ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY REPORT FOR THE PROPOSED MOMBASA-NAIROBI STANDARD GAUGE RAILWAY PROJECT

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OCTOBER 2012

SUBMISSION OF DOCUMENTATION

I, **Prof. Jacob K. Kibwage** on behalf of Africa Waste and Environment Management Centre (AWEMAC) submit the following Environmental and Social Impact Assessment Study Report for the **Proposed Mombasa – Nairobi Standard Gauge Railway Project.** To my knowledge, all information contained in this report is accurate and a truthful representation of all findings as relating to the proposed project.

Signed at **NAIROBI** on this ……. day of **October 2012.**

Signature: ……..

Designation: **Lead Environmental Consultant**

SUBMISSION OF DOCUMENTATION

I, ……....., on behalf of **China Road and Bridge Corporation (Contractor)** and **Kenya Railways Corporation(Proponent)** submit this Environmental and Social Impact Assessment Study Report for the **Proposed Mombasa – Nairobi Standard Gauge Railway Project** . To my knowledge, all information contained in this report is accurate and a truthful representation of all findings as relating to the proposed project.

Signed at **NAIROBI** on this……day of **October 2012**

Signature……...

Designation: ……..

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSSMENT STUDY REPORT FOR THE PROPOSED STANDARD GAUGE RAILWAY DEVELOPMENT PROJECT

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ACRONYMS

ASALs	Arid and Semi-arid Lands
AWEMAC	Africa Waste and Environment Management Centre
CITES	Convention on International Trade in Endangered Species
CO_2	Carbon Dioxide
CPP	Consultation and Public Participation
CRBC	China Roads and Bridges Corporation
CRP	Compensation and Relocation Plan
CSR	Corporate Social Responsibility
CTC	Centralized Traffic Control
CWTL	Central Water Testing Laboratories
DRC	Democratic Republic of Congo
DRSRS	Department of Resource Surveys and Remote sensing
EA	Environmental Audit
EAC	East African Community
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Co-ordination Act
EMP	Environmental Management Plan
EMS	Environmental Management System
ERS	Economic Recovery Strategy
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GOK	Government of Kenya
GPS	Geographical Positioning System
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICD	Internal Container Deport
IFC	International Finance Corporation
ILO	International Labour Organization
IUCN	International Union for Conservation of Nature
JKIA	Jomo Kenyatta Intenational Airport
KAA	Kenya Airports Authority
KAM	Kenya Association of Manufacturers
KARI	Kenya Agricultural Research Institute
KBS	Kenya Bureau of Standards
KCAA	Kenya Civil Aviation Authority
KEFRI	Kenya Forestry Research Institute
KENHA	Kenya Highways Authority
KeRRA	Kenya Rural Roads Authority
KETRACO	Kenya Electricity Transmission Company Ltd.
KFS	Kenya Forest Service
KM	Kilometre

KMFRI	Kenya Marine and Fisheries Research Institute
KPA	Kenya Port Authority
KPC	Kenya Pipeline Company
KPLC	Kenya Power and Lighting Company
KRC	Kenya Railways Corporation
KRP	Kenya Railway Police
KURA	Kenya Urban Roads Authority
KVA	Kilo Volts Amperes
KWS	Kenya Wildlife Service
M & E	Monitoring and Evaluation
MIA	Mombasa International Airport
MIS	Management Information System
MOF	Ministry of Finance
MOT	Ministry of Transport
MOU	Memorandum of Understanding
NEAP	National Environment Action Plan
NEC	National Environmental Council
NEMA	National Environment Management Authority
NGOs	Non-Governmental Organizations
NMCS	Nairobi Metropolitan Commuter Services
NMK	National Museums of Kenya
NO^x	Nitrogen Oxides
NRM	Nairobi Railway Museum
OSHA	Occupational Safety and Health Administration
PAP	Project Affected People
PAPs	Project Affected Persons
PCB	Polychlorinated biphenyls
PCR	Physical Cultural Resources
PD	Public Disclosure
PIC	Prior Informed Consent
PM	particulate matter
PPG (E)	Personal Protective Gear (Equipment)
PPM	Parts Per Million
PPP	Public Private Partnerships
PTC	Positive Train Control
PVC	Polyvinylchloride
RAP	Relocation Action Plan
RDSO	Research Design and Standards Organization
RTI	Railway Training Institute
RVR	Rift Valley Railways
RVR	Rift Valley Railways Ltd
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
UAE	United Arab Emirates
UK	United Kingdom
UNAIDS	United Nations and AIDS
USA	United States of America
USDA	United States Department of Agriculture
VAT	Value Added Tax
VCT	Voluntary Counseling and Testing
WHO	World Health Organization
WRMA	Water Resources Management Authority

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Background and Rationale for an Environmental Assessment

The proposed Mombasa-Nairobi Standard Gauge Railway Project is the most important railway channel in Kenya, which links the coastal city of Mombasa and the capital city of Nairobi. The railway starts from the city of Mombasa, which is the largest port in East Africa, and ends in Nairobi, the political, economic and cultural centre in Kenya and a key traffic hub in East Africa. The proposed railway line passes through eight (8) Counties: Mombasa, Kilifi, Kwale, Taita-Taveta, Makueni, Kajiado, Machakos and Nairobi. It has a total length of 485.303km consisting of 33 yards/terminals. The study years of the project include the short-term in 2023 and the long-term in 2028.

The existing railway links the coastal city of Mombasa in Kenya and Kampala the capital city of Uganda, which was the only railway in East Africa at that time. Over so many years, because of serious aging of equipment and usage of the old meter gauge, this railway is in very poor conditions. Therefore, East African Community (EAC) five member states, Ethiopia and Sudan plan to construct more than 10 new railways in this region in 12 years in order to form a modern railway network to promote regional economic growth. Large amounts of container freights that arrive at the Port of Mombasa by sea have to be transferred by road to Uganda, Rwanda, Burundi, South Sudan and other destinations, not only causing huge pressure to Kenyan road system, but also increasing the freight cost, as well as causing negative impacts to the development of regional trade. The existing rail system has also negative environmental, health and safety issues.

This proposed Standard Gauge Railway Project is one of the Kenya's Vision 2030 flagship projects that will play an important role in strengthening cooperation among EAC member states and promote regional economic development. It is an important measure for improving Kenyan transportation network, and an important means to save resources and protect the environment.

Kenya Government policy on such projects, programmes or activities requires that an EIA be carried out at the planning stages of the proposed undertaking to ensure that significant impacts on the environment are taken into consideration during the detailed design, construction, operation and decommissioning stages. Since environmental concerns now need to be part of the planning and development process and not an afterthought, and in compliance with the law so as to avoid unnecessary conflicts that retard development in the country, the proponent undertook this ESIA and incorporated environmental concerns as required.

Project Description

The proposed project covers the proposed main line of Mombasa-Nairobi Standard Gauge Railway from the Mombasa Changamwe marshaling station to the Nairobi Embakasi marshaling station, as well as the Mombasa Port demurrage line. Generally, the proposed new Line is within the existing Mombasa-Nairobi transport corridor or parallel to the existing corridor. In some areas, it deviates from the existing line in

order to attain a relatively straight alignment which will enhance train speed. The proposed railway line passes through eight (8) Counties: Mombasa, Kilifi, Kwale, Taita-Taveta, Makueni, Kajiado, Machakos and Nairobi. It will pass through 31 urban centres/ towns. It has a total length of 485.303km consisting of 33 yards/terminals. The length of section subgrade will be 427.377 km; 98 large and medium bridges; 969 culverts (2 culverts per kilometer); 77 overpasses across road (highway). The rail line route generally runs parallel to the Mombasa-Nairobi Road, also commonly referred to as No. A109 Highway which is 482km. The design is for 4 and 6 Passenger Locomotives for short and long terms, respectively. It will also accommodate, 56 and 100 Freight Locomotives for short and long terms, respectively.

The main technical standards for proposed railway are as summarized in table 1 below.

Table 1: Main Technical Standards for the Railway 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‰ (15‰ in difficult section)
5.	Minimum radius of curve	1200m (800m in difficult sections)
6.	Axle weight	25t
7.	Load specification	Double stacked container
8.	Freight vehicle	DF_{8B}
9.	Maximum speed of freight vehicle	80kM/h
10.	Maximum speed of passenger car	120kM/h
11.	Passenger car	DF_{4D}
12.	Type of traction	Diesel traction
13.	Tractive tonnage	4000t
14.	Effective length of arrival-departure track	880m

As for Line, the freight volume forecasted is 12.7 mt/yr in the short term (2023) and 21.64 mt/yr in long term (2028). The estimated construction period is 60 months (5 years), starting from 1st July 2013 to 31st June, 2018.

The horizontal location of the Line is mainly controlled and influenced by the track connection stations, topography of village, railway, highway, urban planning, special geology, water resource facilities, natural reserve, etc. along the Line. The Line will also intersect with other urban roads for many times which will be merged, altered or diverted. In terms of safety facilities for railway line, the Line is designed to be a National Class I railway. The whole corridor will also be characterized by a guard fence made of reinforced concrete, composed of columns and metal meshes and will be 1.8m high. At Tsavo National Park, the fence design will be modified to fit the requirements of Kenya Wildlife service (KWS) standards in order to control the

crossing of wild animals especially the elephants, giraffes and buffalos. The line has generally been detoured away from natural reserves and wildlife areas.

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, saline soil subgrade, swelling soil subgrade, black cotton soil subgrade, impervious embankment protection, etc.

The KRC and the contractor (CRBC) 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 recent feasibility study report by CRBC. A participatory Resettlement Action Plan (RAP) will be developed and executed professionally to ensure to reduce conflicts and ensure project sustainability.

Other operational and support facilities include maintenance & assembly workshops, shed for shunting locomotive, staff living quarters at each of the stations, general office buildings, canteens, bathrooms and other sanitary facilities, water Supply, 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 Line shall be made up 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. Nine (9) 33kV distribution substations will be additionally set up for the power supply for continuous power line.

Project justification

The existing railway network built in 1891 is in poor operations due to serious aging of equipment, usage of the old meter gauge, unreliability and long turn round trips, poor infrastructure and outdated technology i.e. basic manual engineering characteristics and geometrics limiting axle loads, speed and train capacity. Therefore, large amounts of container freights that arrive in Port of Mombasa by sea have to be transferred by roadway to Uganda, Rwanda, Burundi, South Sudan and other destinations within the country. This situation not only cause huge pressure to Kenya road system, but also increasing the freight cost, as well as causing impact to the development of regional trade. According to 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. The current railway being operated by Rift Valley Railways (RVR) can only handle about 6% of the cargo from the Mombasa Port(approximately 13 mt per year). The rest (94%) has to be hauled by road which is unsustainable in the long run as the cargo volumes increase.

According to the present planning, after completion, the Mombasa- Nairobi railway will connect to South Sudan, Rwanda, Burundi and Congo of the East African railway

network planning, to form a regional railway network. Thus, this Project is a key skeleton line of East African railway networks.
The proposed Standard Gauge Railway Project is one of the Kenya's Vision 2030 flagship projects that will play an important role in strengthening cooperation among EAC member states and promote regional economic development. It is an important measure for improving Kenyan transportation network, and an important means to save resources and protect environment. Therefore, the project is a necessity.

Project Cost and Period

As per the MOU on the Construction of Mombasa-Nairobi Railway System that was signed between China Road and Bridge Corporation (CRBC) and Ministry of Transport, Republic of Kenya (MOT), the estimated project cost is **USD 4billion.** The estimated total amount excludes the following expenses: Land acquisition, demolition cost and relevant expense; VAT, Duty and relevant tax; Financing, loan interest and relevant expense; and other expenses in need of Kenya government's entrustment. The project period is five years (2012/2013-2018). The total investment of this project includes: Fixed asset investment (civil works) and locomotive acquisition.

Objectives and Scope for ESIA

Africa Waste and Environment Management Centre (AWEMAC) a NEMA- registered firm of experts was appointed as a Consultant to conduct the Environmental and Social Impact Assessment (ESIA) of the proposed Mombasa – Nairobi Standard Gauge Railway Project. The scope of the assessment covered the project site, surrounding and the utilities proposed. The output of this work was a comprehensive ESIA report for the purposes of applying for an EIA licence.

The consultant on behalf of the proponent conducted the ESIA study by incorporating but not limited to the following terms of reference: -

- The baseline environmental conditions of track alignment area
- Description of the proposed standard gauge railway project,
- Provisions of the relevant environmental laws
- Identification and discussion of any adverse negative impacts to the environment anticipated from the proposed project,
- Propose appropriate mitigation measures,
- Provision of an Environmental Management Plan (EMP).

Methodology Outline

Given the magnitude and nature of the proposed railway project, a full ESIA study was opted to ensure comprehensiveness and completeness of the assessment. The general steps followed during the assessment were as follows:

- Environment screening, in which the proposed standard gauge railway project was identified as among those requiring EIA under schedule 2 of EMCA, 1999.
- Environmental scoping that provided the key environmental issues
- Desktop studies and interviews

- Physical inspection and assessment of the railway track alignment from its starting point Mombasa to the end point at Embakasi terminal Nairobi.
- ESIA Experts team technical consultative meetings
- ESIA public meetings of the stakeholders and affected people
- ESIA Public participation via the use of questionnaires and interviews
- Reporting.

Positive Environmental and Social Impacts anticipated from the proposed project

The proposed project will come along with numerous positive impacts as exhaustively discussed within the report. The positive environmental impacts during construction and operation activities include:-

- Creation of employment opportunities for construction and operation crew
- Creation of faster means of transport for bulk cargo from the ports.
- Decongestion at the Port of Mombasa
- Increased business opportunities for small and medium -scale traders such as hotel and shop owners, food vendors, etc.
- Increased regional trade
- Reduced pressure on the road system
- Reduced risk of accidents on the roads
- Contribution of revenue to the county, national and regional governments
- Emergence of new towns such as Konza Technology City
- Reduction of HIV/AIDS along the Mombasa –Nairobi Highway
- Revitalization of large-scale agricultural production in rural areas along the new route.
- Improved tourism
- Development of other sectors of the economy especially mining and construction due to reduced goods transportation costs

Negative Environmental and Social Impacts anticipated from the proposed project.

The key negative impacts and proposed mitigation measures for the project are summarized in Table 2 below:-

Table 2: Summary of Negative Environmental and Social Impacts and Mitigation Measures

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 and other loose materials • Provide dust screen where necessary
Increase in	• Provide VCT services among construction workers and surrounding

Possible Impacts	Mitigation measures
HIV/AIDs and STDs infection incidence during construction	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) to 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 at all disturbed areas • Avoid fragmentation or destruction of critical terrestrial and aquatic habitats. • Construction of bridges to span at-risk areas (e.g. wetlands) • Minimize the clearing of riparian 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 Control Regulations • Avoid exposure to Diesel Exhausts • 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, Level 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, etc
Disruption of livelihoods, loss of jobs and businesses for people depending on the	• Employment of locals and considerations in job allocations especially for activities requiring unskilled labor • Training in emerging job opportunities and requirements in the new railway system • Commissioning of other potential income generating activities along the

Possible Impacts	Mitigation measures
long-distance road trucks	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 wastes 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 • Maintain 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

Recommended Actions

- 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 environmental conditions need to be done systematically to ensure 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 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 to re-invest the revenue from the 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.

- Government to support current truck owners to transfer their business and clients to the railway system.

Conclusions

The current railway system is constrained in its operations. This has resulted in the congestion of Mombasa Port and the road system leading to damage to the road network in the region, increased road accidents, loss of regional trade opportunities, high transportation and maintenance costs. Implementing the proposed project will address this problem and further stir economic development and growth in Kenya and the region at large. The construction of the new railway will impact positively on the area lying on the transport corridor from Mombasa-Nairobi.

There are serious and unique negative impacts on the environment associated with the construction of the railway. The impacts which have been identified by this study are those that are manageable through the adoption of the mitigating measures that have been listed in this report. Exhaustive consultation with all the major stakeholders holds the key to the acceleration and successful completion of the project. Being a Vision 2030 flagship project and its expected positive benefits, the project is highly recommended for NEMA approval.

1.0 INTRODUCTION

1.1 Background of the Project

The Kenya Railways Corporation (KRC) is a wholly owned public enterprise 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 within Kenya of rail and inland waterways transport services and inland port facilities. The Corporation is also regulated under the State Corporations Act (Cap 486). The Act 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 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 Metre Gauge track. The railway line runs across from the coast of Mombasa to Malaba with principal branch lines connecting Nakuru-Kisumu, Nairobi-Nanyuki, Kisumu-Butere, Eldoret-Kitale, Gilgil-Nyahururu, Voi-Moshi and Konza-Magadi. KRC has its headquarters in Nairobi (see Plate 1: below) with wide spread assets worth billions in major towns in the country.

Plate 1: Kenya Railways Corporation Headquarters in Nairobi City

The existing railway links the coastal city of Mombasa in Kenya and Kampala the capital city of Uganda, which was the only railway in East Africa at that time. Over so many years, because of serious aging of equipment and usage of the old meter gauge, this railway is in very poor conditions. Therefore, East African Community (EAC) five member states, Ethiopia and Sudan plan to construct more than 10 new railways in this region in 12 years in order to form a modern railway network to promote regional economic growth. Large amounts of container freights that arrive at the Port

of Mombasa by sea have to be transferred by road to Uganda, Rwanda, Burundi, South Sudan and other destinations, not only causing huge pressure to Kenyan road system, but also increasing the freight cost, as well as causing negative impact to the development of regional trade. The existing rail system has also negative environmental, health and safety issues.

The proposed Mombasa-Nairobi Standard Gauge Railway Project is the most important railway channel in Kenya, which links the coastal city of Mombasa and the capital city of Nairobi. The railway starts from the city of Mombasa, which is the largest port in East Africa, and ends in Nairobi, the political, economic and cultural centre in Kenya and a key traffic hub in East Africa. The proposed railway line passes through Mombasa, Kilifi, Kwale, Taita-Taveta, Makueni, Kajiado, Machakos and Nairobi Counties. It has a total length of 485.303km consisting of 33 yards/terminals. The study years of the project include the short-term in 2023 and the long-term in 2028.

1.2 Project justification

The existing railway network built in 1891 is in poor operations due to serious aging of equipment, usage of the old meter gauge, unreliability and long turn round trips, poor infrastructure and outdated technology i.e. basic manual engineering characteristics and geometrics limiting axle loads, speed and train capacity. Therefore, large amounts of container freights that arrive in Port of Mombasa by sea have to be transferred by roadway to Uganda, Rwanda, Burundi, South Sudan and other destinations within the country. This situation not only cause huge pressure to Kenya road system, but also increasing the freight cost, as well as causing impact to the development of regional trade. According to 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. The current railway being operated by Rift Valley Railways (RVR) can only handle about 6% of the cargo from the Mombasa Port (approximately 13 mt per year). The rest (94%) has to be hauled by road which is unsustainable in the long run as the cargo volumes increase.

According to the present planning, after completion, the Mombasa- Nairobi railway will connect to South Sudan, Rwanda, Burundi and Congo of the East African railway network planning, to form a regional railway network. Thus, this Project is a key skeleton line of East African railway networks. Kenya Economic Survey of 2011 highlights indicated that revenue earned from cargo transportation in the railway subsector decreased from KSh 4.3 billion in 2009 to KSh 4.1 billion in 2010. Therefore, operations restructuring and infrastructure improvement of the sector is inevitable in order to realize increased revenue.

The proposed Standard Gauge Railway Project is one of the Kenya's Vision 2030 flagship projects that will play an important role in strengthening cooperation among EAC member states and promote regional economic development. It is an important measure for improving Kenyan transportation network, and an important means to save resources and protect environment. Therefore, the project is a necessity.

1.3 ESIA process and Scope of the Report

EIA is a tool for environmental conservation and has been identified as a key component in new project implementation. According to section 58 of the Environmental Management and Coordination Act (EMCA) No.8 of 1999 second schedule 9 (1), and Environmental (Impact Assessment and Audit) regulation, 2003, new projects must undergo ESIA. The report of the same must be submitted to National Environment Management Authority (NEMA) for approval and issuance of relevant certificates. Since environmental concerns now need to be part of the planning and development process and not an afterthought and in compliance with the law so as to avoid unnecessary conflicts that retard development in the country, the proponent undertook this ESIA and incorporated environmental concerns as required.

This ESIA Report is submitted to the National Environment Management Authority (NEMA) under the Environmental Management and Coordination Act (EMCA) No.8 of 1999 Second Schedule 9 (1), and Environmental (Impact Assessment and Audit) regulation, 2003. The regulations states that all new development projects, programs or activities requires that an ESIA be carried out at the planning stage of the proposed undertaking to ensure that significant impacts on the environment are taken into consideration during the construction, operation and decommissioning of the facility.

The ESIA report provides information on the nature and extent of environmental and social impacts arising from the Pre-construction, construction and operational phases of the project and their related activities. The purpose of the ESIA study is to determine the acceptability of the standard gauge railway in terms of any adverse environmental impacts that may arise, provide mitigation requirements for the control of construction and operational consequences in the detailed design and determine the acceptability of any residual impacts after the application of mitigation measures. The scope of the ESIA, therefore, covered:

- The baseline environmental conditions along the proposed railway line
- Description of the proposed project,
- Provisions of the relevant environmental laws
- Identification and discussion of any adverse negative impacts to the environment anticipated from the proposed project,
- Appropriate mitigation measures,
- Provision of an environmental management plan outline.

1.4 Terms of Reference (TOR) for the ESIA Process

Africa Waste and Environment Management Centre (AWEMAC) a registered Firm of Experts was appointed as the consultant to conduct the ESIA of the proposed railway construction project. The scope of the assessment covered the project site, surrounding and the utilities under the project. The output of this work is a comprehensive ESIA study report for the purposes of applying for an EIA licence.

It was recognised this form of development is likely to impact on the existing railway track and the surrounding environment hence, before commencement of any work, there was need to carry out an ESIA in compliance with the Environmental

Management and Coordination Act (EMCA) of 1999 and Environmental Impact Assessment/Audit Regulations of 2003.

The ESIA Study 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 appropriate measures to ensure co-existence of the proposed development with other social and economic activities in the railway line are provided as part of Environmental Management Action Plan.

The consultant on behalf of the proponent conducted the assessment by incorporating the following terms of reference: -

- Description of the proposed standard gauge railway project
- A concise description of the national environmental legislative and regulatory framework, baseline information, and any other relevant information related to the project.
- The objectives of 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.
- A description of the potentially affected environment.
- 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.
- Recommendation of a specific and environmentally sound and affordable waste management system.
- Analysis of alternatives including project site, design and technologies.
- An 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.
- Provide a monitoring plan for the prevention and management of the foreseeable accidents and hazardous activities in the cause of carrying out development activities.
- Propose 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.
- An identification of gaps in knowledge and uncertainties which were encountered in compiling the information.
- An economic and social analysis of the project.
- Such other matters as the Authority required.

1.5 Data Collection Procedures

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 (section 31-41) of the Environmental (Impact Assessment and Audit) Regulations, 2003. Data collections tools can be referred into the Appendix of this report.

1.6 Methodology Outline

The exercise was conducted through desk studies and field work. Before the field work, specific areas were identified for subsequent site visits. These included areas where major operations and work components would take place during construction and operation as a result of the proposed line. Such areas were; the port of Mombasa, proposed marshalling yards, Internal Container Deport, major stations, bridge location areas and flood prone zones. After making observations, expert judgment and conducting interviews, identified impacts were recorded for further evaluation. In many sections of this study, the existing rail operations and layout was used to inform the study.

A review of geotechnical reports, 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 a GPS for the various teams for easier navigation to these sites prior to visiting the sites.

The general steps followed during the assessment were as follows:

- Environment screening, in which the project was identified as among those requiring ESIA under schedule 2 of EMCA, 1999
- Environmental scooping that provided the key environmental issues
- Desk Stop studies and interviews
- Physical inspection of the site and surrounding areas
- Reporting.

1.7 Environmental Screening and Scoping

This step was applied 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. Issues considered included the physical location, sensitive issues and nature of anticipated impacts.

The Scoping process helped narrow down onto the most critical issues requiring attention during the assessment. Environmental issues were categorized into physical, natural/ecological and social, economic and cultural aspects.

1.8 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 neighbors.

1.9 Site Assessment

Field visits were carried out for physical observations of vegetation, water resources, physiography, geology and soil in order to gather information on them along the proposed line. At the visited sites, documentation on geology, soil characteristics and landscape were recorded. Photographs at selected sites were taken for inclusion in this report to further emphasis 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 neighbors, surrounding enterprises and key stakeholders.

1.10 Responsibilities and Undertaking

The Consultant undertook to meet all logistical costs relating to the assignment, including those of production of the report and any other relevant material. The consultant arranged for own transport and travels during the exercise. On the site of the proposed development project, the proponent provided a contact person(s) to provide information required by the Consultant. The proponent also provided GPS Coordinates and site plan(s) showing roads, service lines, design and the actual sizes of the line, details of raw materials, proposed process outline and anticipated by-products, future development plans, operation permits and conditions, land-ownership documents and site history, and estimated investment costs. The output from the consultants includes the following:

- An ESIA report comprising of an executive summary, assessment approach, baseline conditions, anticipated impacts and proposed mitigation measures
- Environmental Management Plan outline, which also forms part of the report recommendations.

1.11 ESIA Organization and Reporting

The ESIA was be carried out to full completion within a period of 45 days from the date of undertaking. The Consultant (Lead Expert) coordinated the day-to-day functions and any related institutional support matters. Otherwise, all formal communications were directed to NEMA through the proponent.

The ESIA Report from the findings was compiled in accordance with the guidelines issued by NEMA for such works and was prepared submitted by the proponent for review. The Consultant ensured constant briefing of the client during the exercise. Description plans and sketches showing various activities are part of the Appendices. In addition to constant briefing of the client, this ESIA report was prepared. The contents were presented for submission to NEMA as required by law.

2 PROJECT DESCRIPTION

2.1 General Specification

This chapter is based on two main studies, i.e. CRBC, 2012 (Feasibility Report) and CRBC, 2012 (Preliminary Project Design Report). The project covers the proposed main line of Mombasa-Nairobi Railway from the Mombasa Changamwe marshaling station to the Nairobi Embakasi marshaling station, as well as the Mombasa Port demurrage line. Generally, the proposed new Line is within the existing Mombasa-Nairobi transport corridor or parallel to the existing corridor. In some areas, it deviates from the existing line in order to attain a relatively straight alignment which will enhance train speed. Based on the functional orientation of railway line, for the purpose of scientific and rational estimate of transport volume, the study region incorporates such provinces as Eastern, Coast and Nairobi Area, and the direct influence districts include Mombasa, Mariakani, Voi, Athi River, Mtito Andei, Sultan Hamud and Nairobi. The recommended Chinese railway design criteria have been adopted for this project.

The main line is from Mombasa Port (station center DK1+000), a port city in Kenya, to Nairobi (station center DK469+500), the capital of Kenya. The main line of the through line is 471.045 km long. The Mombasa Port demurrage line is from the designed starting point of Mombasa-Nairobi Railway (mileage SDK0+000= DK0+000 in Mombasa) to the buffer stop of port loading & unloading station (terminal mileage SDK7+917.24) and the total length is 7.917 km. The new port line is from the designed starting point of Mombasa-Nairobi Railway (mileage SDK0+000= DK0+000 in Mombasa) to the buffer stop of new port loading & unloading station (terminal mileage XDK6+341.42) and is 6.341 km long. The main technical standards for proposed railway are as summarized in table 3 below.

Table 3: Main Technical Standards for the Railway Project

S/N	Items	Standards
15.	Design standard	Chinese Railway Design Standard (CRDS)
16.	Gauge	1435mm (standard gauge)
17.	Number of main lines	Single track railway
18.	Limiting gradient	12‰ (15‰ in difficult section)
19.	Minimum radius of curve	1200m (800m in difficult sections)
20.	Axle weight	25t
21.	Load specification	Double stacked container
22.	Freight vehicle	DF8B
23.	Maximum speed of freight vehicle	80kM/h
24.	Passenger car	DF4D
25.	Maximum speed of passenger car	120kM/h
26.	Type of traction	Diesel traction
27.	Tractive tonnage	4000t
28.	Effective length of arrival-departure track	880m

As for Line, 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 adopted for the Line.

The estimated construction period is 60 months (5 years), starting from 1st July 2013 to 31st June, 2018 (see details in table 4 below).

Table4: Planned Project Important Timelines

Works	2013		2014				2015				2016				2017				2018	
	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter
Construction preparation																				
Subgrade and minor bridge & culvert works																				
Bridge works																				
Track laying and bridge erection works																				
E & M auxiliary works																				
Integrated commissioning and trial operation																				

2.2 Route and Track

The planned project is part of a regional railway network planned as shown in the map below. The Line starts from the Mombasa Port and then to the existing Changamwe marshalling yard/ Station. This will involve re-organization of existing Changamwe marshalling yard. Changamwe yard as KM 0, the line sets off towards Nairobi and joins Magongo road at approximately KM 2, about 50 metres from the edge of runway for Moi International Airport. The railway line crosses Mombasa road (A 109) at coordinates 565886.74 m E, 9556926.17 m S and moves northwards towards the Kaya forest then through Mwatsama and Mwangutwa primary schools and crosses Mazera's – Kaloleni road at coordinates 561837.41 m E, 9562571.98 m S at approximately 12km from Changamwe yard.

It heads northwestward along No. A109 Highway, spans over the existing narrow-gauge railway and No. A109 Highway in order near DK3km, crosses over coastal gully through the super major bridge, stretches forward along the ridge, and stretches forward along the left side of narrow-gauge railway after spanning over the No. A109 Highway and the existing narrow-gauge railway near Mazeras. The line continues to move on the northern side of road A109 until at approximately KM 15 where it

crosses Mombasa road at coordinates 559512.09 m E, 9564094.93 m S and moves to the southern side of Mombasa road.

With an intermediate station set near the Mariakani Town, the Line continues stretching northwestward, spans into the right side of existing narrow-gauge railway through the adjacent Mackinnon Road and stretches to Maungu by keeping about 30m spacing parallel with the existing railway. Then, the Line gradually enters the Tsavo National Park and stretches forward to Voi town, where an intermediate station is planned. The section at the mileage of DK118km-DK240km in the Line will be mostly on the Tsavo East National Park, and will run in parallel with the existing railway but next to the main road highway. All possible measures have been taken to prevent the proposed railway from entering into the park. Strict protective measures will be taken during the construction period the local ecological environment against illegal human activities.

Next, the Line proceeds in the intermediate zone between the No. A109 Highway and the existing narrow-gauge railway, spans over Tsavo River after proceeding about 50 km in the corridor zone between the said two lines, continues stretching forward closely along the existing narrow-gauge railway, and proceeds to Mtito Andei town, where a new intermediate station is set near the existing station. Then, the Line passes by Darajani, Kibwezi, Makindu, Simba and other towns and reaches Sultan Hamud town, an important economic town, near which an intermediate station is set.

From Sultan Hamud, the landform becomes complicated and the longitudinal grade of the Line rises. The Line spans over the existing narrow-gauge railway connecting to Kajiado near the Konza market. After that, the longitudinal grade of the Line smoothly declines. The Line enters Athi River, a satellite town of Nairobi, after spanning over the existing narrow-gauge railway at about DK440km, with an intermediate station set at the southeast side of the east zone of Athi River town. Then, the Line detours northwestward, spans over Athi River through 79-32m super major bridge, arrives at Embakasi Nairobi Station, the designed terminal point of the Line after passing beneath the existing narrow-gauge railway. Since Athi River Town is a satellite town of Nairobi city, its fast growing economy and several planned industrial parks in the town, an Intermediate Station has been proposed in the southwest of the town on the open space behind the Export Processing Zone Industrial Park.

From Athi River town to Embakasi station, the proposed new railway is outside the Nairobi National Park, and is on the right of the existing railway. On the whole, it will not affect the national reserve at all but it is likely to bring in more tourists from the Coast to visit the Park, which will impact on it positively. During the route selection of the Line, the relative relationship between the new Mombasa-Nairobi Railway and the existing narrow-gauge railway has been taken into full consideration to avoid frequent crossing between the proposed new railway and the existing railway as far as possible. As per the engineering characteristics and geological and topographic conditions of the Line, the Line will intersect with the existing narrow-gauge railway for 8 times, and with the branch lines or industrial sidings of the existing narrow-

gauge railway for 5 times. The railway line passes through various centres in Mombasa, Kilifi, Taita Taveta, Makueni, Kajiado, Machakos and Nairobi Counties (see figure 1and 2 and table 5 below). The main line of Mombasa-Nairobi Railway is proposed to be 485.303 km long in total and goes through about 31 towns/ urban centres.

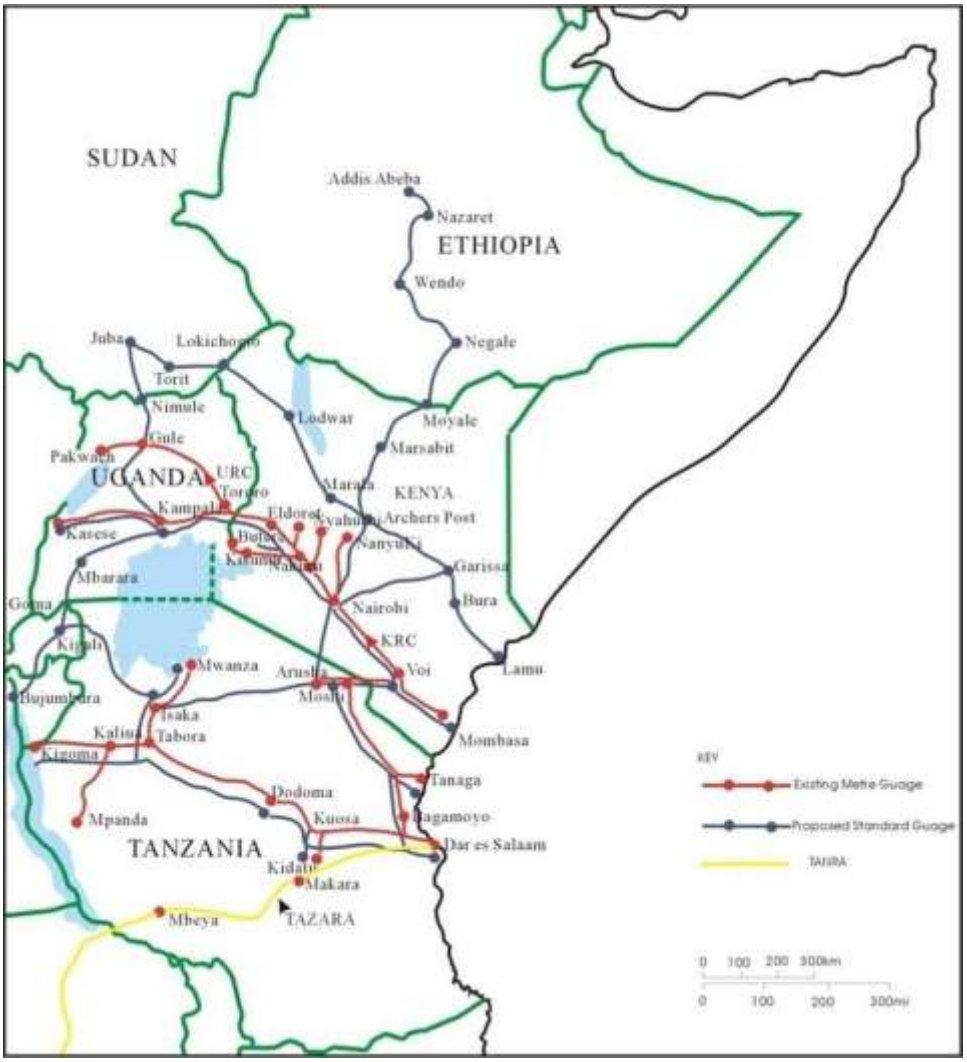


Figure 1: Major railway networks planned in East Africa region

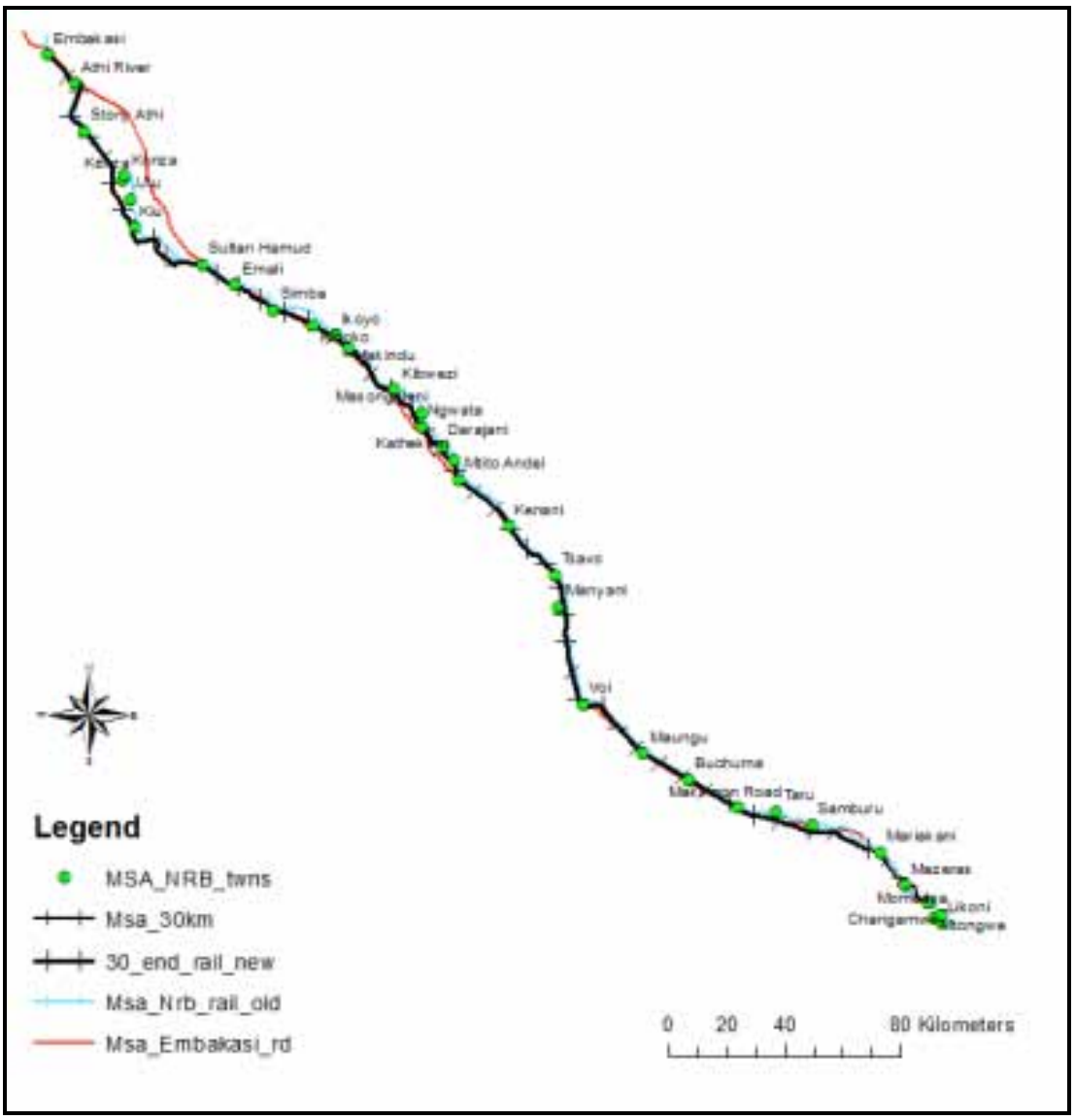


Figure 2: Proposed Route showing urban centres through the Line

Table 5: Towns along the Proposed Railway Line

S/N	Town/ Centre	County	S/N	Town/ Centre	County
1	Changamwe	Mombasa	17	Masongaleni	Makueni
2	Mazeras	Kilifi	18	Kibwezi	Makueni
3	Mariakani	Kwale	19	Makindu	Makueni
4	Samburu	Kwale	20	Kiboko	Makueni
5	Taru	Kwale	21	Koyo	Makueni
6	Mackinnon Road	Kwale	22	Simba	Kajiado
7	Buchuma	Kwale	23	Emali	Kajiado
8	Maungu	Kwale	24	Sultan Hamud	Kajiado/ Makueni
9	Voi	Taita-taveta	25	Kiu	Machakos
10	Manyani	Taita taveta	26	Ulu	Machakos
11	Tsavo National Park	Taita taveta	27	Konza	Machakos
12	Kenani	Taita taveta	28	Stony Athi	Machakos
13	Mtito Andei	Makueni	29	Athi River	Machakos
14	Kathekani	Makueni	30	Kitengela	Kajiado
15	Darajani	Makueni	31	Embakasi	Nairobi
16	Ngwata	Makueni			

The 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. As indicated above, the Main Line is from Mombasa District Station (Changamwe Station) to Nairobi District Station (Embakasi Station).

According to the tractive tonnage and type of locomotive of the Line, the effective length of arrival-departure track of station is 880m in this design. The length of station site of district station, 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 village, railway, highway, urban planning, special geology, water resource facilities, natural reserve, etc. 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.

The rail line route generally runs parallel to the Mombasa-Nairobi Road, also commonly referred to as No. A109 Highway. Mombasa Road is 482km long totally and is mainly used for material transportation from Mombasa Port to Nairobi and to other inland countries, and is a main transportation trunk in Kenya. For the construction of the proposed new railway, the principle of "giving priority to overpass" will be followed, in order to cut down the influences on the existing traffic as far as possible. This proposed new railway will intersect with No. A109 Highway four times totally. So, during the construction, the construction specifications should be followed strictly to reduce the influence on No. A109 Highway. According to the type of traction, the tractive tonnage and the approval opinion of feasibility study, the limiting gradient of the route is 12% (15% in difficult conditions).

The Line will also intersect with other urban roads for many times. Except passing under the existing narrow-gauge railway near the terminal point, the new railway will pass over rest existing narrow-gauge railways, so as to keep the existing railway unchanged as far as possible. The intersections with other branch railways and roads are the vertical control points of the Line. In the regions through which the proposed railway will run, there are many other low-class roads and rural earth roads, all of which will be merged, altered or diverted. For the intersections between these roads and the Line, the design of grade separation will be adopted, except that greater work will be caused due to any ground object prohibit or grade separation. In such exception case, a level crossing will be adopted. Otherwise, no level crossings are planned. At the intersection between the Line and other roads, the over-crossing is adopted except for individual positions where the level crossing may be adopted. The topographic condition or technical & economical comparison will determine the form of under-crossing or over-crossing of highways (roads).

When the Line crosses over other railways and highways (roads), the clearance of grade separation will be designed as per relevant regulations for railways. It is ensured that the Line should be provided with an underneath clearance of no less than railway clearance 5.0m when passing over the existing narrow-gage railway, 4.5m when passing over the No. A109 Highway and other classified roads, and 4.5m or 3.5m when passing over other rural roads. Besides the above-mentioned clearances, the bridge construction height and the safety height of the Line have been taken into account for all the grade separations. The clearance of railways or highways (roads) passing over the Line should be no less than 7.56m. In the preliminary design(see appendix A), there are 94 highways (roads) grade separations in the Line, saying 37 crossings over highways (roads) and 57 crossings under highways (roads).

Buildings (structures) within the railway land boundary will be required to be demolished or relocated. The demolishment works mainly relate to residential houses, enclosures, graves, water wells, etc. The demolishment works will be the

responsibility of the Kenya Government through Ministry of Transport / Kenya Rails Corporation. But the contractor (CRBC) will only provide technical data related to the demolishment location, area, etc.

In terms of safety facilities for railway line, the Line is designed to be a National Class I railway. According to the requirement of China Regulation on Protecting the Railway Transport Safety and Regulations on Railway Technical Operation, safety protection areas will be set along both sides of the Line. The safety protection area along the railway line spreads outward from the toe of slop of embankment and top of slop of cutting of railway line or the outside of railway bridge and is provided with a distance of no less than 8m to the urban areas, 10m to the residential areas in the suburban areas, 12m to the residential areas in the rural areas and 15m to other areas. The safety protection area along the railway line is provided with boundary posts. 5,338 stakes are planned in the safety protection areas in the Line in total. 13,470 route markings and signal signings in various kinds will be set. Separation nets will be set at both sides of the over-bridge to avoid the falling of objects; and height limit frames and anti-collision overhead guards are planned at both sides of flyover crossings. The whole corridor will also be characterized by a guard fence made of reinforced concrete, composed of columns and metal meshes and will be 1.8m high. At Tsavo National Park, the fence design will be modified to fit the requirements of Kenya Wildlife service (KWS) standards in order to control the crossing of wild animals especially the elephants, giraffes and buffalos.

As for the track maintenance mechanism for the Line, the principle of "repairing and maintenance separation" will adopted and the designed arrangement for maintenance facilities and equipment are carried out accordingly in major stations. As for the line maintenance, the mechanized maintenance team in the track maintenance section and personnel will mainly responsible to carry out the routine maintenance and temporary repairing in the work area and back up the line maintenance and first-aid repairing work. The comprehensive line maintenance will be carried out in the subdivision and the site routine inspection, constant maintenance and temporary repairing of route, bridges and other support facilities. According to the data from route discipline, two track maintenance points are set in the Mombasa and Nairobi Stations.

The track for main line is the standard steel rail which is 60kg/m and 25m long. In the main line, the new prestressed concrete sleeper with shoulder will be adopted and will be laid in 1760/km. The Class I stone track bed is adopted in the entire line. During construction, ballast that will be required will be purchased from a licensed quarry operator. The contractor may also apply for license for operating quarries along the line as need may arise.

2.3 Subgrade

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, saline soil subgrade, swelling soil subgrade, black cotton soil subgrade, impervious embankment protection, etc.

2.4 Land Utilization

The KRC and the contractor (CRBC) 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 (CRBC, 2010). 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 carried out 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 Mombasa-Nairobi Railway will have a total length of 485.303 km. The length of section subgrade will be 427.377 km; 13 super major bridges with an extended length of 14,256.9m; 85 large and medium bridges with an extended length of 15,923.1 m; 969 culverts with linear meter of 27,746m; 77 overpasses across road (highway). 40 stations will also be set in the whole line with 7 reserved stations.

The areas along this route are mainly wasteland and grassland, and partial dry land, forest land and building land. This route is going to reacquire permanent land (acquired land) use with a total area of 1,841 hectares including 1,409.5 hectares of section land and 427.5 hectares of station land, also temporary land use of 602.6 hectares including temporary works, road diversion, borrow pit and spoil yard, etc. The average land use per kilometer in the whole line is about 3.8 hectares (excluding temporary land use).

2.5 Bridge & Culvert

The best Chinese Bridges and Culverts codes and standards will be adopted. The distributions of bridge and culvert along the line are summarized below. The main line has a total length of 485.303km, and the 98 bridges with linear mater of 30180m, which accounts for 6.2% of the total line length; 969 culverts (2 culverts per kilometer) with linear mater of 27746m. The distributions of bridges and culverts in the main line are shown in table 6 below.

Table 6: Bridge and Culvert Distribution table of the main line

Projects	Quantity	Length
Super major bridge	13	14,256.9m
Major bridge	41	14294.4m
Medium-sized	10	998.4m
Minor bridge	0	0m
Frame bridge	20	641m(7180m^2)
Culvert	969	27746m
Highway bridge	7	4225m^2

2.6 Railway Stations/ yards

40 stations are set along the line, of which 33 will be opened in short term, and all will be opened in long term. Wherein, 2 are district stations, Mombasa Station and Nairobi Station; 5 are intermediate stations, Mariakani Station, Voi Station, Mtito Andei Station, Sultan Hamud Station and Athi River Station; and the remaining stations are passing stations. The maximum station interval is 14.35km (Mazeras-Mariakani), the minimal station interval is 6.9km (Marimbeti-Nairobi), and the average station interval is 12.01km. The situations on the number and property of all stations and switching station are shown in table 6 below.

The project will composed of 2 new district stations, 5 intermediate stations and 33 passing stations, wherein, 33 stations will be put into operation in short term and 7 stations will be reserved. See table 7 below for details.

Table 7: Proposed Railway Stations

N0.	Name of station	Central mileage	Station interval (km)	Location of station building (left and right sides)	Property of station	Condition of main line at a station		Station track boundary mileage	Remarks
						Radius of curve (m)	Gradient (‰)		
1	Mombasa	DK1+000	11.0	Left	District station		0	DK0+000 DK2+500	
2	Mazeras	DK12+000	13.35	Left	Passing station		6	DK11+400 DK12+600	
3	Mariakani	DK25+350	14.35	Left	Intermediate station	1200	1	DK24+850 DK27+100	
4	Manjewa	DK39+600	11.4	Right	Passing station		4.5	DK39+000 DK40+200	
5	Samburu	DK51+000	14.2	Left	Passing station		1	DK50+400 DK51+600	

6	Mugalani	DK65+200	13.1	Left	Passing station		1	DK64+600 DK65+800	
7	Mackinnon Raod	DK78+300	13.9	Right	Passing station		6	DK77+700 DK78+900	
8	Miaseny	DK92+200	14	Right	Passing station		0	DK91+600 DK92+800	
9	Wangala	DK106+200	12.5	Right	Passing station		1	DK105+600 DK106+800	
10	Maungu	DK118+700	11	Left	Passing station				Reserved
11	Ngutini	DK129+700	13.1	Right	Passing station		1	DK129+100 DK130+300	
12	Voi	DK142+800	13.9	Right	Intermediate station		0	DK142+200 DK143+500	
13	Ndi	DK156+700	13.5	Left	Passing station		0.5	DK156+100 DK157+300	
14	Maololo	DK170+200	13.8	Left	Passing station		-1	DK169+200 DK170+800	
15	Manyani	DK184+000	10.3	Left	Passing station		0		Reserved
16	Tsavo	DK194+300	11.5	Left	Passing station		6	DK193+700 DK194+900	
17	Kyulu	DK205+800	13	Right	Passing station		0	DK205+200 DK206+400	Reserved
18	Kenani	DK218+800	13	Right	Passing station		1	DK218+200 DK219+400	
19	Knaga	DK230+300	11.5	Right	Passing station		1		Reserved
20	Mtito Andei	DK240+600	10.3	Left	Intermediate station		0	DK239+850 DK241+150	
21	Ndalasyani	DK251+650	11.05	Left	Passing station	1000	1	DK251+200 DK252+400	
22	Ngwata	DK264+300	12.65	Left	Passing station	800	1	DK263+700 DK264+900	
23	Kibwezi	DK276+750	12.45	Right	Passing station		1	DK276+250 DK277+450	
24	Kinyambu	DK288+200	11.45	Left	Passing station		1	DK287+600 DK288+800	
25	Musamba	DK301+200	13	Left	Passing station		1	DK300+600 DK301+800	
26	Ikoyo	DK314+400	13.2	Left	Passing station		-1	DK313+800 DK315+000	
27	Kiboko	DK325+200	10.8	Left	Passing		0.5	DK324+600	

			12		station			DK325+800	
28	Simba	DK337+200	11	Left	Passing station	800	6	DK336+600 DK337+800	
29	Emali	DK348+200	13.4	Left	Passing station		1	DK347+600 DK348+800	
30	Sultan Hamud	DK361+600	12	Left	Intermediate station		0	DK360+900 DK362+300	
31	Arroi Ranch	DK373+600	11.2	Left	Passing station		1	DK373+000 DK374+200	
32	Kima	DK384+800	9.8	Left	Passing station	1200	1	DK384+300 DK385+500	
33	Kiu	DK394+600	11.6	Left	Passing station	800	6	DK393+950 DK395+200	
34	Ulu	DK406+200	10	Right	Passing station		1	DK405+600 DK407+800	
35	Konza	DK416+200	12	Right	Passing station		-1		Reserved
36	Kapiti Plains	DK428+200	13.5	Left	Passing station		-1	DK427+600 DK428+800	
37	Olerukenya	DK441+700	9.5	Right	Passing station		0		Reserved
38	Athi River	DK451+200	11.4	Left	Intermediate station		0	DK450+600 DK451+900	
39	Marimbeti	DK462+600	6.9	Right	Passing station		6	DK461+900 DK463+100	Reserved
40	Nairobi	DK469+500		Right	District station		1	DK468+200 Designed terminal point	

As outlined above, 26 passing stations will be distributed along the whole line. The Mombasa Station will be designed newly on the open field on the southern side of the existing marshalling station at Changamwe. The station is the starting station of Mombasa-Nairobi line and a district station. 2 small-mileage connecting lines leading to Mombasa Port will be provided in the station, and a container loading and unloading station is set in the container operation site leading to Mombasa Port area where 2 arrival-departure tracks, 2 loading and unloading lines and 1 engine waiting line are set. Nairobi Station will be a newly constructed at Embakasi in an existing open field and it will be the terminal station of Mombasa-Nairobi line and a district station. Fences are set at the sections of Mombasa and Nairobi Stations without other equipment and on both sides of station building. The fences will of metal columns.

2.7 Locomotive Facilities

Passenger train locomotive routing: Rebuild the diesel locomotive (DF_{4D}) of the Nairobi locomotive depot to take on the passenger train locomotive routing between Nairobi and Mombasa.

Freight train locomotive routing: Rebuild the diesel locomotive (double locomotives of DF_{8B}) of Nairobi locomotive depot to take on the freight locomotive routing between Nairobi and Mombasa.

The great advantage of this proposed scheme is that the locomotive depot is set in the junction station in Nairobi, which is favourable for using this locomotive facility when the junction station connects the new railway line in the future. The disadvantage is that locomotive depot is not set in the starting station of the loaded car direction, which is not favorable for timely providing locomotives with reliable quality. The crew working system proposed is crew shifting system with configurations of short term and long term locomotives as shown in table 8 below.

Table 8: Type and Number of Locomotive

Item	Passenger train locomotive		Freight train locomotive	
	Short term	Long term	Short term	Long term
Type of locomotive	DF_{4D}	DF_{4D}	DF_{8B}	DF_{8B}
Number of locomotive	4	6	56	100

2.8 Rolling Stock

The rolling stock depot will be located on the southeast side of Nairobi station. Taking the maintenance & 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 & assembly workshop and tank washing point, shed for shunting locomotive, wheelsets 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, wheelsets deposit sheds, etc.

2.9 Water Supply, Sewage and Waste Oil Treatment Facilities

There will be two water supply stations to be built in the design scope, Mombasa and Nairobi. There are in total 31 living water supply stations to be built in the design scope, including Mazeras, Mariakani, Manjewa, Samburu, Mugalani, Mackinnon Raod, Miaseny, Wangala, Ngutini, Voi, Ndi, Manyani, Tsavo, Kenani, Mtito Andei, Ndalasyani, Ngwata, Kibwezi, Kinyambu, Musamba, Ikoyo, Kiboko, Simba, Emali, Sultan Hamud, Arroi Ranch, Kima, Kiu, Ulu, Kapiti Plains and Athi River. At each water supply station, four new water source wells, one water supply point, one 400m^3 water tower and one 1,000m^3 water tank will be built. At each living water supply station, one new water source well, one water supply point, one 200m^3 or 100 m^3 water tower and one 300m^3 or 100 m^3 tank will be built.

Within the new water supply point at each water supply station, one chlorine dioxide sterilization unit and one centralized control unit and two fire pumps will be arranged. 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 processing operation.

For sewage treatment facilities and discharge scheme, if there will be urban drainage pipe net near the station, the fecal sewage treated by septic tank, the bathroom sewage treated by hair trapping well and the oil-bearing production wastewater treated by oil separator will be led into the nearby urban drainage pipe net.

If there is no urban drainage pipe net near the station, the domestic sewage treated by septic tank, the bathroom sewage treated by hair trapping well and the oil-bearing production wastewater treated by oil separator will be discharged into the SBR sewage treatment facility in a centralized manner. The qualified sewage after treatment will be recycled for greening irrigation and the residual sewage will be discharged nearby.

At the living water supply station, the domestic sewage treated by septic tank, the bathroom sewage treated by hair trapping well and the oil-bearing production wastewater treated by oil separator will be discharged into the separate sewage treatment equipment for treatment. The qualified sewage after treatment will be recycled for greening irrigation and the residual sewage will be discharged nearby.

Coagulation and settling shall be performed on the washing sewage of new passenger car. The sewage will be filtered and treated and then recycled for washing the external face of the passenger car, flushing the ground, greening etc. The oil-bearing sewage form the locomotive and rolling stock depots will receive air floatation and then flow into the drainage pipe of the station area.

2.10 Communication

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 etc. and satisfies the comprehensive business and development demands for voice, data, image etc. 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.

2.11 Signal System

This will be based on the railway construction concept of "people orientation, serving transport, system optimization and focusing on development", and 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.

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 marshalling information management, shunting operation management, comprehensive maintenance management, manual and automatic planned selection sort of train and shunting route, etc.

2.12 Information 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 & depot.
- The freight billing, reporting, freight safety, existing car management, freight plan and other business terminals are set up in station & 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.

2.13 Electric Power Supply

Loads of stations along the Project 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 and other electric facilities and the loads in the interval mainly are optical fiber repeater, etc,. The power supply scheme with 33kV distribution substation and 33kV continuous power line will be adopted.

In the whole line, nine (9) 33kV distribution substations at Mombasa, Mugalani, Ngutini, Tsavo, Ndalasyani, Masimba, Sultan Hamud, Ulu and Nairobi, will be additionally set up for the power supply for continuous power line.

2.14 House Building

Production houses are set up in the concentrated area for personnel in whole line as per the "people oriented" principle. Under consideration to the bad natural environmental condition, activity rooms are provided in the living houses besides bachelor apartment, canteen, bathroom, etc and the finishing standard is improved properly, so as to improve the living quality of the employees.

Requirements for use function of production shall be met. Various buildings and structures shall be arranged as per the mutual function relations and property characteristics, so that the arrangement is compact and reasonable and the process flow is smooth. Reasonable technique shall be pursued. In connection with the local topography, geology, hydrology, meteorology, etc. the general planar design of building is implemented. Production and living houses shall be arranged in accordance with concentrated and comprehensive design principles, arranged concentratedly, planned conformably and in consistence with Kenya urban housing standards.

2.15 Environmental quality design principles along the line

The line has been detoured away from natural reserves and wildlife areas. For railway alignment, land resources must be used reasonably, to detour the mining area with great reserve and high exploitation value, natural conservation core areas and their buffer zones. 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 the 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 should 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 by local environmental protection department.

After the train is put in operation, productive and domestic wastewater will be drained from the facilities in stations and depots, and main pollutants include oil, SS, BOD, COD, etc. During the design this time, 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.

Refuses in the stock yard should be piled in the stock place and protected by some measures to avoid environmental pollution. Solid wastes during the construction period and domestic refuses produced by contractors shall be stockpiled concentratedly and treated by the responsible municipal department. After the 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.

2.16 Estimated Project Investment Cost

According to an MOU on the Construction of Mombasa-Nairobi Railway System that was signed between China Road and Bridge Corporation (CRBC) and Ministry of Transport (MOT)/ Government of the Republic of Kenya on August 12th 2009; the estimated project cost is **USD 4billion.** The estimated total amount excludes the following expenses: -

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

The total investment of this project is mainly for civil works investment, locomotive acquisition expense and loan interest during the construction period.

3.1 Kenya National Socio-Economic Profile

Administration: Kenya nationwide is divided into 47 counties and each county is further divided into districts/ sub-counties, a district further divided into divisions, and a division further divided into locations and Sub-locations, totally covering an area of 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.

Population: Currently, the national total population had reached about 40.0 million, with an annual population growth rate of 2.2% (see Figure 3 below). 40% of the population is in urban areas. The coutry has a total of 42 tribes, among which Kikuyu nationality is the largest clan, accounting for 21% of national population, followed by Luhya, Kalenjin, Luo, Kamba and etc. Moreover, there are a minority of Indians-Pakistanis, Europeans and Arabs. Swahili is the national language and English is the official language.

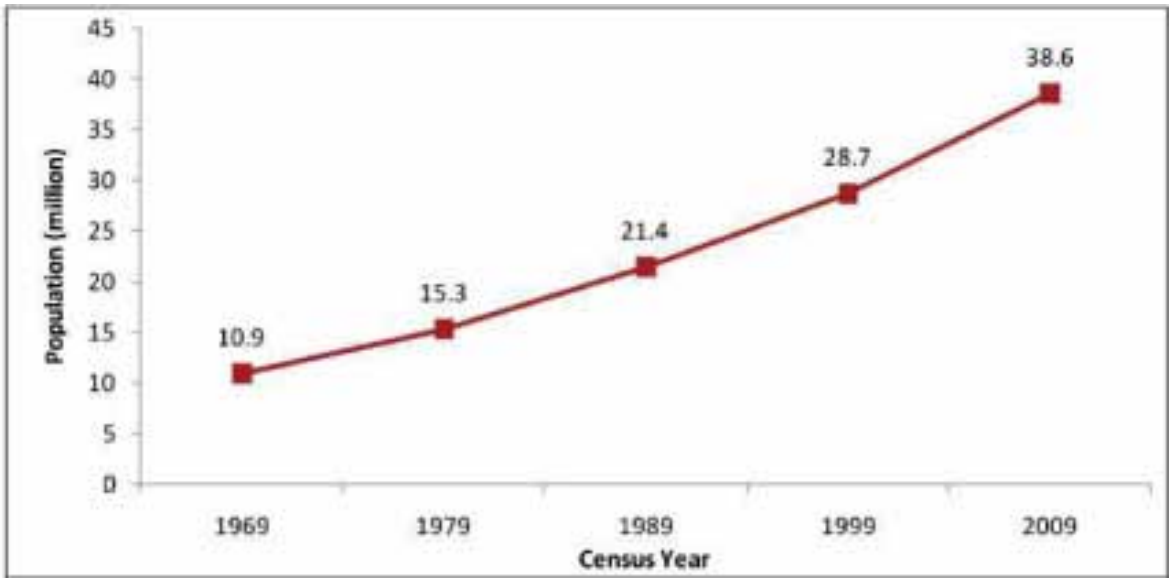


Figure 3: Population Growth in Kenya

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 world 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.

Agriculture: Agriculture is one of Kenya's national economic mainstays. Kenya's agricultural growth rate is currently about 2.3%, with an output value accounting for around 23.9% GDP and agricultural export accounting for more than half overall exports of Kenya and it is 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.

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.

Foreign Trade: Foreign trade occupies a key status in Kenya's economy, however, which has been in deficit for a long time. 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.

Mineral Resources: Kenya's mineral reserves are mainly composed of soda ash, salt, fluorspar, limestone, barytes, gold, silver, copper, zinc, niobium and thorium, and most mineral deposits are as yet unexploited except for soda ash and fluorspar. The main minerals consist of barytes in the southeast, niobium at Mrima Hill 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 discories 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 the north coastal parts of the country.

Tourist Resources: Tourism is the third largest source of foreign exchanges in Kenya. The main tourist resources include seashore, wildlife parks, museums, East Africa Great Rift Valley, Mount Kenya and lake scenic area. 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. Rift Valley runs a length of more than

800 km in Kenya, with a width of 50-100 km and a depth of 450-1000 m, with steep bluffs on both sides and luxuriant forests, the most distinct geomorphic features, which is an important sightseeing district and wildlife reserve in Kenya. 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.

3.2 National Transportation Structure

Kenya provides mainly 4 passenger and freight trip modes consisting of roadway, railway, waterway and air transportation. In these 4 transport means, (see table 9 below) the transport volume of roadway has the largest proportion and is the most important form of transportation. The railway development is relatively laggard and not making any progress, hence restricting the rapid economic development of Kenya.

Table 9: Transport sector percentage (%) value contribution by sub-sector

Sub-Sector	2005	2006	2007	2008	2009
Road transport	62.8	66	67	70	72
Railway transport	1.8	1	1	1	1
Water transport	6.9	7	7	6	3
Air transport	25.3	23	23	21	22
Pipeline transport	3.2	3	2	2	2
Total	**100**	**100**	**100**	**100**	**100**

Source: Economic Survey 2010

Roadways: Kenya has a road network of about 177,800 km out of which only 63,575 km is classified (see Figure below). The classified road network has increased from 41,800 km at independence to 63,575 km today, a development rate of less than 600 km per annum. During the same period, the paved road length grew from 1,811 km to 9,273 km. It is presently estimated that about 70% (44,100 km) of the classified road network is in good condition and is maintainable while the remaining 30% (18,900 km) requires rehabilitation or reconstruction.

Railway: Kenya's railway trunk line consists of the railway linking the capital Nairobi with the Port of Mombasa and the railway linking the capital and Kisumu, the third largest city of the nation (see Figures below). The railway trunk line has a total length of 2,597km, including national railway total length of 1,738km and private railway of 859km. The current annual freight volume amounts to about 1.763mt. In 2011/2012 financial year, the railway subsector recorded increase in earnings in both passenger

and freight of 20.2 and 14.5 per cent respectively. This is attributed to restructuring of the operations of the Rift Valley Railways (RVR).

Kenya is planning to build two new railways, one of which is from the capital Nairobi to the capital Addis Ababa in Ethiopia and the southern city Juba in Sudan, the other (which is part of this proposed project) is to be constructed in parallel with the existing railway link Mombasa with Kampala in Uganda. 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. The current status of the Kenya railway network between Mombasa-Nairobi is detailed below.

Waterway: Mombasa has enjoyed a well-developed port industry since long, 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 centre of inward and outward freights, but also an important outgoing sea port for the freights from Uganda, Burundi, Rwanda, Congo (K) and South Sudan.

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 4 40-ton container cranes. The Port's current imports are about 13.311mt. The cargo throughput of Mombasa Port is expected to increase rapidly along with the economic development in Kenya and associated East African countries. 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.

Air Transportation: The nation contains 3 international airports, 4 domestic airports and more than 300 small airfields and airstrips. Kenya Airways currently is operating more than 40 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.

Pipeline Transport: 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 612,000 m^3 covering all over the country.

3.3 Existing Railway Operations between Mombasa-Nairobi

The proposed Mombasa- Nairobi Standard Gauge Railway is parallel with the existing one, which is within an important transportation corridor Kenya and East Africa (see figures 4 and 5). Based on the location of the proposed railway line, the baseline study covered a quick description of existing railway operations (see Appendix B for list of existing railway stations) and baseline environmental and socio-economic

information for Mombasa, Kilifi, Kwale, Taita-Taveta, Makueni, Kajiado, Machakos and Nairobi Counties.

Figure 4: Map of Kenya-major road and rail networks

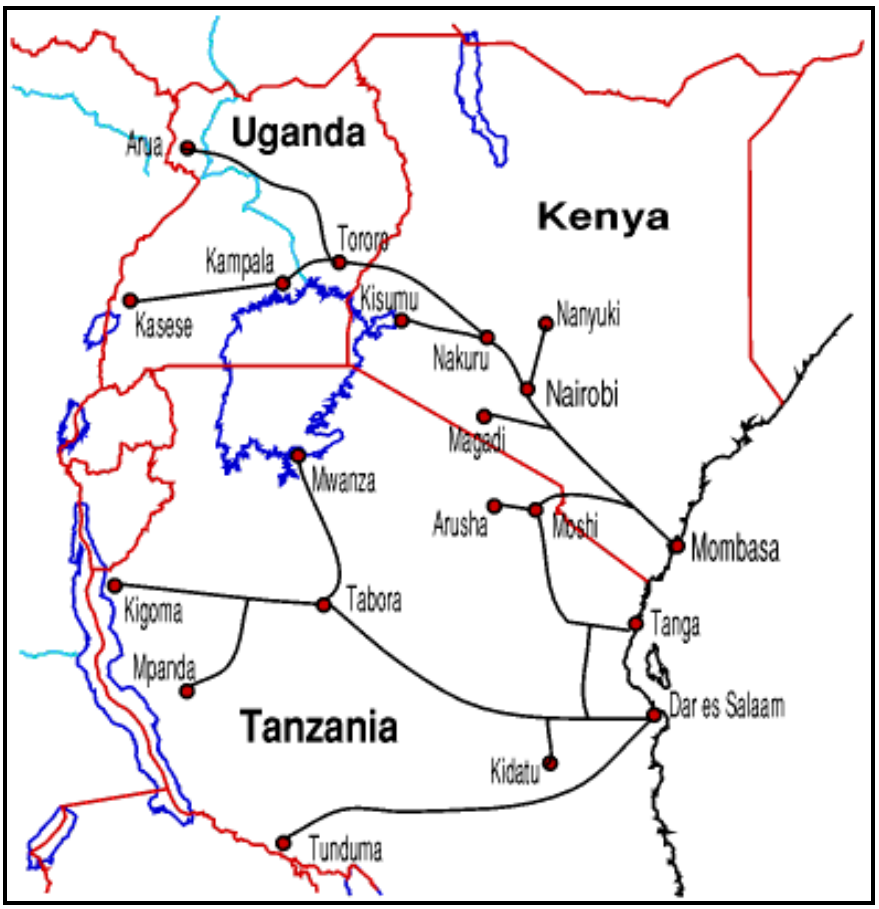


Figure 5: Major railway networks existing in East Africa

The existing railway line links Mombasa Port to Nairobi (see Figure 6 below) facilitate import and export trade in the country. The Mombasa Port is the center of operation and experiences serious congestion as shown in Plate 2 below. Consequently, the road network has been congested see Plate 3 below.

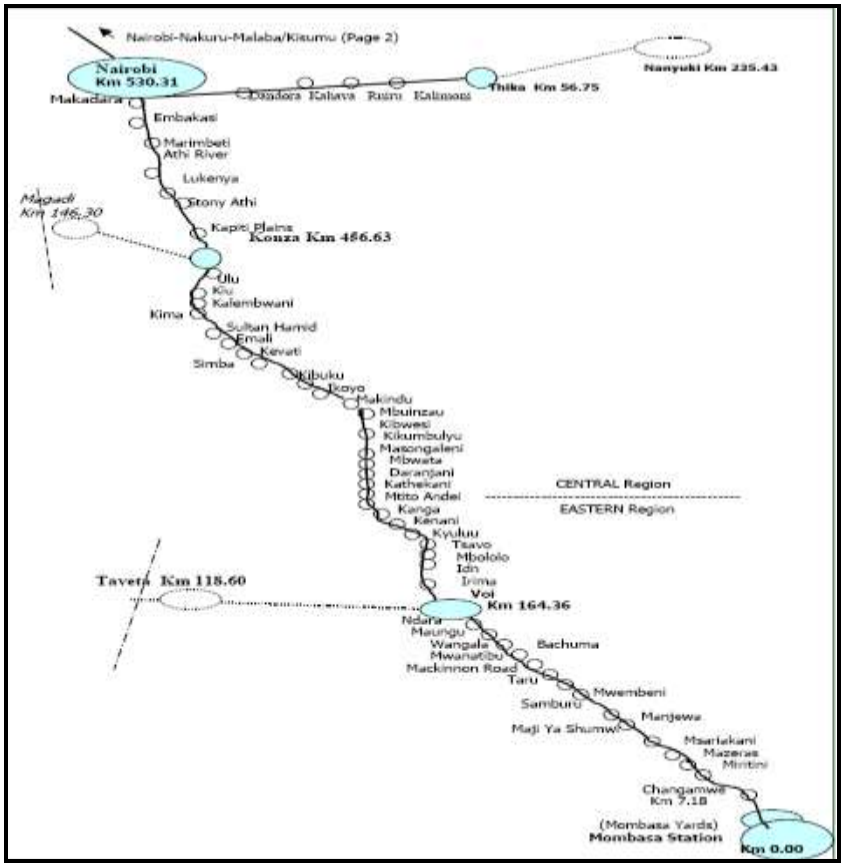


Figure 6: Diagram for Existing Mombasa-Nairobi Railway Network

Plate 2: Congestation at Mombasa Kilindini Port

Plate 3: Congestation on Mombasa Highway and parking on roadsides

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 marshaling operations in Mombasa are confined at the Changamwe yard for trains bound to and out of the Port. In Nairobi, most freight trains start and terminate at the Kenya Port Authority (KPA) Internal Container Deport (ICD) Embakasi from where they are delivered to customers by road or sidings. Long Distance Passenger service to Mombasa starts at Nairobi railway station and ends at Mombasa railway station.

Stations & rolling stock: There are thirty-three stations between Mombasa and Nairobi some of which are in major urban centers like Voi, Mtito Andei, Makindu, Kibwezi, Emali, Sultan Hamud, and Athi River (*See Plates 4 and 5 below*). The operations include services to Magadi Soda Company which exports soda ash and runs its own locomotives and rolling stock. The operations have crew interchange at Mombasa, Mtito Andei, and Nairobi. The interchange for loco and rolling stock is at Mombasa and Nairobi only, where also fuel depots are located as by the current operation of the Rift Valley Railways. Each of the station that is currently operational works on a shift of 8hours. Along the line also exists a track maintenance personnel distributed evenly along the entire line and operates from designated depots like Voi, Mtito Andei ,Sultan Hamud, Athi River and Mombasa.

Track structure: 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 and beyond. 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 as shown on Plate 6 below.

Plate 4: Voi and Sultan Hamud railway stations

Plate 5: Kima and Konza railway stations

Plate 6: Bridge Crossing at Changamwe

Bridges & terrain: The line runs through hilly terrain as it climbs from Mombasa which is at sea level to the Savanna plains. 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 as shown in Plate 7 below.

Plate 7: Bridge on hilly terrain within East Tsavo Park

Railway corridor: The corridor size is generally 60m wide i.e. 30m from centre of the track on either side of the track, and it is increases to 100m on either side for minor stations and wider than that figure on either side for major depot stations. On station yards, line interchanges are facilitated by turn-outs laid on wooden sleepers. There are no tunnels on this section of Nairobi-Mombasa but we have one spiral close to Mombasa.

Interaction with other services: The railway generally runs alongside the existing road highway from Mombasa to Nairobi. The two facilities crisscross 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 centers where it crosses with service supply lines to the towns including water supply, power supply, telephone and sewer lines. There crossings are prone to collisions with vehicles and running trains because of the existing level crossings (see Plates 9 and 10 below).

Accidents/ Derailment: Rift Valley Railways as the operator of the conceded rail network is required by law to investigate all accidents that occur in all the operations of the conceded 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. Derailments may be caused by mechanical failures, track defects, staff error/ train crew; while collisions and accidents may be due to level crossings (see Plate 9 and 10 below),

trespassing, staff on duty or line blockage. Table 10 below shows a summary of derailments recorded since the year 2000 with the highest number recorded in 2010.

Table 10: Mainline/Branch line Goods Train Derailments 2000-2012

YEAR/ MONTH	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
JAN	18	17	9	11	22	19	18	43	21	35	75	-	40
FEB	19	11	13	17	26	18	30	25	41	31	71	-	34
MAR	24	15	13	26	24	31	37	42	33	42	108	77	52
APR	13	13	16	25	25	18	33	44	35	33	84	68	31
MAY	18	15	10	27	32	19	29	36	37	48	71	33	40
JUN	14	15	14	26	22	17	24	38	34	39	59	29	37
JUL	23	17	14	26	40	22	40	42	34	55	96	31	
AUG	22	14	24	20	46	29	32	34	46	40	59	26	
SEPT	11	12	14	25	24	23	30	28	31	52	80	29	
OCT	9	18	19	15	22	23	29	28	40	61	79	37	
NOV	11	13	17	22	23	14	48	20	31	52	90	39	
DEC	12	7	20	20	14	16	21	26	40	54	80	32	
TOTAL	**194**	**167**	**183**	**260**	**320**	**249**	**370**	**406**	**423**	**542**	**952**	**401**	**234**

Source: Kenya Railways Corporation Periodical Reports

Plate 8: Underpasses for wildlife and livestock to avoid accidents

Plate 9: Level Crossing Vehicles

Plate 10: Level crossing for animals

Urban development along the line: There are several towns along the old 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 and the low speed at which they move. The rail system has been neglected and is in a state of disrepair. However these towns still utilize the railway system in small scale in the following ways:

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 Mariakani, Mtito Andei, Voi etc depended the railway line to for transport, however presently, there is little dependence on the railway line since only a small percentage of these residents still use it to travel and for transporting goods.

3.4 Kenya Vehicle Registration Statistics

From 1996 to 2010, the total number of vehicles registered in Kenya has grown by 2.5 times (see Table 11 below). While cars have seen a growth of 6.59%, buses have grown at a rate of 7.24% and Trucks have grown by averagely about 6.87%. Currently, about 125,000 trucks operate on Kenyan roads. The 125,000 trucks are mainly operating on the Mombasa-Nairobi Highway and are the most likely to be affected by the new railway proposed. As the rail system deteriorates more, the number of trucks is expected to increase in future and make the road almost impassible unless this proposed rail project is implemented soon.

Table 11: Registered Vehicles, 2001-2010

Type	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Motor Cars	255,379	269,925	286,281	307,772	329,068	372,530	410,812	450,137	499,679	780,273
Utilities, Panels Vans, Pick-ups, etc	162,603	166,811	172,571	179,613	184,125	195,153	202,671	209,628	219,901	N/A
Lorries, Trucks and Heavy Vans	58,501	59,835	61,538	63,999	66,472	69,716	75,347	81,285	118,470	125,773
Buses and Mini-buses	42,629	46,606	50,428	55,705	60,109	50,242	55,997	61,886	84,844	89,708
Motor and Auto cycles	46,004	47,451	49,257	53,508	57,465	63,321	78,981	130,307	252,960	N/A
Trailers	13,897	14,261	14,994	16,106	17,296	40,010	41,803	43,485	27,039	N/A
Other motor vehicles**	32,255	32,724	33,439	34,439	35,145	28,472	30,961	32,710	45,229	N/A
Total	**611,268**	**637,613**	**668,508**	**711,142**	**749,680**	**819,444**	**896,572**	**1,009,438**	**1,221,083**	N/A

* Provisional
** Includes road construction vehicles and farm tractors

Source: *Tables are sourced from 'Statistical Abstract 2011'*

3.5 The Mombasa Port

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 linked to 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 can trace its history back many centuries 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 colonised 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 interior of East Africa was opened up by the new railway, 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 railborne 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 (see Plate 11 below) 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).

Plate 11: The Mombasa Port

3.6 County Profiles along the Proposed Railway Corridor

The proposed railway line project passes through eight (8) Counties: Mombasa, Kilifi, Kwale, Taita-Taveta, Makueni, Kajiado, Machakos and Nairobi Counties. The counties which the proposed railway project transverses are shown in Figure 7 below.

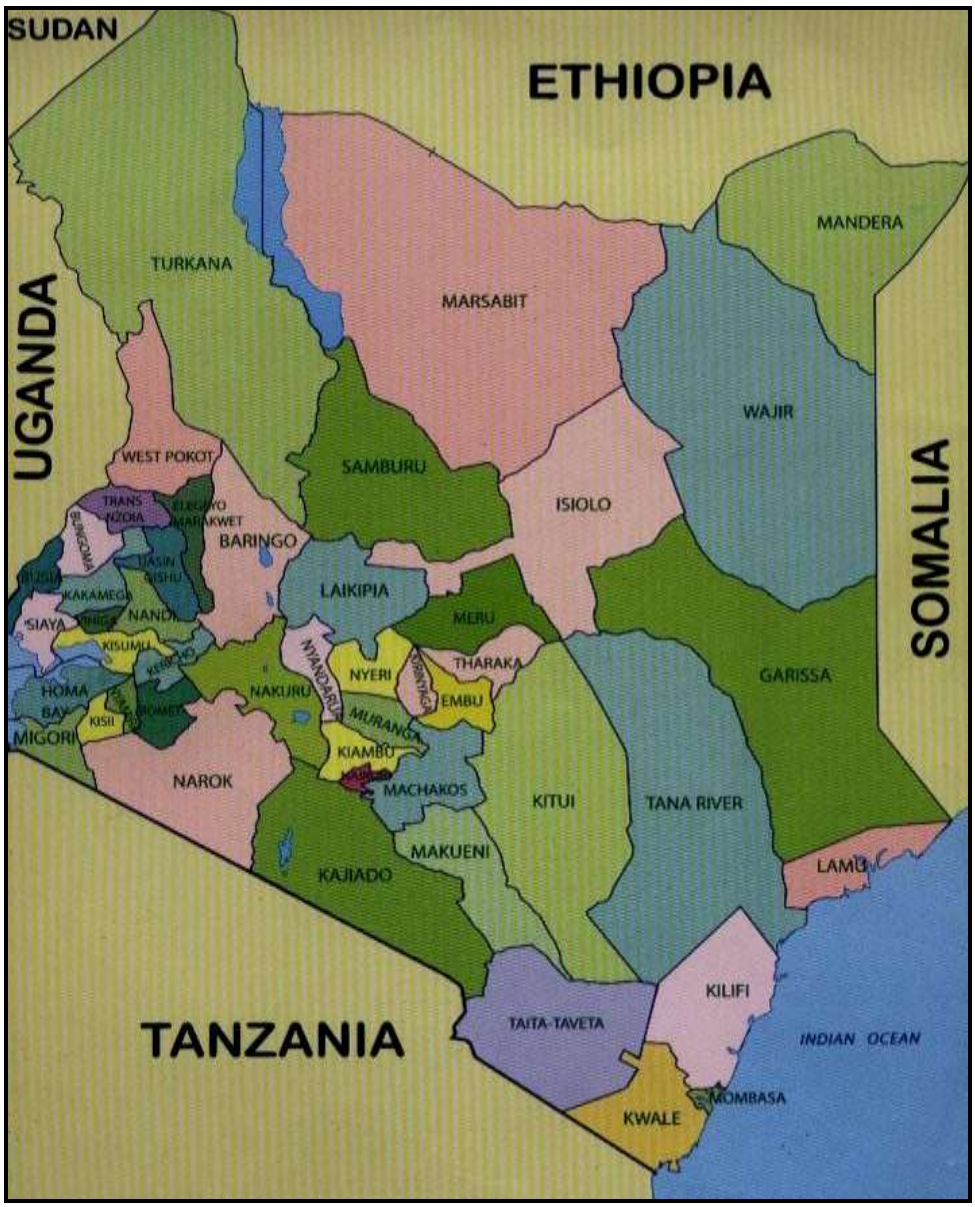


Figure 7: Map of Kenya showing counties

3.6.1 Mombasa County

Mombasa County lies on the shores of the Indian Ocean along Kenya's coastline. It is located on the South Eastern part of the Kenya Coast and lies between latitudes 30 – 800 and 4 –100 South of the Equator and between longitudes 39 – 80' East of the Greenwich Meridian. It borders Kilifi County to the North, Kwale County to the South and West and the Indian Ocean to the East. The County covers an area of 219 Km^2 whereby water mass account for 65 Km^2 with a population of 939,370 people (2009 census). The county has a population density of 4,292 people per km^2. Population distribution and settlement patterns in the County are influenced by infrastructure network such as roads, water, electricity, availability and accessibility of areas of gainful employment, availability of cheap housing, security and land tenure systems. Mombasa County is connected to the rest of Kenya mainland via air, rail and road. The Headquarter of Mombasa County is Mombasa City which is the second-largest city in Kenya, located in the southeast of Kenya, about 482km from Nairobi. The county has

six constituencies namely Changamwe, Jomvu, Kisauni, Nyali, Likoni, Mvita. The city has an international airport and a sea port. The city is not only a major trade centre and home to Kenya's only large seaport, the Kilindini Harbour, but also the centre of coastal tourism in Kenya.

Mombasa County has a warm, tropical climate, specifically a tropical wet and dry climate. The amount of rainfall depends essentially on season the rainiest months being April and May, while in January to February the rainfall is minimal.

3.6.2 Kilifi County

The proposed line from Mombasa passes through Mazeras and Mariakani within Kilifi County. Kilifi County lies between the Mombasa and Tana River counties. The county covers an area of 12,639 Km^2 (with 109 Km^2 water mass of Indian Ocean) with a population of 1,109,735 (2009 census). The county has a population density of 88 people per km^2. Its administrative town is Kilifi Town. The County has the following constituencies: Kilifi North, Kilifi South, Kaloleni, Rabai, Ganze, Malindi, Magarini.

The county receives an average annual rainfall of about 900mm to 1000mm. The pattern of rainfall in Kilifi County is bimodal. The long monsoon rains fall from April to June with a peak in May. The short rains, on the other hand fall from October to December. Apart from monsoon rains the other dominant feature of the weather along the coastal strip is the heat, temperatures range from a minimum of 21^oC to 32^oC.

3.6.3 Kwale County

The proposed railway line enters Kwale through Samburu and passes through Taru, Mackinon road, Bachuma and Maungu towns. Kwale County is one of the counties within the coastal area. It borders Taita Taveta County to the West, Kilifi County to the North West, Mombasa County and Indian Ocean to the East and Republic of Tanzania to the South. The county covers area of 8270 Km^2 with a population of 649 931 (2009 census). It has a population density of 79 people per km^2. The county has four constituencies namely Msambweni, Lunga Lunga, Matuga and Kinango.

Kwale County has monsoon type of climate; it is hot and dry from January to April while June to August is the coolest period of the year. Rainfall comes in two season's i.e. short rains are experienced from October to December while the long rains run from March- June/July. The County has an average rainfall ranging from 400 - 1200mm. Seasonal rivers and the Ramisi River form the drainage pattern in the County. The main rivers and streams are Marere, Mwalunganje and River Ramisi. Rivers Marere and Mwaluganje have been harnessed to provide piped water.

3.6.4 TaitaTaveta County

Taita Taveta County is located in the Coastal region of Kenya; it borders Makueni, Kitui and Tana River Counties to the North, Kilifi and Kwale Counties to the East, Republic of Tanzania to the South and South-west, and Kajiado County to the North West. The County covers area of 17,084 Km^2 with a population of 284,657 (2009

census). The County has a population density of 17 people per km^2. It has four constituencies namely Taveta, Wundanyi, Mwatate and Voi. Tourism is the main economic activity within the County. Taita Taveta is home to the largest National park in the Country which is split into Tsavo East and Tsavo West. It is also home to conservancies like Taita Hills and Saltlick Lodges Sanctuary. The County is also known for sisal farming. The proposed railway line enters Taita through Voi and enters Tsavo West through Manyani town.

The climate here varies with the altitude. The lowlands are generally hot and dry, while the hills receive more rainfall and cooler temperatures. The County has two main rainy seasons (bimodal). The long rains occur between March and June while the short rains are experienced from October to December. The mountainous zone serves as rain catchment area with more than 900mm of rainfall per annum. Descending the hills, rainfall becomes less. Due to high rainfall and low evaporation rate, the County experiences an annual mean rainfall of 650mm per annum with temperatures averaging 23^{o}C.

3.6.5 Makueni County

The proposed railway line enters Makueni through Kenani and passes through MtitoAndei, Kathekani, Darajani, Ngwata, Kibwezi, Makindu and Ikoyo towns. Makueni County is located in Lower Eastern part of the country and lies between Latitude 1º 35´ South and Longitude 37º10´ East and 38º 30´. The County covers an area of 7,965.8km^2, with a population of 884,527 people (2009 census). This population is sparsely distributed in the area except Mbooni and Kilungu areas which have high population densities of over 450 persons per square kilometre. Makueni County has five constituencies namely: Mbooni, Kilome, Kaiti, Makueni and Kibwezi. Makueni County's main mode of transport is roads. The road network in the County is fairly poor given the fact that most of them are rendered impassible during the rainy seasons. In addition to roads, the Nairobi - Mombasa railway is also used for transport where trains can be boarded at the Emali Railway station.

Makueni County is home to two of the world's renown wildlife habitats namely: Tsavo West National Park and the Chyullu Game Reserve. These two resources occupy an area of 474.1 sq. km and 724.3 sq. km respectively. However, majority of people living in the rural areas of the County are poor. Most of the population is housed in mud-walled, grass-roofed houses with sanitation facilities being detached from main houses. In terms of waste disposal, pit latrines are the preferred and affordable method. Due to the acute shortage of water, the towns lack functional sewerage systems.

The County is characterized by extreme rainfall variability. Typically good seasons are interspersed with extremely dry seasons and variations in the onset of rainy seasons add to the difficulty of ensuring adequate food production. The County has two rainy seasons with two peaks in March / April (long rains) and November/December (short rains). June to October is a long dry period, while January to March is a short one. The hilly part of the County receives 800 to 1200 mm of rainfall per year while the rest receives less rainfall at about 500mm per annum. The mean temperatures in the

County range from 20.2°C to 24.6°C. The high temperatures experienced in the low-lying areas cause high evaporation.

3.6.6 Kajiado County

The proposed railway line enters Kajiado through Simba and passes through Emali, Sultan Hamud then crosses to Kitengela. Kajiado County is located in the Rift Valley and constitutes 3 constituencies (Kajiado Central, Kajiado North and Kajiado South) with a population of 687,312**.** It covers an area of 21,903 km^2 and borders Nairobi County to the North and extends to the Kenya-Tanzania border further south. It also borders Taita Taveta (to the south East), Machakos (to the East), Kiambu (to the North) and Narok (to the West). The local people in the area are the Maasai but there is an increasing influx of people from other ethnic groups. The Life is extremely hard for the Maasai pastoralists who make up the majority of the population. The livestock here interact freely with wildlife.

The County has a bimodal rainfall pattern. The short rains fall between October and December while the long rains fall between March and May. Annual rainfall in Kajiado County is strongly influenced by altitude. Loitokitok which has a high elevation has the highest average rainfall of 1250mm while Magadi and Amboseli with the lowest elevation have the lowest annual average rainfall of about 500mm. Heavy rains also occur around Ngong Hills, Chyulu hills and Nguruman Escarpment. Temperatures in the county vary with both altitude and season. The highest temperatures of about 34°C are recorded around Lake Magadi while the lowest minimum of 10°C is experienced at Loitokitok on the Eastern slopes of Mt. Kilimanjaro. The coolest period is between July and August while the hottest months are from November to April throughout the County.

3.6.7 Machakos County

The proposed railway line enters Machakos County through Ulu, Kiu, Konza and passes through Stony Athi and Athi River towns. Machakos County is located in Eastern province. The county covers area of 6208 Km^2 with a population of 1,098,584 (2009 census). The County has a population density of 177people per km^2. Machakos town is the administrative capital of the County. The County has six constituencies namely Machakos Town, Masinga, Yatta, Kangundo, Kathiani, Mavoko and Mwala. Subsistence agriculture is practiced with Maize and drought-resistant crops such as sorghum and millet being grown.

The County is also host to the open air market concept with major market days where large amounts of produce are traded. Fruits, vegetables and other food stuffs like maize and beans are sold in these markets. The County has beautiful hilly scenery that is perfect for tourist related activities such as camping, hiking safaris, ecotourism and cultural tourism, dance and music festivals and many more. A number of establishments ensure the region has a well rounded hospitality industry. The County has been selected as the home to the upcoming Konza Technology City due to its close proximity to Nairobi, good infrastructure and availability of land. The proposed railway line will be integrated into the Konza city development.

The County is generally hot and dry. It has two rainy seasons, the long and the short rain seasons. The long rains seasons starts at the end of March and continues up to

May, while the short rains season starts at the end of October and lasts till December. The annual average rainfall ranges between 500mm to 1300mm. There are significant regional and seasonal variations within the County and rainfall reliability is quite low. Mean monthly temperatures vary between 18^{o}C and 25^{o}C. The coldest month is July while October and March are the hottest. The highland areas which receive higher rainfall are more suitable for rain-fed agriculture than the lowland areas, while the plains support ranching.

3.6.8 Nairobi County

The proposed railway line enters Nairobi through the Embakasi station which is going to be the main terminal. Nairobi is the capital city of Kenya that is situated in the south central highlands at an altitude of above 1,700 meters, covering an area of 696 km^2, a distance of about 480km to Mombasa. The County has a population of 3,138,369 (in 2009 census). The Nairobi city is the administrative city of the County and it has the following constituencies: Westlands, Parklands, Dagoretti, Karen/Langata, Kibira, Roysambu, Kasarani, Ruaraka, Kariobangi, Kayole, Embakasi, Mihango, Nairobi West, Makadara, Kamukunji, Starehe and Mathare.

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.

Nairobi County lies so close to the Equator but being 1680m above sea-level, its temperatures are altitude-modified tropical, but not torrid. 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. The Northern and Western areas have a high rainfall; the East and South a low rainfall.

3.7 Physiography, Terrain and Landform

Four prominent physiographic units are recognized in the Nairobi area reflecting the volcanic rock types and the tectonic movements which have affected them. They are the lava plains where the Embakasi station is proposed, the kikuyu highlands, the rift flank, and the Ngong hills (EPML, 2011). This is followed by a vast and arid region that extends to the east of the highlands and includes the middle section in the Makueni and Machakos area to the Coast province. This plateau, descending smoothly to the shores of the Indian Ocean, displays a smooth orography, only interrupted by

isolated low hill assemblies. Their main geographic features are in the zone of Tsavo: the Taïta Hills, to the west of Voi, and the Chyulu mountain range, that runs in parallel to the railroad and the Nairobi-Mombasa highway.

The landform from Mombasa to Nairobi belongs to typical tectonic plain, which is a flatland that slightly tilts down to the sea due to slow crustal uplift and continuous recession of the sea, along the Line, which can be divided into the zones of flatlands and highlands according to absolute elevation.

Mombasa is situated on the west coast of Indian Ocean, with an absolute elevation of around 20m, which belongs to the plain zone where the absolute elevation is generally below 200m within 20km to the interior from the coastline. The absolute elevation gradually rises to 1,700m towards along the direction to Nairobi, which belongs to the highland zone.

The terrain along the Line is relatively flat with few mountains, along the existing line, the region between Makindu and Konza is mountainous, but little ups and downs. The region between Emali and Sudan has many volcanic cones.

3.8 Geological Setting of the project route

Kenya is a country of many earthquakes, the East African Great Rift Valley passes across Kenya from north to south, besides its spectacular scenery of "a big scar on the skin of the Earth", which is also one of the global four biggest volcanoes and earthquake-prone areas.

The main unfavorable geological issues along the line mainly consist of artificial pot holes, earthquake areas, etc. The terminal of the Line is in Nairobi, which is on the east boundary of the Great Rift Valley, where the basic seismic intensity is, and the seismic peak ground acceleration is 0.15g. Neogene gypsum-carrying clay distributes in some parts, and gypsum is developed. The mining sites of gypsum are mainly found in the southeast of Athi River. Many pits caused by mining were found in the areas where the Line will run through. Such pits are not of the same size. Such pits range from 1.5 to 3.5m in diameter, and from 1 to 4m in depth. All of such pits are plumb shafts, and have some influence on the Project.

According to the soil survey data and exploration photo analysis, the Stratum Lithology along the Line generally consists of:

(1) The quaternary sedimentary layers, including:

Coastal marine sedimentary layers such as coral sediments and marine sand sediments; alluvial sediments in the plain and highland area, which are mixed sedimentary layers of various lithology formed by surface water flow sediments; alluvium, such as riverbed sediments in Voi River and Tsavo River;

Eluvium such as silt, silty clay, red clay and sandy clay that are formed by various weathered rocks; volcanic soils, consisting of volcanic sediments in the area close to

volcanic cones, which are loose, with relatively high contents of iron, magnesium and sulphur. According to the survey data, the quaternary sedimentary layer thickness along the line is generally within 10m.

(2) Rock Strata: According to the gathered data concerning strata, along the Line, there are: mudstone, shale (swelling - rock consists mainly of shale), sandstone and limestone formed in the period from Jurassic to Permian or Triassic; old crystal basement that is composed of various schist, gneiss and migmatite formed in the Precambrian Period; Volcanic lava rock that is formed by volcanic eruption consisting of porous olivine lava.

The region where Mombasa-Nairobi railway passes through is located in the east of the world-renown Great Rift Valley of East Africa, which is the world largest continental rift zone, also known as "Great Rift Valley" or the "Great Rift trench".

According to the Plate tectonics, it is the place where continental segments are separated, i.e., the East African area is exactly right located where the mantle materials show strong uplifts and flows. Due to the upward flow, the East African crust uplifted and formed highlands, which flowed to the opposite sides and produced a stretching force that made the weaker part of the crust cracked and rifted to form the rift zone. According to relevant measuring data, such cracks have an average velocity of 2-4cm/y, so far, the rift zone is still continuously expanding to both sides. Because it is an area of active crust movement, it has a lot of volcanoes and earthquake. Along the Line, Sultan Hamud vicinity situated a section of around 50km full of dense volcanic cones, which is a branch fault of East Africa Great Rift Valley.

The swelling rock consists mainly of shale, and is near Mombasa Low Mountain and hill area. The shale that distributes along the Line consists of Jurassic shale and Triassic shale, is grey and fuscous, and contains many hydrophilic minerals. The completely weathered shale is clastic, and the volume of such shale changes as its water content changes. Such completely weathered shale swells and becomes soft when being exposed to water, and shrinks, cracks and disintegrates in case of water loss.

The railway line transverses Palaeozoic and Mesozoic sediments along the coast. It then gets into basement system in the eastern region between south of Voi through Machakos and touches on the volcanic system near Kajiado and in the Nairobi area (Davies, 1993).

The coastal stretch around Mazeras transverses areas of the only records of Palaeozoic and lower Mesozoic times in Kenya, the Karroo system, noted for their fossil beds as is the case with the Mariakani sandstones.

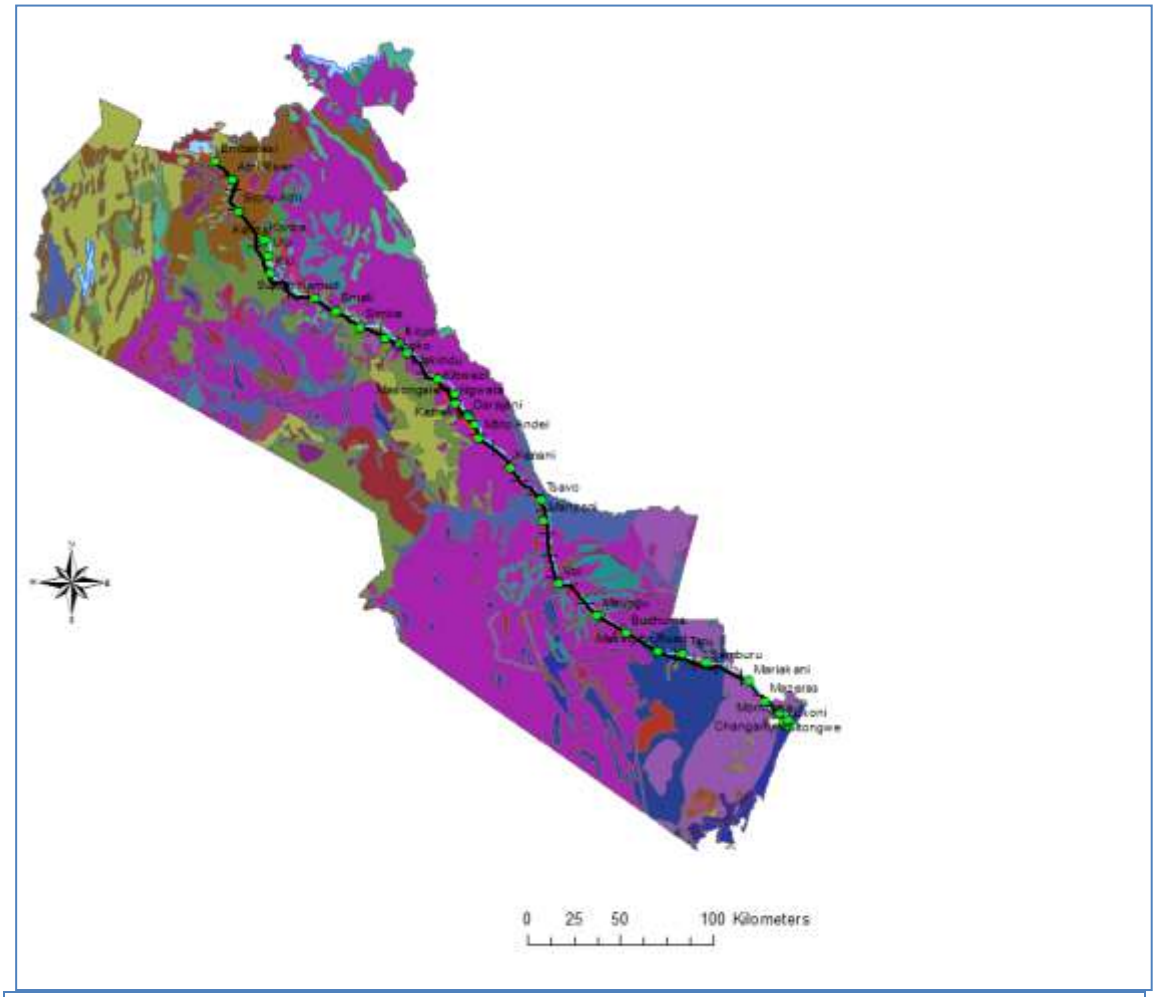
The Basement system is part of the Mozambique Belt: a complex of metamorphic, igneous and sedimentary rocks. It was formed in the Precambrian during the Katangan period. Marine sediments were deposited and later folded and metamorphosed due to Upper-Precambrian orogenesis (Schoeman, 1951).

The section between Kajiado and Nairobi, extending into Tanzania is covered by volcanic of Tertiary to Recent origin- the product of some of the tectonic disturbances that have so greatly affected the topography and drainage of the area. Volcanic activity within the rift during the Miocene resulted in flood phonolites that overflowed the rift which are now found in this area often referred to as Kapiti plains (Boshoven, 2002). The Great Rift Valley is only one feature of these disturbances. Associated with the formation of the Rift Valleys was an upwarping of large plateau surface which, with additional lava flows and ash deposits formed much of the Kenya Highlands as is the case with Ngong hills whose lava flows are evident at the proposed Embakasi station.

The geology of the area transacted by the proposed line can therefore be subdivided into three main sections namely: Volcanic rocks (Kajiado-Nairobi section), Pre-Cambrian Metamorphic Basement rocks (Taita-Machakos section) and Sedimentary rocks (Mombasa-Kwale section).

The Volcanic rocks cover a small section of the rail path with a lithology widely variable but mainly Phonolites with Tuffs in a few areas. The Metamorphic basement rocks are widely distributed in the area between Voi and Machakos and covers more than 50% of the path. The lithology is dominated by granitoids, gneisses and schists. The Sedimentary rocks cover the lower part of the line in the coastal areas and comprise of limestones, grits, arkoses, sandstones and siltstones.

The line thus generally passes through relatively stable geology other than along the coast where it passes through some sections of sedimentary formations which could be unstable upon excavation. As for the basement and volcanic sections, the rocks offer quite some stable ground for construction even though with pockets of thick Quaternary sediments mostly of terrestrial origin that include lake and river deposits from Pleistocene times and more recent alluvial and swamp deposits in some parts of the Eastern lowlands. The line also generally passes through low terrain with no major risks as to rock falls or landslides due to slope failure. It is only in a few sections where such instability could be experienced (see Figure 8 below).



Legend

LITHOLOGY

- Acid metamorphic rock
- Andesite, trachyte, phonolite
- Basalt
- Basic igneous rock
- Clastic sediments
- Conglomerate, breccia
- Diorite-syenite
- Eolian unconsolidated rock
- Fluvial
- Gneiss rich in ferro-magnesian minerals
- Gneiss, migmatite
- Granite
- Igneous rock
- Intermediate igneous rock
- Lacustrine unconsolidated rock
- Limestone, other carbonate rocks
- Marine unconsolidated rock
- Metamorphic rock
- Pyroclastic unconsolidated rock
- Quartzite
- Sandstone, greywacke, arkose
- Shale
- Siltstone, mudstone, claystone
- Ultrabasic igneous rock
- Water

Figure 8: Geology along the railway project corridor

3.9 Soils along the project route

Geology and geomorphology processes influence soil in that both are concerned with the processes of erosion in the current landscape and with deposition on the land of the products of that erosion. The soils in the study area are strongly related to the geology and geomorphology, with the hills and plains/uplands as the determining landforms. The soils vary along the length of the rail track based both on landform and geology.

Swelling soil: - The swelling soil distributes mainly in the black cotton soil sector and the small lateritic soil sector in Nairobi area. In addition, a small proportion of swelling soil is near Mombasa Low Mountain and hill area. The detailed distribution range of the swelling soil is presented in the part of the geological data. The swelling soil in the black cotton soil section consists of highly swelling soil and lowly swelling soil.

Soft soil:- The soft soil distributes mainly in the marine sedimentary deposit of Mombasa Island. The soft soil at DK1+000-DK2+000 and DK2+400-DK4+400 consists mainly of silty soil and silty sand, is homogeneous, wet-saturated, loose-a little tight, and thicker than 5m.

The soils at the start of the line at the coast ranging from *Eutric Regosols* around Mazeras to *vertic Luvisols* around Tarus described to be of saline sodic phase (FAO, 1990). The soils in this section have been described to cause corrosion of the railway tracks due to their high salinity and the constructor will need to take this into consideration in the design.

The middle section is a mix of red sandy and vertic soils. The hills in this section consist of quartz rich granitoid gneisses that were mostly metamorphosed during the folding. This parent material in combination with a mountainous topography has resulted in the formation of somewhat excessively drained, reddish brown, stony and rocky sandy clay loam soils, that vary in depth (Siderius, 1978).

The plains and uplands in the section that surround the hills consist of variety of less metamorphosed rock (mainly banded gneisses). The flat plains consist of ferromagnesian gneisses in which poorly drained, black cracking and swelling firm clay soils are found. In the uplands well drained dark reddish brown clay and sandy clay soils are formed (Ellenkamp, 2004).

In the section between Sultan Hamud and Embakasi, the soil consist of vertisols, known for their high shrink swell potential the soils comprise mainly of pelitic vertisols (FAO, 1990). Soils in this section therefore require special attention in the project design due to these geotechnical properties. The soils are known to experience over 50% change in volume through absorption and dispensing water. This offers a great challenge to engineering works where such soils are present and will thus require some mitigative measures in the process of project design.

In terms of hazards posed by the soils to the proposed line, in the areas south of Voi town the soils have been described to be of high corrosive properties thus, the need to mitigated against such possibility. The soils in the section between Voi and Sultan Hamud is generally good even though with high sand content thus of poor compaction. These soils could be described to be generally good for the project.

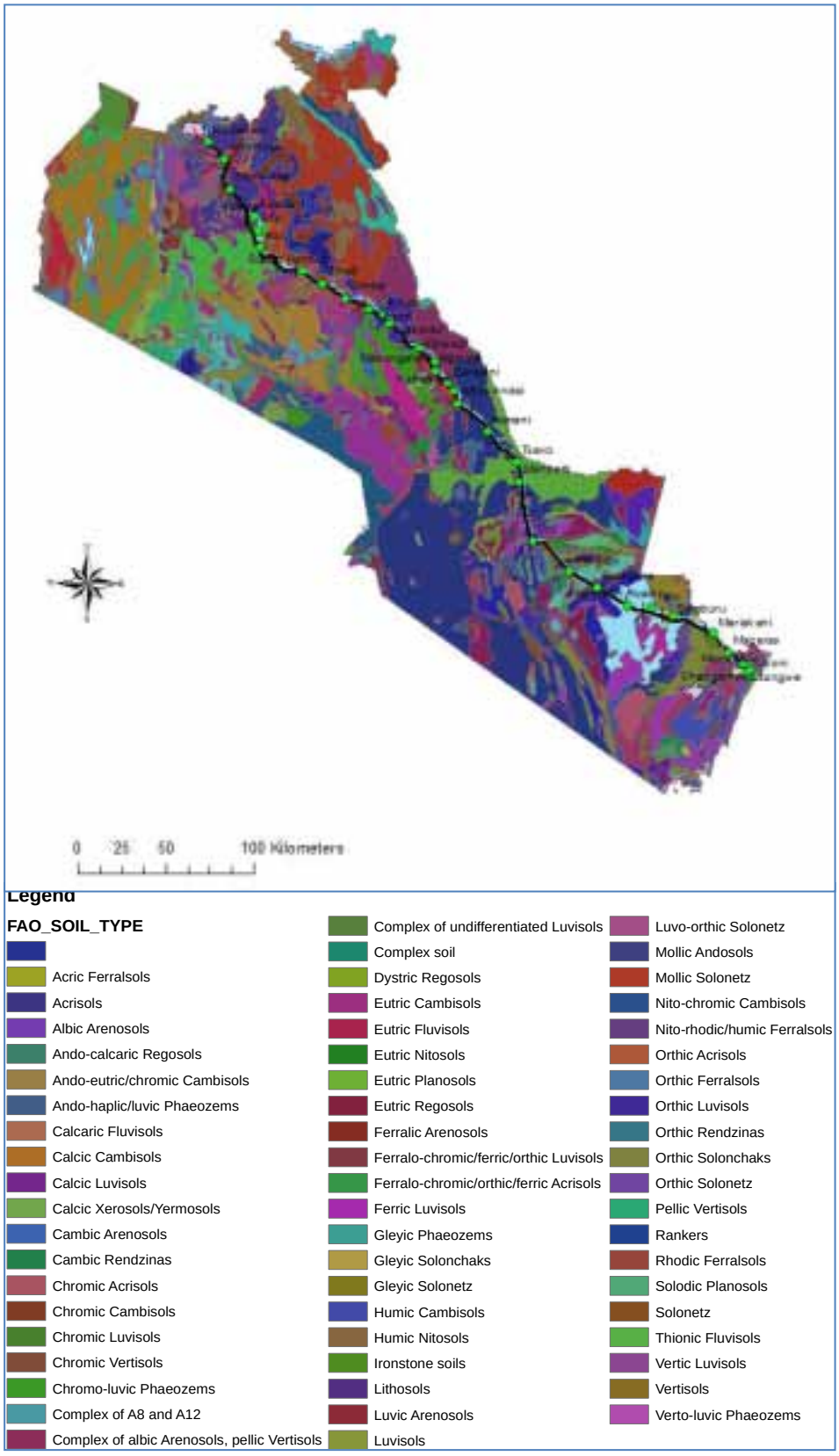


Figure 9: Soil Map along the railway project corridor

3.10 Water Resources Survey and Quality Analysis

3.10.1 Water Resources Survey

The proposed line passes across a number of permanent and seasonal rivers and wetlands. A number of water harvesting and distribution structures (bore holes, Earth dams, water piping and storage systems) are present along the project site. As part of the surveys, one of the tasks was to undertake baseline assessment of the potential impacts of the project on the water resources situated within the vicinity of the proposed railway activities, especially stations.

Wetlands: At Mazeras (09565309, 0559421), the proposed line will pass less than 50m from an expansive wetland (Plate 13). The proposed site, that forms the upper catchment, has been heavily eroded. The situation has been worsened by extensive farming activities on the upper catchment and within the wet land. The soils are unstable. Farming activities are highly prevalent (Plate 12). These activities interfered with the wetland through land clearing and over browsing/grazing. The wet land drains into a surface well that provides water for livestock and other domestic uses. Sustainable provision of this water is dependent on the future of the wet land. Though most of the wetlands around the world are known to be biodiversity hotspots, this one seems highly disturbed and degraded. Siltation and sedimentation of wetland from the project area and upper catchment are evident. To protect such wetlands, bridges will be designed for ecologically sensitive areas.

Plate 12: Mazeras wetland

Plate 13: Farming activities at Mazeras wetland

Rivers: The major sources of water are permanent and seasonal rivers that mostly drain into the Tana River drainage basin - Kenya's largest river that drains the Eastern flank of the Aberdares and the Southern slopes of Mount Kenya. The permanent river flows are characterized by moderate flows (base flows) during the dry season and high flows during the rainy season. The seasonal rivers are characterized by very low flows in dry season and high flows during rainy seasons, i.e. 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.

At Voi town, the proposed line will cut across the Voi River that provides water for domestic and construction activities within Voi town. Riverine vegetation along the river is characterized by key riverine species: *Acacia eliotar, Ficus thonningii, Cocos nucifera, Vangueria madagascarensis* among others. The riverine vegetation offer the necessary protection and stabilization of the river banks. Other anthropogenic disturbances such as sand harvesting and bricks making are prevalent on the banks of the river.

Other rivers that are within the project site include Manyani, Kambu, Kibwezi, Umani springs, Ulu and Athi. Kibwezi River and Umani springs originate from the Kibwezi forest (9734123, 383412). These water sources provide clean water to Kibwezi town residents as well as the local communities. Within the river and the springs, rich floral and faunal diversity is evidenced by high diversity of tree species and animals. Baboons and *colobus guezeras* use these water points for their water needs. The presences of these animals create an attractive spectacle to residents and passengers on transit along the Nairobi-Mombasa highway.

Earth dams: Since permanent rivers are few and far apart, earth 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 whose major land use activities are wildlife and livestock keeping depend on these dams as watering points during seasonal scarcity.

At Arroi village (9777828, 308227) and the larger Kajiado North, the area inhabited by the Maasai community who practice large scale livestock keeping some earth dams are strategically located within and adjacent in the remote and sparsely populated project area. Similar earth dams are also scattered in Kitengela, Lukenya, Athi river, Mlolongo (0269044, 5846866) and Embakasi (Plate 15). Some of the Earth dams have been constructed by government and NGOs while others are privately owned. Excavation of privately owned dams is a long-term and expensive undertaking especially for the marginalized Maasai community. At Embakasi area (0269044, 5846866) where project will pass, many dams that arose accidentally during construction of roads, factories and estates are randomly scattered (see Plate 14 below). In the process of excavating ballast for construction, open quarries are left that serve as water harvesting points. These are important watering points especially for the nomadic pastoralists and the locals who cannot afford excavating private dams.

Plate 14: Earth dam at Embakasi near the terminal

Boreholes and water piping and storage systems: To supplement water from other sources, boreholes have been sunk in the project area. Water piping systems criss-crosses the project site and storage structures such as tanks are also common. Bore holes sinking and construction of water piping and storage systems are expensive investments especially for the dryland and marginalised Kamba and Maasai communities. These water structures greatly support the rural livelihoods especially on the entire region that is prone to water scarcity.

At mazeras, the proposed line will cut across the Voi-Mazeras pipeline. At Taru, the line will also affect the main pipe line as well as a communal water kiosk and animal watering point (Plate 17&18). At Mackinnon, a borehole in Mbele primary school is adjacent the proposed line. At Miangeni (9707271, 405948), the World Vision and Ausaid funded Mangelete water project is adjacent to the proposed line. The piping system, water tanks and kiosk may be affected by the project. Scattered boreholes at the Aloe village in the large Kajiado North supplement water from Earth dams. Watering points, piping systems and tanks are prevalent at the Aloe village (see plate 15 and 16 below)

	
Plate 15: Main water pipeline at Taru	**Plate 16: Animal watering point at Taru**

3.10.2 Water Quality Analysis

For chemical analysis, the water samples were collected at four (4) sites, namely; (i) Miritini Swamp downstream of Changamwe Railways Terminal, (ii) Voi River downstream of Voi Railway Station, (iii) Kibwezi river downstream of Kibwezi Railway Station and (iv) Athi-River downstream of the proposed Railway Terminal. The sampling was carried out between 28th and 31st September 2012 and the laboratory analyses were carried out between 6th and 24th September 2012 *(See Appendix C for laboratory analysis results).*

The water samples were collected in clean 1 litre plastic bottles and were stored and transported according to the standard procedures. The full physical-chemical analysis of water samples collected in these stations were analysed at the Central Water Testing Laboratories (CWTL) of the Water Resources Management Authority in Nairobi. The main physical-chemical parameters that were tested are pH, Colour, Turbidity, Conductivity, Iron, Manganese, Calcium, Magnesium, Sodium, Potassium, Total Hardness, Total Alkalinity, Chloride, Fluoride, Nitrate, Nitrite, Sulphate, Free Carbon Dioxide and Total Dissolved Solids (TDS). In this report, the levels of the above listed parameters are compared with the World Health Organization (WHO) Standards and the Kenya Bureau of Standards (KEBS) (KS 459-1:2007) Standards. The results of the analysis are outlined below.

***pH*:** The pH of water in all the four (4) sampling stations were generally within the WHO and KEBS Standards, although there was a tendency for the levels to be towards the upper limit of the two standards. The pH ranged from 7.31 to 7.69.

***Colour*:** With the exception of the Athi River and Voi river, colour of water in other two (2) water bodies were within the WHO and KEBS Standards. At the Athi River sampling station, color was 60 mgPt/l which is above the WHO and KEBS Standard of a maximum of 15 mgPt/l. At the Voi River, color was 40 mgPt/l which is also above

the WHO and KEBS Standard of a maximum of 15 mgPt/l. In other two (2) water bodies, the levels were generally low, being of the order 5 mgPt/l.

Turbidity: The turbidity of water was very high (162.5 NTU) at Athi River sampling station and this was much higher than both the WHO and KEBS Standards. However, turbidity at the Miritini Swamp, Voi River and Kibwezi river were generally low (<3.3 NTU) and are therefore within the WHO and KEBS Standards.

Conductivity: The conductivity of water in the Miritini Swamp, Voi River, Kibwezi River and Athi River was generally within the WHO Standards. The highest levels were however recorded at Miritini Swamp (1261 µS/cm) and Voi River (1771µS/cm) but these were still relatively lower than the WHO standards (2500 µS/cm).

Iron*:* The levels of iron in water samples collected at the Miritini Swamp, Voi River, and Kibwezi River were generally within the WHO Standards. The highest levels were often less than 0.01 mg/l. However, the levels of iron in Athi River was high (1.7 mg/l) and above both the WHO and KEBS Standards.

Manganese: The levels of manganese in water samples collected at the Voi River and Athi River were generally above the WHO and KEBS Standards. The highest levels were often less than 0.01 mg/l. However, at the Miritini Swamp and Kibwezi river the levels were lower (0.02 mg/l) than the WHO and KEBS Standards.

Calcium*:* The levels of calcium in water samples collected at the Voi River was generally above the WHO and KEBS Standards. However, the levels were generally low and within the WHO and KEBS Standards at the Miritini Swamp, Kibwezi river and Athi River.

Magnesium*: The* levels of magnesium in water samples collected at the Miritini Swamp, Voi River, Kibwezi river and Athi River were generally within the WHO and KEBS Standards. However, there was a tendency for the levels at Miritini and Voi River to be relatively high, but still within the WHO and KEBS Standards.

Sodium*:* The levels of sodium in water samples collected at the Miritini Swamp, Voi River, Kibwezi river and Athi River were generally within the WHO and KEBS Standards. However, there was a tendency for the levels at Miritini (130.3 mg/l), Voi River (80 mg/l) and Kibwezi River (50 mg/l) to be relatively high, but within the maximum allowable level of 200 mg/l according to WHO and KEBS Standards.

Potassium*:* The levels of potassium in water samples collected at the Miritini Swamp, Voi River, Kibwezi river and Athi River were generally within the WHO and KEBS

Standards. However, there was a tendency for the levels at Voi River (10.1 mg/l) and Athi River (14 mg/l) to be relatively high but were still within the maximum allowable limit of 50 mg/l according to WHO Standards.

Total Hardness*:* The levels of the Total Hardness in water samples collected at the Voi River were generally higher (700 mg/l) than the WHO and KEBS Standards of 500 mg/l. However, the levels for Miritini Swamp, Kibwezi and Athi River were within the maximum allowable limit according to WHO and KEBS Standards. There was however a tendency for the levels at Miritini Swamp to be high (340 mg/l) although this is still lower than the WHO and KEBS Standards.

Total Alkalinity*:* The levels of the Total Alkalinity in water samples collected at the Miritini Swamp, Voi River, Kibwezi river and Athi River sampling stations were generally within the WHO and KEBS Standards. However, the levels for Miritini Swamp and Voi river tended to be relatively high (of the order 200 mg/l) although this is still within the maximum allowable level according to the WHO and KEBS Standards.

Chloride*:* The levels of Chloride in water samples collected at the Miritini Swamp, Kibwezi river and Athi River were generally within than the WHO and KEBS Standards. However, the levels for Voi river tended to be relatively high (of the order 400 mg/l) and was above the maximum allowable level of 250 mg/l according to the WHO and KEBS Standards.

Fluoride*:* The levels of Fluoride in water samples collected at the Miritini Swamp, Voi river, Kibwezi river and Athi River sampling stations were generally within than the WHO and KEBS Standards. However, the levels for Miritini Swamp, and Athi River tended to be relatively high (1.1 - 1.3 mg/l), but were still within the maximum allowable level of 1.5 mg/l according to the WHO and KEBS Standards.

Nitrate*:*The levels of Nitrate in water samples collected at the Miritini Swamp, Voi river, Kibwezi river and Athi river were generally within than the WHO and KEBS Standards. However, the levels for the Athi River tended to be relatively high (13.42 mgN/l), but was still within the maximum allowable level of 50 mgN/l according to the WHO and KEBS Standards.

Nitrite*:* The levels of Nitrite in water samples collected at the Miritini Swamp, Voi river and Kibwezi river sampling stations were generally within than the WHO and KEBS Standards. However, the levels for the Athi River tended to be relatively higher (1.18 mgN/l) than the maximum allowable level of 0.1 mgN/l according to the WHO and and 0.003 mgN/l according to KEBS Standards.

***Sulphate**:* The levels of Sulphate in water samples collected at the Miritini Swamp, Voi river, Kibwezi river and Athi river sampling stations were generally within than the WHO and KEBS Standards. However, the levels for the Miritini Swamp tended to be relatively high (82.43 mg/l), but was still within the maximum allowable level of 450 mgN/l according to the WHO and 450 mg/l according to KEBS Standards.

***Free Carbon Dioxide**:* The levels of Free Carbon Dioxide (CO_2) in water samples collected at the Miritini Swamp, Voi river, Kibwezi river and Athi river were generally variable ranging from 10 to 66 mg/l. Unfortunately there is no WHO and KEBS Standards on which to compare these levels. The highest free CO_2 levels were found at Kibwezi and Voi Rivers and were lowest at Athi River sampling station.

***Total Dissolved Solids (TDS)**:*The levels of Total Dissolved Solids (TDS) in water samples collected at the Miritini Swamp, Voi river, Kibwezi river and Athi river were generally within than the WHO and KEBS Standards. However, the levels for the Miritini Swamp (782 mg/l) and Voi river (1100 mg/l) tended to be relatively high, but was still within the maximum allowable level of 1500 mgN/l according to the WHO and 1000 mg/l according to KEBS Standards.

Generally, the water quality of Miritini Swamp and Kibwezi River can be said to be satisfactory in the sense that most of the key water quality parameters are within the acceptable WHO and KEBS standards. However, the water quality for Voi river and Athi river are below the WHO and KEBS Standards for some key parameters. In particular, the water quality of Voi River is below the two standards with regard to the levels of Color, Manganese, Calcium, Total Hardness, Chloride and the Total Dissolved Solids. Also, the water quality of the Athi River is below the WHO and KEBS standards with regard to the levels of Nitrite, Color, Turbidity, Iron and Manganese. The sources and causes of these high levels are suspected to anthropogenic in nature.

3.11 Land tenure system and human settlements

The land along the railway (Mombasa – Mackinon – Mtito Andei – Makindu), road is privately owned although none of the families interviewed possess a land Title deed, they possess letters of allotment. Next to the old railway, on the private land and within the railway compound are many human settlements. The houses consist of permanent and semi-permanent structures. The population is high (about 40 households within 100 square meters of land (Mariakani (95722876, 552232) /Mazeras (09565309, 0559421). After Mazeras, the population density is low except near the towns where it is high. The high population in the towns and the lack of livelihood support systems encourages vandalism of rails. Majority of households cultivate maize, cassava on their land and within the railway corridor. From Mombasa to Mazeras town most people interviewed are businessmen/women and of these 80

percent practice urban livestock keeping. The businesses include livestock trading, bar tending and shop keeping.

From Samburu - Mtito Andei - the majority of people outside the urban centres make charcoal for sale, cultivate crops (maize, pigeon peas, fruit trees) and grow vegetables (tomatoes, sukuma week) where irrigation is possible. This is in addition to livestock keeping.

From Kiboko to Konza, except in the towns, the population density is very low. The farmers in Kajiado own land title deeds, while those in Makueni and Machakos Counties do not have but only have allotment letters. Little crop cultivation occurs along this corridor. From Lukenya to Embakasi the railway passes through privately owned ranches and public land. In Mlolongo (0269044, 5846866) to Embakasi (0269044, 5846866) the proposed corridor is majorly occupied by urban squatters.

3.12 Livestock Farming Activities

No livestock was observed in the railway premises within and around the terminus in Mombasa town (0573375, 9551796). However, livestock was observed from Mariakani (9572876, 552232) to Bachuma Gate of Tsavo East (9594795, 493419). No livestock was observed after Bachuma upto where the Tsavo National Park ends at Mtito Andei. The population of animals increases in urban areas during the holiday seasons i.e. Christmas and Ramadhan. That is when some livestock accidents are reported along the existing rail line.

The livestock kept by the households in Mariakani area (9572876, 552232) include indigenous and exotic dairy cattle (Friesian and Friesian crosses), sheep, goats, ducks, turkey, chicken. The subsistence urban agriculture (livestock and crop farming) along the railway contribute to the livelihoods of the households. Animals could be seen grazing within the railway corridor where pastures are greener. The new railway will pass west of the old one at Mazeras i.e. Mbuyuni. This area has a high population of livestock (zebu cattle and goats) and plantations of mangoes and maize fields.

The number of households decreases from Mbuyuni (09565309, 0559421) to Kasimbandwela (9574211, 549230) and Samburu (9580873, 528161) where the new railway will pass a few kilometers west of the old railway and the Nairobi – Mombasa main road. Livestock are also few in these areas. At Kasimbandwela and Samburu, the main source of livelihood support is livestock farming, cultivation of maize and charcoal making. At Samburu the railway line passes near west of the town which is densely populated (50 -80 households per 100 meters square) and crosses the Mombasa - Nairobi highway and old railway as one enters Mackinon (9587961, 505057). The area is sparsely populated. The farmers near the site of the new rail corridor are both subsistence livestock and crop farmers.

From Mackinon through Tsavo National park along which the railway line will pass, there is a danger of attack by wild animals. From Mackinon (9587961, 505057) to the Buchuma gate of East Tsavo (9594795, 493419) are many livestock (zebu cattle, sheep and goats, donkeys). Many livestock (Indigenous Cattle, Sheep and Goats, Donkeys, Chicken) could be seen in the ranches in the Kiboko – Emali- Sultan Hamud-

Eloi – Enkarau-Ilmamen - Konza area east and west of the new Railway corridor (see Plate 17 below). From Konza to Embakasi there are Masai livestock ranches with cattle, sheep and goats.

Plate 17: Livestock Market in Sultan-Hamud situated next to the proposed line

3.13 Vegetation Characteristics

The land types along the Line are mostly savannas and shrubberies, where there are many national parks and wildlife reserves (See Figure 10 below). The land of residential density area is mostly farmland. The vegetation in the project area is characterized by urban/on-farm exotic trees, indigenous forests, savannah-type woodlands and grasslands, Tree research trial plots and sisal plantations.

Urban and On-Farm Exotic/Indigenous Trees: At the coastal region mainly areas within the vicinity of the port of Mombasa, Mombasa railway station (0573375, 9551796), Mombasa Moi International Airport and Mariakani(95722876, 552232), the vegetation is majorly under farm forestry (Plate 18) and Urban forestry(Plate 19). Fruit trees such as *Cocos nucifera* (Coconut) and *Mangifera indica*(Mango) forms at least 50% of farm forestry species while ornamental and indigenous species(Appendix D) form the other 50%. *Cocos nucifera* and *Mangifera indica* are major cash crops within the region. Urban forestry is highly developed in the coastal region. Urban and farm forestry are important in landscaping, reducing the heat by providing the cooling effects on the island, shade, wind break, fodder, fruits, construction materials, soil erosion control, bee foraging, medicinal value, fuel wood, nitrogen fixation among others (Cheboiwo & Langat, 2006). Most of these trees date back to the early 1900. This implies that the beauty of the island attributed to trees has taken over a century to be achieved.

Plate 18: Farm-forestry at Mariakani

Plate 19: Urban forestry in Mariakani town

Indigenous Forests: The main vegetation/forest types at the coast region are the mangrove forests, Arabuko-sokoke and Kaya forests and dryland forests such as Taita and Kibwezi forests. The mangrove ecosystem cushions the island against the impacts of ocean currents while at the same time stabilizing the riparian zones. The Arabuko-sokoke forests form an important catchment within the coastal region while the Kaya forests are important cultural and religious sites for the Mijikenda. The Taita forest forms a key part of the expansive Arc Mountains comprising of the Taita hills and Usambara Mountains in Tanzania. The Arc Mountains are important catchments in Taita land and Tanzania (USDA Forest Service, 2000). The Kibwezi forest is an important catchment for the dry Kibwezi region and its environs.

The new railway line will not affect mangrove and Arabuko-sokoke forests. Similarly, despite the railway passing adjacent the highly valued Kaya forests, the impact on the forest will be negligible since no clearance will be done. However, the new line passes through Kibwezi forest (Plate 20 below). The forest not only provides non-timber forest products but also acts a key water catchment in the dry zone. The forest acts as the main source of Kibwezi River and Umani springs that provide clean (Plate 21 below) and sustainable water for domestic use to Kibwezi town and its environs as well as serves as the main watering points for wildlife. The baboons, *Colobus guezellas* (monkeys) among others depend heavily on these water points. The Kibwezi forest, at the point where the new line will pass through, was subjected to other forms of anthropogenic disturbances in the past i.e. during construction of the Kenya pipeline from Mombasa to Nairobi, Mombasa-Nairobi highway, electric fence on the eastern side of the forest. All these infrastructures establishment not only led to vegetation clearance but also a compromise on the integrity, stability and resilience of the forest.

Plate 20: Kibwezi River

Plate 21: Water on Umani springs

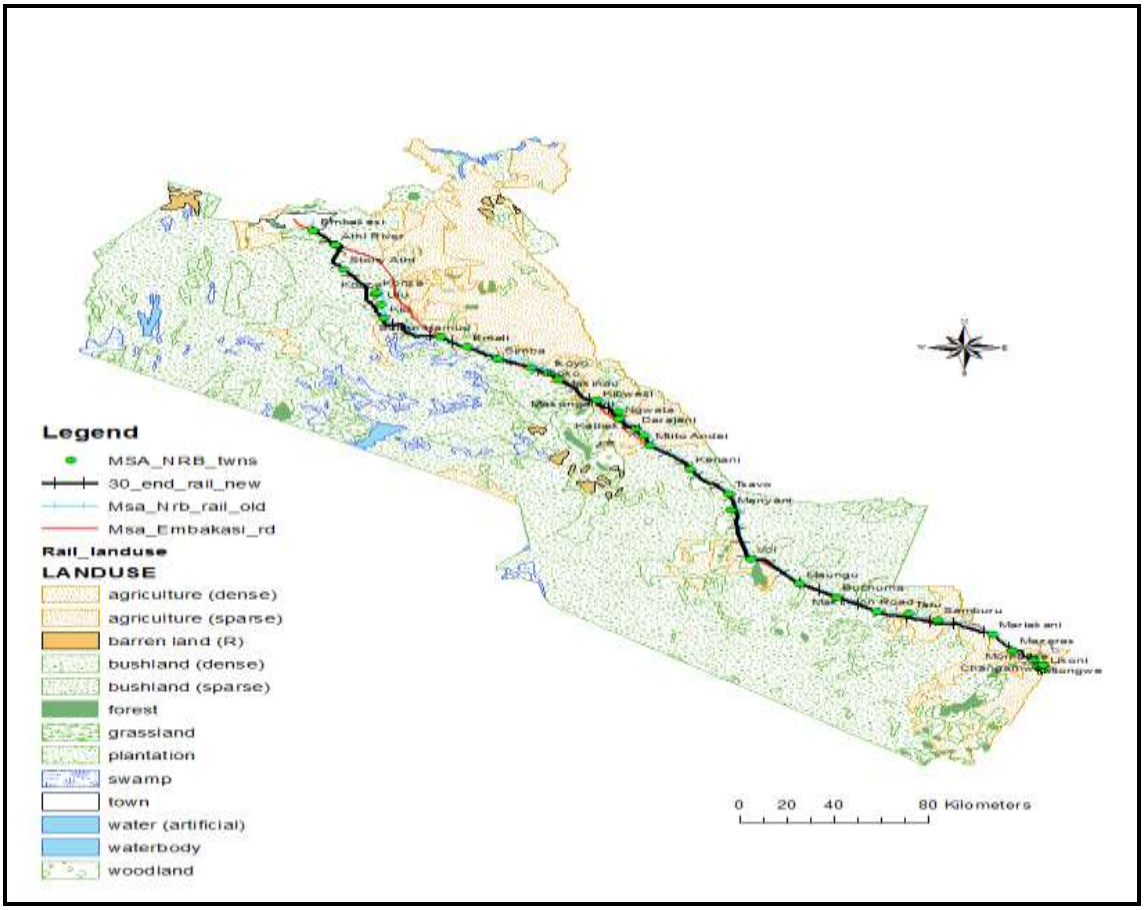


Figure 10: Map of land use along the project area

Savannah-type Woodlands and Grasslands: At the point where the proposed line will pass, the vegetation grades from mixed indigenous/exotic vegetation in Mombasa and its environs to Savannah-like woodland along Kasimbandwela (9574211, 549230) near Mazeras, Samburu (9580873, 528161), Taru, Mackinnon (9587961, 505057), Buchuma gate where the line enters Tsavo, Mutito Andei, Voi, Manyani, Miangeni, Kambu, Makindu, Ngiluni, Sondukai near Kiboko, Sultan Hamud, Aloe village, Uru and Ilmamen near Konza city. From Konza, the vegetation grades further

from Woodland to grassland with scattered and dwarfed acacia trees along Kitengela, Lukenya, Athi River, Mlolongo and Embakasi. The woodlands and grasslands vegetation is characterized by wild trees.

Tree research trial plots and sisal plantations: Extensive sisal plantations characterize the Taita-taveta and Mtito Andei regions. The proposed line passes through some of these plantations. Sisals is a major cash crop within this regions providing income to local investors and some small-scale farmers. It also provides employment at the farms to thousands of the locals who are landless peasants. The proposed line also passes adjacent to Kenya Forestry Research Institute (KEFRI) trial plots. At Ilmamen, Konza (9803417, 287376), the proposed line passes about 50m from the Eco-green demonstration site. The site sits on private land but acts as a demonstration site for the local community members. A number of dryland forestry activities are active at the site: plantation of *Eucalyptus camadulensis* and a tree nursery. Apiforestry (integration of bee keeping and forestry) is also being demonstrated here.

3.14 Wildlife

3.14.1 Profile of Wildlife in Protected Areas/ Tsavo National Park

One of the key areas where proposed railway line passes through is the Tsavo National Park. The Park covering an area of approximately 20,747 Km^2 was established as a national park in 1948 due to the high wildlife species diversity and wildlife numbers. Most of the land was seen unsuitable for crop farming due to lack of water. Livestock farming was detested because of the high tse tse fly infestation in most of the parts of Tsavo. In 1949, the Tsavo National Park was gazetted and divided into two for administrative purposes, with the area on the western side of the Mombasa – Nairobi highway forming Tsavo West (7065 Km^2) and Tsavo East being the area on the eastern side (13,747 Km^2). Since then, the two parks have established themselves as one of the most important biodiversity baskets in the country, attracting local and international researchers. The Tsavos are a reputed high-end tourist destination due to the high wildlife species diversity, wilderness value and good tourist facilities and as such are among the most visited parks earning the country the much needed foreign exchange.

Climate: The Tsavo climate is characterized by alternating dry and rainy seasons: a long dry seasons from June to October, short rains in November/December, a short dry season from January to March and long rains in April/May (Leuthold, 1973). However, this pattern is quite variable and often modified by 'out of season' rains or dry spells. Rainfall in the Tsavo West is generally higher and less erratic in spatial and temporal distribution than in Tsavo East National Park. Mean annual rainfall ranges between 250-500mm (Leuthold, 1973). Tsavo East is generally flat (300-500m above sea level) except for a few granitic hills while Tsavo West has more higher altitude and broken topography which include the Ngulia hills and the neighbouring Chyulu hills which rise about 1800m above sea level. These high altitude areas generally receive more rainfall.

Vegetation: The vegetation in the Tsavos is much related to the soils and a high degree of homogeneity is observed. *Acacia-Commiphora* woodlands dominate most of the undisturbed areas. *Combretum, Adansonia, Delonix, Melia volkensii* and *Balanites aegyptiaca* represent the common trees species. *Grewia bicolar, Grewia tenux, Grewia villosa* and *cordia sinensis* species are most common shrubs in the Tsavos. Additionally in areas where water seasonally collects like waterholes the common species include *Boscia augustifolia, Boscia coriacea, Acacia tortilis, Lawsonia inermis, Grewia bicolor* and *Rhus natalensis*. In terms of grasses diversity, Jensen and Belsky (1989) conducted a study on grassland homogeneity in Tsavos and observed that *Chloris roxburgghiana, Digitaria macroblephara* and *Eragrostis caespitosa* dominate most of the herbaceous species. Other common grass species observed during this study include *Cynodon, Sporobolus fimbriata* and *Panicum maximum*. Long term researches on grassland ecology have indicated that rainfall, soil type, fires, intense grazing and disturbance by wildlife, livestock and local differences in water infiltration as key in factors in influencing structure and homogeneity.

Soils/Geology*:* Most of this area comprises of rolling peneplain of low relief. The configuration is strongly influenced by the underlying geology, deviations from a flat surface being an expression of contrasting resistances to erosion of the sandstones, shale's and hard metamorphic rocks. Towards the north, the plain is eroded to a level of 200-250m by the perennial Galana River, which runs in front of the Yatta plateau, an extensive phenolithic lava flow which forms the most significant landmark in the northern part of Tsavo East.

The soils of the Tsavo show a wide range in depth, colour, drainage condition, structure and chemical and physical properties however, extreme differences in texture are uncommon. Most of the area of the rail corridor within the Tsavos has red sandy soils derived from the basement system. These soils are shallow in most areas and deepest at the base of hills. The soils are rich in quartz and ferruginous gravel with finer sand cemented by a red lateritic crust. Grey acid soils in form of dark heavy clays are an accumulation in the flat poorly drained plains and valley bottoms in the central and eastern parts of Tsavo East National park (Ayeni, 1974).

Drainage systems: The project area has few perennial rivers within the protected area such as Tsavo and Mtito which drain into Athi River. Several seasonal rivers also exist in the area including Voi and Mbololo rivers whose main catchment is the Taita hills of Wudanyi and Mbololo respectively. These water sources are very important in supplying water needs for wildlife, agriculture and domestic uses. Aruba dam on the Voi River and other scattered water holes and pans in protected areas are popular dry season wildlife concentration points.

Wildlife Diversity: The Tsavo ecosystem is an important biodiversity gene pool owing to the large contiguous area estimated to be over 40,000Km^2. The Tsavo national parks (East and West) constitute about 52 % of total protected areas in Kenya and therefore remain one of the focal areas by the government in terms of conservation. The Tsavo ecosystem hosts the largest single elephant population and about a third of the country's elephants (Ngene *et al*, 2011).

The elephant and buffalo (*Syncerus caffer*) constitute the main large mammal population in the area .Other common fauna in the protected areas and dispersal areas include the Kirk's dikdik (*Madoqua kirkii*), Impala (*Aepyceros melampus*), Masai giraffe (*Giraffa camelopardalis tippelskirchi)*, Burchell's zebra (*Equus burchellii*), Grevy's zebra (*Equus grevyi*), hirola (*Beatragus hunteri*), waterbuck (*Kobus ellipsiprymnus)*, Gerenuk (*Litocranius walleri*), lesser kudu (*Tragelaphus imberbis*), Black rhino (*Diceros bicornis*), warthog (*Phacochoerus aethiopicus*), yellow baboon (*Papio cynocephalus*), Lion (*Panthera leo*), leopard (*Panthera pardus*), spotted hyena (*Crocuta crocuta*), black-backed jackal (*Canis mesomelas*), wild dog (*Lycaon pictus*) and Cheetah (*Acinonyx jubatus*). (see Plate 22, 23 and below).

Plate 22: Common zebra herd and Elephants in Tsavo East

Plate 23: A Masai giraffe and Buffalos in Tsavo West

Plate 24: Birdlife in the Tsavos: (a) Black headed plover (b) Secretary bird

The presence of species listed under the IUCN Red List as vulnerable, endangered and even some critically endangered in the Tsavos calls for careful considerations while planning infrastructural development projects within the area.

Key economic activities at the Tsavo National Park in relation to the rail system: The main economic development in the Tsavos is tourism and related developments. These include tourist lodges and curio shops selling African artifacts to tourists who visit the National Parks for game viewing. Several tourist facilities have been constructed in and outside the protected areas to provide accommodation.

Tourism: The Tsavo National Parks are popular tourist destinations, receiving both local (citizens and residents) and foreign (non-residents) visitors throughout the year. Tsavo East National Park is most visited of the two parks and receives well over 200,000 visitors annually, while Tsavo West records over 100,000 visitors annually. Of all visitors recorded the highest percentage is non-residents, followed by citizens and residents constituting the smallest percentage. The main mode of transport used by visitors is by road and a small number uses 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 railway 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 from the over 300,000 currently recorded to probably well over 400,000 annually. This will arise from low costs of transport, comfort and reliability provided in rail system. This anticipated preference for rail transport is likely to have a major ripple effect on the economic growth in towns like Voi and Mtito Andei which will be terminals on the proposed new railway line.

Historical data/incidents/accidents along the Mombasa-Nairobi highway: Roads and railways are recognized for creating barrier effect with often demographic and genetic consequences. Key variables affecting road or rail transport system is the allowed corridor width, connectivity and usage intensity (Forman & Alexander, 1998). Studies show that many large predator species move along roads that have little vehicular or people traffic. The vicinity of a large natural vegetation patch and the area between such patches are likely road kill locations for foraging or dispersing animals, with even more likely locations being where major wildlife movement routes are interrupted such as in roads crossing, drainage valleys and open landscapes on the effect of crossing railway routes. Evidence from past surveys indicate that carnivores do not cross highways at random, but rather focus their crossing activity in locations that vary with passage characteristics, road related attributes, surrounding habitat characteristics and human disturbance levels (Grilo *et al*, 2008)

KWS conducts regular road kill data collection between Mtito Andei and Mackinnon which is restricted to the Mombasa – Nairobi highway. This road kill data indicates that the most affected species are small mammals including different species of rodents, dikdiks, hares and carnivores (Table 12 below). Road kill incidents involving reptiles are also high. The data also indicates that large mammals like the buffalo and elephant are also at risk. Of all the cases presented in Table 14 below, one incident involving an elephant was caused by a train in Maungu area. It is therefore, important for KWS to continuously undertake road/rail kill data collection to inform infrastructural planning processes. During the dry season (June-September), wildlife (Buffalo, elephant, giraffe) stray from the Tsavo Parks in search of water and pasture and are a serious threat to human life and this is when most accidents are reported.

Table 12: Most affected species by transport systems 2007-2012

Animal species	Frequency
Rodents	304
Dikdiks	75
Hare	59
Snakes	70
Genet	33
Spotted hyena	25
Mongoose	19
Buffallo	11
Squirrel	9
Olive baboon	9
Civet	9
Monitor lizard	8
Hedgehog	8
Zebra	6
Tortoise	6
Black backed jackal	5
Elephant	4

Data source: KWS road kill research database

Animal Crossings along the Existing Railway: Data used in this analysis has focused on the elephant which is a flagship species in the Tsavo ecosystem. The data on train-elephant collision hot spots also corresponds very well with known traditional elephant movement routes as shown in Figure 11 below; hence it is important to put adequate mitigation measures to ensure the East-West wildlife movement is maintained in Bachuma, Maungu, Ngutuni, Ndara, Manyani, Kyulu station and Kenani areas.

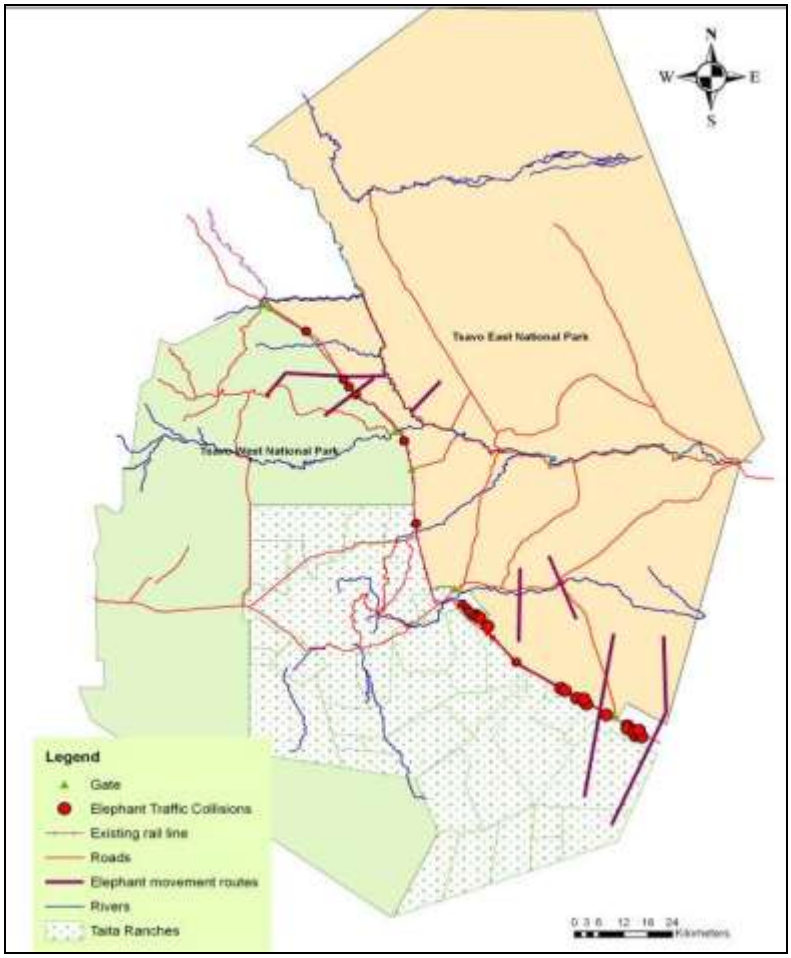


Figure 11: ***Showing major elephant crossing points and sites along the existing rail line where train-elephant collision incidents have been recorded in the period 2007-2012.***

3.14.2 Existence of Wildlife outside the Protected Areas

There exists a lot of wildlife along the project site which are outside government protected areas. Many crows were observed in the Railway terminus in Mombasa, while many monkeys were observed along the road and near the railway at Manyani and the Kibwezi forest. Neighboring the Tsavo National Park are many ranches. The wildlife in these ranches migrates to and from the Tsavo National Park, across the railway corridor through known wildlife corridors. Many wildlife (Wildebeest, Antelope, Ostrich, Giraffe, Kuddu) were observed on private land around Ilmamen, Konza, Kajiado. There are many wildlife (Wildbeeste, grants gazelle, antelopes, ostrich and zebra on Lukenya Ranch (0273786, 9831088) (see Plate 25 below).

Plate 25: An Ostrich and Giraffe on private land near the proposed railway line in Kapiti Plains

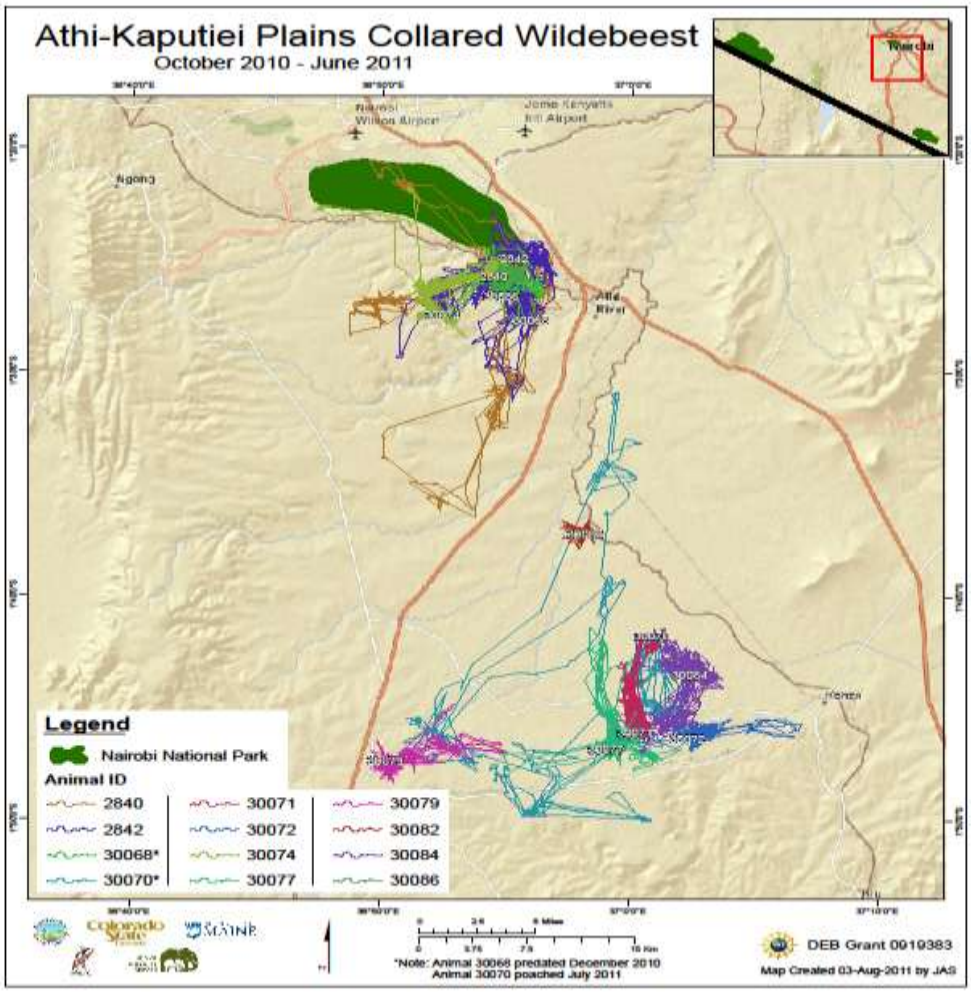


Figure 12: Movement of collared wildebeests within the Athi-Kapiti plains- (different colors indicate different group movements)

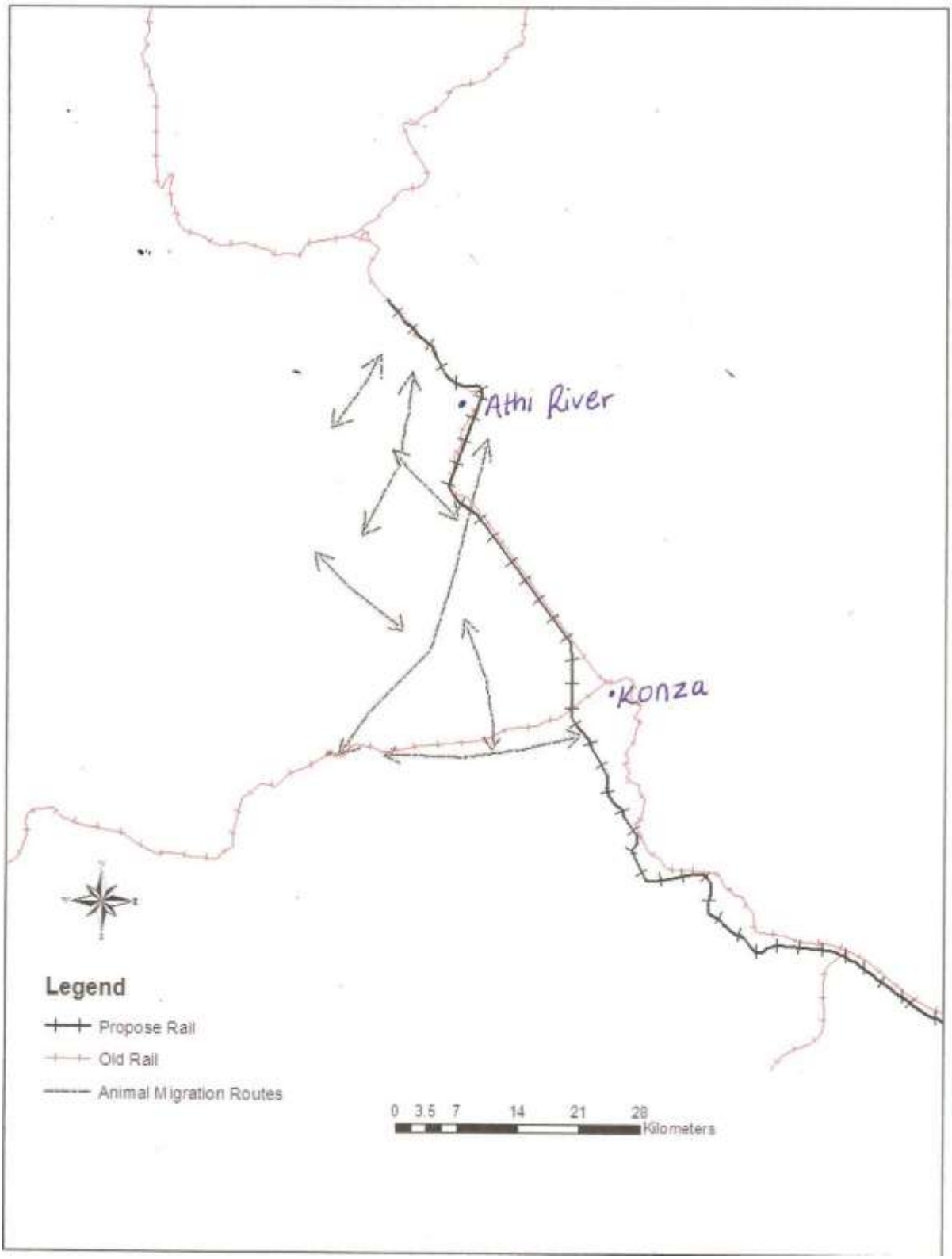


Figure 13: Movement of collared wildebeests within the Athi-Kapiti plains in relation with the existing and planned railway lines

Land use activities: Land use activities such National parks, group ranches and livestock ranches by the Maasai tribe predominate the area (Figure 14, Plate 26 below). Land holding by the Parks, group ranches and livestock ranches is large.

Present in the woodlands are infrastructures such as electric fences in the park, game drives, offices, roads, game corridors among others. For instance, at Buchuma gate, East Tsavo, the proposed line enters the park at this point, the line passes less than 30m from the park electric fence and less than 10m from a game drive circuit, less than 40m from a game moat made to control elephants and barely less than 100m from Bachuma Gate (9594795, 493419). The Rukingo game corridor, where the line crosses provides an important wildlife migratory route from Tsavo West to Tsavo East.

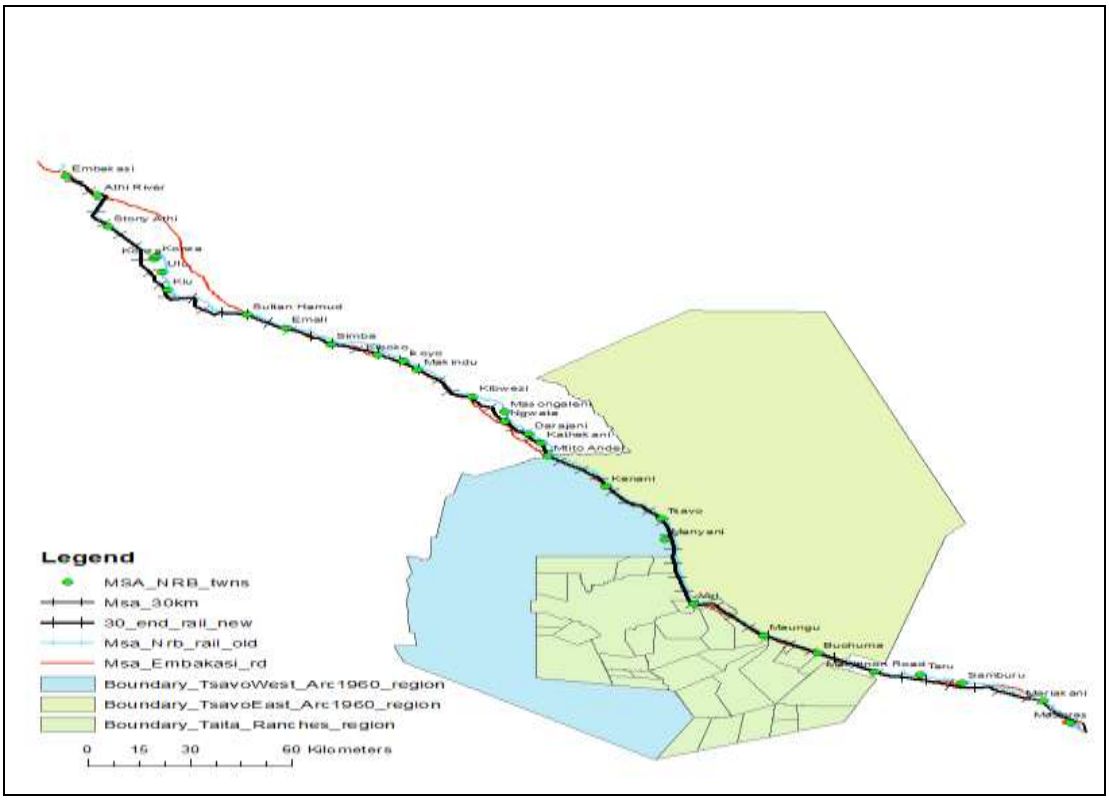


Figure 14: Map of predominant wildlife land use along the project site

Plate 26: Expansive woodlands and grasslands under livestock and wildlife activities

4 RELEVANT LEGISLATIVE AND REGULATORY FRAMEWORK

There is a growing concern in Kenya and at global level that many forms of development activities cause damage to the environment. A major national challenge today is how to maintain sustainable development without damaging the environment. Kenya is today faced with grave environmental problems and challenges. Among 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 the local communities in the participatory planning and management of their environment and natural resources and the environment in general. The Government of Kenya 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 impact negatively on the environment, human health and socio-economic well-being of the people who interact with such projects.

Until 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 on this, establishment of appropriate policies and legal guidelines as well as harmonization of the existing ones have been accomplished or is in the process of development. The NEAP process introduced environmental assessments in the country culminating into the enactment of the Policy on Environment and Development under the Sessional Paper No. 6 of 1999.

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 study are presented below. An EIA 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 EIA studies in accordance with section 58 (1- 4) of the Act.

Projects under the Second Schedule comprise those considered to pose potentially negative environmental impacts. This ESIA has been prepared to fully comply with environmental legislations for Projects with Impacts and as per various NEMA Regulations.

4.1 The Constitution of Kenya

The provisions of Chapter IV (Protection of Fundamental Rights and Freedoms of The Individual) protects citizens from deprivation of property. No property of any description shall be compulsorily taken possession of, and no interest in or right over property of any description shall be compulsorily acquired, except where it is necessary for public interest. Every person has also the the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures.

Chapter V (Land and Environment) of the constitution gives provisions of protecting land, environment and natural resources. The State is required to:—

a) Ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of the accruing benefits;
b) Work to achieve and maintain a tree cover of at least ten per cent of the land area of Kenya;
c) Protect and enhance intellectual property in, and indigenous knowledge of, biodiversity and the genetic resources of the communities;
d) Encourage public participation in the management, protection and conservation of the environment;
e) Protect genetic resources and biological diversity;
f) Establish systems of EIA, environmental audit and monitoring of the environment;
g) Eliminate processes and activities that are likely to endanger the environment; and
h) Utilize the environment and natural resources for the benefit of the people of Kenya.

Every person has a legal duty to cooperate with State organs and other persons to protect and conserve the environment and ensure ecologically sustainable development and use of natural resources.

4.2 Kenya Vision 2030

Kenya Vision 2030 is the new country's development blueprint covering the period 2008 to 2030. It aims at making Kenya a newly industrializing 'middle income country providing high quality life for all its citizens by the year 2030. The vision has been developed through an all-inclusive stakeholder consultative process, involving Kenyans from all parts of the country. The vision is based on three 'pillars' namely; the Economic Pillar, the Social Pillar and the Political Pillar. The vision 2030 comes after the successful implementation of the Economic Recovery Strategy (ERS) for Wealth and Employment Creation 2003-2007.

The Kenya Vision 2030 economic pillar aims at providing prosperity of all Kenyans through an economic development programme aimed at achieving an average GDP growth rate of 10% per annum over the next 25 years from the year 2008. The social pillar seeks to build 'a just and cohesive society with social equity in a clean and secure environment'. On the other hand, the political pillar aims at realizing a democratic political system founded on issue–based politics that respects the rule of law, and protects the rights and freedoms of every individual in the Kenyan society.

The proposed project is one of the flagship projects that falls under the Economic Pillar whereby Kenya plans to construct more new standard gauge railways in 12 years in order to form a modern railway network within the country by 2030.

4.3 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 (KMFRI), the Kenya Agricultural Research Institute (KARI) among others. There are also local and international NGOs involved in environmental issues in the country.

4.3.1 National Environmental Council (NEC)

EMCA 1999 No. 8 part iii section 4 outlines the establishment of the National Environment Council (NEC). Top most in the administration of EMCA is National Environment Council (NEC), which is responsible for policy formulation and directions for purposes of EMCA; set national goals and objectives and determines policies and priorities for the protection of the environment and promote co-operation among public departments, local authorities, private sector, non-governmental organizations and such other organizations engaged in environmental protection programmes. NEC also performs such other functions as assigned under EMCA. The implementing organ is National Environment Management Authority (NEMA) (see Figure 15 below).

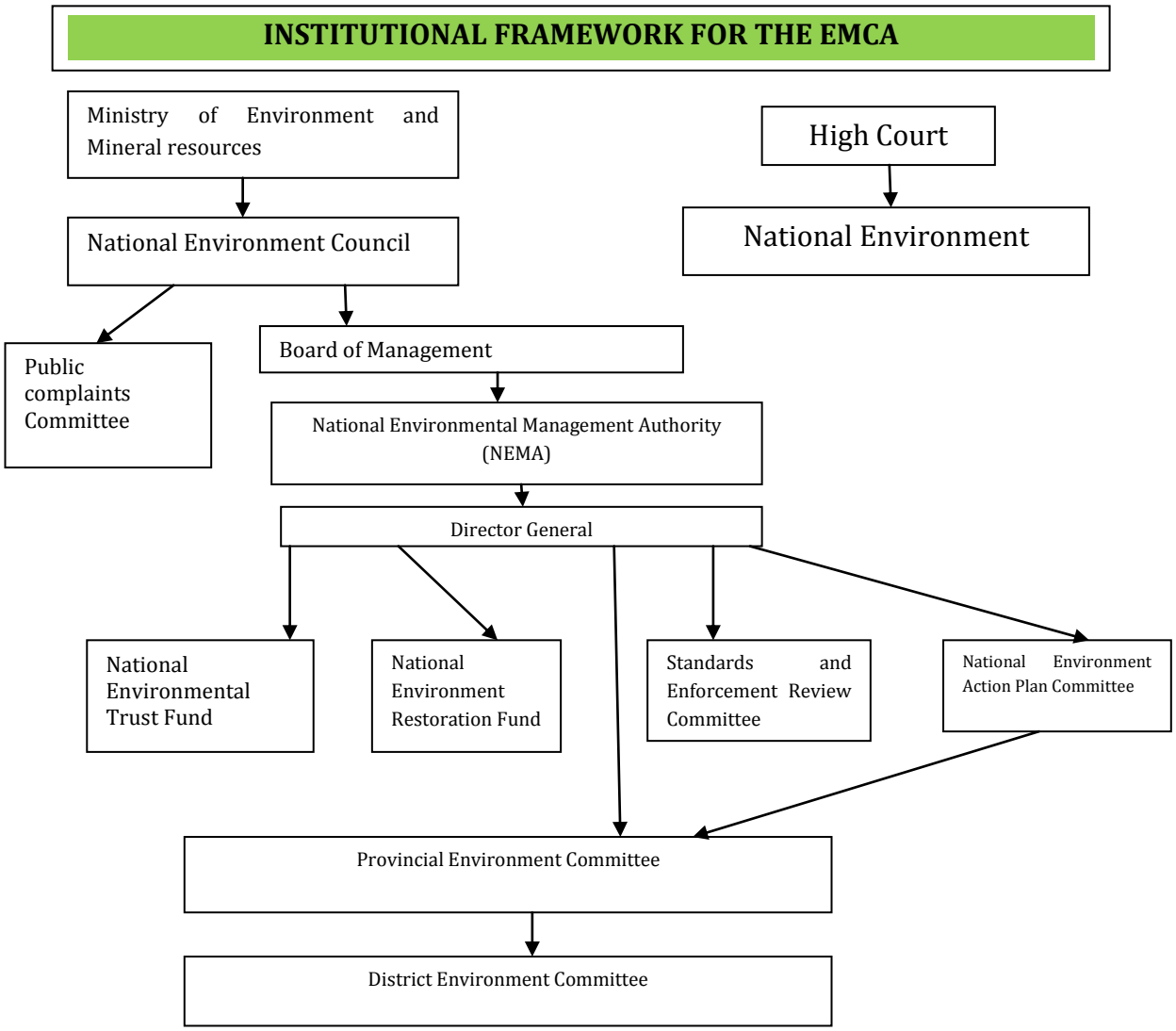


Figure 15: EMCA, 1999 Institutional Framework

4.3.2 National Environmental Management Authority (NEMA)

The object and purpose for which NEMA is established 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. A 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 to 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 in the proper management and conservation of the environment.
- Advise the government on legislative and other measures for the management of the environment or the 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.
- 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:

4.3.3 Provincial and District Environment Committees

According to EMCA, 1999 No. 8, the Minister by notice in the gazette appoints Provincial and District Environment Committees of the Authority in respect of every province and district respectively.

District Environment Committee: District Environment Committees are responsible for the proper management of the environment within the District in respect of which they are appointed. They are also to perform such additional functions as are prescribed by the Act or as may, from time to time be assigned by the Minister by notice in the gazette. The decisions of these committees are legal and it is an offence not to implement them.

Provincial Environment Committee: Like in the case of District Environment Committees, the Provincial Environment Committee is responsible for the proper management of the environment within the province, which they are appointed. They are also to perform such additional functions as prescribed by this Act or as may from time to time be assigned by the Minister by notice in the gazette. For this project, the comments of the Provincial Environment Committees of Nairobi, Eastern, Rift Valley and Coast will be very crucial to the decision making process. Due to the on-going restructuring of NEMA to County levels, the comments of relevant NEMA Directors based eight (8) Counties: Mombasa, Kilifi, Kwale, Taita-Taveta, Makueni, Kajiado, Machakos and Nairobi will be very useful.

4.3.4 Public Complaints Committee

The 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 perform such other functions and excise such powers as may be assigned to it by the council.

4.3.5 National Environment Action Plan Committee

This Committee is responsible for the development of a 5-year Environment Action plan among other things. 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 as 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.
- Prioritise 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.

4.3.6 Standards and Enforcement Review Committee

This is a technical Committee responsible for environmental standards formulation methods of analysis, inspection, monitoring and technical advice on necessary mitigation measures.

Standards and Enforcement Review Committee consists of the members set out in the third schedule to the Environmental Management and Co-ordination Act. The Permanent Secretary under the Minister is the Chairman of the Standard and Enforcement Review Committee. The Director General appoints a Director of the Authority to be a member of the Standards and Enforcement Review Committee who is the Secretary to the committee and who provides secretarial services to the Committee. The Committee also regulates its own procedure. The Standard and

Enforcement Review Committee may co-opt any person to attend its meetings and a person so co-opted shall participate at the liberations of the committee but shall have no vote. Finally, the Committee shall meet at least once every three months for the transactions of its business.

4.3.7 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 to this project arise, they are supposed to be presented here for hearing and legal direction.

4.4 Environmental Policy and Legal Framework

4.4.1 National Environmental Action Plan (NEAP)

The NEAP for Kenya was prepared in mid 1990s. It was a deliberate policy effort to integrate environmental considerations into the country's economic and social development. The integration process was to be achieved through a multi-sectoral approach to develop a comprehensive framework to ensure that environmental management and the conservation of natural resources are an integral part of societal decision-making.

4.4.2 Environmental Management and Co-ordination Act (EMCA) 1999

Environmental Management and Co-ordination Act No. 8 of 1999, provide a legal and institutional framework for the management of the environmental related matters. It is the framework law on environment, which was enacted on the 14th of January 1999 and commenced in January 2002. The Environmental Management and Co-ordination Act, 1999, is the legislation that governs ESIA studies. The Proponent carried out an ESIA as per the second schedule of this act. This schedule lists the projects required to undergo EIA studies in accordance with section 58 (1-4) of the act. Transport is covered in part 3 of this schedule and this includes railway lines (3c). The proposed Mombasa – Nairobi Standard Gauge Railway line falls in this category of projects for which EIA is mandatory. This railway line can also be classified as rural per-urban and urban development. The Act provides for the National Environmental Management Authority (NEMA) whose objective and purpose is to exercise general supervision and coordination 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.

Following the introduction of EIA and Audit Regulations, (2003) issued through Kenya Gazette Supplement No. 56 of 13 June 2003, the submission of environmental reports became mandatory. According to these regulations no proponent shall implement a project likely to have a negative environmental impact or for which an ESIA has not been concluded and approved in accordance with these regulation.

This Project falls within Schedule 2 of EMCA 1999 and therefore requires an EIA. The Proponent has commissioned the ESIA study in compliance with the Act. The Proponent shall be required to commit to implementing the environmental

management plan laid out in this report and any other conditions laid out by NEMA, prior to being issued an EIA license.

4.4.2.1 Environmental Impact Assessment and Audit Regulations, 2003

Environmental Impact Assessment (EIA) is a critical examination of the effects of a project on the environment. The goal of an EIA is to ensure that decisions on proposed projects and activities are environmentally sustainable. An EIA is conducted in order to identify impacts of a project on the environment, predict likely changes on the environment as a result of the development, evaluate the impacts of the various alternatives on the project and propose mitigation measures for the significant negative impacts of the project on the environment.

The EMCA, 1999 requires that during the EIA process a proponent shall in consultation with the Authority seek views of persons who may be affected by the project or activity through posters, newspaper, radio and hold at least three public meetings with the affected parties and communities. The Project proponent pays for the entire EIA process. The fee payable to NEMA is 0.05% of the project cost.

Environmental Audit (EA) is the systematic documentation, periodic and objective evaluation of activities and processes of an ongoing project. The goal of EA is to establish if proponents are complying with environmental requirements and enforcing legislation. The purpose of EA is to determine the extent to which the activities and programs conform to the approved environmental management plan. A comprehensive EA ensures a safe and healthy environment at all stages of project operations and decommissioning.

An initial environmental audit and a control audit are conducted by a qualified and authorized environmental auditor or environmental inspector who is an expert or a firm of experts registered by the Authority. In the case of an ongoing project the Authority requires the proponent to undertake an initial environmental audit study to provide baseline information upon which subsequent environmental audits shall be based.

Self Audits are carried out after the ESIA study report has been approved by the Authority or after the initial audit of an ongoing project. The proponent shall take all practical measure to ensure the implementation of the environmental management plan by carrying out a self-auditing study on a regular basis.

This report complies with the requirements of the Environmental Regulations in the coverage of environmental issues, project details, impacts, legislation, mitigation measures, management plans and procedures. The Proponent shall be required to commit to implementing the environmental management plan laid out in this report and any other conditions laid out by NEMA.

4.4.2.2 Water Quality Regulations, 2006 (Legal notice No. 121)

Water Quality Regulations apply to water used for domestic, industrial, agricultural, and recreational purposes; water used for fisheries and wildlife purposes, and water

used for any other purposes. Different standards apply to different modes of usage. These regulations provide for the protection of lakes, rivers, streams, springs, wells and other water sources. The objective of the regulations is to protect human health and the environment. The effective enforcement of the water quality regulations will lead to a marked reduction of water-borne diseases and hence a reduction in the health budget.

The regulations also provide guidelines and standards for the discharge of poisons, toxins, noxious, radioactive waste or other pollutants into the aquatic environment in line with the Third Schedule of the regulations. The regulations have standards for discharge of effluent into the sewer and aquatic environment. While it is the responsibility of the sewerage service providers to regulate discharges into sewer lines based on the given specifications, NEMA regulates discharge of all effluent into the aquatic environment.

Everyone is required to refrain from any actions, which directly or indirectly cause water pollution, whether or not the water resource was polluted before the enactment of the Environmental Management and Coordination Act (EMCA) Gazetted in 1999. It is an offence to contravene the provisions of these regulations with a fine not exceeding five hundred thousand shillings.

4.4.2.3 Waste Management Regulations, 2006 (Legal notice No. 121)

The Minister for Environment and Natural Resources gazetted these regulations in 2006. These Regulations may be cited as the Environmental Management and Co-ordination (Waste Management) Regulations, 2006. Waste Management Regulations are meant to streamline the handling, transportation and disposal of various types of waste. The aim of the Waste Management Regulations is to protect human health and the environment. Currently, different types of waste are dumped haphazardly posing serious environmental and health concerns. The regulations place emphasis on waste minimization, cleaner production and segregation of waste at source.

The Proponent shall observe the guidelines as set out in the environmental management plan laid out in this report as well as the recommendation provided for mitigation /minimization /avoidance of adverse impacts arising from the Project activities.

4.4.2.4 Controlled Substances Regulations, 2007 (Legal Notice No.73 of 2007)

The Controlled Substances Regulations defines controlled substances and provides guidance on how to handle them. This regulation mandates NEMA to monitor the activities of persons handling controlled substances, in consultation with relevant line ministries and departments, to ensure compliance with the set requirements. Under these regulations, NEMA will always be publishing a list of controlled substances and the quantities of all controlled substances imported or exported within a particular. The list will also indicate all persons holding licenses to import or export controlled substances, with their annual permitted allocations.

The regulations stipulate that controlled substances must be clearly labeled with among other words, "Controlled Substance-Not ozone friendly'') to indicate that the substance or product is harmful to the ozone layer. Advertisement of such substances must carry the words, "Warning: Contains chemical materials or substances that deplete or have the potential to deplete the ozone layer."

Producers and/or importers of controlled substances are required to include a material safety data sheet. Persons are prohibited from storing, distributing, transporting or otherwise handling a controlled substance unless the controlled substance is accompanied by a material safety data sheet. Manufacturers, exporters or importers of controlled substances must be licensed by NEMA. Further, any person wishing to dispose of a controlled substance must be authorized by NEMA. The licensee should ensure that the controlled substance is disposed of in an environmentally sound manner. These regulations also apply to any person transporting such controlled substances through Kenya. Such a person is required to obtain a Prior Informed Consent (PIC) permit from NEMA.

4.4.2.5 Conservation of Biodiversity Regulations 2006

These are supposed to ensure Conservation of Biodiversity in the country because, Kenya has a large diversity of ecological zones and habitats including lowland and mountain forests, wooded and open grasslands, semi-arid scrubland, dry woodlands, and inland aquatic, and coastal and marine ecosystems. In addition, a total of 467 lake and wetland habitats are estimated to cover 2.5% of the territory. In order to preserve the country's wildlife, about 8% of Kenya's land area is currently under protection. One requires NEMA approvals is areas of rich biodiversity are going to be affected by a development project.

4.4.2.6 Air Quality Regulations, 2008

The objective these Regulations is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources, including as mobile sources (e.g. motor vehicles) and stationary sources (e.g. industries) as outlined in the Environmental Management and Coordination Act, 1999. It also covers any other air pollution source as may be determined by the Minister in consultation with the Authority. Emission limits for various areas and facilities have been set. The regulations provide the procedure for designating controlled areas, and the objectives of air quality management plans for these areas. The Proponent shall observe policy and regulatory requirements and implement the mitigation measures proposed in this document in an effort to comply with the provisions of these Regulations on abatement of air pollution.

4.4.2.7 Noise and Excessive Vibration Pollution Control Regulations, 2009

These regulations were published as legal Notice No. 61 being a subsidiary legislation to the Environmental Management and Co-ordination Act, 1999. The regulations provide information on the following:

- Prohibition of excessive noise and vibration

- Provisions relating to noise from certain sources
- Provisions relating to licensing procedures for certain activities with a potential of emitting excessive noise and/or vibrations and
- Noise and excessive vibrations mapping

According to regulation 3 (1), no person shall make or cause to be made any loud, unreasonable, unnecessary or unusual noise which annoys, disturbs, injures or endangers the comfort, repose, health or safety of others and the environment. Regulation 4 prohibits any person to (a) make or cause to be made excessive vibrations which annoy, disturb, injure or endanger the comfort, repose, health or safety of others and the environment; or (b) cause to be made excessive vibrations which exceed 0.5 centimeters per second beyond any source property boundary or 30 metres from any moving source. Regulation 5 further makes it an offence for any person to make, continue or cause to be made or continued any noise in excess of the noise levels set in the First Schedule to these Regulations, unless such noise is reasonably necessary to the preservation of life, health, safety or property.

The Proponent shall observe policy and regulatory requirements and implement the measures proposed in this documenting an effort to comply with the provisions of the Regulations.

4.4.2.8 Wetlands, River Banks, Lake Shores and Sea Shore Management Regulation, 2009

This Act applies to all wetlands in Kenya whether occurring in private or public land. It contains provisions for the utilization of wetland resources in a sustainable manner compatible with the continued presence of wetlands and their hydrological, ecological, social and economic functions and services. The project traverses several rivers, wetlands and streams. The Proponent shall comply with the provisions of the Act in protecting wetlands, preventing and controlling pollution and siltation of rivers.

4.4.2.9 Prevention of pollution in coastal Zone and other Segments of the Environment) Regulation, 2003

The objective of these Regulations is to provide for prevention, control and abatement measures of shipping activities to ensure harmful substances or effluents are not released into the sea or ocean. The Proponent shall comply with the provisions of the regulation in protecting coastal environment.

4.4.2.10 Wildlife Management and Conservation Act, Cap 376

This Act provides for the protection, conservation and management of wildlife in Kenya. The provisions of this Act should be applied in the management of the project. Part III Section 13 subsection (I) stipulates that any person who not being an officer of Kenya Wildlife Service hunts any animal in a National Park shall be guilty of a forfeiture offence and liable to a fine or imprisonment. Subsection 2 of the Act likewise provides that any person who, without authorization conveys into a National Park, or being within the area thereof, in possession of, any weapon, ammunition, explosive, trap or poison, shall be guilty of a forfeiture offence. The Act provides that

no person is allowed to use any aircraft, motor vehicle or mechanically propelled vessel in such a manner as to drive, stampede or unduly disturb any protected animal or game animal. Therefore it will be prudent that the construction workforce is conversant with the provisions of this Act.

The Wildlife Bill of 2007 states the following in section 42 on Consent for mining and quarrying:

(1) No person shall mine or quarry in a national park or national reserve without the approval and consent of the Board.

(2) The Board shall, in consultation with the relevant regional wildlife conservation committee, only approve and give consent for mining or quarrying where:-

a) The area does not contain rare, endangered or threatened species;
b) The area is not a critical habitat and ecosystem for wildlife; the area is not an important catchment area or source of springs;
c) An ESIA has been carried out for quarrying sites in accordance with the provisions of the environmental management and coordination act no. 8 of 1999;
d) The miner has undertaken through execution of a bond the value of which will be determined by the board, to rehabilitate the site upon completion of his operation to a level prescribed by the board: provided that the minister may, on the recommendation of the board, and in consultation with the minister responsible for mining, by notice in the gazette, publish rules to regulate and govern mining operations in such protected areas;
e) The carrying on of mining or quarrying operations shall not contravene any rules made under this act.

The Proponent shall implement the proposed measures in this document towards protection and conservation of wildlife in the project areas.

4.4.2.11 The Agricultural Act (Cap 318)

Legislative control over soil conversation 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 Minister administering the Act, after concurrence with the Central Agricultural Board and consultation with the District Agricultural Committee, can impose land conservation orders on lands to control cultivation, grazing and clearing. These controls may be necessary to protect the land against soil erosion, to protect fertility, and to maintain catchments. Local authorities are generally empowered to administer these sections of the Act, and the District Agricultural Committee is entitled to make regulations relating to these controls. Agricultural Rules are prescribed under the Act, whereby vegetation clearing in steep slopes areas or adjacent watercourses, without authorization, is controlled.

4.4.2.12 Energy Act, 2006

The Energy Act 2006 became law on 2nd January 2007. The Act establishes an energy commission, which is expected to become the main policy maker and enforcer in the energy sector. With this Act, all the different aspects of energy e.g. electricity,

petroleum and renewable energy are brought under one ambit unlike as was the case before.

4.4.2.13 The Water Act, 2002

The Water Act, 2002 provides the legal framework for the management, conservation, use and control of water resources and for the acquisition and regulation of right to use water in Kenya. It also provides for the regulation and management of water supply and sewerage services. In general, the Act gives provisions regarding ownership of water, institutional framework, national water resources, management strategy, requirement for permits, state schemes and community projects. Part IV of the Act addresses the issues of water supply and sewerage. The project shall have no adverse impact on the local water supply during operations as there are no requirements for the installation of water supply and sanitation facilities on-site. Observation of the requirements of the Act shall be observed by the Proponent especially during the construction and even during the operation stages.

4.4.2.14 Forest Act, 2005

The Act highlights the integration of the community on the management, utilization and conservation of forests and its resources. It prohibits wanton destruction of the forests. As hydro dams depends on good water catchments protection and management, on the upstream and around the reservoirs the enforcement of this Act will minimize the flow of sediments into the rivers which are being utilized for generation of hydro-electric power generation. Apart from the Kibwezi forest, there are no other formally identified forests along line routes, but there are some localities with significant tree and vegetation that will require adherence to this Act.

4.4.2.15 The 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. Some of the areas addressed here are machinery safety, chemical safety and health and safety. 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.

The report advices the Proponent on safety and health aspects, potential impacts, personnel responsible for implementation and monitoring, frequency of monitoring, and estimated cost, as a basic guideline for the management of Health and Safety issues in the proposed project.

4.4.2.16 Public Health Act 1986

The public Health Act regulates activities detrimental to human Health. An environmental nuisance is one that causes danger, discomfort or annoyance to the

local inhabitants or which is hazardous to human health. The Act prohibits activities (nuisances) that may be injurious to health. The primary purpose of the Act is to secure and maintain public health. It defines nuisances on land and premises and empowers public health authorities to deal with such conditions.

Part IX, section 115, of the Act states that no person/institution shall cause nuisance or condition liable to be injuries or dangerous to human health. Section 116 requires that Local Authorities take all lawful, necessary and reasonably practicable measures to maintain their jurisdiction clean and sanitary to prevent occurrence of nuisance or condition liable to be injuries or dangerous to human health.

On responsibility of the Local Authorities Part XI, section 129, of the Act states in part "It shall be the duty of every local authority to take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its district has a right to use and does use for drinking or domestic purposes. Section 130 provides for making and imposing regulations by the local authorities and others the duty of enforcing rules in respect of prohibiting use of water supply or erection of structures draining filth or noxious matter into water supply as mentioned in section 129. This provision is supplemented by section 126A that requires local authorities to develop by laws for controlling and regulating among others private sewers, communication between drains, power lines, and sewers as well as regulating sanitary conveniences in connection to buildings, drainage, cesspools, etc. for reception or disposal of foul matter. Part XII, Section 136, states that all collections of water, sewage, rubbish, refuse and other fluids which permits or facilitates the breeding or multiplication of pests shall be deemed nuisances and are liable to be dealt with in the matter provided by this Act.

The Proponent shall observe policy and regulatory requirements and implement measures to safeguard public health and safety.

4.4.2.17 Physical Planning Act (Cap 286)

An Act of Parliament to provide for the preparation and implementation of physical development plans and for connected purposes enacted by the Parliament of Kenya Under this Act, no person shall carry out development within the area of a local authority without a development permission granted by the local authority under section 33. 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. If on the expiry of the ninety days notice given to the developer such restoration has not been affected the concerned local authority shall restore the site to its original condition and recover the cost incurred thereto from the developer.

The site layout plan appended to this report shows the proposed route for the railway line. The Proponent shall secure all mandatory approvals and permits as required by the law.

4.4.2.18 Way Leaves Act (Cap. 292)

The Act provides for certain undertakings to be constructed e.g. rail lines transmission lines, pipelines, canals, pathways etc., through, over or under any lands. This project is under the provision of the Act. Section 3 of the Act states that 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. In accordance with the Act (section 4), notice will be given 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 to the owner as per section.

4.4.2.19 Trust Lands Act, 2010

This Act applies to all land which for the time being is Trust land. Under Section 38, a 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 for the carrying out of any such purposes, and to maintain any such works as aforesaid. However, 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.

4.4.2.20 The Land Registration Act, 2012

The Land Registration Act is place to revise, consolidate and rationalize the registration of titles to land, to give effect to the principles and objects of devolved government in land registration, and for connected purposes. This Act applies to Subject to section 4, this Act shall apply to:

(a) Registration of interests in all public land as declared by Article 62 of the Constitution;
(b) Registration of interests in all private land as declared by Article 64 of the Constitution; and
(c) Registration and recording of community interests in land.

Section 24 states that: (a) the registration of a person as the proprietor of land shall vest in that person the absolute ownership of that land together with all rights and privileges belonging or appurtenant thereto; and (b) the registration of a person as the proprietor of a lease shall vest in that person the leasehold interest described in the lease, together with all implied and expressed rights and privileges belonging or appurtenant thereto and subject to all implied or expressed agreements, liabilities or incidents of the lease.

4.4.2.21 The Environment and Land Court Act, 2011

This Act is in place to give effect to Article 162(2) (*b*) of the Constitution; to establish a superior court to hear and determine disputes relating to the environment and the

use and occupation of, and title to, land, and to make provision for its jurisdiction functions and powers, and for connected purposes.

4.4.2.22 The National Land Commission Act, 2012 (No. 5 of 2012)

Section 5 of the Act outlines the Functions of the Commission, pursuant to Article 67(2) of the Constitution as follows 5(1):-

(*a*) to manage public land on behalf of the national and county governments;
(*b*) to recommend a national land policy to the national government;
(*c*) to advise the national government on a comprehensive programme for the registration of title in land throughout Kenya;
(*d*) to conduct research related to land and the use of natural resources, and make recommendations to appropriate authorities;
(*e*) to initiate investigations, on its own initiative .or on a complaint, into present or historical land injustices, and recommend appropriate redress;
(*f*) to encourage the application of traditional dispute resolution mechanisms in land conflicts;
(*g*) to assess tax on land and premiums on immovable property in any area designated by law; and
(*h*) to monitor and have oversight responsibilities over land use planning throughout the country.

4.4.2.23 The Land Act, 2012

This is an ACT of Parliament to give effect to Article 68 of the Constitution, to revise, consolidate and rationalize land laws; to provide for the sustainable administration and management of land and land based resources, and for connected purposes. Part viii of this ACT 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. The Act also provides for settlement programmes. Any dispute arising out of any matter provided for under this Act may be referred to the Land and Environment Court for determination. The proponent will acquire land for the proposed project in accordance with this Act.

4.4.2.24 Land Adjudication Act, 2010

This 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; and where the Land Consolidation Act does not apply to the area. 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.

4.4.2.25 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. Code of practice is interpreted in the Act as a set of rules relating to the methods to be applied or the procedure to be adopted in connection with the construction, installation, testing, sampling, operation or use of any article, apparatus, instrument, device or process. The Proponent shall ensure that commodities and codes of practice utilized in the project adhere to the provisions of this Act.

4.4.2.26 Kenya Railways Corporation Act (Cap. 397), 1979

The Kenya Railways Corporation was established by an Act of Parliament (Cap 397) of the Laws of Kenya, and commenced operations on January 20, 1978. The overall mandate of the Corporation then was to provide a coordinated and integrated system within Kenya of rail and inland waterways transport services and inland port facilities. Rail transport is the second most important mode of transport in Kenya, after road transport. The nature of Kenya Railways, its operations and business are defined by this Act. Currently, operations of Kenya Railways lie on a national network of railway tracks covering a total distance of 2,778 km. The land corridor on which the rail tracks are laid belongs to Kenya Railways. Under the Vesting of Land Order of 1996 made under the Act, Kenya Railways owns the land corridor of 60 metres on for the main running line.

The Act 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 1, 2006 for 25 years for freight services and 5 years for passenger services. The railway network handed over to the Concessionaire comprised of 2,156 route kilometers of Metre Gauge track. The railway line runs across from the coast of Mombasa to Malaba with principal branch lines connecting Nakuru-Kisumu, Nairobi-Nanyuki, Kisumu-Butere, Eldoret-Kitale, Gilgil- Nyahururu, Voi-Moshi and Konza-Magadi. The Kenya Railways (Amendment Act of 2005) amends Cap 397 in so far as concession arrangements are concerned. Specifically this relates to facilitation of concession of railway operations and business only, otherwise the original statute is still operational in its aims, objectives and jurisdiction.

The proposed project is located entirely parallel to the Nairobi-Mombasa main railway line and will run for a distance of 485.303km km, therefore it will interfere with the current railway operations in some points, especially at some of the existing stations. This calls for consultations between CRBC, KRC and RVR.

4.4.2.27 Local Authority Act (Cap. 265)

The Local Government Act is concerned with a wide range of matters that affect the day to day activities of individuals and organizations. The Sections, which have the most direct relevance, are Sections 145, 146, 147 and 163.

Section 145 is concerned with the miscellaneous powers of local authorities. Subsection (w) empowers a local authority to take measures that may be necessary or

desirable for the preservation or protection of wildlife, and provide amenities for the observation of wildlife. Section 146, Subsection (d) empowers a local authority, with the consent of the Minister, to make grants for the establishment and maintenance of various infrastructural facilities. Section 147, Subsection (d) controls the cutting of timber and the destruction of trees and shrubs. Section 163, Subsection (e) empowers municipal councils, town councils and urban councils to control or prohibit all businesses, factories and workshops which by reason of smoke, fumes, chemicals, gases, dust, smell, noise or vibration or other cause may be a source of danger discomfort or annoyance to the neighbourhood and to prescribe the conditions subject to which business, factories and workshops shall be carried on. The Proponent shall comply with the provisions of the Act in seeking the required authorizations from the Local Authorities as stipulated in the Act.

4.4.2.28 Public Roads and Roads of Access Act (Cap. 399)

Sections 8 and 9 of the Act provides for the dedication, conversion or alignment of public travel lines including construction of access roads adjacent lands from the nearest part of a public road. Section 10 and 11 allows for notices to be served on the adjacent land owners seeking permission to construct the respective roads. During the construction phase of the project, access to the site areas will be required for the construction vehicles. Where existing roads do not exist, the Proponent shall seek permission from the appropriate authorities to create such access during the construction phase.

4.4.2.29 Use of Poisonous Substances Act Rev. 1983, Cap 247

This Act under 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. It also requires observance of precautions against poisoning and provides for periods of exposure to risk of poisoning. This will be very important during the rail operation stage.

4.4.2.30 Traffic Act Cap 403

This Act specifies that motor vehicles use proper fuel. The Traffic regulations promulgated under the Act specifies that every vehicle is required to be so constructed, maintained and used so as not to emit any smoke or visible vapour.

4.4.2.31 The Kenya Civil Aviation Act, Cap 394

Under this Act, the Kenya Civil Aviation Authority (KCAA) has 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 especillay where the line cuts through the Moi International Airport landing site and even the Embasaki Terminal site.

The International Air Transport Association(IATA) Standards Manual October 2012 provide detailed guidelines of safety within and without airport activities. The

proposed railway will pass near Moi International Airport Mombasa whereby it may inconvenience the airport operations during construction activities hence need to embrace these standards for harmonious development.

The International Standards and Recommended Practices to the Convention on International Civil Aviation Organization (ICAO), requires that each Contracting State shall ensure that the access to airside areas at airports serving civil aviation is controlled in order to prevent unauthorized entry. Each 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.

4.4.2.32 Building Code 1997

The Local Government By-Laws include Building By-Laws that give the Municipalities or County Councils powers to approve building plans. Such plans are expected to provide for public buildings and factories among others. The By-Laws covers factory chimney shafts, stairs, lifts, rain water disposal, refuse disposal, ventilation of buildings, drainage, sanitary conveniences, sewers, septic and conservancy tanks, fire and means of escape in case of fire. Compliance with this Act in up scaling of power supply is necessary. Section 194 requires that where sewer exists, the occupants of the nearby premises shall apply to the local authority for a permit to connect to the sewer line and all the wastewater must be discharged into sewers. The code also prohibits construction of structures or buildings on sewer lines and under power lines. 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.

4.4.2.33 Penal Code Cap 63

Section 191 of the penal code 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 of the same act says a person who makes or vitiates the atmosphere in any place to make it noxious to health of persons /institution, dwelling or business premises in the neighbourhood or those passing along public way, commit an offence. The Proponent shall observe the guidelines as set out in the environmental management and monitoring plan laid out in this report as well as the recommendation provided for mitigation/ minimization/ avoidance of adverse impacts arising from the project activities.

4.4.2.34 The Antiquities and Monuments Act, 1983 Cap 215

The Act aim 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, its principal mission being to collect, document, preserve and enhance knowledge, appreciation, management and the use of these resources for the benefit of Kenya and the world. Through the National Museums of Kenya many of these sites are protected by law by having them gazetted under the Act. The proponent will ensure the cultural sites near or along the proposed railway line are preserved.

4.4.3 World Bank Safeguard Policies

The objective of the World Bank's environmental and social safeguard policies is to prevent and mitigate undue harm to people and their environment in the development process. These policies provide guidelines for bank and borrower staffs in the identification, preparation, and implementation of programs and projects. Safeguard policies have often provided a platform for the participation of stakeholders in project design, and have been an important instrument for building ownership among local populations (World Bank, 1999-2006). Though this project will not be funded by the World Bank, its best practices will be used where local regulations are not sufficient especially of rail projects EHS issues.

4.4.3.1 Environmental Assessment: OP/BP 4.01

The environmental assessment process provides insights to ascertain the applicability of other WB safeguard policies to specific projects. This is especially the case for the policies on natural habitats, pest management, and physical cultural resources that are typically considered within the EA process. The policy describes an environmental assessment (EA) process for the proposed project. The breadth, depth, and type of analysis of the EA process depend on the nature, scale, and potential environmental impact of the proposed project. The policy favours preventive measures over migratory or compensatory measures, whenever feasible. The requirements of the policy are similar to those of EMCA which aims to ensure sustainable project implementation. Most of the requirements of this safeguard policy have been responded to in this report by evaluating the impact of the project, its alternatives, existing legislative framework and public consultation.

4.4.3.2 Forests: OP/BP 4.36

This safeguard policy provides measures for protection of forests through impact evaluation and conservation of forest during project development. This policy is triggered because the proposed railway passing adjacent the highly valued Kaya forests, the impact on the forest will be negligible since no clearance will be done. However, the new line also passes through Kibwezi forest.

4.4.3.3 Natural Habitats: OP/BP 4.04

This safeguard policy requires that the study use precautionary approach to natural resources management to ensure environmental sustainability. The policy requires conservation of critical habitat during project development. To ensure conservation and project sustainability the policy requires that:

- Project alternative be sought when working in fragile environment areas;
- Key stakeholders be engaged in project design, implementation, monitoring and evaluation including mitigation planning.

The requirements of this policy were observed as much as possible during the EIA study. The consulting team engaged several stakeholders during project impact evaluation and those consulted included the KWS and KFS among others. This policy was triggered by the proposed project as the project area has protected forests and

wildlife conservation areas (Tsavo National Park). Despite this, the line shall traverse several areas with swamps, rivers and streams though the field visits indicated that the project impact on them will be minimal.

4.4.3.4 Physical Cultural Resources: OP/BP 4.11

This policy assists in preserving physical cultural resources and helps reduce chances of their destruction or damage. 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. The project shall traverse several homes in rural Kenya thus it shall stumble onto several burial sites within the affected homesteads; since the tradition of burying the deceased within the homesteads is practiced in the project area. The community members likely to be affected by the project have suggested that such sites should be avoided as much as possible through consultations with individual home owners before project implementation to enable develop appropriate mitigation measures. The proposed project will have no effect to the physical cultural resources because they are not present in the proposed route for the railway line.

4.4.3.5 Indigenous Peoples: OP/BP 4.10

The objective of this policy is to ensure that development projects identify indigenous peoples, consult with them, ensure that they participate in, and benefit from the operations in a culturally appropriate way; and that adverse impacts on them are avoided, or where not feasible, minimized or mitigated. This policy is triggered since there are some indigenous people who live along the proposed line that will be affected by the project. These are the Maasai community in Sultan Hamud (Mashuruu District) who may be affected.

4.4.3.6 Involuntary Resettlement: OP/BP 4.12

Resettlement due to infrastructure development is not a new phenomenon in Kenya but the government has no Policy Document or Act (it is still under consideration by relevant authorities before it becomes law) that aims at ensuring that persons who suffer displacement and resettlement arising from such development activities can be compensated adequately for their losses at replacement costs. The proponent plans to implement the World Bank's Operational Policy 4.12 which has been designed to mitigate against impoverishment risks associated with Involuntary Resettlement and the restoration or improvement of income-earning capacity of the Project Affected People (PAP). The policy requires full public participation in resettlement planning and implementation and describes the conditions that borrowers are obliged to meet in operations involving involuntary resettlement. The proposed project triggers resettlement and relocation in the project area especially for community members with small parcels of land.

4.4.3.7 Projects in International Waters: OP 7.50

The objective of this policy is to ensure that Bank-financed projects affecting international waterways would not affect: Relations between the Bank and its

borrowers and between states (whether members of the Bank or not); and the efficient utilization and protection of international waterways. This policy is triggered if Any river, canal, lake or similar body of water that forms a boundary between, or any river or body of surface water that flows through two or more states, whether Bank members or not; Any tributary or other body of surface water that is a component of any waterway described under Any bay, gulf strait, or channel bounded by two or more states, or if within one state recognized as a necessary channel of communication between the open sea and other states, and any river flowing into such waters. This policy is partly triggered since the proposed project will terminate at the Mombasa Port which is on an international water body, Indian Ocean.

4.4.3.8 Projects in Disputed Areas: OP 7.60

The objective of this policy is to ensure that projects in disputed areas are dealt with at the earliest possible stage. The proposed railway line will pass through some disputed areas which are currently settled by squatters. It is recommended any dispute over area earmarked for project development should be dealt with at the earliest possible stage.

4.4.3.9 World Bank Safeguard Policy BP 17.50- Public Disclosure

This policy encourages Public Disclosure (PD) or Involvement as a means of improving the planning and implementation process of projects. This procedure gives governmental agencies responsibility of monitoring and managing the environmental and social impacts of development projects particularly those impacting on natural resources and local communities. The policy provides information that ensures that effective PD is carried out by project proponents and their representatives. The BP requires that Public Involvement should be integrated with resettlement, compensation and indigenous peoples' studies. Monitoring and grievances address mechanism should also be incorporated in the project plan. The proposed project incorporated public participation and stakeholders' consultation as part of the ESIA studies in order to collect the views of the local communities and their leaders for incorporation in the project mitigation plan. The consultation was successful and the community members gave a number of views that have been considered in the mitigation plan.

4.5 Relevant International Conventions and Treaties

Kenya is signatory to several international conventions and treaties that would need to be adhered to in implementing this project and are geared towards environmental protection and conservation. Some of these include;

- ILO Conventions ratified by Government of Kenya
- Safety and Health in Construction Recommendation, 1988
- Recruiting of Indigenous Workers Convention, 1936 (No.50)
- Convention on Wetlands or the Ramsar Convention
- Convention on Biodiversity
- The Convention on International Trade in Endangered Species (CITES)
- Convention on the Conservation of Migratory Species
- United Nations Framework Convention on Climate Change

- United Nations Convention to Combat Desertification
- Important Bird Areas
- The World Heritage Convention, among others

The Ministry of Foreign Affairs deals with international treaties at the primary stages of negotiation. The ministry offers advisory guide to the government on the need to ratify such a treaty if considered to be of national interest. Implementation portfolio then moves to the line ministry, relevant departments and co-operating agencies. If some international issues arise, various international agreements listed above or that exist will be applied for this project.

5 PUBLIC PARTICIPATION

5.1 Introduction

The Consultation and Public Participation Process is a policy requirement by the Government of Kenya and a mandatory procedure as stipulated by EMCA 1999 section 58, on ESIA for the purpose of achieving the fundamental principles of sustainable development. This chapter describes the process of the public consultation and public participation followed to identify the key issues and impacts of the proposed project. Views from the local residents, local leaders, surrounding institutions and development partners for the proposed standard gauge railway line, who in one way or another would be affected or have interest in the proposed project were sought through interviews and public meetings as stipulated in the Environment Management and Coordination Act, 1999.

5.2 Objectives of the Consultation and Public Participation (CCP)

The objective of the consultation and public participation was to:

- Disseminate and inform the stakeholders about the project with special reference to its key components and location.
- Create awareness among the public on the need for the EISA for the proposed project.
- Gather comments, suggestions and concerns of the interested and affected parties.
- Incorporate the information collected in the ESIA study.

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.

5.3 Methodology used in the CPP

The environmental and social assessment public participation exercise was conducted in August-September 2012 by a team of experienced registered environmental experts in three ways, namely, (i) Focus group and Key informant interviews and discussion, (ii) Field surveys and observations and (iii) Public meetings.

In general, the following steps were followed in carrying out the entire CPP process:-

- 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 site.
- Public / Technical Meetings at various levels and with different target groups

5.3.1 Interested and Affected Parties Consulted

The following list outlines the parties consulted, that will be affected or have interest in the proposed Mombasa-Nairobi Standard Gauge Railway Line to be undertaken by the proponent (See Appendix E for the full list of the Stakeholders and Appendix F for key stakeholders sample questionnaire).

- Government Institutions officials including, Kenya Pipeline Company (KPC), Kenya Civil Aviation Authority (KCAA), Kenya Power and Lighting Company (KPLC), 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) and Kenya Rural Rural Roads Authority among others.
- Rift Valley Railways (RVR),
- Long Distance Truck Drivers Union,
- Kenya Association of Manufacturers (KAM)
- Local community representatives (Local political and Community leaders)
- Local community members along the proposed railway line
- Business operators – Hotel owners, shop owners, freight terminal owners, truck owners among others.
- Truck drivers, turn boys, mechanics, puncture repairers

5.3.2 Key informant interviews

About 217 people residing and those owning business properties along the proposed standard gauge railway line were interviewed.(See Appendix G for the public participation questionnaire) The exercise was conducted by experienced experts via interviews and discussions under the guidance of questionnaires developed to capture the concerns, comments and issues comprehensively. The completion of such questionnaires subsequently allowed for the synthesis and analysis of issues that arose which provided basis upon which the environmental, economic and social aspects of the ESIA was undertaken. The purpose for such interviews was to identify the positive and negative impacts and subsequently promote proposals on the best practices to be adopted and mitigate the negative impacts respectively. It also helped in identifying any other miscellaneous issues which may bring conflicts in case project implementation proceeds as planned.

5.3.3 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. Eight (8) comprehensive public meetings and technical meetings were held on various dates in September 2012, with the local residents, Chiefs, Village elders, and other local administrative leaders in attendance, along the proposed railway line at various locations which include ;(See Appendix H for a sample public notice)

- Mombasa – Jambo Village Hotel

- Jomvu – Community Grounds at Ngamani Narcol
- Mazeras – Mwatsama Primary School, Rabai
- Voi Town – Birikani Nursery School
- Tsavo National Park - KWS Offices
- Sultan Hamud Town– Chiefs Baraza/ Miryam Village Inn
- Athi River Town/ Kitengela – Athi River Railway Station Open Grounds
- Mlolongo/Embakasi Town – Connections Hotel

The summary of the number of participants at public/technical meetings/ community interviews for the project are listed in the Table 13 below.(see also Appendix I and J for the minutes and attendance lists of public meeting respectively)

Table 13: Number of Participants in Public Consultations

NO.	PUBLIC/TECHNICAL MEETING/ CONSULTATIONS	NO. OF PARTICIPANTS
1.	Key Stakeholders meeting at Mombasa, Jambo Village Hotel (see Plate 27 below)	26
2.	Jomvu public meeting at the Community Grounds, Ngamani Narcol (see Plate 28 below)	167
3.	Mazeras public meeting at Mwatsama Primary School, Rabai (see Plate 29 below)	110
4.	Voi Town public meeting at Birikani Nursery School(see Plate 30 below)	132
5.	Technical Consultative meeting for Tsavo National Park, at KWS Offices, Voi Town(see Plate 31 below)	14
6.	Sultan Hamud public meeting at Chief's Baraza/ Miryan Village Inn(see Plate 32 below)	175
7.	Athi River Town/ Kitengela public meeting at Athi River Railway Station Open Grounds(see Plate 33 below)	48
8.	Mlolongo/Embakasi Town public meeting at Hotel Connections Mlolongo(see Plate 34 below)	69
9.	House-to-House Consultations along the route	217
Total		**958**

Plate 27: Key stakeholders meeting at Jambo Village Hotel, Mombasa

Plate 28: Jomvu public meeting at the community grounds, Ngamani Narcol

Plate 29: Mazeras Public meeting at Mwatsama primary school, Rabai

Plate 30: Voi Town public meeting at Birikani Nursery school, Voi.

Plate 31: Technical Consultative meeting for Tsavi National Park at KWS Offices, Voi Town

Plate 32: Sultan Hamud Public meeting at Chief's Baraza/ Miryan Village Inn.

Plate: 33 : Athi River Town/ Kitengela public meeting at Athi River Railway Station open grounds

Plate 34: Mlolongo/ Embakasi Town public meeting at Hotel Connections, Mlolongo

From the field work and the public 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 Mombasa to Nairobi, to be used by high speed trains (80Km/hr for freight and 120km/hr for passengers). The consultant and proponent 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 public meetings captured the concerns of the people especially those directly affected by the project. The issues raised during the public meeting enabled the identification of the specific issues from the stakeholders' response which provided the basis upon which the aspects of the ESIA were undertaken. The consultant particularly gave close attention to persons within the proposed railway wayleave corridor. The views of these stakeholders were considered and their names, and their contacts were taken for future references as required by NEMA. (*See Appendix K for the list of participants in the Public Participation and Consultation)*.

However, all the environmental issues raised can be adequately mitigated exhaustively as explained 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.

5.4 POSITIVE COMMENTS MADE BY THE PARTICIPANTS

The following are the positive views about the proposed project given by those interviewed and attendants of the meetings:

5.4.1 Employment opportunities

The respondents interviewed/ consulted were optimistic that the project will create numerous employment opportunities for both for skilled and unskilled labor alike during the construction and operational phases. Despite the fact that most of the project will need skilled labour force during operation, the people 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 33 terminals which will be created, in the trains and maintenance workshops. This will be a source of income for several individuals and households and hence is expected to boost the GDP and improve the living standards of Kenyans.

5.4.2 Increased Business Opportunities

The respondents and participants were optimistic that business opportunities will arise during construction of the new standard gauge railway project. Small scale business people such as food vendors and kiosk owners will benefit greatly during construction. Once the construction of the railway line is complete, new towns will be created. There will 33 new terminals created which will lead to creation of new or renewal/ revitalization of existing old towns leading to new business opportunities. Mining of building materials especially the Mazeras flat stones will greatly improve due to cheap and affordable transport.

5.4.3 Increased Security

The respondents also noted that security will generally be improved in various regions where the railway passes through, especially during construction and operation stage. Since the line will be fenced all the way from Mombasa to Nairobi, security will be improved especially in areas where the railway is passing next to the National Parks and other protected areas. Cases of human-wildlife conflicts will decrease in such places. Security is also guaranteed in areas where the new terminal stations will be created.

5.4.4 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 Mombasa to Nairobi. This will be the best means of travel compared to the air transport which is very expensive to ordinary people and road transport which most people use.

5.4.5 Ease of traffic and congestion along the Mombasa-Nairobi 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 Mombasa – Nairobi Highway. After completion of the proposed railway system, transportation of cargo by road will be switched to transportation by rail system. This will lead to elimination of trucks on the Highway therefore leading to ease of traffic and congestion.

5.4.6 Improved Tourism

The members were positive that with the proposed railway, tourism would be improved. They agreed that with the railway going through the park, it would be a very convenient means of transport for tourists visiting the Tsavo National Parks.

5.4.7 Improved Road Safety

The public expects the road safety from Mombasa to Nairobi Road highway to improve since most long-distance trucks will be removed. This will drastically improve the safety of public road users and reduce number of road accidents in the long run.

5.4.8 Improved Agricultural Production

The public indicated that their agricultural products will be able to reach the market easily, hence improved rural incomes. They indicated that cultivation of sisal, fruits and other food crops for ASALs will greatly be improved.

5.5 NEGATIVE CONCERNS FROM MEMBERS OF THE PUBLIC

5.5.1 Noise and Vibrations

There was concern over the possibility of high noise and vibration levels at the project site as a result of excavation, construction and demolition works. The source of noise pollution will include; transport vehicles, construction machinery, metal grinding and cutting equipment. Excavations will cause vibrations; however, the proponent will take appropriate steps to minimize noise impacts including provision of appropriate protective equipment to construction workers, planning and minimizing the frequency materials transport and ensuring that all equipment are well maintained. The public also feared that there would be noise and vibrations during operation stage of the project depending on the type of trains or locomotives that would be introduced to the new railway line.

5.5.2 Dust Generation

The participants expressed 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 proponent will ensure that dust levels at the site are minimized through sprinkling water in areas being excavated and along the tracks used by the transport trucks within the site. Additional mitigation measures presented in this report will be fully implemented to minimize the impacts of dust generation.

5.5.3 Waste disposal

The people expressed concern over possibility of generation of large volumes of waste during the construction phase. The proponent should ensure that the waste are collected at all times and disposed in appropriate manner to ensure a clean and healthy environment for all.

5.5.4 Loss of Vegetation and Agricultural Crops

Some trees and 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 condition of the area will be affected for example those who practice small scale farming along the railway line. Most of the respondents proposed that a major landscaping and tree planning should be done in such areas hence leading to beautification of the environment.

5.5.5 Displacement of People and loss of Property

The participants were worried that the proposed project may demand land acquisitions which will lead to displacement of persons and loss of property in the area. Their main concern was that the affected persons be informed in good time and compensations should be done fairly, using the law and best practices. They stated that previous compensations on projects by the government had not been satisfactory especially in terms of valuation of property. Residents were worried that they would lose their homes, land and businesses since the proposed railway will require a way leave. Final designs will be realigned ensure that displacements of any nature are minimized. Most of them felt 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 a participatory process.

5.5.6 Displacement of institutions

Others were concerned about displacement of institutions such as schools, churches, hospitals, etc, and wondered whether compensation and relocation will be done the same way as for individual properties. They suggested that such institutions be rebuilt by the proponent in good time so that livelihoods are not so much disrupted. Final designs will be realigned ensure that displacements of any nature are minimized.

5.5.7 Loss of Jobs

Since the cargo trains will transport containers and other goods from the port to their various destinations, the community felt that the number of long distance trucks plying the Mombasa-Nairobi 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.

5.5.8 Loss of Businesses

The participants also raised concern over loss of businesses. Businesses in towns such as Simba, Sultan- Hamud, Salama and Mlolongo among others will be affected since they depend on the long distance trucks for business. Many business owners, among them hotels, lodges and shop owners are the ones who depend greatly on the trucks. They offer accommodation, foods and drinks and other goods and services to truck operators since they are their major customers. Therefore if trucks are removed from the roads once the rail project is complete, most business owners will be greatly affected. Commercial Sex Workers depending on the drivers and turn-boys along the main road will be among the great users and they may have to migrate elsewhere.

5.5.9 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 of humans and livestock crossing the rail track. However, this will not be a problem since the proposed line will be fenced off all the way from Mombasa to Nairobi. On the other hand, underpasses and over-passes will be provided for people and animals to crosss. There will be no level crossings in the proposed rail project.

5.5.10 Inaccessibility

The residents will lose contact with their neighbours on either side of the railway line due to a barrier created by the fencing off of the railway 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.

5.5.11 Emergence of Diseases

The residents along the proposed line feared that there would be emergence of new diseases such as HIV/AIDS especially during construction of the railway line since many people would be working at the site. There would also be possibility of prostitution. The proponent will be expected to put in place an HIV/AIDs control programme during the construction stage.

5.5.12 Alignment of the of the proposed railway line

Most people wanted to know the exact alignment of the railway line through the protected area, towns so that they could be aware if they would be affected or not. They also stated that the rail may need to be redesigned if it lies close to the road A109 since the road reserve may also be affected. The Rift Valley Railways (RVR) staff in most stations were also worried that the realignment and re-constructions on new railway stations may interfere with their operations. However, this will be handled through consultations and agreement among the parties affected.

5.5.13 Fencing of the Railway Corridor

Fencing of the high speed rail would be in order to reduce wildlife accidents on the railway. However, participants from KWS stated that the type of fencing would really determine the safety of the animals. They said that the proposed iron wire fence and concrete poles would not be ideal for the section running through the park since elephants and buffalos will damage/ break it therefore animals may still run the risk of accidents. They suggested that the final type of to be designed in consultation with KWS Engineering department to ensure it meets the required standards.

5.5.14 Interference of other infrastructure

Some participants were concerned that the proposed project would interfere with other infrastructure 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. The proposed railway is likely to run over the KPC pipeline or water systems hence cause damage of 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.

5.5.15 Livestock and Human Crossings

Since the proposed railway will be fenced off all through on both sides, the residents 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.

5.5.16 Animal Crossings (Wildlife)

The members wanted to know how many animal crossings 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 and in consultation with local community leaders and livestock group ranches.

5.5.17 Insecurity to and from Wildlife

There were concerns that due to an influx of many people to work as construction workers at the project, insecurity is likely to arise. The wild animals may befall the risk of poaching hence loss of wildlife especially elephants. On the other hand, construction workers may be attacked by wild animals in areas where the proposed line passes through the parks.

5.5.18 Disturbance to Wildlife

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. The influx of many people working at the project may also cause change in animal behavior. 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 (see sample in Plate 35 below).

Plate 35: KWS proposed sample of a modified electric fence for easy control of wildlife through an underpass

5.5.19 Efficiency of Transport of Cargo

The 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. They stated that for this to be achieved then trains to be used for transportation on the rail will have be very long. The consultant indicated that the short and long term designs have taken into consideration the amount of exports and imports to ensure efficiency, reliability and sustainability.

5.5.20 Expansion of the railway stations

The proposed project will require expansion of some railway stations especially at Sultan-Hamud, Athi River, Nairobi among others which will demand more land for acquisition. Some of the existing stations are just within the town and therefore if the expansion is done, then a lot of people and buildings will be affected. The residents felt that the cost of compensation may be higher than relocating the station to available idle land in the outskirts of town. This consultant indicated that the designers will take note of that.

5.5.21 Fate of existing railway

The participants were curious to know what will happen to the existing railway when the proposed one is complete, since it serves as the administrative boundary between some areas such as Makueni and Kajiado. They suggested that it is either retained for local operations or if decommissioned then it should be converted to a road and still

serve as a boundary to prevent disputes over administrative boundaries. The consultant also reminded 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.

5.5.22 Use of the way leave

The locals also wanted to know if they would be allowed to use the rail way leave 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.

5.5.23 Resettlement of 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 the local livelihood conditions and land availability.

5.5.24 Source of Construction Materials

Some of the participants wanted to know if the Proponent would consider sourcing construction materials from their land in areas where such materials as quarry materials would be available, so as to benefit the community as well. Others also wanted to know if the contractor would need to obtain materials for the project from the protected area (Tsavo National Park). 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.

5.5.25 Availability of Final and Detailed Project Designs

Some key project stakeholders like RVR, KCAA, KENHA, KURA and KERRA requested for detailed designs before they give their approvals or comments. While these stakeholders were given preliminary designs to make comments which will shape the final designs, some of them lost the opportunity due to lack of understanding that ESIA is a process that shapes the final detailed designs for approval. However, they will still have the opportunity when the ESIA report will be advertised in local dallies for public comments.

5.6 Recommendations made by the participants

The following suggestions were made during the consultations and house-to-house interviews:-

- The welfare and comfort of the community and neighbours should be considered seriously by the developer.

- The proponent should consider employing locals as casuals 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.
- 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 Tsavo National Park 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 railway route map for the proposed rail for the section of the park should be reviewed and approved by KWS before implementation of the project.
- The proponent should ensure that all the stakeholders (including KWS, Water, Roads, Pipeline, Kenya Power), are involved 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 should be sent to the park and other areas to survey potential borehole sites within the protected areas to allow access to water for construction and may later benefit the park and local community.
- The railway terminals should be used by tourists to access the park by establishing a tourism system whereby the railway promotes tourism into the park especially local tourism.
- 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.
- The proponent should work in close consultation with the KAA and KCAA officials to ensure safety of aircrafts during construction.

6 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

The primary function of an ESIA study is to identify, predict and quantify where possible the magnitude of impacts, evaluate and assess the importance of the identified changes and formulate plans to monitor and mitigate the actual changes. The construction of the proposed Mombasa-Nairobi Standard Gauge railway 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. ESIA is a tool used to guide environmentally sustainable decisions especially through the identification of potential impacts of the proposed project.

This chapter focuses on the positive and negative impacts that are likely to occur as a result of the proposed construction works on 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.

6.1 POSITIVE ENVIRONMENTAL AND SOCIAL IMPACTS DURING CONSTRUCTION PHASE

The following are the positive impacts during construction phase of the proposed railway:

6.1.1 Employment opportunities

One of the main positive impacts during projects construction phase is the availability of employment opportunities 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 area and improve several people's living standards.

6.1.2 Economic growth

Through the use of locally available materials during the construction phase e.g. 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.

6.1.3 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 caused a negative impact to 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 good like petroleum products, building materials, cereals and food stuffs, minerals, etc are expected to drop and this will greatly improve regional trade by making the country's goods and services competitive with other Ports in the world.

6.1.4 Increased local incomes

The local community may get extra income from the sale of construction materials from their farms and also renting spaces for company sites, borrow pits, dumping sites, lease of ground for yards and temporary passage to pick materials.

6.1.5 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 to aid in the process.

6.1.6 Optimal use of land resources

The proposed line will traverse expansive areas whose main land uses are livestock keeping and wildlife conservation. 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.

6.1.7 Provision of more water points

Apart from replacing affected water points, the developer will also put up more water points for the construction works and at all Railway Terminals. After completion of the work, some of these water points will serve the local communities.

6.1.8 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.

6.1.9 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 in within the project surrounding areas. This provides ready market to the suppliers such as quarrying companies and individuals with such materials. The Mazeras stones for pavements in staff houses within the terminals will be one of the natural materials recommended among others.

6.2 NEGATIVE ENVIRONMENTAL AND SOCIAL IMPACTS DURING CONSTRUCTION PHASE

6.2.1 Land acquisition and involuntary resettlement/displacement of persons

Land will be required for construction of the new railway project. 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. 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 will lead to physical displacement of people, loss of shelter, assets, income sources and livelihood, and restriction of access to economic resources.

The proposed line runs parallel with the existing railway but, at some points it deviates thereby necessitating land acquisitions and displacement of public utilities as well as properties. Land acquisition for some sections of the proposed alignment will affect the built environment, agricultural lands especially in, forested areas and protected areas such as Tsavo National Park and wildlife ranches among others. Most of the structures built on the proposed alignment to be affected lies along the following centres: Jomvu, Mazeras, Mariakani, Samburu, Voi, Mtito Andei, Sultan Hamud, Athi River and Embakasi among others. The alignment of the proposed line where it 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.

Mombasa and Kwale Counties: The proposed railway line commences within Mombasa through Changamwe, Jomvu, Darajani, Miritini, Mazeras, Mariakani, Samburu and Taru. Human settlements in these areas are mainly informal with a mixture of residential and business structures mainly consisting of temporary and semi-permanent structures with a few permanent ones. Majority of these settlements are densely populated with population becoming sparse as the railway line leaves the urban settlements to rural settlement areas like Mazeras and Mariakani. There are many squatter families living on the railway reserves. Small businesses and squatters will be affected in Jomvu with several large businesses affected in Miritini area (see plates 36 and 37 below). The proposed railway line passes through Mwatsama Primary school, Mwangutwa primary school (Mazeras) and the Roman Catholic Primary School (Mariakani). Similarly, there are other institutions such as Churches

will be affected. There are also graves in Mazeras and Mariakani that will be affected by the proposed railway line. In Kwale County, no many buildings will be affected.

Majority of the areas visited especially in the Coast Province, residents neither have title deeds nor allotment letters yet they claim ownership of the areas they inhabit. This will lead to problems in resettlement and might lead to some of the community members displaced without compensation or resettlement due to lack of ownership documents. This will in turn lead to crime since livelihoods will have been interfered with and such people will end up being squatters with no reasonable income.

Plate 36: Jomvu area in Mombasa where most of the human displacements are likely to take place

Plate 37: On-going constructions within the railway corridor in Mombasa

Taita Taveta County: The proposed railway line enters Taita through Voi and enters Tsavo West through Manyani. Human settlements here are sparse apart from Birikani and Kaloleni villages in Voi. This being ancestral land, there are also existence of graves in these villages. Human settlements in these areas mainly consist of temporary and permanent structures and comprises of those whom these areas are their ancestral land and those who had purchase the land from their original owners and had put up or were in the process of putting up homes. Those who had purchased land are mostly employed people working in Voi town.

Makueni County: The proposed railway line enters Makueni County through Kenani and passes through Mtito Andei, Kathekani, Darajani, Ngwata, Kibwezi, Makindu and Ikoyo. Many households will be affected in Mtito Andei town and the villages surrounding it (Miamba, Nadaoni, Kalata). Small and large businesses, one school, a church and a Health Centre will be affected in the areas. Similarly, the railway line passes through businesses whose owners have taken several years to set up.

Kajiado County: The railway line enters Kajiado district through Simba and passes through Emali, Sultan Hamud, Kiu and Ulu. Simba has a few squatter families inhabiting the rail corridor. In Sultan Hamud, the proposed railway line will pass through farmlands, human settlements, a livestock market as well as private ranches in Arroi Location. There are temporary and permanent structures on the rail corridor with some being Kenya Railway houses.

Machakos County: The proposed railway line enters Machakos County through Konza and passes through Stony Athi, Kitengela and Athi river. At the Konza station, a few families may be displaced to give way for expansion of the station. There are farmlands that will be affected by the proposed railway line. In Athi River, the proposed railway line will pass through big business enterprises mainly Athi river steel mill and ISL Kenya Ltd. Similarly, there are residents farming vegetables, maize and beans as well as the existence of Kenya Meat commission lagoons on the rail reserve.

Nairobi County: The railway line enters Nairobi through the Embakasi station which is going to be the main terminal. The proposed station will displace squatter families who were originally squatting on Kenya Pipeline land and decided to settle here after they had been evicted. A fabric manufacturing factory, Sanflag also exists in the proposed station land. There are also land owners next to the station at Embakasi that will be affected.

6.2.2 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 rail reserves both for human settlement and commercial purposes
- Leasing of railway land by Kenya Railways to private developers
- Allocation of railway land to private developers by Ministry of Lands/ Commissioner of Lands or Local Authorities without the corporation's consent.

For instance, approximately 1 and 0.75 acres of land adjacent to the Mombasa station have been allocated without the corporation's consent (Kenya Railways Annual Report 2009/2010).

- Railway houses/quarters falling within the rail corridor
- Private developers with property on or close to the rail corridor. For example in Athi River, several Go-downs under construction will be affected.

6.2.3 Traffic diversions and risk to existing buildings

During construction, traffic diversions on roads will be essentially required especially 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 changes due to this action will inconvenience people or even make people lose property and business. Road signs will be used and some personnel will be stationed on strategic points to help during the diversions.

6.2.4 Disruptions of public utilities

Interaction with other infrastructural services during construction may disrupt supply of these services like power, water, fuel, telecommunications and sewage systems. This is because in the areas where the proposed railway line crosses the utilities they will be relocated to convenient positions. Infrastructure such as electric fences in the Tsavo Park, game drive, offices, roads and game corridors will be affected (see Plate 38). This will mean relocation or redesigning of these infrastructures thus resulting to further vegetation clearance e.g at Buchuma gate, East Tsavo, where the proposed line enters the park at a point where we have electric fence, game drive circuit, a game moat, Park main gate and Rukingo game corridor. Similar infrastructure are at Athi River. Harmonization of the infrastructures needs to be done by the developer in consultation with other affected parties. This will reduce relocation or redesigning of the existing infrastructures. As such, the Contractor will need to critically evaluate the designs of the existing infrastructure and ensure the new line is in harmony with them.

Plate 38: Bridge, Power line, Road, Farming, Urban forestry infrastructure within the proposed railway wayleave

6.2.5 Habitat loss, alteration and fragmentation

The construction of rail track may result in alteration and disruption to terrestrial and aquatic habitats. Construction activities along a railway alignment may adversely affect wildlife habitats depending on the characteristics of existing vegetation, topographic features, and waterways. Habitat alteration may include fragmentation of forested habitat; loss of nesting sites and other wildlife habitat through bush clearing; disruption of watercourses; establishment of non-native invasive plant species; creation of barriers to wildlife movement; and visual and auditory disturbance due to the presence of machinery, construction workers, and associated equipment.

Clearing of vegetation to pave way for railway construction will be done. This will greatly affect natural habitats along the proposed alignment. Tsavo National park is likely to be affected by the proposed project. This protected area is likely to lose some track of land along the edge right from Voi area to Mtito Andei town. This is likely to affect the natural habitat for wildlife within the park. Other areas likely to be affected include the wildlife ranches especially in the Kapiti plains. The wildlife habitats to be occupied by the railway line will be permanently lost/ adversely affected.

6.2.6 Clearance of urban and farm trees

Clearance of part of the existing on-farm and urban tree cover at the construction sites has to occur. This will cause changes in temperature, light, moisture and nutrient levels, landscape. Loss of plant communities at the coastal urban towns and homes will expose the residents to the drying effects of wind from the oceans, increased soil erosion, loss of cash crops (*Cocos nucifera* and *Mangifera indica*), loss of shade, wind breaks, fodder, fruits, construction materials, medicinal herbs, fuel wood among

others. Establishment of woodlots in affected farms will go a long way in replacing on-farm trees. This impact on the vegetation will be minimal (value of 1) and reversible since the proposed line in most of the areas will make use of over a narrow stretch of the existing Kenya Railway land.

6.2.7 Destruction of indigenous forests and Grasslands

Clearance of parts of the Kibwezi forest will be done hence permanent loss to indigenous vegetation. The forest acts as a catchment area for Kibwezi River and Umani springs hence loss of plant communities may lead to some decrease in water quality and flows. The forest is characterized by huge acacia species probably approaching climax stage which takes a long time to be achieved. Thus disturbance at this stage will affect the status of the forest in terms of forest structure, species composition and diversity. The developer need to note that the forest was previously disturbed during construction of Mombasa-Nairobi petroleum pipeline, Mombasa-Nairobi highway and electric fence around Kibwezi forest. 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.

6.2.8 Interference with Sisal Plantations and Tree Research Plots

Clearance of some sisal plantations at Taita-taveta and Mutito Andei regions will occur. This will impact negatively to the land owners and private investors as well as the local communities who derive their livelihoods from these plantations. The loss of income by thousands of landless peasants will have a localized impact on rural household economy. Adequate compensation and minimization of the disturbances of plantations, where possible, will reduce the negative impact. Some of the trial plots by KEFRI of *Mellea volkensii* and other species within Kibwezi region and isolated small plantations of *Eucalptus camadulensis* past Sultan Hamud may be affected. At Ilmamen, Konza, the Eco-green demonstration site activities (trial plot of *eucalyptus camadulensis*, a tree nursery and apiforestry) at the demonstration site and its future expansion may be impacted negatively. Such a demonstration site on such a remote and expansion dry land is an indicator to the local community of the potential of the dry land.

6.2.9 Disturbances to Wetlands

At Mazeras, the construction works will affect a wetland within the site. Also of importance is a well where the wetland drains. While ensuring the wet land is 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.

6.2.10 Disturbances to bore holes, water piping and storage systems

Disturbances to these structures will affect the water quality, quantity and distribution. This will have major negative impacts on rural livelihoods especially on most regions which are prone to water scarcity. Also to be impacted negatively are the NGOs and other charitable organizations that funded some of the constructions. Impacts will be felt at, e.g. Mazeras(pipeline), Taru (pipeline, kiosk, Trough) Mackinnon (borehole), Miangeni (World Vision and USAID funded Mangelete water project). Scattered boreholes and watering points, piping systems and tanks in the larger Kajiado north will be also affected. The developer will need to critically evaluate the location of these boreholes and the accompanying piping and storage systems. This will help in reduction of activities on these points or relocation of the same or compensation. The RAP report will definitely identify and profile the affected assets into detail.

6.2.11 Loss of pasture for livestock and wildlife

The excavation and construction of the new railway corridor will result in removal of grass and tree pasture permanently. Thus loss of pasture for both the livestock and wildlife will take place. The excavation of various sites for collection of construction material will result in a permanent loss if the areas are not filled 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.

6.2.12 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 gears etc. All necessary health and safety guidelines should 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.

6.2.13 Oil Spillage

Oil spillages are likely to occur by leaks of these 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. Spillages of liquids stored on site, such as oil, diesel and solvents could also result in water quality impacts if they enter surrounding water bodies and contamination of wildlife conservation areas. Oil spill containment measures must be ensured by the contractor.

6.2.14 Increase in HIV/AIDs infection Incidence

According to the latest UNAIDS estimates, HIV prevalence rates in East African countries / great Lakes 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 likely increase of HIV/AIDS incidence. This will result from socialization with the local residents.

6.2.15 Increased crime rates/ culture erosion

Social crime rate in the construction areas is expected to rise with the beginning of the construction as local youths may target project construction workers. There would also be interaction with other cultures especially with 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.

6.2.16 Obstruction of flight paths

Construction activities may cause obstruction to the landing flight path near the landing runway due to proximity to Moi International Airport Mombasa (see Plate XX below) and Jomo Kenyatta International Airport in Nairobi which is near the proposed Embakasi Terminal. This may be minimized by carrying out work at this point in close consultation with both Kenya Airport Authority and Kenya Civil Aviation Authority to enhance safety.

Plate 39: Proposes rail site cutting across the Mombasa Airport flight path lights

6.2.17 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. This 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, at Voi town, the proposed line will cut across the Voi River; that provides water for domestic and construction activities within Voi town. This will compromise the quality of the water during the bridge construction period thus affecting the town and downstream population. Other rivers whole water quality will be affected during construction include Manyani, Kambu, Kibwezi, Umani springs, Ulu and Athi.

6.2.18 Disturbances to earth dams

Earth dams at Aloe village, Kitengela, Lukenya, Athi River, Mlolongo and Embakasi will be affected among other points. The impact in Embakasi may be negligible given that the area has extra ordinary big number of dams that arose accidentally during construction of roads, factories and estates. Nevertheless, interference with water quality and quantity will definitely affect the locals as many dams will be destroyed and others polluted. Also to be impacted greatly are the marginalized Maasai community livestock-keepers. Excavating more earth dams to replace those affected will minimize the impacts.

6.2.19 Disposal of excavation materials and equipment

Some of the excavation tools and equipment will be rendered rudimentary and thus will have to be disposed of. This also applies 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 needs 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.

6.2.20 Soil Erosion

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.

6.2.21 Slope destabilization

Excavations on landscape and hill sides 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 thus resulting in increased erosion and possibility of slope failures. This based on the fact that most of the landslides that have occurred in the past in these areas (example Kibwezi) have been occasioned by the existence of steep slopes, heavy rainfall and response of high clay soils with high absorption capacity and well-jointed fractured metamorphic rocks (Ngecu and Mathu, 1999).

6.2.22 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.

6.2.23 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.

6.2.24 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.

6.2.25 Solid Waste Generation

A lot of solid waste will be generated from soil excavations and construction material remains as well as their packaging materials. Municipal/ 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.

6.2.26 Noise and Vibrations

Increased noise levels will be experienced from the construction equipment, blasting and quarrying activities. Noise may also be brought near to the residential areas or

institutions when diversions are made to pass nearer to the residential areas or institutions when diversions are made to pass nearer to the buildings, housing, where people live and do business. 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.

6.2.27 Interruptions of the existing railway operations

There may be interference with the existing RVR/Magadi railways operations at crossing locations and common yards and depots during construction period. This may come from the need to relocate certain services, temporary occupation for work purposes and diversions. Extensive consultation among affected parties and rational planning/ scheduling of works / activities may reduce the impact on business operations of RVR and Magadi Soda Ash Company.

6.3 POSITIVE ENVIRONMENTAL AND SOCIAL IMPACTS DURING OPERATION PHASE

This section outlines possible **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.

6.3.1 Emergence of new towns and urban development

As the railway line commences in Mombasa, it takes the same route as the old railway line, however as it gets to Mazeras it starts to deviate and takes a totally different route, infact all the way past Mariakani town the proposed railway line is on the left hand side of the road while the old railway line is on the right hand side of the road. This deviation goes all the way past Taru up to Mackinon Road. The stations at Mariakani and Samburu will be relocated based on the new route. Growth of businesses, estates, market centres and other essential services will be witnessed at the new stations and along the new railway lines. The deviation between Maungu and Voi will also affect the location/positions of the passing stations at Maungu, Ngulini and the intermediate station at Voi.

The deviation of the new railway line between Kibwezi and Kiboko will reposition the Kibwezi, Musamba, Ikoyo and Kiboko stations. In Ulu and Konza, the proposed station passes very far from the old line hence new market centers are more likely to develop in these areas. The fact that the new railway completely deviates in these towns will mean that the stations will be moved hence market centers next to the old stations like Konza market will die. The markets and shopping centres in these towns are most likely to shift based on the location of the railway especially in those towns that will have inter stations and passing stations.

6.3.2 Growth of businesses and market centres

In areas where the proposed railway line takes a new route but near to the existing line like Voi and Mtito Andei, there will be growth of towns, businesses and market

centres leading to growth of the local economy. 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 terminal which will later connect to Nairobi Metropolitan Commuter railway network.

6.3.3 Reduced Road Accidents

Accidents on the roads will be reduced due to reduced traffic flow on the Mombasa-Nairobi highway as freight trucks will be less on the roads. The fact that the rail 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 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.

6.3.4 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. While at the moment it takes about 2-3 days to transport freight from Mombasa to Nairobi, the new project will reduce this to less than six hours for express trains because of limited obstructions normally experienced on roads. This will be important in better resource 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 from.

6.3.5 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 and thus reduce traffic volume on the Mombasa-Nairobi highway thereby reducing the number of vehicles this in turn will lead to reduction of emissions. This will improve the human health especially those with residential houses near the road for example in Athi River and Mombasa and its satellite towns along the road.

6.3.6 Fire risk reduction along the highway

Fires are often lit by long-distance truck drivers during vehicle breakdowns to keep wild animals away during vehicle breakdowns within the protected area. Over the years fires in the protected area has led to alteration in vegetation structure and composition. In certain cases, grasslands with unpalatable browse material have been created which often leads to species displacement especially of the browsers. Fires in a place like the Tsavo where annual rainfall ranges between 200 - 700mm, habitat recovery is slow and such burnt areas are left to the agents of erosion and

subsequently environmental degradation. In other instances deaths have been recorded of animals that cannot effectively escape from a fire. These fire risks will drastically reduce when the rail operations fully start and reduce the number of trucks on the highway.

6.3.7 Reduced littering along the highway

Reduced vehicular movement especially within the park area will lead to reduced littering from used tyres, food packets, cigarrete filters, etc. Awareness creation to minimize littering in the protected area can conveniently be conducted in trains and thus the message can reach a wider audience as opposed in road transport system.

6.3.8 Improved tourism opportunities

The Tsavo National Parks are popular tourist destinations, receiving both local (citizens and residents) and foreign (non residents) visitors throughout the year. Tsavo East National Park is most visited of the two parks and receives well over 200,000 visitors annually, while Tsavo West records over 100,000 visitors annually. Of all visitors recorded, the highest percentage is non-residents, followed by Kenyan citizens from other parts of the country and finally local community residents constituting the smallest percentage. The main mode of transport used by visitors is by road and a small number uses 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 from the over 300,000 currently recorded to probably well over 500,000 annually. This will arise from low costs of transport, comfort and reliability provided in rail system. This anticipated preference for rail transport is likely to have a major ripple effect on the economic growth in towns like Voi and Mtito Andei which will be terminals on the proposed new rail line. More tourist will also prefer rail transport for purposes of site seeing along the railway corridor.

6.3.9 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 33 railway stations planned.

6.3.10 Economic growth

The project is anticipated to generate revenue since rail transporters will contribute to revenue collection by paying 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, increased export and import volumes and improved foreign trade, tourism, agriculture, hence increase in the national economy.

6.3.11 Regional Economic growth

The railway line will improve the inter-country transportation status in East Africa, so as to form 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 in the region.

6.3.12 Reduction of Road maintenance costs

Because of 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 be followed by diversion of the road transportation to the railway line. With a reduction of the number of heavy trucks on the road will be followed by a drastic reduction of the maintenance costs.

6.3.13 Reduction in HIV/AIDs infection incidence

According to the latest UNAIDS estimates, HIV prevalence rates in East African countries / great Lakes 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. 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 areaway from home for long periods of time. Commercial and casual sex is available at truck stops, border crossing points and major transportation hubs. Truckers may acquire HIV infection in these environments, spread it along their route, and infect their regular partners in their home communities. With the rail project, the prevalence rates are expected to drop drastically along the transport corridor among the local populations and truck drivers.

6.3.14 Revitalization of the agricultural production in rural areas

Transportation is a tremendous challenge in rural areas along the proposed railway line. This is because roads are rough, mostly unpaved and often rendered barely passable by potholes, erosion, ruts, and axle-deep mud. With the introduction of the railway like in such areas people will be motivated by available transport 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 forestry products to distance markets fast and cheap, especially Mangifera indica (Mango) and Cocos

nucifera (Coconut) which characterize farm forestry at the coastal region. Also other non-timber forest products such Mabuyu can be harvested from Adansonia digitata (boabob) in the expansive area and transported to various markets cheaply and fast. 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 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.

6.4 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.

6.4.1 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 : Mombasa satellite urban areas (like Changamwe, Jomvu), Mazeras, Mackinon Road, Mariakani, Samburu, Voi, Mtito Andei, Masongaleni, Kibwezi , Makindu, Masimba, Emali, Sultan Hamud, Salama, Athi River and Mlolongo. These towns and centres act as stop-overs for long distance trucks transporting containers and goods from the port of Mombasa to their various destinations with Mariakani, Salama and Mlolongo being the main stop overs with weigh bridges. When the new railway line whose main aim is decongest the Mombasa-Nairobi highway of these long distance transport trucks starts operating, the economy of these towns which are largely dependent to the transport 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.

6.4.1 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, vendors, etc. When operations will start these groups of people are expected either to 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.

Table 14 below shows the population sizes of towns along the proposed railway line which will be affected negatively. This means that the livelihoods of an estimated 2.0 million people will be negatively affected directly and indirectly when this project starts operation.

Table 14: Population of towns along the proposed railway line

S/N	COUNTY	MAJOR URBAN AREA	ESTIMATED POPULATION SIZE
1	MOMBASA	Changamwe	132, 692
2	MOMBASA	Jomvu	117, 487
3	KILIFI	Mazeras	25, 251
4	KWALE	Mackinon Road	31, 128
5	KILIFI	Mariakani	43, 199
6	KWALE	Samburu	32,641
7	TAITA	Voi	87, 103
8	MAKUENI	Mtito Andei	34, 354
9	MAKUENI	Masongaleni	32, 270
10	MAKUENI	Kibwezi	248, 704
11	MAKUENI	Makindu	42, 094
12	MAKUENI	Emali	25, 657
13	KAJIADO	Sultan Hamud	17, 096
14	MACHAKOS	Athi River	51, 293
15	NAIROBI	Embakasi / Mlolongo	940,907
OTHERS (10% of the Above)			186,189
Total Estimate			**2,048,065**

Source; Kenya National Population and Housing Census, 2009

6.4.2 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 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 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 to be offered by then. Some bus and truck owners may have to shift their business interests to the new railway in order to survive.

6.4.3 Interference with cultural-set up of communities

Interference with cultural set-up of communities will be experienced. Similarly, loss of graves (Plate 40 below) will also be an issue in areas where the railway line passes through ancestral lands. Areas like Mariakani and Uwanja wa ndege graves were noticed to be within the proposed railway corridor.

Plate 40: Graves at Uwanja wa Ndege and Mariakani

6.4.4 Increased crime rates/ culture erosion

Business enterprises along the proposed track alignment will be affected thereby disrupting their sources of income and livelihood per se. As a result, social crime rate in the area is expected to rise with the beginning of the operations as people are left without jobs might resolve to go into crime to earn their daily livelihood. There would be interaction with other cultures especially during operation, especially 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.

6.4.5 Loss of Vegetation during wayleave 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 cover 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 wayleave to control vegetation may involve the use of mechanical methods (e.g. mowing), manual methods (e.g. 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.

6.4.6 Change in wildlife behaviour

The proposed fencing of the rail line within the protected area, introduction of underpasses and overpasses, may change the movement and general behavior of wildlife. This impact is likely to occur in Tsavo Parks and in open ranches all the way from Mtito Andei to Kitengela in Nairobi as you pass through the wildlife Kapiti Plains.

6.4.7 Modification of Stream flow

After completion of the project, many water harvesting structures like earth dams will be destroyed. This has a potential of modifying the patterns of stream flow downstream since during rainy season, surface flow will not be hindered hence increased water loss and soil erosion. Also, there would be decrease in base flow during dry season since most of the water during rainy season will be lost as stream flow. The project should put measures to ensure there is only minimal modification of stream flow downstream.

6.4.8 Emissions to air

Locomotive engines may be significant contributors to air pollution in urban areas, especially in the vicinity of rail yards. Worldwide, approximately 60 percent of passenger trains and 80 percent of freight trains are powered by diesel locomotives which emit combustion products, including nitrogen oxides (NOX) and particulate matter (PM), both of which contribute to public health problems, and carbon dioxide (CO2), a greenhouse gas. Transportation and transfer of dry granular materials (e.g. minerals and grain) may result in dust emissions, while the storage and transfer of fuels or volatile chemicals may result in fugitive emissions.

6.4.9 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

6.4.10 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.

6.4.11 Wastewater Management

Rail operations may generate sanitary wastewater primarily from passenger terminals and from passenger rail service. Rail car 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.

6.4.12 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.

6.4.13 Oil pollution/ spillage

Oil spillage during change of lubricants, cleaning and repair processes, in the maintenance of rolling stock, is very common. Oil spillage are 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.

6.4.14 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.

6.4.15 Wildlife and livestock accidents due to damaged fence

Many livestock and wildlife are killed along the old railway line as they cross the railway line corridor. As the railway line is to be fenced, the large animals like elephants and buffalos are likely to damage the fence. With the introduction of fast moving trains it is expected that the number of livestock and wildlife deaths will more than double. This will be a big loss to local people. Construction of earth embankments, strong or an electric fence and underpasses will prevent any accidents occurring. This will also reduce damage of trucks that may occur during accidents

6.4.16 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

6.4.17 Blockage of wildlife, livestock and human corridors

Livestock and wildlife cross the current railway line freely move from East to West in search of pasture. Since it is proposed that the new railway line corridor will be fenced from Nairobi to Mombasa, the corridors will be blocked and the wildlife and livestock will not be able to move freely in search of pasture and breeding ground. To prevent this, 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 attracted to the underpasses which they will be used with over time.

6.4.18 Noise pollution

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.

6.5 POSITIVE IMPACTS DURING DECOMMISSIONING PHASE

6.5.1 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.

6.5.2 Employment Opportunities

Temporary employment opportunities will be created for the demolition staff during the demolition phase of the proposed project.

6.5.1 Reduced Environmental Pollution

Decommissioning will obviously lead to reduced air, water, soil and general environmental pollution that is experienced during operations.

6.5.1 Reduced Negative Environmental Impacts of Operation

All other negative impacts listed under the operations section will drastically reduce when the decommissioning will take place.

6.6 NEGATIVE IMPACTS DURING DECOMMISSIONING PHASE

6.6.1 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.

6.6.2 Solid Waste Generation

Demolition of the office building 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.

6.6.3 Dust

Large quantities of dust will be generated during demolition works. This will affect demolition workers as well as the neighboring residents.

6.6.1 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.

6.7 ENVIRONMENTAL 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.

6.7.1 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.

6.7.2 Corrosion of rail material from salty soils and rocks

Corrosion of rail materials occurs between Mombasa and Km 83 (Maungu) due to saline weather conditions. Rail base corrosion is a combination of corrosion environments; for example, humidity (seawater and highly polluted water) and soil. Corrosion is due to saline climate (chloride ions). The presence of salt on rails creates a very detrimental effect on the integrity of the rails because the salts form electrolytes promoting oxygen to react with the rails, thereby accelerating corrosion. This can be reduced by practices like pre-coating with epoxy resins (RDSO guildelines). Preventing stray leaks and reducing humidity (particularly the salts in water leaks) minimizes corrosion. Therefore, the following guidelines are recommended to eliminate or to reduce conditions causing or contributing to corrosion:

- Maintain good maintenance and good insulation. Clean and keep track roadbed water-free.
- Maintain a stray current control program by conducting rail-to-earth resistance and substation-to-earth tests
- Identify locations where stray currents are occurring or have a tendency to occur and create proper insulating conditions.
- Maintain clean and dry ballast or slabs. Any direct contact between the rail and ballast must be avoided. It is recommended to have at least 1 in. (25 mm) of clearance between the rail and the ballast

6.7.3 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 thereby destabilizing the slope. This will disrupt the operation of the railway. Soil erosion and sedimentation of silt below underpasses make some impassible (see Plate 42 below). Such cases were reported between Kibwezi and slightly past Konza Station Stations (see Plate 41 below of a re-enforced bridge to avoid collapse from heavy run-off). All these risks can be mitigated by using environmental catchment protection and mechanical soil erosion methods.

Plate 41: Re-enforced bridge to avoid collapse from heavy run-off

Plate 42: An underpass that has been filled by silt and requires opening

6.7.4 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-signalled 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.

6.7.5 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.

6.7.6 Earthquakes and volcanic eruptions

One of the main unfavourable geological troubles along the Line is the existence of earthquake areas. The terminal of the Line is in Nairobi, which 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 MITIGATION MEASURES AND MONITORING PROGRAMMES

The proponent of the proposed project acknowledge 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 Chapter 6. The potential key negative impacts and the possible mitigation measures have herein been analysed under two categories: Construction and Operational.

7.1 MITIGATION OF CONSTRUCTION RELATED KEY IMPACTS

7.1.1 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.

7.1.2 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.

7.1.3 Disturbances to Wetlands

The proponents 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.

7.1.4 Disturbances to Earth Dams

The proponents shall put in place several measures that will mitigate disturbance to Earth Dams arising during the construction phase by adhering to the provisions of Wetlands, River Banks, Lake Shores and Sea Shore Management Regulation, 2009.

7.1.5 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.

7.1.6 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.

7.1.7 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.

7.1.8 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.

7.1.9 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.

7.1.10 Minimise 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.

7.1.11 Minimise 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

7.1.12 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)

7.1.13 Modification of Forest and Woodland Infrastructure Designs

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 minimises.

7.1.14 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.

7.1.15 Increase in HIV/AIDs infection Incidence

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.

7.2 MITIGATION OF KEY IMPACTS DURING OPERATION PHASE

7.2.1 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.

7.2.2 Separation of communities as well as inaccessibility to market centres and other 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 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

7.2.3 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.

7.2.4 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.

7.2.5 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. Kenya Railways 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.

7.2.6 Accidents involving wildlife and livestock

To minimize accidents along the rail, the proposed rail line will be built with earth embankments and the corridor fenced off. The proponent will construct underpasses and overpasses at strategic points for animal crossing. Security at the park will be ensured especially during construction. The public will also be educated to ensure the crossing provisions are used. All level crossings are avoided at the design stage.

7.2.7 Flooding, surface run off

Poorly designed drainage systems will 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 to expand their department to undertake rehabilitation of areas affected.

7.2.8 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. The proponent will adhere to the Environmental Management and Coordination (Waste Management), Regulations 2006.

7.2.9 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.

7.2.10 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.

7.3 ENVIRONMENTAL MONITORING PLAN

7.3.1 Introduction

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 the table 15 below

Table 15: 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	Miritini Swamp, Voi River, Kibwezi river, Athi-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, SO2, 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/ decibels	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

Environmental Component	Impacts/Parameters to be monitored	Points to be monitored	Frequency of Monitoring	Lab Materials and Equipment and Other Requirements	Responsibility	Cost Kshs
Wildlife	Total number of wildlife accidents, type of animals knocked by the train, locations where the animals are knocked	Along Tsavo National Park, private Ranches and Kapiti plains	Continuous during the project cycle	Accident recording book, Camera, Field vehicle, GIS Machine	Contractor and Kenya Railways Corporation	25,000 per month
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 commencement of operations	Office supplies	Kenya Railways Corporation	150,000 per month
Environmental Risks/ Hazards	Earthquakes/ tremours 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

This section analyses the project alternatives in terms of site, technology scale and route options.

8.1 Analysis of project route alternatives

Relocation option to a different site is an option that was available for the project designers and planners. The feasibility study and preliminary design reports of this project indicated three options of this project and recommends only one as follows:

Scheme One: The ruling grade 12%, (recommended)

The mainline length is 485.303km. The assessments of infrastructure are as follows:

- Total roadbed length is 427.377km, roadbed earthwork is 74.9165 million cubic meters;
- 98 grand bridge and bridges, total length is 30180m;
- No tunnel;
- Bridge-tunnel ratio is 6.2%;
- Track work for mainline is 485.303km, for yard and terminal is 124km, switch set is 336,
- Housing and supporting facilities is 164,949 m^2

Scheme Two: The ruling grade 9%, (Alternative Route)

Its total length is 493km. The infrastructure assessments are as follows:

- Roadbed length is 443.2km, with earthwork 46.281 million cubic meters; 65 grand bridges and bridges, with 46,362.4 linear meters;
- 2 tunnels with 3440 linear meters;
- Bridge-tunnel ration is 10.1%;
- Track work for mainline is 493km, for yard and terminals is 129.54km; switch set is 366;
- Housing and supporting facilities is 166,506m^2;

Scheme Three: The ruling grade 9%, (Alternative Route)

Its total main length is 471.5km; its assessment of infrastructure consists of:

- Roadbed length is 438.9km, roadbed earthwork is 69.05 million cubic meters ;
- 55 grand bridges and bridges, linear meter is 32,604.2m;
- No tunnel;
- Bridge-tunnel ratio is 6.9%;
- Track work for mainline is 471.5km, for yards and terminals is 124.25km, switch set is 352;
- Housing and supporting facilities 165,008m^2;

Analysis of strengths and weaknesses of the three schemes

The comparison of strengths and weaknesses of the three schemes is shown in table 16 below.

Table 16: Comparison Table of Strengths and Weaknesses of Schemes

Name	Strengths	Weaknesses
Ruling Grade 12% Scheme 1	Good conformity to the terrain, short line length. Due to existing railways and roads , the function of the railways can be used properly	It is not good for upgrading of the railway function in the future.
Ruling Grade 9% Scheme 2	Passing through most economic towns which is good for capability upgrading of the railway in future	Long line length, costly project
Ruling Grade 9% Scheme 3	Short line length, low operating expense.	Due to lacking of existing railways and roads, the function of the railways was not used properly. It has bad affects of the environment along the alignment.

The Ruling grade 12% scheme has lower investment compared with the Ruling grade 9% and Ruling grade 9% scheme 2, which is in a long term capable to meet the passenger and freight volume in the project section. In addition, the ruling grade 12 ‰ line is basically along the existing railway, which takes into account the economic strongholds along the Line and is convenient for the passenger and freight transport along the Line, with little interference to the operation of existing line, so it is easier to be implemented. In brief, Scheme one is the most recommended because of its cost effectiveness and sensitivity to environmental conservation.

8.2 Analysis of alternatives in the selection of the locomotive routing

SCHEME ONE: Rebuild the locomotive depot in Nairobi

Passenger train locomotive routing: Rebuild the diesel locomotive (DF_{4D}) in the Nairobi locomotive depot to take on the passenger train locomotive routing between Nairobi and Mombasa.

Freight train locomotive routing: Rebuild the diesel locomotive (double locomotives of DF_{8B}) in Nairobi locomotive depot to take on the freight locomotive routing between Nairobi and Mombasa.

SCHEME TWO: Rebuild the locomotive depot in Mombasa

Passenger train locomotive routing: Rebuild the diesel locomotive (DF_{4D}) in Mombasa locomotive section to take on the passenger locomotive routing between Nairobi and Mombasa.

Freight train locomotive routing: Rebuild the diesel locomotive (double locomotives of DF_{8B}) in Mombasa locomotive section to take on the freight locomotive routing between Nairobi and Mombasa.

The advantages and disadvantages of above two schemes presented in table 17 below:

Table 17: Comparison between the Advantages and Disadvantages of the Locomotive Routing Schemes

Routing scheme	Advantages	Disadvantages
Scheme one	• Locomotive depot is set in the junction station Nairobi, which is favourable for using this locomotive facility when the junction station connects the new railway line in the future.	• Locomotive depot is not set in the starting station of the loaded car direction, which is not favourable for timely providing locomotives with reliable quality.
Scheme two	• Locomotive depot is set in the Mombasa, starting station of the loaded car direction, which is favorable for timely providing locomotives with reliable quality.	• It is not favourable for using this locomotive facility when the junction station Nairobi connects the new railway line.

Conclusion: Scheme one is recommended for the designed locomotive routing of this track design because of its advantages listed above and for future developments.

8.3 Analysis of option of retaining/ refurbishing the existing railway line

One alternative to the proposed new railway line is to retain the operations of the existing railway line as it is. However, the current railway line is very inefficient and has led to an increase of heavy trucks on the Mombasa-Nairobi road. This has led to high road maintenance costs, increased loss of foreign exchange through importation of the tracks repair materials and increased environmental pollution. 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 not preferable. The proposed rail is therefore more acceptable than retention of the proposed railway line. This 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 attain high speeds of the trains which are currently desirable, to lower the cost of doing business by industry, attract more local and foreign tourists and increase volume of 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 proposed railway line is therefore a better option than refurbishing and retaining the old railway line. Because of the foregoing reasons, this option is dismissed.

8.3.1 Construction of an underground railway line

The third option is to construct an underground railway system from Mombasa to Nairobi. This will barely affect human activities, livestock, wildlife pasture (habitat), forestry cover and will lead to less accidents, noise and exhaust fumes. It is however more expensive to construct underground tunnels and the alternative may not be feasible for a young economy like that of Kenya. The railway line will also take long to complete which is not desirable now and therefore this option is dismissed.

8.3.2 Use of air transport

Use of air transportation is the fourth alternative for consideration. This type of transport is more expensive and is out of reach by many Kenyans. It is also not practicable to transport most industrial goods via this means of transport. It would also be more hazardous to transport dangerous chemicals by air. This option is therefore dismissed**.**

8.3.3 Upgrading the existing Mombasa-Nairobi road to a super highway

Another option to the project would be to upgrade the road system by construction of super-highways. Currently the cost of maintaining the Mombasa-Nairobi highway is very high. Further to this the cost of upgrading the road will be very high (estimate of about 400 billion shillings) and uneconomical. The road is heavily used by transport trucks therefore many accidents leading to loss of human life, livestock and wildlife will occur and maintenance costs will escalate. 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 fewer accidents. Though this option is dismissed, it should be considered in the long run to passenger services and local supply of goods and services in the region. However, it will not be economical to use it for goods because of high fuel and road maintenance costs.

A summarized comparison of the three most possible project alternatives for consideration (i.e. *Road Transport, Existing meter gauge Rail and the Proposed Standard Gauge Rail*) is shown table 18 below:

Table 18: Comparison of Best Three Alternatives

No.	Item	Road Transport	Existing meter gauge Rail	Proposed Standard Gauge Rail
1.	Tractive resistance	More than that on the rail	Less compared to road.	Less compared to road. More hauling capacity
2.	Right of way	Its open to all types of vehicular vehicles including pedestrians	Track is specific to trains designed for the track	Track is specific to trains designed for the track
3.	Cost analysis	Cost of construction and its maintenance is less in short term but high in long term	Cost of construction and its maintenance is more in short term but low in long term	Cost of construction and its maintenance is more in short term but low in long term
4.	Gradient curves	Steeper gradients and sharper curves may be provided	Gentle gradient exist up to 1.5%	Gradient more gentle up to 1.2%. better in haulage and speed capacity
5.	Flexibility of movement	More flexible to serve door to door	Less flexible, movement of trains is restricted between fixed stations	Less flexible, movement of trains is restricted between fixed stations
6.	Pollution to environment	Pollutes the most	Less pollution	Least pollution
7.	Suitability	Suitable for lighter goods and for passengers travelling over short distances	Suitable for carriage of heavy goods and long distance passengers	Most Suitable for carriage of heavy goods and long distance passengers. More capacity of haulage and high speed than meter gauge
8.	Lifespan	10 to 15 years for the existing road	The Existing line has lived its design life of over 100 years. Can only be improved.	Design life is over 100 years.
9.	Safety	Prone to many incidents and accidents	Prone to incidents due to existing conditions;- poor track, level crossings,	Less accidents because it will be secured, better track conditions and design.

No.	Item	Road Transport	Existing meter gauge Rail	Proposed Standard Gauge Rail
			unfenced etc	
10.	Haulage	Limited by road capacity and vehicle numbers	Very low capacity due to conditions of the current railway	Designed to be high
11.	Operations	Many uncoordinated operators in freight transport	More organized and coordinated	More organized and coordinated
12.	Current estimated average travel time (NRB-MSA)	10hrs due to congestion of the road	14-24 hrs due to the poor state of the rail system	5hrs due to the good state of the new system

8.4 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 conditions. This option will however, involve several losses both to the proponent, government and the society as a whole.

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

- Increased congestion at the Mombasa Port.
- Increased cost of transporting goods in the region.
- Increased accidents on highways
- Increased cases on HIV/AIDS among along major highways
- There will be no added value to other establishments in the neighbourhood.
- The proponent will not benefit from the revenue expected from the 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 interaction both at local, national, regional and international levels.
- No employment opportunities will be created for thousands of Kenyans who will work in the project
- Increased urban and rural poverty and crime in Kenya.
- Discouragement for investors to Kenya and the East African region.

From the analysis above, it becomes apparent that the *No Project Option* is no alternative to the proponent, local people, Kenyans, and the government of Kenya.

8.5 The Proposed Development Alternative

After analysis of various alternative, 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 license, NEMA would approve the proponent's proposed development of the Project, provided all environmental measures are complied with during the construction and operational phases.

This chapter presents the Environmental Management Plan (EMP) that will need to be implemented by the proponent to prevent or reduce significant negative impacts to acceptable levels. All the project components were considered when this comprehensive EMP was developed.

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.4 billion.)**. Compensation to the affected parties 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.

8.1 Construction Phase 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 associated with the construction phase of the proposed project are outlined in Table 19 below.

Table 19: Construction Phase Environmental Management Plan for the proposed Mombasa-Nairobi Standard Gauge Railway project

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Land acquisition and involuntary resettlement/displacement of persons	• Land transfer agreements should be formalized before the project start as per the laws of the land • Community support mobilization and sensitization through consultative forums or questionnaire methods • Resettlement Action Plan to guide the resettlement and compensation of the Project Affected Persons • Proper sensitization of the community at the initial stages of the project about their options and rights pertaining to resettlement	Kenya Railways Corporation (KRC)	Once-off during project planning phase
Loss of property and assets	• Provide prompt and effective compensation at full replacement cost for losses of assets attributable directly to the project.	Kenya Railways Corporation (KRC)	Once-off during project planning phase
Traffic diversions and risk to existing buildings	• Advance information on traffic circulation change; • Provide Road signs and some stationed on strategic points to help during the diversions.	Contractor	Throughout construction period
Disruptions of public utilities	• Involvement and continuous consultation of key stakeholders with respect to water, sewerage, pipelines, electricity, old rail, roads, etc., 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, etc	Kenya Railways Corporation (KRC)	During project planning phase and throughout construction period

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Habitat loss, alteration and fragmentation	• 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. • Minimize the clearing of riparian vegetation during construction; • Ensure proper demarcation and delineation of the project area to be affected by construction works. • Specify locations for trailers and equipment, and areas of the alignment which should be kept free of traffic, equipment, and storage • Designate access routes and parking within the construction sites • Avoid construction workers camps within the protected areas • Design and implement an appropriate landscaping programme to help in re-vegetation of part of the project area after construction	Contractor	Throughout construction period
Clearance of urban and farm trees	• Establishment of woodlots in affected farms to replace farm trees.	Contractor	During project planning phase and throughout construction period

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Destruction of indigenous forests and Grasslands	• Minimize magnitude of clearance especially in areas of previous destruction by other projects	Contractor	During project planning phase and throughout construction period
Interference with Sisal Plantations and Tree Research Plots	• Adequate compensation and minimization of the disturbances of plantations, where possible,	Contractor	Once-off during project planning phase
Disturbances to Wetlands	• Stabilization and protection of the upper catchment through: enrichment tree planting and establishment of soil erosion control structures (terraces and cut-off drains). • Sensitization of the local communities and complete eradication of cultivation and grazing at the wetland area.	Contractor	Throughout construction period
Disturbances to bore holes, water piping and storage systems	• Evaluation of the location of these boreholes and the accompanying piping and storage systems to reduce activities on these points or relocation of the same or compensation. • The RAP report will identify and profile the affected assets into detail for compensation if they have to be relocated.	Contractor	Once-off during project planning phase
Loss of pasture for livestock and wildlife	• Excavated areas should be filled and the tree and grass cover re-established	Contractor	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Occupational health and safety issues	• Management must ensure that fire extinguishers are located in strategic and visible places • Ensure that all vehicles and equipment are under control of competent personnel • Provide adequate facilities to treat staff emergencies. • Employees need to be informed on the necessary safety procedures and be competent in the work they are employed to do • All necessary safety regulations must be abided by including building codes and fire practice requirements • Inspection of material and harmonization to the occupational health and safety standards. • Organize provision of adequate security for workers during construction, • Sensitize workers to operate in teams • Ensure that a rapid response unit is on call in case of any incidents • Acquire necessary access permits from KWS for each individual, machinery and vehicle to be involved in the rail construction within the protected area limits	Contractor	Continuous
Oil Spillage	• Proper storage of liquids on site, such as oil, diesel and solvents. • Proper maintenance of construction vehicles and equipment. • Containment of Oil spills	Contractor	Continuous
Increase in HIV/AIDs infection Incidence	• Provide counseling and testing for HIV/AIDS to incoming construction personnel	Contractor	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
	• 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.		
Increased crime rates/ culture erosion	• Provide community awareness programmes	Contractor	Continuous
Obstruction of flight paths	• Carrying out all works near MIA and JKIA in close consultation with both Kenya Airports Authority and Kenya Civil Aviation Authority to enhance safety	Contractor	Continuous
Increased water demand and changes in water quality	• Install water conserving taps that turn-off automatically when water is not being used within the site camps. Promote recycling and reuse of water as much as possible • Sensitize staff to conserve water by avoiding unnecessary water use	Contractor	Continuous
Disturbances to earth dams	• Excavating more earth dams to replace those affected	Contractor	Continuous
Disposal of excavation materials and equipment	• All these materials needs 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.	Contractor	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Soil Erosion	• Construction of cross drains • Avoid bare, disturbed surfaces for long periods (e.g. re-vegetation of stockpiled soils). • Avoid undue storm-water concentration (e.g. construct run-off measures according to soil conservation of stockpiled soils). • Areas of localized fill and hill wash are to be avoided. • Where pipelines have been excavated, the areas must be returned to pre-construction state. • Subsoil must be returned to trenches after all pipes and other public utility facilities have been installed. • Topsoil must be reinstated and rehabilitated on top of sub soil. • All excavation works must be properly backfilled and compacted. • Rip compacted areas to reduce runoff and improve re-vegetation where required.	Contractor	Continuous
Slope *destabilization*	• Incorporate rehabilitation of the slopes measures through grass and tree planting. Alternative is to build concrete embankments.	Contractor	Continuous
Generation of exhaust emissions	• NEMA/ WHO environmental air emission standards should always prevail controlling black smoke, suspended particles of matter, Sulphur Dioxide, Nitrogen Dioxide and other parameters	Contractor	Continuous
Dust emissions to air	• Spray stock piles of earth with water • Avoid pouring dust materials from elevated areas to the ground	Contractor	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
	• Cover all trucks hauling soil, sand and other loose materials • Provide dust screen where necessary • Suitable wet suppression techniques need to be utilized in all exposed areas • All unnecessary traffic must be limited • Strict on-site speed controls are to be enforced • Wet suppression techniques will need to be undertaken, as necessary • Phasing of all earth moving activities must occur • Exposed areas not for farming or any other use must be re-vegetated at the earliest possible time		
Hydrology and water quality degradation	• Create diversion channels to ensure that no water flows across rehabilitated area until it is stable • Minimize reduction of channel length and preserve some meanders of the Rivers. • Control surface runoff by diverting run-off around the work areas • Construction of sedimentation retention ponds (if necessary) • In areas which are likely to experience increased runoff as a result of gradient and excessive clearing it will be necessary to construct silt traps. • Measures such as the use of hay bales in drainage lines or elsewhere • Use of gravel and geo textile silt barriers. • All diverted and pumped water shall be discharged at locations on the surface from which it cannot re-enter	Contractor	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
	the works and in a manner which does not cause erosion, pollution or nuisance.		
Solid Waste Generation	• 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 • Through accurate estimation of the sizes and quantities of materials required, order materials in the sizes and quantities they will be needed rather than cutting them to size, or having large quantities of residual materials • Ensure that construction materials left over at the end of construction will be used in other projects rather than being disposed off. • Ensure that damaged or waste construction materials will be recovered for refurbishing and use in other projects • Donate recyclable/reusable or residual materials to local community groups, institutions and individual. • Provide facilities for proper handling and storage of construction materials to reduce the amount of waste caused by damage or exposure to the elements • Use construction materials that have minimal or no packaging to avoid the generation of excessive waste	Contractor	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
	• Running an educational campaigns amongst employees, e.g. through use of posters, to encourage reuse or recycling of the solid waste • Adequate measures to collect, remove and safely dispose of waste must be implemented during each stage of the proposed development from site preparation to final construction.		
Noise and Vibrations	• 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 • Maintain all equipment • Workers in the vicinity of high level noise to wear safety and protective gear • The planning of construction activities (Construction site) must endeavour to minimize the noise impact on adjacent communities. • In this regard vehicles should idle as little as possible, construction schedule times must be encouraged to keep noise to a minimum on site; • All generators and heavy duty equipment are to be insulated and /or placed within buildings to minimize the ambient noise levels.	Contractor	Continuous
Interruptions of the existing railway operations	• Extensive consultation among affected parties and rational planning/ scheduling of works / activities	KRC/ Contractor	Continuous

8.2 Operational Phase 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 associated with the operational phase of the standard gauge railway project are outlined in **Table 20 below**

Table 20: Operation Phase Environmental Management Plan for the proposed Mombasa-Nairobi Standard Gauge Railway project

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Collapse of towns and market centres and economic downfall	• Improve infrastructure such as roads to the nearest railway terminals • Enhancing incentives for major economic activities in the market centres	Kenya Railways Corporation (KRC)	Once-off
Disruption and change of local livelihoods / outward migrations	• Employment of locals and considerations in job allocations especially for activities requiring unskilled labor • Re-training of directly affected person into railway related careers • Commissioning of other potential income generating activities along the rail line, e.g. revitalization of large-scale agricultural activities, mining, livestock farming, tourism, etc.	Kenya Railways Corporation	Continuous
Loss of Jobs	• Truck owners to sell their trucks to other countries and also to be financed to shift to investment on private train locomotives • Provide structures to give possibilities of previous truck owners becoming shareholders and even empowered to purchase cargo trains • Consider employment of locals and considerations in job allocations especially for activities requiring unskilled labor.	KRC	Continuous
Interference with cultural-set up of communities	• Ensure preservation of the cultural resources as per the provisions of World Bank Physical Cultural Resources: OP/BP 4.11.	KRC	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Increased crime rates/ culture erosion	• Develop programmes to enhance cohesion between project employees and the local community.	KRC	Continuous
Loss of Vegetation during wayleave maintenance	• Ensure the rail system design allows large scale-habitat permeability on major east-west wildlife corridors • Vegetation clearance to be restricted within the wayleave	KRC	Continuous
Change in wildlife behaviour	• Consultations with KWS in ensuring animals adopt to co-exist with the project	KRC	Continuous
Modification of Stream flow	• Well designed drainage system and re-afforestation of affected catchment areas will minimize such impacts. • Undertake rehabilitation of areas affected.	KRC	Continuous
Emissions to air	• 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	KRC	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Solid waste Management	• Provide solid waste handling facilities such as waste bins and skips at the stations and the trains • 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. • Ensure that solid waste generated is regularly disposed off appropriately at authorized dumping sites • Donate redundant but serviceable equipment to charities and institutions • Passenger train operators and cleaning contractors to segregate waste in the trains • Instituting a solid waste recycling program for Waste from Passenger Trains and Terminals • Waste storage, collection, transportation and disposal as per Waste Management Regulations, 2006	KRC	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Fuel Management	• Use of modern, fuel-efficient, low-emission • locomotives or scheduled substitution or re-powering of existing fleets • Maximizing cargo and passenger space utilization within safety standards to minimize specific fuel consumption • Optimizing efficiency of passenger comfort functions during service and while parked • Improving driving economy through staff training, incentive programs, driving advice systems, and improved traffic flow to minimize unnecessary acceleration and deceleration	KRC	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Waste water Management	• Provide adequate and safe means of handling liquid waste at the stations and terminals • Conduct regular inspections for pipe blockages or damages and fix them appropriately • 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 • 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 wastes to septic systems, drain fields, dry wells, cesspools, pits, or separate storm drains or sewers • Pretreatment of effluents to reduce contaminant concentrations • Comply with the provisions of Environmental Management and Co-ordination (Water Quality) Regulations 2006	KRC	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Hazardous Materials	• 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; • 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.	KRC	Continuous
Oil pollution/ spillage	• Storage tanks and components should meet international standards for structural design integrity and operational performance • Storage tanks should have appropriate secondary containment • 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. • The spill retention area should be equipped with an oil / water separator to allow the routine discharge of collected rainwater • Fueling facilities should develop a formal spill prevention and control plan	KRC	Continuous
Pollution on vegetation	• Removal of blow down and other high-hazard fuel accumulations;	KRC	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Wildlife and livestock accidents due to damaged fence	• Provide and maintain structures for effective species dispersal along the rail-road system • Provide and maintain a comprehensive fence design that deters crawling animals from going through the rail corridor • Provide underpasses and over passes for wild animals in the corridors • Earth embankments • Fence the railway corridor • Construct underpasses and overpasses at strategic points • Avoid all level crossings	KRC	Continuous
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	KRC	Continuous
Blockage of wildlife, livestock and human corridors	• Provide underpasses and overpasses where animals and human will cross the railway track	KRC	Continuous
Noise pollution	• Implementation of noise reduction or prevention measures at the source • Installation of noise controls at the source for improved sound-proofing, and other noise reducing features	KRC	Continuous

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Fire risks	• Install adequate bill boards cautioning rail users against activities that may cause accidental fires • Provide and strategically place rapid response fire brigade services within the protected area section • Train several field KWS and KRC personnel on firefighting techniques	KRC	Continuous
Health and Safety	• Implement all necessary measures to ensure health and safety of workers and the general public during operation of the offices as stipulated in the Occupational Safety and Health Act,2007	KRC	Continuous
Environmental compliance	• Undertake an environmental audit within 12 months after operation commences as required by law	KRC	Yearly

8.3 Decommissioning Phase Environmental Management Plan

In addition to the mitigation measures provided in **Tables 19** and **20**, it is necessary to outline some basic mitigation measures that will be required to be undertaken once all operational activities of the project have ceased. Though it is envisaged that the rail services will be always provided. The necessary objectives, mitigation measures, allocation of responsibilities, time frames and costs pertaining to prevention, minimization and monitoring of all potential impacts associated with the decommissioning and closure phase of the project are outlined in **Table 21** below.

Table 21: Decommissioning Phase EMP for the proposed Mombasa-Nairobi Standard Gauge Railway project

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Demolition waste	• Use of an integrated solid waste management system i.e. through a hierarchy of options: 1. Source reduction 2. Recycling 3.Composting and reuse 4. Combustion 5. Sanitary land filling. • All buildings, machinery, equipment, rail structures such as slippers and others that will not be used for other purposes must be removed and recycled/reused as far as possible • All foundations must be removed and recycled, reused or disposed of at a licensed disposal site • Where recycling/reuse of the machinery, equipment, implements, structures, partitions and other demolition waste is not possible, the materials should be taken to a licensed waste disposal site • Donate reusable demolition waste to charitable organizations, individuals and institutions	Contractor	Throughout the demolition
Noise and Vibration	• 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 • Proper maintenance of all equipment • Workers in the vicinity of high level noise to wear safety and protective gear	Contractor	Throughout the demolition

IMPACT	RECOMMENDED MITIGATION MEASURES	RESPONSIBLE PARTY	FREQUENCY
Dust	• Spray demolished piles of earth with water • Avoid pouring dust materials from elevated areas to ground • Cover all trucks hauling soil, sand and other loose materials • Provide dust screen where necessary	Contractor	Throughout the demolition
Site degradation	• Implement an appropriate re-vegetation programme to restore the site to its original status • Consider use of indigenous plant species in re-vegetation	Kenya Railway Corporation (KRC)/ Contractor	Throughout the demolition

8.4 Conclusion and Recommendations

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 for the project for NEMA approval because of its enormous contribution to achievements of Vision 2030 goals.

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Appendix A: Proposed railway preliminary design

Appendix B: List of existing railway stations

Appendix C: Water samples analysis results

Appendix D: List of major vegetation species in urban/farm forestry

Appendix E: List of Key Stakeholders who were consulted

Appendix F: Sample questionnaire for key stakeholders

Appendix G: Sample Public participation questionnaire

Appendix H: Public notices for public meetings

Appendix I: Minutes of the public meetings

Appendix J: Attendance lists of the public meetings

Appendix K: List of participants in the public participation and consultation