareness by the contactor of the environmental sensitivity of the NNP SGR corridor in Nairobi National Park		**Mitigation**
Pre-construction	• The contractor will undertake a comprehensive survey of the NNP SGR route in partnership with KWS at least one month prior to commencement of construction works to avoid negative impacts on small wildlife and breeding animals including nesting birds in the SGR corridor.	• Any vulnerable and easily traumatized wildlife species will be identified during the pre-construction survey of the NNP SGR route and where possible translocated to suitable habitats in the park • If wildlife species are found in the SGR route during the pre-construction survey appropriate measures will be used to minimize their disturbance during reproduction and breeding periods as recommended by KWS • The contractor and KWS will develop a code of conduct that will be used during the construction phase to reduce vegetation destruction, wildlife disturbance and trauma
Construction	Construction sites shall be inspected by the relevant KWS specialist(s) on a regular basis	KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities
Operation & maintenance	The operation of the SGR inside the national park shall be inspected by the relevant KWS specialist(s) on a regular basis	KWS personnel will continuously monitor the SGR operations & maintenance

3. Vegetation clearance – The SGR construction through Route Option 4 will affect approximately 6.43ha of 4 key vegetation types along the 6km stretch including 2.06ha of open grassland, 3.35ha of open low shrub cover, 0.72ha of *Acacia drepanolobium* dwarf shrub grassland and 0.30ha of riverine vegetation		**Mitigation**
Pre-construction	The Proponent (KRC), Contractor (CCCC) and Park Management (KWS) will inspect the SGR route and inspect the baseline vegetation condition with the aim of ensuring its restoration to the same condition after the construction phase	The Proponent (KRC), Contractor (CCCC) and Park Management (KWS) will agree on the vegetation protection plan and handling of the cleared vegetation material
Construction	Construction activities will uproot vegetation along the 6km SGR corridor in the park	• The contractor will ensure that vegetation disturbance along the SGR route is restricted as much as possible to the 187 viaduct pillar sites • KRC and KWS will discuss and agree on appropriate measures to compensate for the disturbed plant biodiversity in the park through consultations to be organized by the Ministry of Environment and Natural Resources

		• KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities
Operation & maintenance	The contractor will adopt an appropriate vegetation restoration plan, which will consider rehabilitation of affected areas. The vegetation restoration plan will be developed and approved by KWS	• Regular watering of the vegetation rehabilitation sites in order to fast track recovery • Rip compacted areas to reduce runoff and improve re-vegetation where required • KWS personnel will continuously monitor the SGR operations & maintenance

4. Soil disturbance		**Mitigation**
Pre-construction	The Proponent (KRC), Contractor (CCCC) and Park Management (KWS) will inspect the SGR route and inspect the baseline soil condition with the aim of ensuring restoration to the same condition after the construction phase	The Proponent (KRC), Contractor (CCCC) and Park Management (KWS) will agree on soil erosion control plan
Construction	• Topsoil removal, transportation and piling-stocking plans, which will consider the methods of topsoil removal, the means of transportation, the volume of stocked soils, stocking sites and creation of adequate conditions for maintenance of topsoil characteristics • The contractor will adhere an appropriate soil erosion prevention control plan as which will be approved by relevant KWS	• The contractor will adopt an appropriate soil reinstatement plan, which will consider reinstatement of trampled areas (access roads), placement of the removed topsoil, sowing and improvement of soil characteristics. The soil reinstatement plan will be approved by KWS • KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities
Operation & maintenance	The operation of the SGR inside the national park shall be inspected by the relevant KWS specialist on a regular basis	KWS personnel will continuously monitor the SGR O&M

5. Landscape impact - The project will have impact on the landscape due to some limited landscape fragmentation		**Mitigation**
Pre-construction	The Proponent (KRC), Contractor (CCCC) and Park Management (KWS) will inspect the SGR route and inspect the baseline landscape condition with the aim of ensuring restoration to the same condition after the construction phase	• The Proponent (KRC), Contractor (CCCC) and Park Management (KWS) will agree on the most suitable landscape preservation plan • The viaduct should be designed to blend with the seasonal environmental changes of the landscape
Construction	• Aesthetic landscape impacts will include the uneven surface of the ground and construction machinery will be seen from the nearby park roadways	The Contractor should strive to ensure that the SGR corridor will blend as much as possible to the park environment through the

	• Substantial visual impact will occur due to the alteration of the original landscape appearance. However, this will mainly affect regular visitors to the national park due to their historical mental maps • The SGR corridor in the park could actually be impressive and attractive to some park visitors	use of suitable strategies which will be approved by KWS
Operation & maintenance	The operation of the SGR inside the national park shall be inspected by the relevant KWS specialist(s) on a regular basis	• The SGR train shall not turn on intense lights in the national park at night in order to reduce impacts on wildlife • KWS personnel will continuously monitor the SGR operations & maintenance

6. Wildlife impacts – The SGR construction through Route Option 4 will affect the habitats of key species in the park including Lion, Black rhino, Zebra, Wildebeest, Coke's hartebeest, Grant's gazelle, Thomson's gazelle, Impala, buffalo, Maasai Giraffe and Eland		**Mitigation**
Pre-construction	The project proponent in collaboration with KWS will undertake a comprehensive education and awareness training to the SGR workers and construction site managers on the acceptable terms, conditions and protocol to be used during the construction work within the park in order to minimize vegetation and environmental impacts and avoid illegal practices	The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park
Construction	• The wildlife in the park might fall into the trenches for the 187 SGR viaduct foundation pillars • Workers might be involved in IN illegal activities detrimental to the environmental state of the park environment including poaching and bush meat activities	• The contractor will install temporal fences to prevent animals from falling into the SGR viaduct pillar trenches. the design and specifications and actual installations of these fences will be approved and supervised by KWS • Reduce the impact of human activity on wildlife • Regulate activities strictly to the construction RoW (15m) • Most wildlife feed in the morning, dusk or night and generally rest around noon. Consequently, construction should be planned reasonably to avoid a lot of noise and vibration in the morning and dusk in order to minimize the level of interference with wildlife • Construction work during the nights must totally be avoided as the movement of many species, especially large mammals and carnivores, is greater during the night • Construction activities shall be

		restricted daytime (6am-6pm) • The contractor will ensure minimum noise levels during construction, especially the pile driving activities • The camping of people/workers in the national park must be avoided • No domestic animals to be allowed in the park • KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities
Operation & maintenance	• SGR maintenance by KRC in the national park will be undertaken in partnership with KWS	• KWS personnel will continuously monitor the SGR operations & maintenance

7. Noise – Ambient noise quality in the project area is generally high (60-80dBA) due to the continuous over-flying of the SGR corridor by large aircraft on the landing approach to Jomo Kenyatta International Airport. This might be amplified by the SGR construction works which might increase disturbance and trauma to wildlife		**Mitigation**
Pre-construction	The project proponent in collaboration with KWS will undertake a comprehensive education and awareness training to the SGR workers and construction site managers on the acceptable terms, conditions and protocol to be used during the construction work within the park in order to minimize noise pollution that may be detrimental to the wildlife	• The contractor and KWS will jointly develop a noise reduction & management for use during the construction phase • The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park including maintaining low noise levels below the current baseline of 80dBA
Construction	The construction activities might increase the noise levels in the park	• The contractor will ensure minimum noise levels during construction, especially the pile driving activities • Construction activities will only be undertaken during the day (6am-6pm) • KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities • KWS personnel will monitor disturbance level and behavior of key vulnerable wildlife species e.g. Black rhino, lion & Coke's hartebeest & wildebeest
Operation & maintenance	SGR maintenance by KRC in the national park will be undertaken in partnership with KWS	• The SGR line over the park will be fitted with an acoustic noise barrier whose

		specifications will be approved by KWS • The contractor in collaboration with KRC will ensure the installation of strict "No Train Whistle Blowing signage" before the railway enters into the park which will be a SGR whistle-forbidding section • KWS personnel will continuously monitor the SGR operation & maintenance and ensure adherence to the L.N. 61: Noise and Excessive Vibration Control Regulations, 2009 • KWS personnel will monitor disturbance level and behavior of key vulnerable wildlife species e.g. Black rhino, lion & Coke's hartebeest & wildebeest along the viaduct include usage of habitats below it

8. Air-quality – The SGR construction and operation activities could lead to the deterioration of air quality in the park which will be unfavourable for the wildlife and tourists		**Mitigation**
Pre-construction	The project proponent in collaboration with KWS will undertake a comprehensive education and awareness training to the SGR workers and construction site managers on the acceptable terms, conditions and protocol to be used during the construction work within the Nairobi National Park in order to minimize environmental impact and avoid illegal practices in the park environment	• The contractor and KWS will jointly develop air quality/dust reduction & management for use during the construction phase • The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park including the maintenance of good air quality & reduction in dust emission
Construction	Negative impact is expected due to mobilization and operation of vehicles and construction equipment. Local air quality will be deteriorated from the emission of vehicles, construction equipments, and the dust generated from construction activities	• Regular spaying of the construction sites • KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities
Operation & maintenance	Negative impact is expected due to operation of passenger and freight trains over the park	KWS personnel will continuously monitor the SGR operations & maintenance and ensure adherence to the EMCA (*Air Quality*) *Regulations*, 2009,

9. Waste disposal - Construction debris and solid/liquid wastes generated along the SGR corridor in the park might be deteriorate to the environment in their immediate surroundings of disposal	**Mitigation**

Pre-construction	The project proponent in collaboration with KWS will undertake a comprehensive education and awareness training to the SGR workers and construction site managers on the acceptable terms, conditions and protocol to be used during the construction work within the Nairobi National Park in order to minimize environmental impact and avoid illegal practices in the park environment	• The contractor and KWS will jointly develop a waste management and disposal framework as provided in the EMCA(Wastemanagement regulations of 2006) • The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park including the maintenance of good air quality
Construction	Disposal of construction wastes	All construction wastes must be carried away from the park every day and with no dumping on site as stipulated in the EMCA(Wastemanagement regulations of 2006)
Operation & maintenance	Disposal of train operation wastes	Wastes generated during the operation phase will be disposed of as stipulated in the EMCA(Wastemanagement regulations of 2006)

10. Water quality – The SGR construction activities might affect the water quality in Mbagathi river		**Mitigation**
Pre-construction	The Proponent (KRC), Contractor (CCCC) and Park Management (KWS) will inspect the SGR route at the Mbagathi River crossing and inspect the baseline condition with the aim of ensuring the restoration of the same condition after the construction phase	The Proponent (KRC), Contractor (CCCC) and Park Management (KWS) will agree on the Mbagathi River Preservation Plan
Construction	• Negative impacts on surface water quality in Mbagathi River might occur due to (i) dredging activities, (ii) construction of viaduct over the river and ii) construction activities near river • Accidental spillage of fuels, lubricants, chemicals/solvents and construction waste will contaminate both surface and ground waters	KWS personnel will be stationed on site throughout the construction phase to monitor the construction activities
Operation & maintenance	No significant impact. However there could be medium to high level risks due to accidental spillage of fuels, lubricants, chemicals/solvents	KWS and KRC to periodically monitor occurrence of accidental spillage into the river

11. Tourism impacts – The construction and operation of the SGR might affect tourism activities in the park especially during the construction stage leading to revenue collection		**Mitigation**
Pre-construction	The project proponent in collaboration with KWS will undertake a comprehensive education and awareness training to the SGR workers and construction site managers on the acceptable terms, conditions and protocol to be used during the construction work in the park in order to minimize	The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park including good public relations with the park tourists

	negative impact on the park tourists	
Construction	The construction activities could have a negative impact on the tourists visiting the park	• The contractor will install appropriate signage in the park to apologize for any inconvenience caused to the park tourists • KWS and KRC will agree on a suitable and effective tourist's public relations framework
	The construction activities could have a negative impact on park visitations and associated revenue collection	• KRC and KWS will discuss and agree on appropriate measures to compensate the impacts on loss of tourism in the park through consultations to be organized by the Ministry of Environment and Natural Resources • KWS and KRC will agree on a suitable and effective tourist's public relations framework
	The construction activities might lead to negative publicity of the park by tourists	KWS and KRC will agree on a suitable and effective tourist's public relations framework
Operation & maintenance	The operation of SGR passenger and freight trains might have a negative impact to a small percentage of tourists with a sentimental attachment to the park	• KRC and KWS will discuss and agree on appropriate measures to compensate the impacts on loss of tourism in the park through consultations to be organized by the Ministry of Environment and Natural Resources. The compensation will not be necessary if such loss does not occur

12. **Train accidents** - The most significant safety issues for any railway operation are derailments, train crash, train collisions, oil spills, chemical spills, fires and explosions (including sabotage/terrorism)		**Mitigation**
Pre-construction	Minimum impacts	The Contractor will prepare an Environmental Risk and Emergency Response Plan to deal with any accidents which must be approved by KWS
Construction	Construction accidents	The Contractor will prepare an Environmental Risk and Emergency Response Plan to deal with any accidents which must be approved by KWS
Operation & maintenance	Operation accidents	• The proponent (KRC) and KWS will prepare a long term Emergency Response

		Plan and appropriate capacity (personnel and equipment) including a clear Command Centre to deal with any accidents
		• The Command Centre should be capable of undertaking the following:
		  o Over-sighting of the relevant departments at KWS and KRC to effectively perform emergency response duties
		  o Determining the technical solutions of the emergency response operations
		  o Coordinating and directing the emergency response operations
		  o Deciding the on-site handling of unexpected emergency situations

13. **Invasive species** – The SGR construction and operation activities have the potential of introducing invader species into the park which might be detrimental to the environment and biodiversity		**Mitigation**
Pre-construction	The project proponent in collaboration with KWS will undertake comprehensive education and awareness training to the SGR workers and construction site managers on the risks associated with invader species, conditions and protocol to be used during the construction work in the park in order to minimize introduction of invasive species	• The contractor and KWS will develop an invader species management framework and protocol to reduce the risk of introducing invasive species • The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park and invasive species management protocol
Construction	The construction activities might introduce invader species in the park	• KWS will inspect all construction materials entering the park • KWS will screen the construction equipment to avoid introduction of invasive species such as *Nicotiana glauca* and *Prosopis* seeds etc. attached to construction machinery • KWS will inspect all the sites where construction materials

		e.g. gravel etc. will be sourced prior their transportation to the construction sites • The contractor will ensure that all SGR workers and construction site managers adhere to the KWS code of practice in the park and invasive species management protocol
Operation & maintenance	The operation of SGR passenger and freight trains might introduce invader species to the park	• KRC to comply with EMCA 1999 (Cap 387) & IUCN-GISP guidelines regarding control and management of invasive species • KWS to have an invasive monitoring programme along the SGR viaduct

8.2: Mitigation of construction related impacts in other SGR route sections

8.2.1: Land Acquisition and Involuntary Resettlement/Displacement of persons

This will cause loss of ancestral land, community institutions and social networks weakened, and kin groups dispersed. Cultural Identity, traditional authority and potential for assistance will be diminished. All these can be mitigated through a Resettlement Action Plan (RAP) where loss of land and crops will be compensated.

A Resettlement Action Plan (RAP) study needs to be commissioned for the proposed project. The RAP needs to be carried out in accordance with the legal framework of the Government of Kenya, and in line with the requirements of the World Bank's OP 4.12 (Involuntary Resettlement) and the IFC Performance Standard 5 on Land Acquisition and Involuntary Resettlement as required. Surveys need to be conducted to establish which properties (land and buildings) lie within the zone affected by the proposed project. The exact number of Project Affected Persons (PAPs) affected and the types of properties affected will be determined. In addition, potential sites for the relocation of the PAPs need to be identified, and an estimation of the total cost for the RAP obtained. The resettlement plan or resettlement policy framework shall include measures to ensure that the displaced persons are:

- Informed about their options and rights pertaining to resettlement;
- Consulted on, offered choices among, and provided with technically and economically feasible resettlement alternatives; and
- Provided prompt and effective compensation at full replacement cost for losses of assets attributable directly to the project.

8.2.2: Habitat loss, alteration and fragmentation

Clearance of part of the vegetation along the track alignment to pave way for rail construction will be inevitable. However, the proponent will ensure proper demarcation of the area to be affected by the construction works. This will be aimed at ensuring that any disturbance to flora and fauna is restricted to the actual project area.

During the construction stage, the proponent will need to minimize impacts on wildlife and use of their habitats, movement and dispersal patterns by: ensuring materials and construction leave space for wildlife movements, avoid any direct mortality to wildlife, and avoid encroachment on sensitive wildlife habitats. The proponent should also ensure that workers do not engage in illegal bush meat activities.

8.2.3: Disturbances to wetlands

The proponent shall put in place several measures that will mitigate disturbance to wetlands arising during the construction phase by adhering to the provisions of Wetlands, River Banks, Lake Shores and Sea Shore Management Regulation, 2009.

8.2.4: Disturbances to public utilities
The developer will relocate all facilities affected in consultations with various parties affected with respect to water, sewerage, pipelines, electricity, old rail, roads, etc.

8.2.5: Increased water demand
The proponent shall ensure that water is used efficiently by sensitizing construction staff to avoid irresponsible water use. The proponent will install water-conserving automatic taps and toilets within the site camps. Moreover, any water leaks through damaged pipes and faulty taps will be fixed promptly by qualified staff.

8.2.6: Soil conservation
The project may require use of available spoil/borrow pits for structural fill for access roads, stations, and embankments before borrow pits are excavated. Borrow pits will be centrally located wherever possible in order so they can serve more than one site. Topsoil from the borrow pits will be removed and set aside. When borrowing from the pit ceases, the areas will be reinstated accordingly to the project engineers' approval. Agreements between the contractor and owners of material and dumping sites should be brought to the attention of the Client representative/Project Engineers who shall ensure implementation of the Environmental Management Plan for these sites.

All steep cuts will be benched accordingly. Special attention will be given to ensuring that watercourses are not blocked and material stockpiles will be designed so that runoff will not induce sedimentation of waterways. In areas of high swell shrink soils, solution would be removal of the soil. Alternative would be to raise the track with base built from the rock level of profile. Dug out quarries should be filled with soil and rehabilitated with grass and tree planting alternatively in some cases as in nomadic pastoralists areas, the open quarries can be left to serve as water harvesting points for watering of livestock.

8.2.7: Slope failure
Proposed mitigative measures on sections likely to experience slope failure is to incorporate rehabilitation of the slopes measures through grass and tree planting. Alternative is to build concrete embankments.

8.2.8: Air Quality
The proponents shall put in place several measures that will mitigate air quality arising during the construction phase by adhering to the provisions of Air Quality Regulations, 2008.

8.2.9: Minimize the effects of noise and vibrations
The proponents shall put in place several measures that will mitigate noise pollution arising during the construction phase by adhering to the provisions of Noise Prevention and Control Rules 2005, Legal notice no. 24 regarding noise limits at the workplace as well as NEMA Noise and Excessive Vibration Pollution Control Regulations, 2009.

8.2.10: Minimize the effects of exhaust emission
The proponents shall put in place several measures that will mitigate exhaust emissions arising during the construction phase by adhering to the provisions of Air Quality Regulations, 2008

8.2.11: Reduction of impacts of extraction sites and efficient use of raw materials
To reduce the negative impacts on availability and sustainability of the materials, the proponent will only extract what will be required through accurate budgeting and estimation of actual construction requirements. This will ensure that materials are not extracted in excessive quantities. Moreover, the proponent will ensure that wastage, damage or loss of materials at the operation site is kept minimal, as these would lead to additional demand for and extraction of materials. In addition to the above measures, the proponent shall consider reuse of building materials and use of recycled building materials. This will lead to reduction in the amount of raw materials extracted from natural resources as well as reducing impacts at the extraction sites.

8.2.12: Stormwater drainage

The contractor will ensure adequate drainage facilities with a design for adequate peak rainfall intensity and non-silting velocity of more than 130mm/hour and more than 0.6m/sec, respectively to facilitate flow in drains.

8.2.13: Hydrology and water quality degradation

The proponents shall put in place several measures that will mitigate noise pollution arising during the construction phase by adhering to the provisions of NEMA Water Quality Regulations, 2006 (Legal notice No. 121).

8.2.14: SGR tunnel integrity for seismic hazards

The contractor and proponent should ensure proper seismic design for the Ngong, Lusigetti and Kamangu SGR tunnels

8.2.15: Requirements for bridge crossing the fracture zone

Detailed survey should be carried out on the location and activity of faults near the bridge locations on the basis of fracture drilling verification and evaluation of fault activities so as to determine the activity and age of such fracture zones, the surface displacement in case of an earthquake with design frequency and the displacement in case of aseismic creep, so as to provide reliable investigation data for bridge span arrangement and design.

8.2.16: Principle for span arrangement and type of bridge

As the fault dislocation generated by an earthquake is unrecoverable, the repair of the bridge crossing the fault after an earthquake is an important part of the design of the bridge of this type. In the view of aseismic design, the structure of the bridge crossing the fault shall be reliable and convenient for repair. Bridges located in fracture zones shall be provided with good adaptability and integrality. Simple supported structures such as steel box girder or steel concrete composite girder with light weight shall be adopted to span the fracture zone, to reduce the additional structure force generated by surface displacement during earthquake and aseismic creep displacement and properly strengthen the foundation.

8.2.17: Modification of forest and woodlands

The proponent shall adhere to Forest Act 2005, which highlights the integration of the community on the management, utilization and conservation of forests and its resources. Wanton destruction of forests should be avoided or minimised.

8.2.18: Occupational health and safety issues

The proponents shall put in place several measures that will mitigate accidents within working place during the construction phase by adhering to the provisions of OSHA 2007 and Public Health Act. The contractor will ensure health, safety and security for all workers including, a) Personal protective equipment (PPE) including gloves, foot and eye protection, protective hearing devices (earplugs, muffs) hard hats, respirators and full body suits to minimize exposure to a variety of hazards, b) good quality drinkingwater, and c) sanitation and waste

8.2.19: Increase in HIV/AIDs infections

Provide counseling and testing for HIV/AIDS to incoming construction personnel

Strengthen advocacy through awareness training in HIV/AIDS and other STDs; encourage the use of preventive measures like condoms by availing condom dispensers to construction staff.

8.2.20: Solid wastes

The contractor will ensure well managed waste collection and disposal system by providing a system of collection and storing in separate container/bin/basket. Inorganic wastes will be sold(plastic can, glasses etc.) and will be used as fuel (tree leaf, waste paper, straw etc.).Organic waste will be collected for aerobic composting.

8.3: Mitigation of key impacts during operation phase

The mitigation strategies for key impacts during the operation phase area highlighted below.

8.3.1: Interference of physical cultural resources

The proponent will ensure preservation of the cultural resources as per the provisions of World Bank Physical Cultural Resources: OP/BP 4.11. The policy considers Physical Cultural Resources (PCR) to be resources of archeological, paleontological, historical, architectural, and religious (including graveyards and burial sites), aesthetic or other cultural significance. There is need to ensure that in communities where graves are likely to be affected by the project, these sites are to be avoided as much as possible through consultations with individual home owners before project implementation to enable develop appropriate mitigation measures.

8.3.2: Separation of communities as well as inaccessibility to market centres another social amenities/ services

Fencing of the rail corridor will also lead to a possible separation of communities in the project areas. The project can give provisions for footbridges and flyovers in areas where the railway line cuts through communities to aid in access to amenities on either side of the railway line

8.3.3: Interaction with other cultures

This is due to influx of construction and rail workers. The local communities would slowly acquire practices from the new populations in the area. The community and proponent should therefore develop programmes to enhance cohesion between project employees and the local community.

8.3.4: Interference with livelihoods

Livelihoods will be disrupted since there will destruction of business premises, loss of agricultural land etc. This might lead to increase in crime and impoverishment. The RAP should aim at promoting the participation of displaced people in the resettlement planning and assist displaced persons in their efforts to improve or at least restore their incomes and standards of living after displacement. This is in compliance with the World Bank OP 4.12, which states in part that "*Resettlement plans should be built around a development strategy and a package aimed at improving or at least restoring economic base for those relocated.*" Preference should be given to land-based resettlement strategies for people dislocated from agricultural settings. If suitable land is unavailable, non-land-based strategies built around opportunities for employment or self-employment may be used.

8.3.5: Disruption of socio-economic activities

Socio-economic activities and market centres will be disrupted especially towns and market centres whose economy depends on the long distance trucks and as well as those where the proposed railway line takes a completely different route. KRC should put in place structures to give possibilities of previous truck owners becoming shareholders and even empowered to purchase cargo trains so that they are not pushed out of transport business when the proposed line comes into operation. The proponent should consider employment of locals and considerations in job allocations especially for activities requiring unskilled labor.

8.3.6: Accidents involving wildlife and livestock

Wildlife train collisions are likely to be a challenge and a major negative impact from the SGR infrastructure in wildlife endowed landscapes. Appropriate and effective mitigation measures are needed (especially if railway is on or raised grounds) to mitigate the impacts. Key measures which should be put in place include wildlife crossing structures, habitat alteration to avoid attracting wildlife use, aversion/exclusion systems, reduced train speeds, appropriate signage and vegetation management (i.e. mowing or pruning vegetation that provides forage or cover. Wildlife crossing structures allow wildlife safe passage across railways and are one of the best strategies to reduce collision mortalities and barrier effects for a large number of species. For cargo trains on transit, there is need to ensure they do not spill potential forage substances such as grains on the railway line which might attract wildlife.

Electronic systems to detect and deter animalswill be mounted to the front of trains or installed as stationary systems along railways. Stationary systems are used to exclude wildlife from fenced areas and on bridges using a motion-activated sensor with an audible or visual signal (lights and horns) to frighten animals. However, as with other auditory deterrents, habituation can occur. Other systems use an electrified pad across the train track at breaks in fences, similar to wildlife guards along roads. Improved signals are also needed to combat the tendency of some wildlife to flee down track. Further, there is need to indicate speed limits and reduce speed in wildlife rich landscapes. Where a tunnel is used, there is need fence these landscapes off from wildlife use with the help of professional design engineers.

8.3.7: Flooding, surface run off

Poorly designed drainage systems may trigger flooding which may in turn be a health problem to the communities around the railway line. Well-designed drainage system and re-afforestation of affected catchment areas will minimize such impacts. KRC will require expanding their department to undertake rehabilitation of areas affected.

8.3.8: Ensuring efficient solid waste management

There will be domestic waste from terminals and stations. The proponent will be responsible for efficient management of solid waste generated by the project during its operation. In this regard, the proponent will provide waste handling facilities such as waste bins and skips for temporarily holding waste generated at the sites. In addition, the proponent will ensure that such disposed of regularly and appropriately. An integrated solid waste management system is recommendable. First, the proponent will give priority to Reduction at Source of the materials. Recycling, reuse and compositing of the waste will be the second alternative in priority. This will call for a source separation programme to be put in place. The third priority in the hierarchy of options is combustion of the waste that is not recyclable in order to produce energy. Finally, sanitary land filling will be the last option for the proponent to consider. Passengers should have waste disposal inside the trains. All these measures are aimed at ensuring that SGR does not have a negative harmful impact on wildlife and environment during its operation. The proponent will adhere to the Environmental Management and Coordination (Waste Management), Regulations 2006.

8.3.9: Wastewater Management

The proponent will ensure that there are adequate means for handling sewage generated from site camps. Waste water shall be disposed in compliance with the provisions of the Environmental Management and Coordination (Water Quality), Regulations 2006.

8.3.10: Permanent changes to traffic routes

There will be temporary and permanent changes to traffic circulation due to fencing of the rail corridor. This impact can be minimized by provision of dedicated underpasses/overpasses at strategic locations throughout the line to ensure free movement of people and animals. This will be done in close consultation with KURA, KENHA and KERRA.

8.3.11: Wildlife impacts outside Nairobi National Park

Potential wildlife train collisions are likely a negative impact from the SGR infrastructure in wildlife endowed landscapes if bypasses are not properly established. Appropriate and effective mitigation measures are needed (especially if railway is on or raised grounds) to mitigate the impacts. Key measures which should be put in place include wildlife crossing structures, habitat alteration to avoid attracting wildlife use, aversion/exclusion systems, reduced train speeds and appropriate signage. Vegetation management (i.e. mowing or pruning vegetation that provides forage or cover. Wildlife crossing structures allow wildlife safe passage across railways and are one of the best strategies to reduce collision mortalities and barrier effects for a large number of species. For cargo trains on transit, there is need to ensure they do not spill potential forage substances such as grains on the railway line which might attract wildlife.

Electronic systems to detect and deter animals will be mounted to the front of trains or installed as stationary systems along railways. Stationary systems are used to exclude wildlife from fenced areas and on bridges using a motion-activated sensor with an audible or visual signal (lights and horns) to frighten animals. As with other auditory deterrents, habituation can occur. Other systems use an electrified pad across the train track at breaks in fences, similar to wildlife guards along roads. Improved signals are also needed to combat the tendency of some wildlife to flee down track. Further, there is need to indicate speed limits and reduce speed in wildlife rich landscapes. Where a tunnel is used, these landscapes, there is need fence them off from wildlife use with the help of professional design engineers.

8.4: Environmental Monitoring Plan

Environmental monitoring is an essential component of project implementation. Environmental Monitoring Plan provides mechanism of monitoring environmental impacts of a project during its execution in order to reduce their negative effects and to introduce standards of good practice to be adopted for all project works. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measures proposed in the EMP. The parameters of the proposed railway project identified for monitoring include; vegetation, water quality, air quality, solid waste generation, occupational health and safety risks, wildlife/livestock/human accidents, AIDS/HIV incidence, Soil erosion, resettlement and livelihood and environmental risks/ hazards as represented in **Table 8-1**

Table 8- 1: Environmental Monitoring Plan for the proposed standard gauge railway project

Environmental Component	Impacts/Parameters to be monitored	Points to be monitored	Frequency of Monitoring	Lab Materials and Equipment and Other Requirements	Responsibility	Cost Kshs
Vegetation	Vegetation growth along the rail track right of way to ensure consistence with EMP	Along the railway track	Continuous	Clearing equipment, Camera, field vehicle	Contractor and Kenya Railways Corporation	45,000 per month
Water quality	pH, Conductivity, Total Suspended Solids (TSS) and Total Dissolved Solids (TDS), heavy metals, COD, BOD and oils	Mbagathi River, Ewaso Kedong River and other water points along the railway	Quarterly	Sampling bottles. Access to a NEMA Accredited Laboratory	Contractor and Kenya Railways Corporation	25,000 per quarter
Occupational Health and Safety risks	Safety training for workers, accident reports, number and types of accidents, causes, etc.	Construction Points, Railway stations and terminals	Continuous	Incidents log-book	Contractor and Kenya Railways Corporation	50,000 per month
HIV/AIDs Incidence	Training programmes, number of incidences, numbers of condoms distributed, seminars, participants trained, etc.	Site camps, Construction sites Railway stations and terminals	Quarterly	Office Supplies	Contractor and Kenya Railways Corporation	50,000 per quarter
Soil Erosion	Soils eroded, Turbidity in storm water, sources and causes, etc	Steep slopes along the railway	Continuous	Camera, field vehicle	Contractor and Kenya Railways Corporation	15,000 per month
Air quality	TSP, NOx, SO_2, CO, Dust particles, particulate matter, etc	Railway terminals, stations, construction sites	Continuous during the project cycle	Air sampling equipment	Contractor and Kenya Railways Corporation	25,000 per month
Noise pollution	Levels of pollutions (dBA)	Railway terminals, stations, construction sites	Continuous during the project cycle	Noise measurement equipment	Contractor and Kenya Railways Corporation	35,000per month
Solid Waste Generation	Slag, domestic refuse, metallic scraps, sludge, waste composition, treatment methods, etc.	Construction sites, site camps and all terminals	Monthly	Office Supplies Waste sampling bins/ plastic bags/ boxes Weighing machines	Contractor and Kenya Railways Corporation	20,000 per month
Wildlife	Total number of wildlife accidents, type of animals knocked by the train, locations where the animals are knocked	NNP ,Mt. Longonot and Hell's gate National Park, private Ranches and	Continuous during the project cycle	Accident recording book, Camera, Field vehicle, GIS Machine	Contractor and Kenya Railways Corporation	25,000 per month

Environmental Component	Impacts/Parameters to be monitored	Points to be monitored	Frequency of Monitoring	Lab Materials and Equipment and Other Requirements	Responsibility	Cost Kshs
		Mt. Suswa Conservancy				
Livestock accidents	Number of animal knocked down by the trains, type of animals knocked, locations where they are knocked	Along the railway track right of way outside the protected areas	Continuous during the project cycle	Accident recording book, Camera, Field vehicle, GIS Machine	Contractor and Kenya Railways Corporation	25,000 per month
Resettlement and livelihoods	Number of people resettled, complaints, poverty levels, new livelihood sources, etc.	Affected areas only	During construction and first 5 years after commencem ent of operations	Office supplies	Kenya Railways Corporation	150,000 per month
Environmental Risks/ Hazards	Earthquakes/tremors occurrences, fire outbreaks, rock falls/ mud slides, collision of materials, etc.	Possible hazardous areas only	Continuous during operation stage	Field inspections and information from lead agencies	Kenya Railways Corporation	45,000 per month

9. ENVIRONMENTAL MANAGEMENT PLAN

9.1 Introduction

The aim of the environmental management plan (EMP) is to detail the actions required to effectively implement the mitigation measures identified and recommended in the ESIA. These actions are required to minimize negative impacts and enhance positive impacts associated with the SGR project. The ESMP actions present the commitments made by the proponent, KRC for addressing the impacts of the project. It is important to note that an EMP is a living document since it is to be updated and amended as new information (e.g. environmental data), policies, authority guidelines and technologies develop.

The EMP identifies management actions that need to be implemented in various phases of the mineral processing mining project life cycle as follows:

a) Planning and design phase

Refers to the stage when the feasibility studies are being undertaken, the project description is being developed and the SGR is being designed. During this phase, the ESIA is completed and license is applied for.

b) Construction phase

This will commence after the SGR-IIA constrction license has been issued and KRC has taken the decision to implement the project. The construction phase involves the development and construction of the project infrastructure.

c) Operations

This is the phase during which the SGR will be operated. Operational activities are anticipated to last for 150-200 years.

d) Decommissioning phase

This refers to the time in the mine life when mining operations are reduced in preparation for closure. This phase will occur once the resource has been fully exploited. The phase also refers to the decommissioning of certain sites or areas during the life of the operations.

Using best practices in other parts of the world, the costs of the mitigation measures and of the institutional and training requirements to implement them will be estimated with a ceiling budget of not more than **2.5% of the total project cost(USD.1,482,745,029.43.)**. Compensation to the affected parties to be identified through a Resettlement Action Plan (RAP) for impacts which cannot be mitigated will need to be considered where applicable. A comprehensive work program, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measure will be prepared based on the above budget guideline.

The following EMP has been structured in such a manner to provide a basis for Environmental Management System (EMS) ISO 14001 Principles for the life of the proposed development. It should be further noted that the proposed EMP is not static, as allowance has been made for it to evolve through the life of the project. Such a characteristic is seen to be important to key factors and processes may change through the life of the project. It is therefore necessary to alter proposed mitigation and monitoring methodologies in order to determine best approach to deal with such changes. This EMP include the necessary specialist input to determine, mitigate and manage any environmental impacts that the proposed development may have, relating to bio-physical and socio-economic aspects. During the planning, construction and operation stages, an expert with an environmental training background is expected to provide a continuous technical support throughout the project cycle to ensure full compliance to environmental laws and best practices for similar projects.

The objectives of the ESMP are as follows:

- To ensure that the project will operate in compliance with applicable national environmental legal requirements throughout the full cycle;
- To outline the institutional measures required to prevent, minimize, mitigate and compensate for adverse environmental and social impacts, or to enhance the project beneficial impacts.

- To indicate the key players to be engaged in the various environmental issues associated with the project.

9.2: Management action

The ESMP provides clear environmental management actions to be undertaken throughout the project cycle. Specific objectives are given for each of the actions described in the ESMP. These objectives relate directly to addressing the impacts identified in the ESIA. The various actions that need to be implemented to ensure that environmental objectives are met are described in the ESMP. Each action is given a reference number. The actions are measurable and are therefore are easy to monitor in order to assess compliance with the ESMP.

9.3: Roles and responsibilities

The successful implementation of the ESMP is however dependent on clearly defined roles and responsibilities for each of the management actions given. Roles have to be ascribed to the relevant parties such as the following:

a) Contractor - CCCC
b) SGR proponent &operator – KRC
c) National Land Commission - NLC
d) Other players

9.4: Environmental Management Plan

The necessary objectives, activities, mitigation measures, and allocation of costs and responsibilities pertaining to prevention, minimization and monitoring of significant negative impacts and maximization of positive impacts for the SGR project is provided below for the; a) project planning and design b) construction stage, c) operational stage, and d) decommissioning stage.

9.4.1: PLANNING & DESIGN

REF NO.	OBJECTIVE	MANAGEMENT ACTION	RESPONSIBILITY	TIMEFRAME	REQUIREMENTS FOR IMPLEMENTATION	REFERENCE GUIDELINES/ STANDARD/
1.1 PERMITS AND LICENCES						
1.1.1	To ensure compliance with Kenyan environmental legislative requirements	Apply and obtain all environmental permits and licenses required for the for the SGR project including the following where applicable: • WRMA licenses water abstraction from rivers and ground water • WRMA borehole drilling permits • NEMA waste licenses • NEMA emissions licenses • NEMA effluent discharge license • NEMA license to Emit Noise/ Vibrations in Excess of Permissible Levels • NEMA permit to Emit Noise in Excess • NEMA license to generate hazardous waste • NEMA EIA licenses borrow pits and quarries • KWS permits for access and operations in Nairobi National Park • KFS permits for access and operations in Ngong and Ololua Forest Reserves • Public Health licenses for workplace eating places such as restaurants and kiosks • Workplace health and safety certification • License for disposal/ storage of	Contractor	After authorization to proceed	• Consultation with relevant environmental authorities. • Supporting documentation for permits and licenses.	EMCA 1999

		poisonous substances • Development application • Licensing for public service or operating a vehicle • Licensing for public service vehicles (PSVs) • Licenser for removal and sale of scrap metal • Any other relevant permits				
1.2 RECRUITMENT OF WORKERS						
1.2.1	To promote the employment of local persons.	Undertake a skills audit and develop a database of available skills in the area for use by the SGR project and its contractors.	Contractor	Prior to the commencement of construction	Database of skills availability in the area	Employment Act, 2007
1.2.2	To promote the use of local service providers	Develop a database of local service providers.	Contractor	Prior to the commencement of construction	Database of service providers in the local community	Employment Act, 2007
1.2.3	To manage and control the immigration of work seekers along the SGR route	Develop a recruitment policy and communicate this to the general public.	Contractor	Prior to the commencement of construction	Recruitment Policy Communication Strategy	Employment Act, 2007
1.3DISPLACEMENT &RESETTLEMENT						
1.3.1	To develop an effective plan for displaced people and institutions	Develop a Resettlement Action Plan (RAP)	KRC/ Contractor	Prior to Resettlement	• Collaboration of District & Traditional Authorities • Detailed Census • Valuation of Assets • Calculation of compensation rates • Agreement with Affected Persons	EMCA (1999)
		KRC to provide compensation through	Kenya Railways	Prior to	Agreement with	EMCA (1999)

		the NLC	Corporation (KRC)	Resettlement	Affected Persons	
		Development of a grievance mechanism to address any complains and grievances of displaced and resettled persons	Contractor	Prior to Resettlement	Grievance Mechanism	EMCA (1999)

9.4.2: CONSTRUCTION PHASE

REF NO.	OBJECTIVE	MANAGEMENT ACTION	RESPONSIBILITY	TIMEFRAME	REQUIREMENTS FOR IMPLEMENTATION	REFERENCE GUIDELINES/ STANDARD/
2.1 LAND ACQUISITION AND INVOLUNTARY RESETTLEMENT/DISPLACEMENT OF PERSONS						
2.1.1	To undertake resettlement of displaced people and institutions with minimal grievance	Land transfer agreements will be formalized before the project start as per the laws of the land	Kenya Railways Corporation (KRC)	Prior to the commencement of construction	Route survey and identification of affected property and valuation	Land Adjudication Act, 2010 & National Land Commission Act, 2012 (No. 5 of 2012
		Community mobilization and sensitization will be undertaken through consultative forums along the SGR route in Tuala, Kindisi, Ongata Rongai, Nkoroi, Bulbul, Kimuka, Kamangu, Nachu, Ewaso Kedong, Mai-Mahout, Longonot, Suswa, & Enosupukia	Kenya Railways Corporation (KRC)	Prior to the commencement of construction	Route survey and identification of affected property and valuation	Land Adjudication Act, 2010 & National Land Commission Act, 2012 (No. 5 of 2012
		Resettlement Action Plan (RAP) will be prepared as a guide the resettlement and compensation of the Project Affected Persons in in Tuala, Kindisi, Ongata Rongai, Nkoroi, Bulbul, Kimuka, Kamangu, Nachu, Ewaso Kedong, Mai-mahout, Longonot, Suswa, & Enosupukia	Kenya Railways Corporation (KRC)	Prior to the commencement of construction	Route survey and identification of affected property and valuation	Land Adjudication Act, 2010 & National Land Commission Act, 2012 (No. 5 of 2012
		Proper sensitization of the community	Kenya Railways	Prior to the	Route survey and	Land Adjudication

		will be undertaken at the initial stages of the project about their options and rights pertaining to resettlement	Corporation (KRC)	commencement of construction	identification of affected property and valuation	Act, 2010 & National Land Commission Act, 2012 (No. 5 of 2012
		Prompt and effective compensation will be provided at full replacement cost for losses of assets attributable directly to the project.	Kenya Railways Corporation (KRC)	Prior to the commencement of construction	Route survey and identification of affected property and valuation	Land Adjudication Act, 2010 & National Land Commission Act, 2012 (No. 5 of 2012
		A clear framework will be prepared for property related compensation related grievance management. The framework should describe the process by which people affected can bring their grievances to the company for consideration and redress	Kenya Railways Corporation (KRC)	Prior to the commencement of construction	Route survey and identification of affected property and valuation	Land Adjudication Act, 2010 & National Land Commission Act, 2012 (No. 5 of 2012
2.2 EMPLOYMENT OF WORKERS						
2.2.1	To promote the employment of local persons	Recruitment of local workers will be undertaken without discrimination and in accordance with the CCCC recruitment policy by contractors involved in construction	Contractor	On commencement of construction activities.	Database of local skills available for recruitment	Employment Act, 2007
2.2.2	To promote the use of local service providers	Local procurement of goods and services will be undertaken wherever possible and cost effective and where practicable to the project	Contractor	On commencement of construction activities.	Database of local service providers and suppliers	Employment Act, 2007

2.3 DISRUPTIONS OF PUBLIC UTILITIES						
2.3.1	To ensure minimum public inconvenience during SGR construction across key public utilities	Continuous consultation and involvement of the directly affected stakeholders (DAS) will be undertaken with respect to water, sewerage, pipelines, electricity, old rail, roads, etc., at all stages of the project cycle	Kenya Railways Corporation (KRC)	During project planning phase and throughout construction period	Database of affected public utilities	Feasibility report/EIA report
2.3.2		Integrated approach will be used in planning public utilities by sharing most transport corridors for roads, pipelines, water, sewerage, electricity lines, etc	Kenya Railways Corporation (KRC)	During project planning phase and throughout construction period	EIA report	Feasibility report/ EIA report
2.4 TRAFFIC MANAGEMENT & SAFETY						
2.4.1	To minimize the SGR construction area traffic interference especially in the road and railway crossings	Prepare and engage proper traffic deviation plans in key crossings such as Magadi road in Ongata Rongai, Ngong Rd in Embulbul and Mai-Mahiu-Narok Road (B3) in order to avoid traffic snarl-ups	Contractor/ KRC/Ministry of Transport	Prior to the commencement of construction	Feasibility report	Public Roads and Roads Access Act, 1972
2.4.2	To promote smooth traffic flow and safety during the construction period	Continuation of the implementation of the Public Traffic Safety Awareness Programme	Contractor	Continued from planning phase	Traffic Safety Awareness Programme	Public Roads and Roads Access Act, 1972
		Signage will be put in place along the affected roads	Contractor	On commencement of construction activities	Signage	Public Roads and Roads Access Act, 1972
		Construction drivers to be subjected to public safety awareness	Contractor	On commencement of construction activities	Traffic Safety Awareness Programme	Public Roads and Roads Access Act, 1972
		Continuation of Public Traffic Safety Awareness Programme	Contractor	Continued from planning phase	Road Traffic Safety Awareness Programme	Public Roads and Roads Access Act, 1972
		Reckless and drunk driving by construction workers will be prohibited	Contractor	Continued from planning phase	Road Traffic Safety Awareness	Public Roads and Roads Access

		and monitored and prohibited			Programme	Act, 1972
2.5 SLOPE STABILIZATION AND SOIL PROTECTION						
2.5.1	To ensure soil conservation along the SGR route	For embankment side slope < 3.0m high, hollow bricks with grassesin soil from other places shall be used and shrubs planted for protection	Contractor	Continued from planning phase	Feasibility report	EMCA (1999)
		Incorporate rehabilitation of the slopes measures through grass and tree planting. Alternative is to build concrete embankments	Contractor	Continued from planning phase	Feasibility report	EMCA (1999)
		Topsoil must be reinstated and rehabilitated on top of sub soil	Contractor	Continued from planning phase	Feasibility report	EMCA (1999)
		All excavation works must be properly backfilled and compacted	Contractor	Continued from planning phase	Feasibility report	EMCA (1999)
		Rip compacted areas to reduce runoff and improve re-vegetation where required	Contractor	Continued from planning phase	Feasibility report	EMCA (1999)
		The subgrade excavation and filling of side slope will be protected in a timely To control the water erosion caused by the excavation	Contractor	Continued from planning phase	Feasibility report	EMCA (1999)
2.6 CONSTRUCTION WASTE MANAGEMENT						
2.6.1	To prevent the contamination of soils and water resources due to inappropriate management and disposal of waste	Every camp site and administrative building will be provided with bins directing waste into collection bins	Contractor	On site establishment	Bins for the separation of waste at contractors lay down areas	EMCA (Waste management regulations, 2006)
		Every camp site, and administrative building will be provided with an appropriate effluent treatment system	Contractor	On site establishment	Bins for the separation of waste at contractors lay down areas	EMCA (Waste management regulations, 2006)
		Domestic effluent can be contained by septic tanks, soak-aways, effluent treatment plants (where appropriate volumes justify the measures)	Contractor	On site establishment	Bins for the separation of waste at contractors lay down areas	EMCA (Waste management regulations, 2006)
		Potential contaminated effluent (by oils	Contractor	On site	Bins for the	EMCA (Waste

		and lubricants), will be disposed captured using oil and water and sand filter separators		establishment	separation of waste at contractors lay down areas	management regulations, 2006)
		Soils contaminated with hydrocarbons will be bioremediated or disposed of as hazardous waste.	Contractor	On site establishment	Bio–remediation facilities	EMCA (Waste management regulations, 2006)
		Hazardous and general waste will be separated and removed from site for disposal at recognized waste management facilities as approved by the Contractor	Contractor	As required	Database of the affected sites	EMCA (Waste management regulations, 2006)
		The management of construction solid waste shall adopt the integrated solid waste management system through a hierarchy of options: • Source reduction • Recycling • Composting and reuse • Combustion • Sanitary land filling	Contractor	Throughout the construction stage	Clear instructions and use of proper awareness methods	EMCA (Waste management regulations, 2006)
		Proper disposal including recycling of tunnel disposal dreg for sub-grade construction where the quality is appropriate	Contractor	Tunnel construction	Clear instructions and use of proper awareness methods	EMCA (Waste management regulations, 2006)
		Application of a good strategy to collect, remove and safely dispose of waste on daily basis to ensure a clean environment throughout the SGR route	Contractor	Throughout the construction stage	Clear instructions and use of proper awareness methods	EMCA (Waste management regulations, 2006)
2.7 POLLUTION CONTROL MANAGEMENT						
2.7.1	To contain spillages of hazardous chemicals	All hazardous chemicals including hydrocarbons such as fuel, oils and greases will be contained in bunded areas with sufficient capacity to contain the quantity stored in the	Contractor	On site establishment	Database of the affected sites	EMCA (Controlled substance regulations, 2007)

		bunded area				
		Hazardous chemicals including hydrocarbons are to be handled over impervious surfaces.	Contractor	On site establishment	Impervious surfaces including concrete slabs, drip trays and the like	EMCA (Controlled substance regulations, 2007)
		Proper storage of liquids on site, such as oil, diesel and solvents will be ensured as well as containment of accidental oil spill	Contractor	On site establishment	Impervious surfaces including concrete slabs, drip trays and the like	EMCA (Controlled substance regulations, 2007)
		Proper maintenance of construction vehicles and equipment will be undertaken	Contractor	On site establishment	Impervious surfaces including concrete slabs, drip trays and the like	EMCA (Controlled substance regulations, 2007)
2.7.2	To manage sewage and effluent	Portable chemical toilets will be provided at site offices and in remote areas that are not connected to the sewage treatment works. The portable toilets are to be cleaned on a regular basis	Contractor	On commencement of construction	Location of key construction campsites	EMCA (Waste management regulations
2.7.3	To prevent sedimentation of local streams and wetlands	Storm water diversion berms will be installed in place up gradient of areas from which vegetation has been removed	Contractor	Prior to the rainy season	List of key stream and river crossings	Water Act, 2002
2.7.4	To monitor the impact of construction activities on surface and groundwater water resources.	Monitoring of ground and surface water	Contractor	Continued from Planning Phase	Ground and Surface Water Monitoring Programme	Water Act, 2002

2.8 PROTECTION OF BIODIVERSITY						
2.8.1	To minimize disturbance of valued habitats along the SGR route	Avoid fragmentation or destruction of critical terrestrial and aquatic habitats by siting railway, rail yards, support facilities, and maintenance roads to avoid such locations or by utilizing existing transport corridors whenever possible	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (2009), Environmental (Conservation of biological diversity and resources, and access to genetic resources and benefits sharing) Regulations, 2006, Wildlife Act, 2015
		Minimize clearing of riparian vegetation during construction	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (2009), Environmental (Conservation of biological diversity and resources, and access to genetic resources and benefits sharing) Regulations, 2006, Wildlife Act, 2015
		Ensure proper demarcation and delineation of the project area to be affected by construction works	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (2009), Environmental (Conservation of biological diversity and resources, and access to genetic resources and benefits sharing) Regulations, 2006, Wildlife

						Act, 2015
		Avoid construction worker's camps within protected areas	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (2009), Environmental (Conservation of biological diversity and resources, and access to genetic resources and benefits sharing) Regulations, 2006, Wildlife Act, 2015
		Design and implement an appropriate landscaping programme to help in re-vegetation of affected project areas after construction	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (2009), Environmental (Conservation of biological diversity and resources, and access to genetic resources and benefits sharing) Regulations, 2006, Wildlife Act, 2015
2.8.2	To minimize disturbance to biodiversity especially in Nairobi National Park	Areas from which vegetation is to be removed are to be delineated prior to removal and vegetation is only to be removed from these areas	Contractor	Prior to site clearance	Clear instructions and awareness campaign	EMCA (1999)
2.8.3	To protect sensitive sites, wildlife habitats and wildlife species in Nairobi National Park	Construction activities will only be restricted to a 15-20m SGR corridor in sensitive biodiversity sites including Nairobi National Park, Ngong Forest, Oloua Forest and neighboring environs will be no-go areas	Contractor	Prior to commencement of construction activities	Contractors to be informed of no-go areas and strictly adhere to guidelines of working in such areas	EMCA (1999)
		Fencing of wildlife underpasses or SGR	Contractor	During the	KWS park	Wildlife Act 2015

		viaduct in Nairobi National Park should be minimized to the flyover pillar sites in order to reduce wildlife fall-in and trapping accidents		construction period	management guidelines	
		KWS rangers will be engaged by the contractor on full time basis in order to ensure comprehensive wildlife security during the construction works of the viaduct in NNP	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015
		All construction works will be done during the day only and should stop at 6pm	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015
2.8.4	To ensure the un-interrupted movement of wildlife in Nairobi National Park during the construction phase	If wildlife fencing is used below viaduct to funnel animals, then fencing should tie into the support structures or be close as possible to side slopes, thus providing the widest area for wildlife passage	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015
		Human use and any signs of human presence (e.g., storage of materials) should be minimized around viaducts	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015
		Road construction and operations should be avoided if at all possible underneath viaducts that are adapted for wildlife use. If roads are necessary, they should have low traffic volumes and be placed to one side of the viaduct	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2013
		KWS rangers will be engaged by the contractor on full time basis to ensure comprehensive wildlife security during the construction works of the viaduct in NNP	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015
		All construction works will be done during the day only and should stop at	Contractor	During the construction	KWS park management	Wildlife Act 2015

		6pm		period	guidelines	
2.8.5	To ensure quick recovery and restoration of the NNP SGR viaduct corridor	Early replanting and regular watering of the disturbed SGR corridor with local native vegetation will be undertaken to ensure speedy recovery of the cleared vegetation	Contractor	During the construction period	KWS park management guidelines	EMCA, 1999 & Wildlife Act 2015
		Efforts will be made to re-vegetate the cleared corridor and eventually have fully grown and continuous vegetation communities within and adjacent to the viaduct	Contractor	During the construction period	KWS park management guidelines	EMCA, 1999 & Wildlife Act 2015
		Areas from which vegetation is to be removed are to be delineated prior to removal and vegetation is only to be removed from these areas	Contractor	Prior to site clearance	Clear instructions and awareness campaign	EMCA (1999)
		Surface soil excavated during construction to be placed back on the sub-soil to fast vegetation recovery	Contractor	During the construction period	KWS park management guidelines	EMCA, 1999
2.8.6	To minimize wildlife disturbance through noise pollution in Nairobi National Park	Loading and unloading of construction materials must be soft and careful so to reduce noise emission that may disturb wildlife	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015
		Regular servicing of construction machinery and vehicles	Contractor	During the construction period	Have a machinery and vehicles servicing schedule	EMCA(Noise &vibration control regulations, 2009)
		Avoid any landscape blasting works that may disturb and scarce away wildlife	Contractor	During the construction period	KWS park management guidelines	EMCA(Noise &vibration control regulations, 2009)
		All construction works will be done during the day only and should stop at 6pm	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015

		Workers to observe noise production guidelines to avoid wildlife disturbance	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015
		KWS rangers will be engaged by the contractor on full time basis to ensure adherence to wildlife disturbance guideline s	Contractor	During the construction period	KWS park management guidelines	Wildlife Act 2015
2.8.7	To ensure compensation for loss of wildlife habitats in Nairobi National Park	Application of the Avoid-mitigate-compensate (AMC) principle to compensate for wildlife habitat loss in the NNP by creation of replacement habitat within the wildlife dispersal area	Kenya Railways	Medium term goal for the SGR implementation programme as part of KRC CSR initiative		
2.8.8	To minimize pressure on wood fuel resources along the SGR route	Chopping of wood by persons involved in construction is to be prohibited	Contractor	On commencement of construction activities	Clear instructions and awareness campaign	EMCA (1999)
2.8.9	To minimize the risk of SGR wildlife accidents outside the NNP	Construct bridge and culvert underpasses at strategic points in wildlife rich sections of the SGR such as Tuala, Suswa and the Naivasha Industrial Park area in Olkaria to facilitate traditional wildlife movements	Contractor/KRC	Construction	KWS guidelines	Wildlife Act 2013
2.8.10	To ensure the speedy recovery of the entire SGR corridor	The SGR living areas shall be greened to recover the vegetation after the completion of construction	Contractor/KRC	During the decoration stage	KRC landscaping guidelines	EMCA (1999)
		Restoration of vegetation on both sides of the railway shall be undertaken besides the subgrade protection, water and soil conservation, the landscape, and environmental protection	Contractor/KRC	During the decoration stage	KRC landscaping guidelines	EMCA (1999)
		The restoration program should consider the issues of water	Contractor/KRC	During the decoration	KRC landscaping guidelines	EMCA (1999)

		conservation, environmental greening, aesthetics, and environmental protection		stage		
2.9 INVASIVE SPECIES						
	To prevent the spread of invasive species along the SGR route especially in the NNP wildlife flyover corridor	Screen the construction equipment to avoid the spread of invasive species such as *Nicotiana glauca* and *Prosopis* seeds attached to road construction machinery	Contractor	Prior to entering the project site	KWS guidelines	EMCA (Cap 387), IUCN-GISP guidelines
		Undertake regular monitoring and control of emerging invasive species in collaboration with KWS	Contractor	Prior to entering the project site	KWS guidelines	EMCA (Cap 387), IUCN-GISP guidelines
2.10 WATER REOURCES						
2.10.1	To ensure the conservative use of scarce resources such as water and energy	Installation of water conserving taps that turn-off automatically when water is not being used within the site camps	Contractor	On commencement of construction activities	Clear instructions	EMCA (1999)
		Promote recycling and reuse of water as much as possible	Contractor	On commencement of construction activities	Clear instructions	EMCA (1999)
		Sensitization of staff to conserve water by avoiding unnecessary water use will be undertaken	Contractor	On commencement of construction activities	Clear instructions	EMCA (1999)
2.10.2	To minimize negative impacts on streams and rivers	Undertake proper rehabilitation of disturbed stream-banks and river banks in collaboration with WRMA	Contractor/WRMA	Construction	WRMA guidelines	Water Act (2014)
2.11 AIR QUALITY & DUST MANAGEMENT						
2.11.1	To minimize the entrainment of dust during construction	Regular surface wetting will be implemented on all construction roads and cleared areas to minimize entrainment of dust.	Contractor	On commencement of construction activities	Minimum of 50% control efficiency to be obtained.	EMCA (Air quality regulations, 2008)
		All unnecessary traffic must be limited	Contractor	On	Minimum of 50%	EMCA (Air quality

				commencement of construction activities	control efficiency to be obtained.	regulations, 2008)
		Strict on-site speed controls are to be enforced	Contractor	On commencement of construction activities	Minimum of 50% control efficiency to be obtained.	EMCA (Air quality regulations, 2008)
		All trucks hauling soil, sand and other loose materials shall be covered	Contractor	On commencement of construction activities	Minimum of 50% control efficiency to be obtained.	EMCA (Air quality regulations, 2008)
		NEMA/WHO environmental air emission standards should always prevail controlling black smoke, suspended particles of matter, Sulphur Dioxide, Nitrogen Dioxide and other parameters	Contractor	On commencement of construction activities	Minimum of 50% control efficiency to be obtained.	EMCA (Air quality regulations, 2008)
2.11.2	To monitor the effectiveness of dust management during construction and implement improvements as required	Continuous monitoring of PM10 and dust fallout	Contractor	Commence prior to construction	Dust Monitoring Programme	EMCA (Air quality regulations, 2008)
2.12 NOISE AND VIBRATIONS						
2.12.1	To minimize disturbance of communities due to noise and vibrations	Sensitization of communities on noise and vibrations will be undertaken along the SGR route by the Contractor in collaboration with the local administration	Contractor	Prior to first grinding and crushing event.	Community Consultation	EMCA (Noise & vibration control regulations, 2009)
		Notice to be given to surrounding communities of grinding and crushing events	Contractor /KRC	Prior to first grinding and crushing event. Information Boards	Public notices	EMCA (Noise & vibration control regulations, 2009)

		All generators and heavy duty equipment are to be insulated and /or placed within buildings to minimize the ambient noise levels	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (Noise & vibration control regulations, 2009)
		Loading and unloading of materials must be soft and careful so to reduce noise disturbance to the wildlife	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (Noise & vibration control regulations, 2009)
		The transport road and the time for heavy trucks should be planned carefully. The trucks should stay far enough from or try not to traverse villages to bring down the impact of transport noises on residents	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (Noise & vibration control regulations, 2009)
		Strict measures should be undertaken to minimize loud noise and fierce vibration in sensitive areas such as hospitals, educational institutions, residential areas, places of worship	Contractor	Throughout construction phase	Clear instructions and awareness campaign	EMCA (Noise & vibration control regulations, 2009)

2.13 OCCUPATIONAL HEALTH AND SAFETY						
2.13.1	To ensure healthy and secure environment along the SGR route for all the construction workers	Management must ensure that fire extinguishers are located in strategic and visible places	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
		All vehicles and construction equipment are under control of competent personnel	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
		Adequate facilities for emergency response will be provided at reasonable intervals along the SGR route in order to deal with emergencies	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
		Employees need will be informed on the necessary safety procedures and be competent in the work they are employed to do	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
		All necessary safety regulations must be abided by including building codes and fire practice requirements	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
		Inspection of material and harmonization to the occupational health and safety standards.	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
		Adequate security for workers will be provided during construction	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
		Sensitize workers to operate in teams	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
2.13.2	To establish a proper accident and emergency response strategy	The construction company shall establish an emergency leading group, accident scene command group, an accident treatment group, a guard and defend group, a medical aid group, an environmental monitoring group, a logistics group, an accident	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007

		investigation team				
2.13.3	To ensure maximum safety during the tunnel construction	The use of explosives for each segment shall be strictly controlled and reasonable detonating sequence shall be followed to ensure safety	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
2.14 TUNNEL INTEGRITY, FORTIFICATION & DRAINAGE						
2.14.1	To ensure adequate for fortification against seismic movements	Use of standard reinforcement materials for tunnel construction	Contractor/KeBs/ Department of Geology & Mines	During tunnel construction	Feasibility report	National Building Code
2.14.2	To ensure no tunnel water leakage	Water-roofing and drainage of tunnels shall apply the principle of "comprehensive management based on local conditions through combination of proofing, drainage, cutting and blocking"	Contractor	Throughout construction phase	Occupational health and safety policy	OSHA, 2007
2.14.3	To guarantee the smooth drainage of water inside of the tunnel, avoid that water outside the entrance washes out the tunnel entrance and side upward slope so as to ensure the stability of the tunnel entrance structure	The design of the drainage system for the tunnel entrance abides by the principles of water interception and drainage	Contractor	Tunnel construction		
2.15 SOCIO-ECONOMIC IMPACTS						
2.15.1	To minimize the risk of SGR livestock accidents in livestock grazing and pastoralism areas	Construct bridge and culvert underpasses at strategic points along the livestock production and pastoralism areas such as Nachu, Kimuka, Ewaso Kedong, Suswa, Duka Moja and Nairegia Enkare areas to facilitate easy livestock movements	Contractor/Ministry of Livestock & Fisheries	-	-	-
2.16 PUBLIC HEALTH						
2.16.1	To promote awareness on issues related to STIs and	Continuation of awareness programme on risks associated with STIs and	Contractor /KRC/Ministry of	Continuation from planning	Community Awareness	Public Health Act, 1986/ National

	HIV/AIDS	HIV/AIDS will be undertaken along the SGR route especially close to the key construction camps and market centres	Health	phase HIV/AIDS	Programme	HIV/AIDs Policy'Kenya AIDS strategic framework 2014/2015-2018/2019
		Development and implementation of an awareness programme on risks associated with STIs and HIV/AIDS for construction workforce.	Contractor/KRC/Ministry of Health	On commencement of construction activities HIV/AIDS Construction Workforce Awareness Programme	National HIV/AIDs Policy	Public Health Act, 1986/ National HIV/AIDs Policy' Kenya AIDS strategic framework 2014/2015-2018/2019
		The use of preventive measures like condoms by availing condom dispensers to construction staff will be undertaken	Contractor/KRC/Ministry of Health	On commencement of construction activities HIV/AIDS Construction Workforce Awareness Programme	National HIV/AIDs Policy	Public Health Act, 1986/ National HIV/AIDs Policy' Kenya AIDS strategic framework 2014/2015-2018/2019
2.17 CLIMATE CHANGE CONSIDERATIONS						
2.17.1	To ensure that all the design of SGR structures especially river bridges and drainage culverts are constructed with adequate considerations for higher flood frequency due to climate change	The design of the bridge and culvert has adopted the flood frequency of 1/100	Contractor	Throughout construction phase	Feasibility report	NCCRS (2009)
		Super large bridges (or at least the big ones across large rivers) should have a flood frequency is 1/300	Contractor	Throughout construction phase	Feasibility report	NCCRS (2009)

9.4.3: OPERATIONAL PHASE

REF NO.	OBJECTIVE	MANAGEMENT ACTION	RESPONSIBILITY	TIMEFRAME	REQUIREMENTS FOR IMPLEMENTATION	REFERENCE GUIDELINES/ STANDARD/
3.1 ENVIRONMENTAL POLLUTION						
3.1.1	To avoid environmental pollution through improper solid waste management (SWM) in the SGR stations and also along the SGR corridor	Waste generated in SGR passenger Waiting Rooms in the railway stations is to be separated at source into recyclable and non-recyclable waste	All	SGR operation	Containers for the separation of waste	Environmental (waste management regulations, 2006)
		Provide solid waste handling facilities such as waste bins and skips at the stations and the trains	KRC	SGR operation	KRC policy	Environmental (waste management regulations, 2006)
		Use of an integrated solid waste management system i.e. through a hierarchy of options: - Source reduction - Recycling - Composting and reuse - Combustion - Sanitary land filling	KRC	SGR operation	KRC policy	Environmental (waste management regulations, 2006)
		Ensure that solid waste generated is regularly disposed off appropriately at authorized dumping sites	KRC	SGR operation	KRC policy	Environmental (waste management regulations, 2006)
		Passenger train operators and cleaning contractors to segregate waste in the trains	KRC	SGR operation	KRC policy	Environmental (waste management regulations, 2006)
		Instituting a solid waste recycling	KRC	SGR operation	KRC policy	Environmental

		program for Waste from Passenger Trains and Terminals				(waste management regulations, 2006)
		Waste storage, collection, transportation and disposal as per Waste Management Regulations, 2006	KRC	SGR operation	KRC policy	Environmental (waste management regulations, 2006)
		Recyclable waste is to be re-used on site ore removed for re-use elsewhere.	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Hazardous and general waste is to be separated at source.	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Hazardous waste is to be disposed at the hazardous waste disposal site.	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
3.1.2	To avoid environmental pollution through improper waste effluent management in the SGR stations	Provide adequate and safe means of handling liquid waste at the stations and terminals	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Conduct regular inspections for pipe blockages or damages and fix them appropriately	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Ensure regular monitoring of the sewage discharged from the project stations to ensure that the stipulated sewage/effluent discharge rules and standards are not violated	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Use of ultra-filtration to extend the	KRC	SGR operation	KRC policy	EMCA (waste

		life of washing solutions for aqueous parts or use of alternatives to water cleaning				management regulations, 2006)
		Plumbing connection of floor drains, if any, in maintenance areas to the wastewater collection and treatment system	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Prevention of discharge of industrial wastes to septic systems, drain fields, dry wells, cesspools, pits, or separate storm drains or sewers	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Pretreatment of effluents to reduce contaminant concentrations	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Comply with the provisions of Environmental Management and Co-ordination (Water Quality) Regulations 2006	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
3.1.3	To avoid environmental pollution through improper management of hazardous cargo and waste in the SGR operation	Use of aqueous detergent cleaning solutions or steam cleaning, or use and recycling of aliphatic cleaning solvents (e.g. 140 solvent), for example when removing axle protective coatings or for cleaning of large equipment;	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Use of water-based paints;	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Use of track mats to retain wayside grease and other contaminants;	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Avoiding use of new or replacement	KRC	SGR operation	KRC policy	EMCA (waste

		parts with asbestos containing materials.				management regulations, 2006)
3.1.4	To avoid environmental pollution through oil spillage in the SGR railway stations	Storage tanks and components should meet international standards for structural design integrity and operational performance	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Storage tanks should have appropriate secondary containment	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Secondary containment in rail fueling areas should be appropriate for the size of the railcar, level, curbed, sealed, and draining to a sump connected to a spill retention area.	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		The spill retention area should be equipped with an oil / water separator to allow the routine discharge of collected rainwater	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
		Fueling facilities should develop a formal spill prevention and control plan	KRC	SGR operation	KRC policy	EMCA (waste management regulations, 2006)
3.2 BIODIVERSITY PROTECTION						
3.2.1	To minimize disturbance to wildlife in Nairobi National Park	Acquisition of modern train engines	KRC	Throughout the operation phase	Train engines servicing schedule	EMCA (Noise & vibration control regulations, 2009)
		Monitor use of the SGR viaduct corridor by key wildlife species including their behavior	KWS	As required	Wildlife monitoring plan	Wildlife Act, 2015

		Put up warning signage on both ends of the viaduct for train drivers to deem train lights	KRC	Throughout the operation phase	Put up warning signage on both ends of the viaduct for train drivers to deem their lights	Wildlife Act, 2015
3.2.2	To reduce security risks to wildlife in NNP due to the viaduct	Maintenance of fences and embankments at both ends of the viaduct	KRC& KWS	As required	NNP viaduct maintenance program	Wildlife Act, 2015
3.2.3	To minimize the disturbance of valued habitats along the SGR route	Routine bush control along the SGR route to be restricted within the way leave	KRC	SGR operation	Clear instructions and awareness campaign	EMCA (2009), Environmental (Conservation of biological diversity and resources, and access to genetic resources and benefits sharing) Regulations, 2006, Wildlife Act, 2015
3.2.4	To minimize the night visual impact in the NNP as a result of artificial linear light	Engage a carriageway-lights off in the 6km section over the NNP	KRC	SGR operation	KRC protocol	-
3.3 VISUAL ENVIRONMENTAL IMPACT						
3.3.1	To ensure minimal visual impact in Nairobi National Park	To ensure the viaduct over the park blends with its immediate environs	KRC	Throughout operation phase	KWS park management guidelines	EMCA, 1999
3.3.2	To ensure minimal visual impact in Ngong and Olulua Forests	To maintain the visual integrity of the SGR corridor through the 2 forest	KRC	As required	KFS forest management guideline	EMCA, 1999 & Forest Act, 2005
3.4 INVASIVE SPECIES						
3.4.1	To prevent the spread of invasive species along the SGR route especially in the	Undertake regular monitoring and control of emerging invasive species in collaboration with KWS	KRC	SGR operation	-	EMCA (Cap 387), IUCN-GISP guidelines

	NNP wildlife flyover corridor	Use modern cargo and passenger coaches with low risk of spreading invasive species	KRC	Throughout the operation phase	Invasive species surveillance guidelines augmented with clear instructions and awareness campaign	EMCA 1999 (Cap 387) & IUCN-GISP guidelines

3.5 AIR QUALITY & DUST MANAGEMENT						
3.5.1	To ensure the SGR does not promote air pollution	Use of fuel-efficient and less pollution trains	KRC	SGR operation	KRC policy	EMCA (Air quality regulations, 2008)
		Use of modern, fuel-efficient, low-emission locomotives	KRC	SGR operation	KRC policy	EMCA (Air quality regulations, 2008)
		Maximizing cargo and passenger space utilization within safety standards to minimize specific fuel consumption	KRC	SGR operation	KRC policy	EMCA (Air quality regulations, 2008)
		Optimizing efficiency of passenger comfort functions during service and while parked	KRC	SGR operation	KRC policy	EMCA (Air quality regulations, 2008)
		Air quality monitoring along the viaduct and its immediate environs	KWS and KRC	Annually	Air quality monitoring framework	EMCA (Air quality regulations, 2008), Wildlife Act, 2015 & EMCA, 1999
3.6 NOISE AND VIBRATIONS						
3.6.1	To minimize disturbance of communities due to noise and vibrations	Strengthen control of locomotive whistle noise	KRC	SGR operation	KRC policy	EMCA (Noise & vibration control regulations, 2009)
		Controlling random whistle noise is very positive and effective to better the sound, environment around railway station.	KRC	SGR operation	KRC policy	EMCA (Noise & vibration control regulations, 2009)
3.6.2	To ensure the operation of technology of railway equipment	Use suitable train braking technology, bogie technology tend to reduce wear and tear as well as noise	KRC	SGR operation	KRC policy	EMCA (Noise & vibration control regulations, 2009)
		Ensure the use of the appropriate wheel and rail conditions of the ve hicles and line to reduce the degree of vibration	KRC	SGR operation	KRC policy	EMCA (Noise & vibration control regulations, 2009)

3.6.3	To undertake regular noise & vibration monitoring in the NNP	Noise pollution monitoring along the viaduct and its immediate environs	KWS and KRC	Annually	Noise pollution monitoring framework	EMCA (Noise & vibration control regulations, 2009)
3.7. SOCIO-ECONOMIC IMPACTS						
3.7.1	To minimize the negative socio-economic associated with the transfer of cargo transport through key roads and market centres	Employment of locals and considerations in job allocations especially for activities requiring unskilled labor	KRC	SGR operation		
		Enhancing incentives for major economic activities in the market centres	KRC	SGR operation		
		Re-training of directly affected person into railway related careers	KRC	SGR operation		
		Commissioning of other potential income generating activities along the rail line, e.g. revitalization of large-scale agricultural activities, mining, livestock farming, tourism, etc.	KRC	SGR operation		
		Encourage truck owners to operate their own carriageways in the SGR as an alternative to their current transport business	KRC	SGR operation		
3.7.2	To avoid the separation of communities as well as inaccessibility to market centres and other social amenities/ services	Provisions for foot bridges and flyovers in areas where the railway line cuts through communities to aid in access to amenities on either side of the railway line	Contractor/KRC/ Ministry of transport & Infrastructure Development	SGR operation		
3.8 ENVIRONMENTAL MONITORING						
3.8.1	To monitor and document the impact of the SGR on the state of on regular basis	Undertake regular monitoring on the following according to the recommended environmental monitoring protocol: 1), Groundwater, 2) surface water, 3) air quality, 4)	KRC	Continued from operational phase	Environmental monitoring protocol	EMCA 1999

		noise & vibration				
3.9 ENVIRONMENTAL AUDIT						
3.9.1	To ensure compliance and enforcement of the ESMP planning and design at pre-project phase	Undertake annual environmental audit (EA)	Third party ESIA Consultant (Habitat Planners) in collaboration with KRC	Annually	NEMA approved ESIA report	EMCA 1999

9.4.4: DECOMMISSIONING PHASE

REF. NO.	OBJECTIVE	ACTION	ROLE	TIMEFRAME	REQUIREMENTS FOR IMPLEMENTATION	STANDARD/ GUIDELINES
4.1 PLANNING						
4.1.1	To promote the success of environmental restoration of construction infrastructure including camps, material borrow sites and other installations without negative environmental impact	A detailed closure and rehabilitation plan is to be completed for each site to be decommissioned aimed at minimizing identified environmental risks.	Contractor/ KRC	Prior to the start of rehabilitation	Closure and Rehabilitation	ESIA
4.2 WASTE MANAGEMENT						
4.2.1	To ensure the safe and appropriate disposal of waste generated during decommissioning.	All waste is to be checked for contamination with hazardous material	Contractor/ KRC/ County Director of Environment	Prior to the start of rehabilitation	Closure and Rehabilitation	ESIA/EMCA
		Waste materials are to be separated into salvageable (scrap metal) and non-salvageable materials.	Contractor/ KRC/ County Director of Environment	Prior to the start of rehabilitation	Closure and Rehabilitation	ESIA/EMCA
		Salvageable waste is to be removed from site for recycling.	Contractor/ KRC/ County Director of Environment	Prior to the start of rehabilitation	Closure and Rehabilitation	ESIA/EMCA
		General waste (not contaminated with hazardous substances) is to be disposed at a general waste disposal facility.	Contractor/ County Director of Environment	Prior to the start of rehabilitation	Closure and Rehabilitation	ESIA/EMCA

		Hazardous waste is to be disposed of at a hazardous waste facility.	Contractor/ KRC/ County Director of Environment	Prior to the start of rehabilitation	Closure and Rehabilitation	ESIA/EMCA
4.3 REHABILITATION						
4.3.1	To facilitate successful restoration of land capability of infrastructure areas.	All infrastructures are to be demolished and removed.	Contractor/ County Director of Environment	During rehabilitation	Closure and Rehabilitation	ESIA/EMCA
		All demolished material and a footprint area is to be checked for contamination with hazardous substances and hazardous material to be removed and disposed of as hazardous waste.	Contractor/ KRC/ County Director of Environment	During rehabilitation	Closure and Rehabilitation	ESIA/EMCA

9.5: Conclusion and Recommendation

9.5.1 Conclusion

The proposed Nairobi South Station-Naivasha Industrial Park – Enoosupukia through Route Option 4 over the Nairobi National Park is one of Kenya's Vision 2030 flagship projects which will contribute significantly to the different sectors in all pillars either directly or indirectly. The SGR construction and operation will contribute positively in enhancing the transport system in the country and the East African Region at large and thus help propel Kenya to a middle-income country as envisioned in Vision 2030. It will influence all the pillars directly, indirectly or induce economic benefits. Economic estimates project that the development of the SGR is expected to add up to 1.5 per cent to GDP by influencing the Vision 2030 pillars directly or indirectly. The project is compliant with Kenya National Transport Policy – Moving a Working Nation (2009) whose vision for the railway sector is to provide efficient, reliable, safe and secure railway transport services that are integrated with national and regional railway, road, water, pipeline and air transport services for the transportation of goods and passengers on a sustainable and competitive basis". The project is in line with the East Africa Railways Master plan (2009)whose goal is to rejuvenate existing railways serving Tanzania , Kenya , Uganda and extending them initially to Rwanda and Burundi and eventually to South Sudan , Ethiopia and beyond. It will play an important role in strengthening cooperation among EAC member states and promote national and regional economic development. Further, it is part of the Northern Corridor Infrastructure Master Plan which was developed for the five Northern Corridor Transit Agreement (NCTA) member countries: Kenya, Uganda, Rwanda, Burundi and the Democratic Republic of Congo (DRC).

In addition, the SGR project will significantly reduce congestion and enhance the volumes that will be handled at the port of Mombasa thus spurring intra-country and regional trade. For instance, currently, the completed cargo handling capacity at Mombasa port is about 25 million tonnes/year. It is predicted that upon the completion of the project, the cargo handling capacity at Mombasa port will almost double to 44 million tonnes/year in 2025; 55.6 million tonnes/year in 2030; and 67.46 million tonnes in 2040. This will help securing the port as a preferred facility in the region. It will reduce road congestion, number of accidents and maintenance cost in the Northern Transport Corridor

The SGR-IIA will connect well with the Ongata Rongai and Ngong Nairobi Metropolitan Region (NMR) Mass Rapid Transit System (MRTS) hubs as envisaged in the integrated Urban Development Master Plan for the City of Nairobi (NIUPLAN, 2014) also commonly known as theNairobi Master Plan (2015) prepared by Nairobi City County government. It will connect well with the urban bus road network including the busy Langata and Ngong Roads. The railway project will also link up with a number of key transport nodes such as Ongata Rongai and Ngong to the west of south west of the CBD.

The SGR project will tranverse and spur economic development in 5 different counties, namely, Nairobi, Kajiado, Kiambu, Nakuru and Narok where it will significantly expand the exisiting railway network and introduce a total of twelve new stations including five (5) in Kajiado County, namely Tuala Station (DK12=150), Ongata Rongai Station (DK20+800), Ngong South Station (DK31+900) and Ngong West Station (DK41+550), one in Kiambu County namely Nanju Station (DK51+850), two in Nakuru County, namely Mai Mahiu Station (DK74+600) Mai-Mahiu West Station (DK86+500) and three in Narok County, namely Suswa Station (DK99+400) Oloshaiki Station (DK110+500) and Enosupukia Station (DK110+500) which will also be the terminating point for the SGR-IIA.

The SGR-IIA will generate employment opportunities for both skilled and semi-skilled workers resulting directly from the construction and maintenance of the SGR-Line and from transport of passengers and freight. There SGR construction will also generate indirect employment opportunities for people who will be supplying construction materials to the site. The operation phase of the SGR will enhance the transport system in the country, which will also ease freight haulage on Kenyan roads. This will make transportation of people, goods and services cheaper, more efficient and safer. Projections are indicating that transport costs will reduce by up to 40%. This will in turn spur industrial growth through establishment of new industries to serve the railway.

The crossing of the SGR-IIA over the Nairobi National Park through a 6km corridor will not have highly significant adverse environment impacts because the railway will cross through a well designed viaduct or flyover with sufficient underpass for wildlife movements in the park. The construction of the SGR over the park will adopt proper mitigation measures which have been identified in close consultation with KWS in order to avoid negative impacts on the world famous national park. Proper mitigation measures have also been recommended for the long term operation of the SGR over the national park as indicated in section 8 of this ESIA report.

9.5.2 Recommendation

The project construction aims to improve the inter-country transportation status in East Africa, so as to form a modern railway network covering most countries in East Africa. The project implementation will promote the regional economic and trade development, support the national economic development in Kenya, and facilitate the regional economy to better and faster development along the Line. Meanwhile, it is significant to enhance the radiating capacity of regional trunk railway, take full advantage of the master channel function of railway and improve the flexibility of railway transport.

This Project is feasible with a perspective of social economic evaluation, financial evaluation and environmental assessment, which has stable economic benefit and strong anti-risk capacity. The study of alternative planning shows this project is indispensable. Therefore, the project is necessary, and should be implemented as soon as possible. Given the magnitude and complexity of the project, a comprehensive Environmental Management Plan (EMP) has been developed of which the proponent will implement to ensure minimal damage to the environment. Key issues that are conditional to full realization of the goals of the project is to ensure a professional Resettlement Action Plan is prepared and implemented fully and alternative urban and rural livelihood strategies are initiated for affected people along the route. We therefore, recommend the project for NEMA approval because of its enormous contribution to achievements of Kenya's Vision 2030 goals.

In view of the findings of the ESIA, the proposed project is considered as environmentally sound. Further, the project proponent is willing to guarantee that the potential adverse impacts whose means of mitigation have been disclosed in this report and most of them have already been incorporated in the project design will be effectively implemented. On the basis of these findings, it is recommended that the proposed plan of constructing the SGR Phase 2 be approved based on **Route Option** 4 and the willingness by the proponent to implement the proposed project in strict adherence to the Environmental and Social Management Plan (ESMP) and Environmental Monitoring Plan. Further, NEMA should issue the proponent with an EIA license as required by Kenya's environmental laws.

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ANNEXES: SCHEDULE I

Annex A: Habitat Plannersprofile and practicing documents
Annex B: SGR Bill of Quantities

ANNEXES-SCHEDULE II

Annex C: Public notices for public consultation meetings
Annex D: Lists of attendance for public consultation meetings
Annex E: Minutes of the public consultation meetings
Annex F: Public participation questionnaires
Annex G: EIACorrespondences and memoranda