THE GREAT RIFT ECONOMIC DEVELOPMENT CORRIDOR (BIRETWO-ARROR-CHESONGOCH (B126) ROAD AND ASSOCIATED SPUR ROADS




ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMET REPORT FOR THE PROPOSED ROAD UPGRADING OF PHASE 1 PROJECT ROADS: BIRETWO - ARROR – CHESONGOCH, NYARU – KIMWARER – KAPKAYO, AND KIMWARER – EMSEA

JUNE 2026

CERTIFICATION

Norken International Ltd and VejTECH Consult Ltd has prepared this Environmental and Social Impact Assessment Report for the proposed Biretwo-Arror-Chesongoch (B126) Road and Associated Spur Roads-Phase 1 in Elgeyo Marakwet County. The report adheres to the EMCA, 1999 (Cap 387) and the Environmental (Impact Assessment and Audit) Regulations, 2003 to bring out the true nature of the intended development. The report was prepared based on the information provided by various stakeholders at the project area as well as from primary and secondary sources. It is therefore issued without any prejudice.

We, the undersigned, certify that the particulars in this ESIA are correct and righteous to the best of our knowledge.

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Disclaimer:

This Environmental Impact Assessment Project Report is strictly confidential to (the Proponent) and any use of the materials thereof should be strictly in accordance with the agreement between the Proponent and the consultant. It is, however, subject to conditions in section 9 of the (Environmental (Impact Assessment and Audit) Regulations, 2003.

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	**Meaning**
AADT	Annual Average Daily Traffic
AfDB	African Development Bank
AR6	Sixth Assessment Report of the Intergovernmental Panel on Climate Change
B122 / B124 / B126	Classified National Roads (Kenya Road Classification System)
CESMP	Contractor’s Environmental and Social Management Plan
DOSHS	Directorate of Occupational Safety and Health Services
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESSCP	Erosion, Sediment and Stormwater Control Plan
GBV	Gender-Based Violence
GoK	Government of Kenya
GRM	Grievance Redress Mechanism
GRC	Grievance Redress Committee
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immunodeficiency Syndrome
IDPs	Internally Displaced Persons
IPCC	Intergovernmental Panel on Climate Change
ISS	Integrated Safeguards System (AfDB)
KeNHA	Kenya National Highways Authority
KES / KShs	Kenya Shillings
Km	Kilometres
KNBS	Kenya National Bureau of Statistics
KS	Kenya Standard
KWS	Kenya Wildlife Service
LGRC	Locational Grievance Redress Committee
MTP	Medium Term Plan
NBSAP	National Biodiversity Strategy and Action Plan
NCCAP	National Climate Change Action Plan
NEMA	National Environment Management Authority
NECC	National Environmental Complaints Committee
NLC	National Land Commission
NTSA	National Transport and Safety Authority
ODS	Ozone Depleting Substances
OS	Operational Safeguard (AfDB)
OSHA	Occupational Safety and Health Act
PAPs	Project Affected Persons
PESSC	Project Environmental and Social Steering Committee
PLWDs	Persons Living with Disabilities
PPE	Personal Protective Equipment
RAP	Resettlement Action Plan
RDM	Road Design Manual
SEA	Sexual Exploitation and Abuse

Acronym	Meaning
SEP	Stakeholder Engagement Plan
SPRP	Spill Prevention and Response Plan
SRH	Sexual and Reproductive Health
STIs	Sexually Transmitted Infections
TBD	To Be Determined
TDS	Total Dissolved Solids
TMP	Traffic Management Plan
WIBA	Work Injury Benefits Act
WRA	Water Resources Authority

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CHAPTER 0: EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

E-1 Introduction and ESIA Approach

The Government of the Republic of Kenya, through budgetary allocations under the Development Vote, proposes to upgrade selected road sections within the Great Rift Economic Development Corridor. The project seeks to improve connectivity between the Nairobi–Nakuru–Eldoret (A8) highway, the Kerio Valley, and adjoining inter-county road networks in Elgeyo Marakwet County, with onward linkages to Uasin Gishu and Baringo Counties. This initiative forms part of a broader strategy to strengthen regional integration, improve access to markets and social services, and enhance climate-resilient infrastructure in historically underserved areas, in line with the Bottom-Up Economic Transformation Agenda (BETA) and Kenya Vision 2030.

This Environmental and Social Impact Assessment (ESIA) has been undertaken based on the project designs to comprehensively assess the environmental and social risks and impacts associated with the proposed development prior to implementation and financing approval. This ESIA provides a detailed and definitive evaluation of impacts, mitigation measures, and management requirements in line with the Kenya's Environmental Management and Coordination Act (EMCA, 1999) and the African Development Bank's Integrated Safeguards System (ISS).

The ESIA establishes the complete environmental and social risk profile of the project, confirms the scope and scale of required safeguard instruments, including a comprehensive Resettlement Action Plan (RAP), and provides an Environmental and Social Management and Monitoring Plan (ESMMP) to guide implementation, monitoring, and compliance throughout the project lifecycle.

The assessment adopted a structured and comprehensive methodology that combined a review of relevant policy, legal, and institutional frameworks with baseline studies covering environmental, ecological, and socio-economic conditions. Field investigations and surveys were undertaken along the project alignment to validate baseline information and identify sensitive environmental and social receptors. In addition, specialist studies—including hydrological, geotechnical, biodiversity, and social assessments—were conducted to provide in-depth analysis of key risk areas. Stakeholder consultations were also carried out between February 2024 and December 2025 to capture the views and concerns of affected communities, institutions, and other interested parties. Further, a total of eight community meetings (barazas) were held between 14th and 18th April 2026 across the project sub-counties, reaching 1,497 participants (580 women and 917 men). Additional meetings with local leaders supported awareness creation and preparation for detailed ESIA and RAP studies.

The geographic scope of the ESIA covers the direct project footprint, associated facilities, and a broader Area of Influence (AoI) to capture direct, indirect, induced, and cumulative impacts. Particular attention is given to sensitive receptors such as settlements, riparian zones, escarpment environments, agricultural land, and ecologically important areas.

The assessment considers impacts across the full project lifecycle, including pre-construction, construction, operation, maintenance, and where applicable, decommissioning phases, with a focus on phases where environmental and social risks are most significant.

E-2 Project Description and Design Considerations

Phase I of the project, which is the subject of this Environmental and Social Impact Assessment (ESIA), comprises approximately 123.4 km of existing road sections, namely the Biretwo–Arror–Chesongoch (B126) Road (72.0 km), the Nyaru–Kapkayo (B124) Road (32.0 km), and the Kimwarer–Emsea (B122) Road (19.4 km). The upgraded road will feature a 7.0 metre carriageway with 1.5 wide metre shoulders, and will consist of a new pavement structure including a prepared subgrade, gravel sub-base, crushed stone base, and an asphalt concrete wearing course. These roads currently exist as substandard alignments and are characterised by poor riding quality, inadequate drainage, slope instability, and frequent seasonal inaccessibility. These conditions impose high transport costs, constrain economic activity, limit access to essential services, and pose safety risks to road users and adjacent communities.

The proposed upgrading to improved all-weather standards is intended to reduce travel time and vehicle operating costs, improve road safety, strengthen climate resilience, and enhance access to markets, health facilities, education services, and employment opportunities. The project therefore responds to a strong development need and enjoys broad support from local communities and county authorities.

The proposed works involve upgrading the three road sections to bitumen standard, classified as Class B (National Highway), in accordance with the Kenya Road Design Manual (RDM 1.3) and relevant international guidelines. The roads traverse highly varied terrain, ranging from rolling highlands and steep escarpments to riverine and floodplain environments within and adjacent to the Kerio Valley. At the design stage, key parameters such as carriageway width, shoulder width, and design speed have been optimised to balance safety, functionality, cost efficiency, and minimisation of land acquisition and resettlement impacts.

Design strategies include the use of reduced cross-sections where feasible to limit land take, reduced speeds and traffic-calming measures through market centres. Drainage improvements, junction upgrades, safety installations, and limited lighting at key nodes have also been incorporated into the design. Given that the existing road reserve is generally narrower than the ideal Class B standard in several sections, additional land acquisition is required to accommodate the proposed road improvements. The extent of land acquisition was determined based on actual construction requirements of the road design rather than the application of a uniform corridor width. The RAP estimates that approximately 15.3 acres (6 ha) of land will be acquired for the Phase 1 roads.

E-3 Policy, Legal, and Institutional Framework

The project is governed by a robust national and international regulatory framework. At the national level, the project is subject to the Environmental Management and Coordination Act (EMCA), 1999 (as amended), which classifies it as a scheduled activity requiring a mandatory Full ESIA and environmental licensing by the National Environment Management Authority (NEMA) before commencement of works.

Complementary legislation and regulations address pollution control, waste management, natural resource use, occupational health and safety, labour conditions, and land acquisition. Land acquisition and resettlement are regulated under the Land Act (2012) and the National Land Commission Act (2012), which require lawful acquisition processes, prompt compensation, and preparation of a RAP.

At the international level, the project is subject to the African Development Bank's Integrated Safeguards System and has been classified as Category 1. The project triggers OS1 (Assessment and Management of Environmental and Social Risks and Impacts), OS2 (Labour and Working Conditions), OS3 (Resource Efficiency and Pollution Prevention and Management), OS4 (Community Health, Safety and Security), OS5 (Land Acquisition, Restrictions on Access to land and land use, and Involuntary Resettlement), OS6 (Habitat and Biodiversity Conservation, and Sustainable Management of living Natural Resources), OS7 (Vulnerable Groups), OS8 (Cultural Heritage), and OS10 (Stakeholder Engagement and Information Disclosure), while OS9 (Financial Intermediaries) is not applicable as the project is directly implemented by KeNHA. This categorisation and the triggered safeguards mandates the preparation of a Full Environmental and Social Impact Assessment (ESIA) and a Resettlement Action Plan (RAP) prior to project implementation. Kenya's commitments under international conventions, including the Paris Agreement and the Convention on Biological Diversity, further necessitate the integration of climate resilience and biodiversity considerations into project planning and design. Implementation will require coordinated oversight from KeNHA, NEMA, the National Land Commission, the County Government of Elgeyo Marakwet, and specialist agencies such as WRA and KWS.

E-4 Baseline Environmental and Social Setting

The project corridor spans diverse physical, biological, and socio-economic environments, each presenting distinct risks and opportunities. Physically, the corridor crosses three main zones: the fertile but landslide-prone Highlands and Escarpment, intermediate slopes, and the semi-arid Kerio Valley, which is particularly vulnerable to erosion. Rainfall varies significantly across these zones, ranging from approximately 700 mm to 1,700 mm annually, with important implications for drainage design, slope stability, erosion control, and construction scheduling.

Numerous perennial and seasonal rivers including the Arror, Kimwarer, and Chemoiben intersect the corridor. These watercourses are critical for local livelihoods and ecosystems but are sensitive to sedimentation and hydrological disruption, particularly on steep slopes. Geologically, the escarpment areas are underlain by volcanic formations with high landslide susceptibility, while the Kerio Valley is characterised by weaker alluvial soils prone to erosion and settlement.

Biologically, the corridor is modified but remains ecologically functional. Vegetation patterns vary by road section, with dryland bushland and shrubland dominating the B126, more heterogeneous woodland and rocky habitats along the B124, and wetter riverine and floodplain systems along the B122. Riparian zones and drainage lines represent localised areas of elevated ecological sensitivity. Seasonal elephant movements from Rimoi National Reserve intersect parts of the corridor, creating human–wildlife conflict risks that will require targeted management.

Socio-economically, the baseline assessment was informed by a 236-household socio-economic survey undertaken as part of the ESIA. This survey was conducted independently of the RAP census, asset inventory, and PAP-specific socio-economic surveys, which are reported separately in the RAP. The corridor supports predominantly rural, low-density populations whose livelihoods depend largely on agriculture and livestock production. Land tenure systems vary, with individual freehold more common in the highlands and communal or customary arrangements prevalent in the valley. Social infrastructure such as schools and health facilities is distributed along the corridor, and many communities rely on vulnerable surface water sources. While the project offers significant opportunities for improved connectivity and economic growth, it also carries risks related to construction-phase disruption, labour influx, gender-based violence, and unplanned development if not carefully managed.

E-5 Stakeholder Engagement and Public Participation

Initial stakeholder engagement was undertaken during the PRESIA stage through high-level entry meetings held on 8th–9th December 2025, coordinated with the offices of Deputy County Commissioners. These meetings brought together community representatives, including local leaders, elders, women, youth, and persons living with disabilities, to introduce the project, capture preliminary concerns and local insights, and inform the design of more detailed consultations for this ESIA.

While preparing this ESIA report, extensive consultations were conducted across national, county, sub-county, and community levels to establish baseline environmental and socio-economic conditions and identify stakeholder needs. Engagements included government institutions, NGOs, CBOs, and community groups such as farmers, transport operators, and traders. A total of eight community meetings (barazas) were held between 14th and 18th April 2026 across the project sub-counties, reaching 1,497 participants (580 women and 917 men). Additional meetings with local leaders supported awareness creation and preparation for detailed ESIA and RAP studies.

Focused Group Discussions (FGDs) and Key Informant Interviews (KIIs) complemented the broader consultations, enabling in-depth engagement on gender, social inclusion, environmental and safety concerns, and benefit-sharing. These targeted discussions included youth, women, men, the elderly, vulnerable groups, and persons with disabilities. Inputs from all consultations were incorporated into the ESMP to guide project implementation, monitoring, and stakeholder engagement throughout the project lifecycle.

E-6 Project Alternatives

A range of alternatives was assessed, including the “No Action” option, alternative transport modes, and new alignments. The No Action alternative was deemed unacceptable due to continued isolation, high transport costs, and safety risks. New alignments and alternative modes were found to be environmentally and socially costly or impractical. The preferred option is upgrading the existing alignment with minor realignments, improved drainage, erosion control, and targeted safety measures, thereby minimising land acquisition, reducing costs, and maintaining strong community acceptance.

E-7 Climate Change Considerations

Climate change poses a significant risk to the project due to observed increases in temperature and rainfall intensity, particularly in steep escarpment areas. Key risks include drainage exceedance, slope instability, pavement damage, and increased accident potential.

A dedicated chapter on Climate Screening and Adaptation has been included in this report to assess potential climate-related risks and vulnerabilities that may affect the project throughout its lifecycle. The chapter outlines the anticipated impacts of climate variability and climate change on project infrastructure and operations and presents appropriate adaptation measures integrated into the project design, construction, operation, and maintenance phases. The findings of the climate screening have informed the incorporation of climate-resilient considerations, including enhanced drainage provisions, slope stabilization measures, pavement durability considerations, and long-term maintenance planning to strengthen the resilience and sustainability of the project infrastructure.

In addition, a Climate Change Management Plan (CCMP) has been prepared as part of the Environmental and Social Management Plan (ESMP) framework to address identified climate-related risks and impacts. The CCMP outlines specific mitigation, adaptation, monitoring, and response measures aimed at enhancing the project's resilience to climate hazards, reducing the vulnerability of project infrastructure and surrounding communities, and ensuring effective management of climate change considerations throughout the project lifecycle. The Climate Change Management Plan is annexed to this report as Annex 4 for reference and implementation during project execution.

E-8 Impacts and Management Measures

The proposed project is expected to deliver substantial socio-economic benefits, including reduced travel time and transportation costs, improved access to markets and essential services, enhanced road safety, reduced dust-related air pollution, and employment creation during the construction phase. These positive impacts are expected to contribute to improved livelihoods and economic development within the project area.

The project will also generate a number of environmental and social impacts. Anticipated environmental impacts include vegetation clearance, soil disturbance, dust emissions, noise and vibration, alteration of drainage patterns, localized habitat disturbance, increased sediment loads in watercourses, and changes to landscape aesthetics. Social impacts may include land acquisition and resettlement, temporary disruption of access and livelihoods, increased traffic and road safety concerns during construction, and occupational and community health and safety effects. These impacts may affect construction workers, nearby communities, adjacent infrastructure, natural habitats, riparian ecosystems, and downstream environmental receptors.

In addition to these anticipated impacts, the project is associated with several environmental and social risks that may materialize if not effectively managed. Key environmental risks include slope instability, rockfalls, severe soil erosion, geotechnical failure of cut and fill slopes, uncontrolled sediment transport, and degradation of sensitive habitats and wildlife movement corridors. Key social risks include labour influx-related pressures on local communities, Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), Sexual Harassment (SH), child protection concerns, social conflict, and health and safety incidents affecting workers and community members. These risks are characterized by uncertainty and may vary in likelihood and severity depending on project implementation and management effectiveness.

A detailed assessment of the project's environmental and social impacts, associated risks, and proposed mitigation measures is presented in Chapter 8 of this report.

E-9 Environmental and Social Management Plan

An Environmental and Social Management Plan (ESMP) has been prepared to address identified environmental and social risks and impacts through the application of the mitigation hierarchy of avoidance, minimization, restoration, and compensation. The ESMP defines mitigation measures, monitoring requirements, institutional responsibilities, and budget provisions to ensure effective implementation throughout the project lifecycle.

Key instruments supporting the ESMP include the Resettlement Action Plan/Livelihood Restoration Plan (RAP/LRP), Stakeholder Engagement Plan (SEP), Grievance Redress Mechanism (GRM), Gender Action Plan (GAP), Biodiversity Management Plan (BMP), and Climate Change Management Plan (CCMP), all of which will be implemented throughout the project lifecycle. Contractors will be required to prepare and implement site-specific Contractor Environmental and Social Management Plans (CESMPs) consistent with the ESMP, Traffic Management Plan, Labor Management Plan and other associated management plans. Continuous environmental and social monitoring, stakeholder engagement, grievance management, and compliance with national legislation and African Development Bank (AfDB) safeguard requirements will be essential to ensure the project's environmental and social sustainability.

E-10 Conclusions and Recommendations

The ESIA for the Phase I Roads Upgrading Project (Biretwo–Arror–Chesongoch Road and associated spurs) confirms that the project is technically feasible and socially beneficial, subject to effective management of identified environmental and social risks. The project is expected to generate substantial socio-economic benefits, including improved connectivity, reduced travel time and costs, enhanced access to markets and services, and stimulation of local economic development.

Potential adverse impacts have been identified, particularly during construction and operation. Key environmental risks include air and noise pollution, vegetation loss, soil erosion, changes in drainage patterns, and contamination from waste and material sourcing activities. Social risks include disruption to livelihoods and services, occupational and community health and safety concerns, labour influx-related issues such as GBV/SEA, and limited resettlement impacts. These impacts are considered predictable and manageable.

An Environmental and Social Management Plan (ESMP) has been developed to mitigate these risks, with measures integrated into project design, contracts, and implementation frameworks. Contractors will be required to prepare site-specific management plans (CESMPs), while continuous monitoring, stakeholder engagement, and compliance with national and international safeguards will be essential.

CHAPTER 1. INTRODUCTION & ESIA APPROACH

1. INTRODUCTION & ESIA APPROACH

1.1 Project Background

The Government of the Republic of Kenya (GoK), through budgetary allocations under the Development Vote, has earmarked funds to engage a Consultancy Firm to undertake Preliminary Design, Detailed Design, Feasibility Study, Environmental and Social Impact Assessment (ESIA) and Resettlement Action Plan for the proposed upgrading and improvement of road infrastructure within the Great Rift Economic Development Corridor.

The project comprises the improvement of the Biretwo–Arror–Chesongoch Road and its associated spur roads located within Uasin Gishu and Elgeyo Marakwet Counties. This network forms a strategic linkage between the Nairobi–Nakuru–Eldoret (A8) highway, the Kerio Valley region, and adjoining inter-county road networks, serving as a vital transport corridor for the movement of people, agricultural produce, construction materials, and goods and services.

Due to the project's magnitude and high capital investment, the project will be implemented in two phases, Phase 1 and Phase 2 as presented below in Table 1-1 and 1-2. This ESIA scope covers phase 1 which includes the improvement of three road sections, namely the Biretwo–Arror–Chesongoch Road (B126) and two associated spur roads, Nyaru–Kapkayo Road (B124) and Kimwarer–Emsea Road (B122). The Biretwo–Arror–Chesongoch (B126) Road starts at Biretwo, located along the Iten–Kabarnet Road, at approximately 0°32'13"N, 35°33'26"E, and proceeds in a generally north-easterly direction through Arror before terminating at Chesongoch, located at approximately 1°07'06"N, 35°38'35"E, within Elgeyo Marakwet County.

The Nyaru–Kapkayo Road (B124) commences at Nyaru, which is located along the Eldoret–Eldama Ravine Road, at approximately 0°19'32"N, 35°34'29"E, and extends eastwards to Kapkayo, located at approximately 0°18'50"N, 35°42'28"E. The Kimwarer–Emsea Road (B122) starts at Kimwarer, located at approximately 0°18'48"N, 35°37'58"E, and terminates at Emsea, which is located along the Iten–Kabarnet Road, at approximately 0°27'09"N, 35°37'48"E. These spur roads provide critical connectivity between the main B126 corridor, the Kerio Valley region, and surrounding rural settlement.

Table 1-1: Phase I Road Sections (Scope of this ESIA)

S/No.	Road Section	Road Classification	Length (Km)	County
1	Biretwo – Arror – Chesongoch	B126	72.0	Elgeyo Marakwet
2	Nyaru – Kapkayo	B124	32.0	Elgeyo Marakwet
3	Kimwarer – Emsea	B122	19.4	Elgeyo Marakwet

Table 1-2: Phase II Road Sections (Separate Assessment)

S/No.	Road Section	Road Classification	Length (Km)	County
1	Bayete – Nyaru	–	27.4	Uasin Gishu/Elgeyo Marakwet
2	Kondoo – Kamwosor – Fluorspar	B125	48.8	Uasin Gishu / Elgeyo Marakwet
3	Kapchamo – Torongo	B122	12.4	Uasin Gishu / Baringo
4	Bayete – Kesses – Tulwet	C123	33.3	Uasin Gishu

The proposed upgrade aims to transform the existing gravel roads to improved all-weather standards through enhancements to road geometry, pavement structure, drainage systems, and safety features. It will address current challenges related to poor riding quality, inadequate drainage, slope instability, and limited accessibility during adverse weather. Upon completion, the project is expected to reduce travel time, lower vehicle operating costs, improve road safety, and enhance climate resilience.

By strengthening inter-county connectivity and access to markets, social amenities, and economic hubs, the project supports broader national and regional development objectives, including the Government's Bottom-Up Economic Transformation Agenda (BETA).

1.2 Overall Project Objectives and Expected Results

The main objective is to design and upgrade the proposed road sections to applicable current road standards, with improved geometry and cross-sections. The scope includes providing adequate drainage, dualling sections where required, constructing bypasses where necessary, and improving major intersections. These interventions aim to:

- Reduce travel time and vehicle operating costs.
- Enhance road safety.
- Promote regional trade and socio-economic development.
- Provide Government decision-makers with the technical, environmental, and socio-economic information needed for rehabilitation and upgrading in line with national policies.

1.3 Project Rationale

The rationale for the project is grounded in the need to address persistent transportation and socio-economic challenges in Elgeyo Marakwet County and the North Rift region. The existing gravel network (approx. 123.4 km in Phase I) suffers from poor riding quality, inadequate drainage, and slope instability, leading to high vehicle operating costs, disrupted access, and safety risks.

These roads are critical linkages:

- Biretwo–Arror–Chesongoch: A north-south corridor linking the A8 highway to the Kerio Valley and onward to West Pokot, Baringo, and Turkana.
- Nyaru–Kapkayo & Kimwarer–Emsea**:** Provide essential east-west connectivity between the Elgeyo Escarpment, agricultural zones, and mineral-rich areas.

Upgrading to all-weather standards will:

- Improve transport efficiency, safety, and climate resilience.
- Facilitate movement of agricultural produce and goods, strengthening livelihoods.
- Enhance security operations and emergency response in areas with historically difficult access.
- Support tourism growth by improving access to attractions like the Rimoi National Reserve.
- Align with national development priorities for inclusive growth and poverty reduction.

1.4 Purpose, Objectives & Scope of the ESIA

1.4.1 Justification for the ESIA

This ESIA has been undertaken following the preparation of the project design to comprehensively assess the potential environmental and social impacts associated with the proposed development prior to implementation and financing approval. The study serves as a key environmental and social due diligence instrument to ensure that the project is planned, constructed, and operated in a manner that is environmentally sustainable, socially acceptable, and compliant with applicable legal and institutional requirements.

The ESIA is intended to:

- Identify and evaluate the likely environmental, social, health, and safety impacts associated with the project design and proposed activities.
- Develop appropriate mitigation and enhancement measures to avoid, minimize, or manage adverse impacts throughout the project lifecycle.
- Ensure compliance with the Environmental Management and Coordination Act (EMCA), relevant Kenyan regulations, and the African Development Bank's Integrated Safeguard System (ISS).
- Inform decision-making by regulatory authorities, financiers, and project stakeholders regarding the environmental and social feasibility of the project.
- Provide an Environmental and Social Management and Monitoring Plan (ESMMP) to guide project implementation, operation, and monitoring.

1.4.2 Objectives of the ESIA Study

The main objective of the ESIA study is to assess the environmental and social implications of the proposed project based on the design and to determine the measures necessary to ensure sustainable project implementation.

The specific objectives of the study are to:

a) Present the project background, rationale, components, and design in the context of national, regional, and sector development priorities.
b) Establish the environmental and social baseline conditions within the project area of influence through field investigations, stakeholder engagement, and review of secondary data.
c) Identify and assess potential environmental, social, occupational health and safety, community health and safety, and cumulative impacts associated with the construction, operation, and maintenance phases of the project.
d) Undertake stakeholder and public consultations with affected communities, institutions, and other interested parties in accordance with Kenyan legal requirements and international safeguard standards.
e) Propose appropriate mitigation, management, and monitoring measures to address identified impacts and enhance positive project outcomes.
f) Prepare an Environmental and Social Management and Monitoring Plan (ESMMP) and other safeguard instruments required for project implementation and compliance.

g) Provide recommendations to support informed decision-making by the proponent, regulatory agencies, and financing institutions.

1.4.3 Scope of the ESIA Study

The ESIA study covers the assessment of environmental and social conditions and the evaluation of potential impacts associated with the proposed project based on the engineering design.

The scope of the study includes:

i. Geographic Scope
The assessment covers the proposed project footprint, associated facilities, and the broader Area of Influence (AoI), including locations potentially affected by direct, indirect, induced, and cumulative impacts. Particular attention is given to environmentally and socially sensitive receptors such as settlements, watercourses, riparian areas, wetlands, forests, agricultural land, public utilities, and community infrastructure.
ii. Temporal Scope
The assessment considers the entire project lifecycle, including the pre-construction, construction, operation, maintenance, and where applicable, decommissioning phases.
iii. Assessment Scope

The study includes:

i. Review of the project design, components, and activities.
ii. Collection and analysis of baseline environmental and social data.
iii. Review of applicable legal, policy, regulatory, and institutional frameworks at national, county, and international levels.
iv. Identification and assessment of potential environmental and social impacts and risks.
v. Stakeholder engagement and public participation.
vi. Development of mitigation measures and environmental and social management plans.
vii. Preparation of monitoring and reporting frameworks for project implementation and compliance.

1.5 ESIA Process, Approach & Methodology

The study was conducted in accordance with Kenya's Environmental Management and Coordination Act (EMCA), 1999 (amended 2015) and the Environmental Impact Assessment and Audit Regulations, 2003, as well as the AfDB's Integrated Safeguard System. The process followed a three-phase approach of Scoping, Screening, and initial Management Planning, as detailed in Figure 1-1 below.

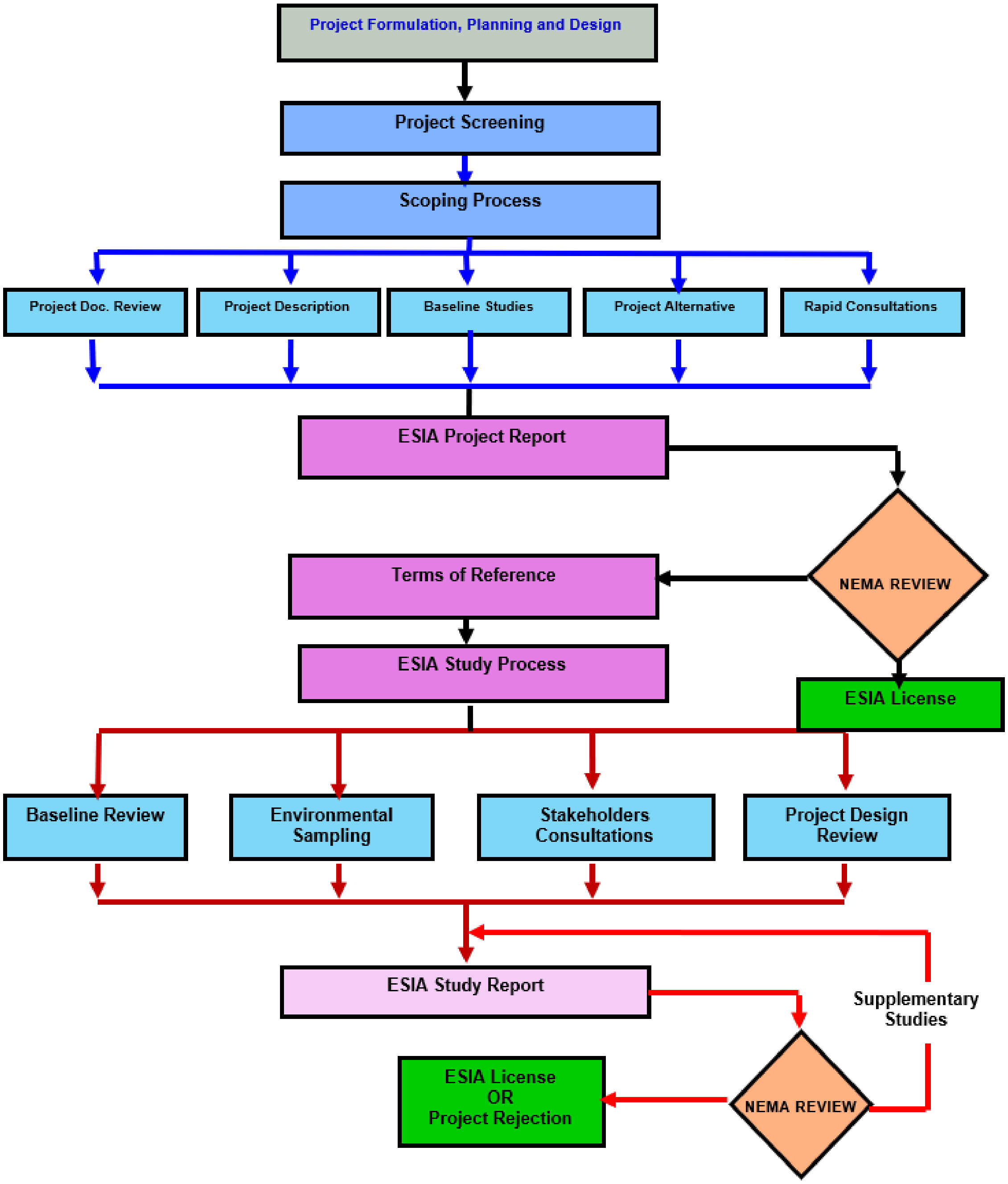


Figure 1-1: ESIA Process Overview

The methodology combined primary and secondary data collection

1.5.1 Desk Study / Literature Review

A review of existing information was conducted to understand the legal framework, baseline conditions, and identify potential issues. Documents reviewed included:

- Elgeyo Marakwet County Integrated Development Plan (2023-2027).
- Relevant Kenyan legislation and AfDB policies.
- Topographical maps, satellite imagery, and government publications.

1.5.2 Field Reconnaissance & Baseline Review

Limited field observations were undertaken to ground-truth desk study findings, identify key environmental and social receptors, and understand the local context through photography, checklists, and informal interviews.

1.5.3 Initial Stakeholder Consultations

During the PRESIA stage, High-level stakeholder engagement meetings were conducted on 8th and 9th December 2025, organized through the offices of Deputy County Commissioners across the project area. These entry meetings involved community representatives (including chiefs, elders, women, youth, and PLWDs) to:

- Introduce the project and the PRESIA process.
- Solicit initial feedback, concerns, and local knowledge.
- Inform planning for more detailed, location-specific public participation during the ESIA.

1.5.4 Socioeconomic Surveys

The socio-economic survey was undertaken to establish baseline conditions within the project's area of influence and provide information for assessing potential environmental and social impacts, identifying vulnerable groups, and developing appropriate mitigation and enhancement measures. The survey collected information on household demographic characteristics, education, livelihoods, income sources, land use and tenure, access to social services and infrastructure, vulnerability, and community perceptions of the proposed Project.

The survey was undertaken between **8 and 21 April 2026** using a digital questionnaire developed and administered through KoBoToolbox on mobile devices. A representative sample of **236 households** was selected using a stratified sampling approach to ensure adequate representation of the different road sections, settlements, socio-economic groups, and potentially vulnerable populations within the Project corridor. The distribution of the sampled households is presented in **Table 1-2**.

Road Section	Locations/Settlements	Households Surveyed
B122	Kibargoi and Soy	54
B124	Chemoibon and Soy	34
B126	Arror, Chemwoyo, Chesigot, Chesuman, Epke, Keu, Kibaimwa, and Kiptuilong	148
Total		**236**

Note: *Soy Location is traversed by both the **B122** and **B124** road sections; therefore, households from Soy were sampled under both sections based on their location along the respective road corridors.*

The KoBoToolbox household questionnaire used for the survey is provided in Appendix X.

The ESIA household survey was conducted solely to establish the environmental and social baseline for the impact assessment and should not be confused with the surveys undertaken for the Resettlement Action Plan (RAP). The RAP involved a 100% census of Project Affected Persons (PAPs), an asset inventory and valuation, and PAP-specific socio-economic surveys to support eligibility determination, valuation of affected assets, compensation planning, and resettlement assistance. These exercises served different objectives and employed separate methodologies from the ESIA household survey. Details of the RAP methodology and findings are presented in the RAP report.

1. **Data Collection Process**

All socio-economic household survey data was collected digitally using KoboCollect, a free open-source mobile data collection platform. The survey questionnaire was programmed into the KoboToolbox platform using XLSForm syntax, enabling the implementation of skip logic, mandatory field constraints, response validation, and automatic GPS coordinate capture at the point of each interview.

KoboCollect enabled real-time, paperless data capture directly in the field. Completed questionnaires were automatically uploaded to a secure, password-protected KoboToolbox server upon internet connection, with offline functionality ensuring uninterrupted data collection in areas with limited connectivity. All data was stored and managed in accordance with Kenya's Data Protection Act (2019) and the KeNHA Data Protection Policy.

Key features of the deployment included automatic GPS coordinate capture linking each respondent to a precise location, built-in skip logic guiding enumerators through the questionnaire, drop-down response lists to minimise transcription errors, photographic documentation of affected structures, automatic date and time stamping of each interview, and offline data storage with synchronization upon reconnection to the internet. Data was exported from Kobo Toolbox in Excel format for subsequent cleaning, analysis, and reporting.

2. **Locally Trained Enumerators**

All field data collection activities were carried out by a team of locally recruited and trained enumerators. The use of local enumerators leveraged their familiarity with the community, proficiency in local languages including Kalenjin dialects, and cultural competence — all essential for building rapport with respondents and ensuring high-quality data collection.

A total of No.16 enumerators was recruited from within the project area communities, with an equal gender balance of 4 male and 4 female enumerators. This ensured that female PAPs, particularly female household heads, were interviewed by female enumerators in line with gender-sensitive data collection best practice. Enumerators were selected based on local language proficiency, prior field research experience, and strong interpersonal communication skills. All enumerators underwent training before the commencement of field data collection and a supervised field pre-test to validate the questionnaire and build enumerator confidence.

Findings from the household socio-economic survey were triangulated with information obtained through various stakeholder consultation methologies including key informant interviews and focus group discussions , as well as baseline field observations and relevant secondary data sources outlined in this section. This approach enabled validation of key findings, enhanced the relialbility and consistency of the data collected, and provided a comprehensive understanding of the socio-economic conditions and potential project impacts within the proposed project road corridor.

1.5.5 Stakeholder Consultations

Key stakeholders in the Elgeyo County, Sub Counties and Community level were identified and consulted with the objective of establishing the existing environmental, social - economic conditions, gather institutional and community needs within the proposed project area and linkage to the neighbouring areas. This was done through visits to various National, County, Sub County government, NGO's, CBOs offices and other community groups such as farmers groups, transport and market groups. Effort was made to collect all information relevant to the project and recommendation incorporated into the ESMP for monitoring during each of the project cycles.

The consultant team carried out number eight (8) meetings forming part of the community consultative meetings /baraza with both the general community and possible project affected persons from the three sub counties traversed by the proposed road corridor. This community meetings took place between 14th April -18th April 2026 whereby a total of No.1497 (F=580, M= 917). ESIA team undertook preliminary entry level meeting with key stakeholders and leaders in all the No.5 sub-counties and No.7 consultation meetings were held with the main objective being to sensitize and create awareness among the leaders through whom the message of the project implementation was to reach the grassroots in preparation of the ESIA/RAP study activities including cadastral surveys and pegging of the corridor, socioeconomic studies, gender assessment studies and valuation of affected properties.

FGDs information was crucial supporting triangulation of the community meetings and KIIs information. A structured focused discussions questionnaire was used to gather detailed input on gender-specific needs, Environmental, Social, safety concerns, perceptions, potential exclusion and inclusion issues, benefit sharing, that pertain to the proposed road project. In this view, the ESIA team conducted FGDs with an average of 30 minutes to specific groups who youth, women, men and each group incorporated the elderly, vulnerable and people with disability. Each group comprised of number 10 participants though some forums they were more due to high numbers of attendance at the community meetings.

1.6 Structure of this ESIA Report

This report has been prepared under the following chapters:

Section	Chapter Title	Description
Executive Summary	Executive Summary	Presents a concise overview of the key findings of the ESIA study, highlighting significant environmental and social issues, anticipated impacts, proposed mitigation measures, and key recommendations for project implementation.
Chapter 1	Introduction and ESIA Approach	Provides the project background, location, rationale, objectives, scope of the study, applicable NEMA reporting requirements, methodology used during the assessment, and the overall structure of the report.
Chapter 2	Project Location and Description	Describes the project location, site characteristics, project components, design features, implementation approach, operational requirements, and proposed activities.

Chapter 3	Relevant Policy, Legal and Regulatory Framework	Reviews the national policies, legislation, regulations, standards, international conventions, treaties, and guidelines relevant to the proposed project and its environmental and social management.
Chapter 4	Baseline Environmental and Social Setting	Describes the existing environmental and social conditions within the project area and surrounding environment, including climate, geology, soils, topography, hydrology, vegetation, wildlife, land use, socio-economic conditions, cultural heritage, and community characteristics.
Chapter 5	Stakeholder Consultation and Public Participation	Outlines the stakeholder engagement process undertaken during the assessment, including consultation objectives, methodologies, stakeholder categories consulted, key issues raised, concerns, expectations, and how stakeholder feedback has been incorporated into project planning.
Chapter 6	Alternatives to the Project	Examines feasible project alternatives, including site alternatives, design alternatives, technology options, implementation approaches, and the no-project alternative, together with their associated environmental and social implications.
Chapter 7	Climate Change Screening and Adaptation	Assesses the project's vulnerability to climate change, identifies potential climate-related risks, and outlines appropriate climate adaptation and resilience measures integrated into project design and implementation.
Chapter 8	Potential Impacts and Mitigation Measures	Identifies and evaluates the potential positive and negative environmental and social impacts associated with the construction, operation, and decommissioning phases of the project. The chapter also proposes mitigation and enhancement measures to avoid, minimize, mitigate, compensate for, or enhance identified impacts.
Chapter 9	Environmental and Social Management Plan (ESMP)	Presents the Environmental and Social Management Plan, including mitigation measures, monitoring requirements, institutional responsibilities, implementation schedules, reporting mechanisms, capacity-building requirements, and budget provisions for environmental and social management.
Chapter 10	Conclusions and Recommendations	Summarizes the overall findings of the assessment, presents conclusions regarding project environmental and social acceptability, and provides recommendations and the proposed way forward for project implementation.
Chapter 11	References	Lists all sources of information, literature, legislation, reports, maps, stakeholder inputs, and other materials consulted and referenced during the assessment process.
Chapter 12	Annexure	This chapter contains the supporting documentation, consultation records, technical drawings, management plans, and statutory compliance documents that complement the findings and recommendations of the ESIA study. The annexures provide detailed evidence of stakeholder engagement processes, project design information, environmental and social management instruments, and regulatory compliance documentation.

CHAPTER 2: PROJECT LOCATION AND DESCRIPTION

2. PROJECT LOCATION AND DESCRIPTION

2.1 Project Location

The proposed Biretwo–Arror–Chesongoch (B126) Road and Associated Spur Roads Project forms part of the Great Rift Economic Development Corridor and comprises the improvement and upgrading of a primary corridor road together with its associated spur roads within Uasin Gishu and Elgeyo Marakwet Counties, located in the North Rift Region of Kenya’s classified road network.

Phase 1of the project includes the improvement of three road sections, namely the Biretwo–Arror–Chesongoch Road (B126) and two associated spur roads, Nyaru–Kapkayo Road (B124) and Kimwarer–Emsea Road (B122). Phase 1 The Biretwo–Arror–Chesongoch (B126) Road starts at Biretwo, located along the Iten–Kabarnet Road, at approximately 0°32'13"N, 35°33'26"E, and proceeds in a generally north-easterly direction through Arror before terminating at Chesongoch, located at approximately 1°07'06"N, 35°38'35"E, within Elgeyo Marakwet County.

The Nyaru–Kapkayo Road (B124) commences at Nyaru, which is located along the Eldoret–Eldama Ravine Road, at approximately 0°19'32"N, 35°34'29"E, and extends eastwards to Kapkayo, located at approximately 0°18'50"N, 35°42'28"E. The Kimwarer–Emsea Road (B122) starts at Kimwarer, located at approximately 0°18'48"N, 35°37'58"E, and terminates at Emsea, which is located along the Iten–Kabarnet Road, at approximately 0°27'09"N, 35°37'48"E. These spur roads provide critical connectivity between the main B126 corridor, the Kerio Valley region, and surrounding rural settlements.

The road is currently in fair condition but the shoulders has been completely eroded in most areas. The road carriageway has a narrow width thereby compromising the safety of road users. The project road traverses through a flat and rolling terrains.

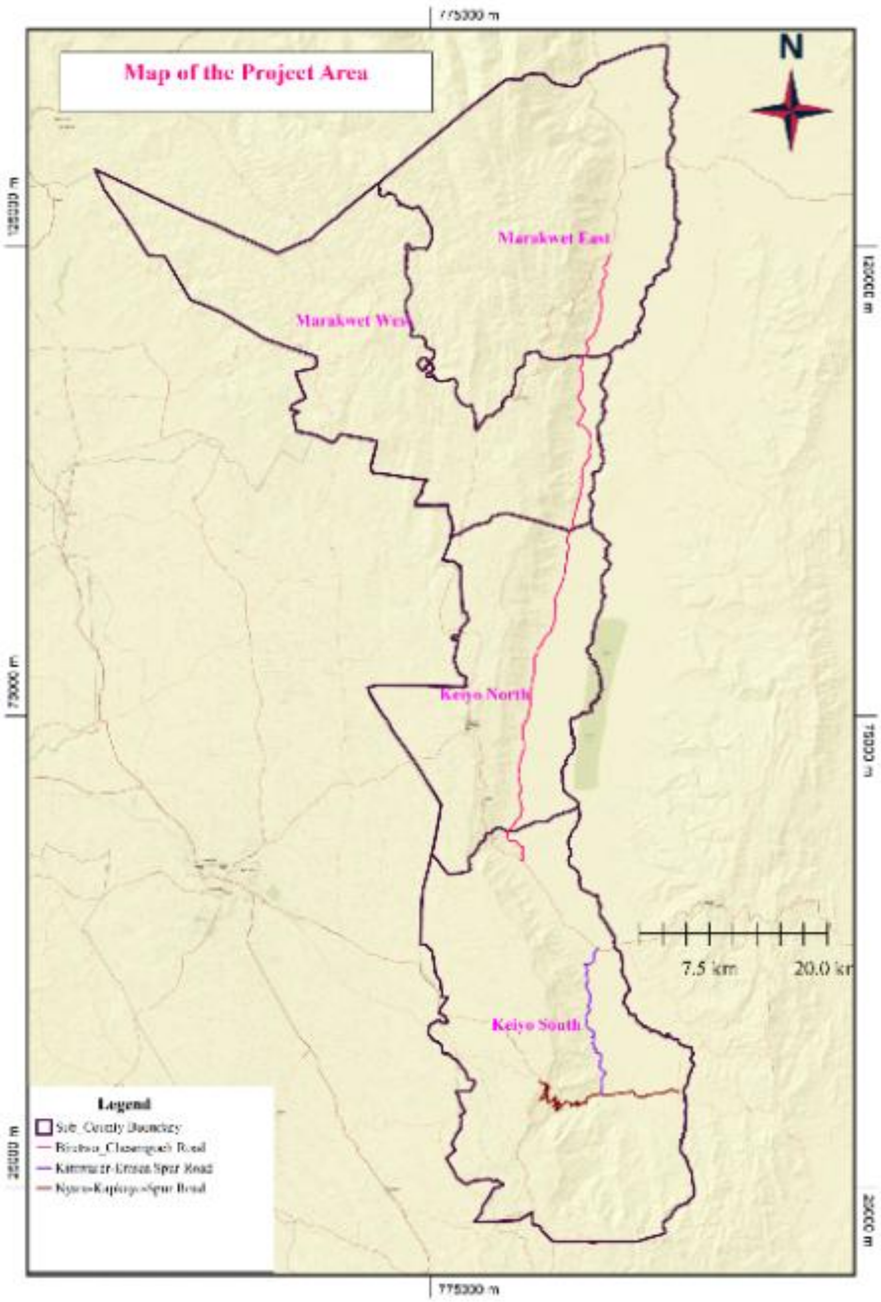


Figure 2-1: Location of the Project Roads

2.2 Project Description

2.2.1 Existing road condition

The Phase I project roads are predominantly earth and gravel rural access roads serving agricultural zones, trading centres, and dispersed rural settlements. The roads exhibit poor to fair condition, characterized by narrow carriageways, uneven riding surfaces, corrugations, potholes, loose gravel and eroded sections.

Drainage-related distress is common along all three corridors, with waterlogging, surface runoff damage, and localized wash-outs evident in low-lying and sloping sections. During the rainy season, some stretches become difficult to traverse, while in the dry season the roads generate excessive dust, affecting roadside communities and users. Geometric limitations, including sharp curves, steep gradients, and limited sight distances, reduce travel speeds and compromise safety. Collectively, these conditions increase vehicle operating costs, restrict reliable access, and constrain socio-economic activities within the project influence area.

2.2.1.1 Existing Drainage Structures

Drainage structures along the three Phase I roads is limited, scattered, and in many sections inadequate. The existing system consists mainly of small culverts, drifts, natural stream crossings, and informal side drains, many of which are undersized, silted, damaged, or poorly aligned.

As a result, several sections experience overtopping, erosion of shoulders and embankments, formation of gullies, and sediment accumulation, particularly near river crossings, seasonal streams, and low-lying terrain. These deficiencies significantly contribute to the rapid deterioration of the road surface. The project therefore proposes the rehabilitation, replacement, and construction of new drainage structures, including cross-drainage works, lined side drains, and erosion protection measures.

2.2.1.2 Existing Road Reserve

The proposed roads generally follow existing road corridors that have been used for many years and form important transport links within Elgeyo Marakwet County. The width of the existing road reserve varies considerably along the corridor, ranging from approximately 30 and 60 meters in rural sections. The sections, are relatively open, bordered by farmlands, grazing areas and natural vegetation. However, within trading centres and settlement clusters including sections of Arror, Biretwo, Emsea, Kimwarer and Kapkayo corridors, parts of the reserve have been encroached by permanent and semi-permanent structures, fences, kiosks, and social facilities. This encroachment has resulted in constrained carriageway widths, limited shoulders, and increased safety risks to pedestrians, traders and other roadside activities. The extent of encroachment varies throughout the corridors, with the most significant impacts occurring within established market centres where commercial activities have expanded into the road reserve over time. The proposed works will primarily utilize the existing reserves, with minor additional land take where required to accommodate realignments, drainage improvements, junction treatments, and road safety features.

Particular attention was given to the alignment section through Arror Town following observations raised during stakeholder engagements and the initial African Development Bank mission. During project design, an alternative alignment following a historical road corridor east of Arror Town was considered. According to information provided by local elders and community members, this corridor was used during the 1960s but was abandoned following the collapse of a bridge. Since then, the area has been utilised for agricultural activities and was not recognised during the ongoing land adjudication process, resulting in the former alignment no longer being readily identifiable on the ground.

To determine the preferred alignment option, a stakeholder consultation meeting involving local residents, business owners, community leaders, local administration, County Government representatives, and KeNHA was held in Arror. During the consultations, residents unanimously rejected the proposed bypass alignment along the historical corridor, citing concerns that diverting traffic away from the town would negatively affect local businesses, reduce economic opportunities, and undermine the future growth of Arror as a trading centre. Community members expressed a strong preference for retaining the road through Arror Town Centre to preserve commercial activity and maintain access to services.

The consultations further established that the existing road reserve through Arror Town is approximately 40 m wide. Community members acknowledged that implementation of the project within this corridor may result in impacts on businesses, structures, and other developments that have encroached into the road reserve. Despite these anticipated impacts, the community indicated that the long-term economic benefits associated with maintaining traffic through the town outweighed the potential losses and supported implementation of the project along the existing alignment.

Consequently, the preferred alignment follows the existing road corridor through Arror Town Centre. While the available road reserve is generally sufficient to accommodate the proposed road cross-section, several structures and developments located within the reserve will be affected and have been identified in the Resettlement Action Plan (RAP). These impacts primarily relate to encroachments within the existing road reserve rather than acquisition of additional private land.

Outside Arror Town, the project will largely utilise the existing road reserve. However, limited additional land acquisition will be required at selected locations where improvements such as curve corrections, road realignments, junction upgrades, drainage structures, slope stabilisation works, and road safety interventions extend beyond the existing corridor. The extent of land acquisition and associated impacts on land, structures, crops, trees, and livelihoods are detailed in the RAP and are further assessed in the impact assessment and ESMP sections of this report.

2.2.1.3 Proximity to the Rimoi Game Reserve

A key consideration for the Biretwo-Chesongoch road is its proximity to the Rimoi Game Reserve. The road alignment does not traverse the protected area itself; however, it passes approximately 3 kilometers from the main reserve entrance. This proximity creates a zone of influence where project-related activities could lead to indirect impacts on the reserve's ecosystems. Primary concerns include increased traffic volume and speed, which could elevate the risk of wildlife-vehicle collisions for animals moving beyond the reserve boundaries, noise disturbance, and the potential for facilitated access leading to increased human-wildlife conflict or illegal activities. These potential indirect and cumulative impacts will be assessed in detail in Chapter 4.

2.2.2 Project Components

2.2.2.1 Road Geometry and Design Standards

The proposed project involves upgrading three existing road sections to bitumen standard, classified as Class B (National Highway). The road geometry has been developed in line with the Kenya Road Design Manual (RDM) Volume 1.3, with supplementary reference to AASHTO (2018) guidelines where appropriate.

The design has been based on optimisation of the existing road reserve, with context-sensitive approach adopted to balance safety, mobility, cost efficiency and minimization of environmental and social impacts.

The upgraded road will feature a 7.0 metre carriageway with 1.5 metre shoulders, supported by a full pavement structure consisting of a prepared subgrade, sub-base, base course, and asphalt concrete wearing course. A cross-section is provided in Annex 4.

Given the varied terrain along the corridor including rolling landscapes, steep escarpments, mountainous sections, and built-up market centres the design avoids a uniform application of standards and instead applies terrain-responsive geometric controls to enhance safety and constructability.

Key geometric parameters for each road section are summarised in Table 2-1 below.

Table 2-1 ***Key Geometric Design Parameters by Road Section***

Parameter	**B126 (Biretwo–Arror–Chesongoch)**	**B122 (Kimwarer–Emsea)**	**B124 (Nyaru–Kapkayo)**
Approximate Length	~72 km	~19 km	~32 km
Terrain	Predominantly rolling	Rolling and mountainous	Escarpment, mountainous and rolling
Design Speed	85 km/h (rural), 50 km/h (market centres)	60–70 km/h	50–85 km/h (terrain-dependent)
Carriageway Width	7.0 m	7.0 m	7 m (approved reduced standard)
Shoulder Width	1.5 m (paved)	1.5 m (paved)	1.5 m (paved)
Typical Cross-Section	Type R5 (RDM)	Type R5 (RDM)	Type R6 (Modified)
Design Vehicle	DV5 (15 m truck + trailer)	DV5 (15 m truck + trailer)	DV5 (16.9 m truck + trailer)

Several design decisions of environmental and social relevance have been incorporated:

a) For the B126 and B122 sections, a carriageway width of 7.0 m with 1.5 m paved shoulders (R5 standard) has been adopted instead of wider Class B standards. This significantly reduces land take and potential displacement while maintaining acceptable safety and operational performance. For the B124 section, a reduced standard of 7.0 m carriageway with 1.5 m shoulders was approved in response to economic considerations and challenging terrain.
b) Following engineering assessment and stakeholder consultations, the preferred alignment through Arror follows the existing town-centre corridor rather than the historical bypass alignment east of the town. This option maintains access to commercial activities and community services while avoiding the need to reinstate the former bridge crossing associated with the historical alignment.
c) The design recognises that the existing road reserve is generally narrower than the ideal 60 m corridor typically associated with Class B roads. As such, land acquisition will be based on the actual construction width required to safely achieve the design geometry, rather than applying a uniform reserve along the entire corridor.
d) Design speeds are reduced to 50 km/h within market centres and other built-up areas such as Biretwo, Arror, Chesongoch, Nyaru and Emsea. These sections will incorporate traffic calming measures to enhance pedestrian safety and reduce accident risk.

2.2.2.2 Road Safety and Ancillary Features

Road safety is a core consideration of the project design and reflects both national highway standards and local conditions along the corridor. The proposed road will incorporate a range of safety and ancillary features, including:

i. Safety hardware, such as guardrails, hazard markers, and retro-reflective road studs at bridges, sharp curves, steep embankments, and other high-risk locations;
ii. Traffic calming measures, including rumble strips and speed humps at approaches to market centres, settlements, and identified livestock and wildlife crossing points;
iii. Street lighting, limited to market centres, major junctions, and designated truck parking areas;
iv. Junction layouts, primarily simple bell-mouth accesses or partly channelised T-junctions to safely manage turning movements;
v. Drainage systems, comprising standard side drains (Types A2, B1, and B2) selected according to terrain and hydrological conditions; and
vi. Public transport and freight facilities, including provision for bus bays and designated truck parking areas where appropriate.

2.2.2.3 Link to Land Acquisition and Resettlement

The adopted geometric design is a key determinant of the project's land acquisition requirements. Design measures such as reduced cross-sections and context-specific speed management have been deliberately applied as impact avoidance and minimisation measures.

The final land acquisition footprint has been confirmed following based on the design, where the horizontal and vertical alignments were fully refined to respond to topography, drainage, and safety requirements. Accordingly, the final land take and asset impacts have been established within the Resettlement Action Plan (RAP), which has been presented separately.

2.2.3 Material Investigations

2.2.3.1 Prospecting for Natural Gravel Material

An extensive materials investigation was undertaken along the project roads to identify potential natural gravel sources suitable for use in pavement layers. The prospecting exercise involved a systematic search of both existing and new borrow areas within the project influence zone, resulting in the identification of several potential gravel sites along the Biretwo–Arror–Chesongoch, Kimwarer–Emsea, and Nyaru–Kapkayo roads as shown in the table below;

Table 2-2: Natural Gravel Sources

Gravel Source	Location	Eastings	Northings	Road
MS 1	KM 15+600 RHS	0788755	333620	Nyaru-Kapkayo
MS 2	KM 29+100 LHS	797545	330150	Nyaru-Kapkayo
MS 3	KM 13+300 LHS	791521	277160	Kimwarer-Emsea
MS 5	KM 25+500 LHS	798719	346080	Nyaru-Kapkayo
MS 6	KM 47+600 LHS	791897	102691	Biretwo-Arror-Chesongoch
MS 9	KM 9+000 LHS	791534	426978	Kimwarer-Emsea

Trial pits and exposures were excavated to depths of approximately 1.2 m to 1.5 m on an approximate 60 m grid, and representative samples were collected for laboratory testing. The materials were subjected to tests including Atterberg limits, particle size distribution, linear shrinkage, compaction, organic content, and California Bearing Ratio (CBR).

Laboratory results indicated that most natural gravels did not meet Road Design Manual specifications for direct use as untreated sub-base or base materials. Consequently, chemical stabilization using cement and lime was investigated. Treatment tests demonstrated that, with appropriate cement stabilization (approximately 2% for sub-base and 3% for base layers), the gravel materials could achieve the required engineering properties for pavement construction.

Based on these findings, several gravel sources were confirmed as technically suitable for use after treatment, subject to licensing of borrow pits, landowner agreements, and implementation of environmental management measures to control dust, erosion, and site restoration.

2.2.3.2 Hard Stone Material Sources

Potential hardstone sources were identified from both existing quarries and commercial crushing plants within and near the project area. Representative rock samples were collected from identified sites and tested to determine their suitability for use in road base, sub-base, asphalt works, and concrete production.

Table 2-3: Hardstone Sources

Quarry Location along existing alignment	Eastings	Northings	Description
HA 1 Bayete-Nyaru	774597	311450	Existing Hardstone
HA 2 Kondoo Quarry	772491	212620	Existing Hardstone
HA 3 Dittman Quarry	746515	500050	Commercial Crusher
HA 4 Rubbi Quarry	792016	510930	Commercial Crusher

Laboratory testing included Los Angeles Abrasion, Aggregate Crushing Value, sulphate soundness, water absorption, relative density, bitumen affinity, and plasticity of fines. The results showed that all sampled hardstone sources complied with the Kenya Road Design Manual (KRDM 2025, Volume 3) specifications for use as graded crushed stone, asphalt aggregates, surfacing chippings, and concrete aggregates.

The identified hardstone quarries are therefore considered suitable sources of construction aggregates for the Phase I roads, subject to compliance with statutory quarry licensing requirements and the implementation of appropriate environmental, occupational health, and safety controls during extraction and haulage.

2.2.3.3 Prospecting for Sand Material

A materials investigation was conducted along the Biretwo–Arror–Chesongich Road to identify potential sources of sand suitable for concrete works. The exercise involved a survey of both natural and commercial sand sources within the project influence area. Three sources were identified and sampled:

Table 2-4: Fine Aggregate Sources

Quarry Location	Location	Eastings	Northings	Description
SA 1	Kapkorokok Lagha	788234	666551	River Sand
SA2	Ditman Quarry	746515	500050	Crushed Rock Sand
SA 3	Rubbi Quarry	792016	510930	Crushed Rock Sand

Samples were collected and subjected to laboratory tests, including particle size distribution, silt content, sulphate content, chloride content, organic content, and sodium or magnesium sulphate soundness.

Laboratory results indicated that the natural river sand (SA 1 – Kapkoromok Lagha) had a silt content of 5%, exceeding the MOTC standard maximum of 3% for sand in concrete works, and was therefore not recommended for use. Conversely, the crushed rock sands (CS 2 – Ditman Quarry and CS 3 – Rubbi Quarry) complied with all MOTC specifications and are recommended for exploitation and use in concrete works.

Based on these findings, crushed rock sand is the preferred source for concrete along the project corridor, subject to proper licensing, landowner agreements, and implementation of environmental management measures during extraction.

2.2.3.4 Water for Construction

Water Adequate water resources for construction are available within reasonable proximity to the project roads, primarily from permanent rivers and streams within the project area. These surface water sources are considered suitable for construction use, subject to obtaining the necessary permits from the legally mandated water resource management authorities.

A literature review and field referencing exercise was undertaken to assess water availability and quality. Potential water abstraction points were geo-referenced using a Garmin GPS receiver, and key rivers identified include the Kerio River (Kimwarer–Emsea Road) and the Mogil, Arror, Chesongoch, and Embotungo Rivers (Biretwo–Arror–Chesongoch Road).

Water quality testing was conducted by the Ministry of Transport and Roads – Materials Testing and Research Division and the Water Resources Authority. The parameters analysed included pH, total alkalinity, sulphates, chlorides, and total dissolved solids (TDS). Results indicate that all sampled sources comply with the requirements of KS EAS 12:2018 and BS 3148:1980 standards for water suitable for concrete works. The water sources are therefore considered technically suitable for use during construction, provided abstraction is controlled and environmental protection measures are implemented.

Table 2-5: Results of Test on Water Samples

Parameter/ Source	pH	Total Alkalinity as $CaCO_3$ (ppm)	Sulphates SO_3 (ppm)	Chlorides Cl, (ppm)	Total Dissolved Solids, (ppm)
Kerio River	6.7	56	2.0	1.0	10
Arror River	6.7	50	<0.3	ND	50
Chesongoch River	8.08	185	4.8	28.4	269
Mogil River	7.77	400	17.15	74.55	557

Embotungo River	7.59	260	13.03	13.03	531
Specifications KS EAS 12:2018 Standards	6.5 -8.5	500 max	400 max	250 max	1,500 max
Specification Limits (BS 3148: 1980)	4-10	1,000 max	1,000 max	500 max	2,000 max

The results show compliance with BS specifications and Kenya Bureau of Standards for water for concrete works in all respects.

2.2.4 Project Costs

An estimate of the cost of the proposed upgrading works was prepared on the estimate basis of local cost of equipment, materials and labour as well as the recent unit rates for awarded construction projects. The estimated cost of the proposed road upgrading project is Kshs. 22,200,000,000.00 inclusive of contingencies, price variation and VAT.

CHAPTER 3: RELEVANT POLICY, LEGAL AND REGULATORY FRAMEWORK

3. RELEVANT POLICY, LEGAL AND REGULATORY FRAMEWORK

3.1 Introduction

This chapter outlines the key policy, legal, and institutional frameworks applicable to the proposed Biretwo–Chesongoch Road and Associated Spur Roads Upgrade Project. The purpose of this review is to confirm the regulatory requirements that will guide project planning, design, implementation, and approval, and to establish the basis for environmental and social risk management.

The chapter focuses on Kenyan national legislation and institutional mandates relevant to road infrastructure development, as well as the safeguard requirements of the African Development Bank (AfDB), a co-financier of the project.

3.2 Approach to the Regulatory Review

The review is based on a desktop assessment of:

a) Relevant national policies, Acts of Parliament, and subsidiary regulations;
b) Institutional roles and responsibilities related to environmental management, land, water, wildlife, and occupational safety; and
c) AfDB Integrated Safeguards System requirements applicable to linear infrastructure projects.

The analysis emphasizes provisions most relevant to the project's risk profile, including land acquisition, biodiversity protection, pollution control, climate resilience, labour conditions, and community welfare.

3.3 Policy Framework

Table 3-1 Policy framework

Policy Framework	Relevance
National Environment Policy, 2014	Guides the ESIA in identifying and mitigating environmental and social impacts along the road corridor, ensuring sustainable resource use, protection of ecosystems, stakeholder participation, inclusion of vulnerable groups, and compliance with national and international environmental obligations.
Kenya Vision 2030	Provides the overarching development framework under which the road project supports economic growth, improved access to services, employment creation, and regional integration, while requiring environmental safeguards and public participation in line with EMCA.
National Land Policy, 2009	Requires ESIA and environmentally sustainable land use for infrastructure projects, ensuring that land acquisition, use, and management for the road are socially equitable, environmentally sound, and supported by public participation and continuous environmental monitoring.
Updated Integrated National Transport Policy (INTP), 2024	Guides the planning and implementation of the road project to integrate environmental and social safeguards, climate change resilience, safety, gender mainstreaming, and legal compliance, thereby shaping the scope of the ESIA and ESMP.

National Biodiversity Strategy and Action Plan (NBSAP), 2007	Requires biodiversity considerations to be integrated into the project, guiding identification and mitigation of impacts on wildlife and natural vegetation outside protected areas to prevent biodiversity loss.
National Policy on Gender and Development, 2019	Ensures gender mainstreaming in project planning and implementation by promoting equitable participation, access to employment opportunities, inclusion of marginalized groups, and consideration of differentiated project impacts on women and men.

3.4 Legal Framework

Table 3-2 Legal framework

Legal Framework	Relevance
Constitution of Kenya, 2010	Guarantees the right to a clean and healthy environment (Article 42) and obligates sustainable resource use, biodiversity protection, public participation, and environmental assessment (Articles 69 & 70). The project must integrate ESIA findings and mitigation measures to safeguard environmental rights.
Environmental Management and Coordination Act (EMCA), 1999 (as amended)	Provides the primary legal framework for environmental management in Kenya, mandating EIAs, audits, monitoring, and compliance with environmental quality standards. The road project is a scheduled high-impact activity requiring NEMA approval.
Environmental (Impact Assessment and Audit) Regulations, 2003 (as amended)	Sets procedures for conducting EIAs, public participation, and submission to NEMA. The ESIA for the road has been prepared in accordance with these Regulations.
EMCA (Air Quality) Regulations, 2024	Relevant due to dust, machinery exhaust, and vehicular emissions during construction and operation. Requires dust suppression, equipment maintenance, and air quality monitoring.
EMCA (Sand Harvesting) Regulations, 2024	Governs sustainable extraction, transport, and rehabilitation of sand sites. Relevant for sourcing construction materials and minimizing environmental impacts such as erosion or habitat loss.
EMCA (Noise and Excessive Vibration Pollution) Regulations, 2009	Controls noise and vibration from construction activities. Requires monitoring, restricted working hours, and mitigation measures to protect nearby communities.
EMCA (Waste Management) Regulations, 2024	Sets requirements for waste segregation, storage, transport, and disposal. Relevant for managing construction, demolition, hazardous, and domestic waste safely and sustainably.
EMCA (Water Quality) Regulations, 2024	Protects surface and groundwater from pollution. Relevant due to sediment-laden runoff, fuel spills, and construction waste, requiring erosion control and stormwater management.

Legal Framework	Relevance
EMCA (Fossil Fuel Emission Control) Regulations, 2006.	Controls emissions from motor vehicles and fossil fuel–powered machinery. Relevant due to the use of diesel-powered construction equipment and increased vehicular traffic during operation, requiring regular maintenance, emission compliance, and control of exhaust pollutants to protect air quality and public health.
Water Act, 2016	Governs sustainable use and protection of water resources. Relevant where construction alters drainage, affects rivers, or requires water abstraction, ensuring permits and pollution control measures are in place.
Kenya Roads Act, 2007	Provides the framework for planning, design, construction, and management of roads. Ensures legal compliance, land acquisition, construction standards, and integration of environmental and social safeguards.
Traffic Act, Cap. 403 (as amended)	Regulates road use and safety. Guides traffic management plans, signage, detours, and worker protection during construction, minimizing accidents and disruptions.
Occupational Safety and Health Act (OSHA), 2007	Ensures health, safety, and welfare of workers. Relevant for camps, machinery operation, and workforce safety, requiring PPE, training, safety committees, medical surveillance, and audits.
Factories and Other Places of Work (Hazardous Substances) Rules, 2007	Regulate handling, storage, and use of hazardous materials such as fuels, bitumen, and chemicals, ensuring worker and environmental safety.
Factories and Other Places of Work (Noise Prevention and Control) Rules, 2005	Protects workers from occupational noise exposure. Requires monitoring, engineering controls, and hearing protection during construction.
Factories and Other Places of Work (Medical Examinations) Rules, 2005	Requires pre-employment and periodic medical examinations for workers exposed to dust, noise, chemicals, and heavy machinery.
Factories and Other Places of Work (Fire Risk Reduction) Rules, 2007	Provides fire prevention measures for workplaces. Relevant due to flammable materials and machinery on site, requiring fire safety equipment, training, and emergency plans.
Employment Act, 2007	Governs recruitment, contracts, working conditions, and protection against discrimination. Ensures fair labour practices and prevents disputes during construction.
Work Injury Benefits Act (WIBA), 2007	Provides compensation for work-related injuries, occupational diseases, or fatalities. Ensures worker welfare and legal compliance.
Wildlife Conservation and Management Act, 2013	Protects wildlife and habitats. Relevant due to proximity to Rimoi National Reserve, requiring consultation with KWS and mitigation of habitat fragmentation, wildlife movement disruption, and indirect impacts.

Legal Framework	Relevance
Public Health Act, Cap. 242 & Drainage and Latrine Rules	Ensures sanitation and disease prevention. Relevant for construction camps, worker welfare, and protection of nearby communities.
HIV/AIDS Prevention and Control Act, 2006	Requires workplace awareness, prevention, and non-discrimination measures. Relevant due to labour influx and community interactions.
National Construction Authority Act, 2011	Governs contractor registration, personnel accreditation, and construction standards. All contractors must be NCA-registered and compliant.
Land Act, 2012 (as amended)	Governs sustainable land administration and acquisition for public projects. Relevant for road reserves, camps, and material sites, ensuring lawful acquisition and compensation.
National Land Commission Act, 2012	Mandates land acquisition and compensation by NLC. Guides RAP implementation for affected communities.
IDPs and Affected Communities Act, 2012	Safeguards against arbitrary displacement. Ensures rights-based resettlement in line with RAP and AfDB OS 5.
Land Registration Act, 2012	Governs updating of land titles following project land take.
Environment and Land Court Act, 2011	Provides dispute resolution mechanisms for land and environmental conflicts.
Land Laws (Amendment) Act, 2016	Aligns land laws with the Constitution for evictions and compulsory acquisition. Ensures lawful land take procedures.
Physical Planning Act, 2019	Governs development approvals and land-use planning. Ensures road works, camps, and ancillary facilities are permitted by county authorities.
Climate Change Act, 2016	Requires climate adaptation and mitigation integration. Relevant for climate-resilient road design.
Urban Areas and Cities Act, 2011	Empowers counties to control dust, noise, and vibration. Ensures enforcement of environmental safeguards in urban/peri-urban areas.
National Museums and Heritage Act, 2006	Protects cultural and archaeological heritage. Requires management of chance finds during construction.
Energy Act, 2019	Regulates storage and use of petroleum products. Relevant for bulk fuel storage and compliance with environmental and safety standards.
Mining Act, 2016	Regulates extraction of construction materials, including quarrying and blasting. Ensures environmental and safety compliance.
National Sand Harvesting Guidelines, 2007	Guide sustainable sand sourcing and compliance with environmental approvals.
Used Oil and Oil Sludge Management Guidelines, 2016	Provide standards for safe handling and disposal of used oils and sludge.
Intergovernmental Relations Act, 2012	Provides framework for coordination between national and county governments. Ensures collaboration where the road traverses multiple counties.

3.5 Institutional framework

The key institutions with roles are as outlined in this table:

Table 3-3 Institutional framework

Institution	Role / Responsibility
National Environment Management Authority (NEMA)	Review and approve the ESIA report; issue the EIA Licence; ensure environmental compliance and monitoring.
Kenya National Highways Authority (KeNHA)	Project proponent; responsible for overall project implementation, adherence to legal and environmental requirements, and compliance with the ESMP.
Kenya Wildlife Service (KWS)	Provide advisory support on wildlife protection; guide mitigation measures for impacts on protected areas and habitats.
Water Resources Authority (WRA)	Regulate water abstraction and use; ensure protection of surface and groundwater resources during project implementation.
National Land Commission (NLC)	Oversee land acquisition, compensation, and resettlement processes for project-affected persons and lands.
County Government of Elgeyo Marakwet	Provide local planning approvals; facilitate stakeholder engagement; manage localized environmental and social impacts.
Directorate of Occupational Safety and Health Services (DOSHS)	Enforce occupational health and safety standards; monitor compliance with OSHA requirements on construction sites.
Ministry of Transport, Infrastructure, Housing and Urban Development	Provide policy oversight, coordination, and strategic guidance for road infrastructure projects at the national level.
National Transport and Safety Authority (NTSA)	Regulate road safety standards, vehicle registration, and traffic management; provide guidelines for safe construction and operation of roads.

3.6 AfDB Operational Safeguard Policies

The project is subject to the AfDB Integrated Safeguards System, 2023, with the safeguards outlined in the table below anticipated to apply based on the assessment.

Table 3-4 AfDB Operational Safeguard Policies

AfDB ISS 2023 Environmental and Social Standard (ESS)	Relevance to the Biretwo–Chesongoch Road Project	Triggered (Yes/No)
OS 1 – Assessment and Management of Environmental and Social Risks and Impacts	Category 1 project due to potential high-risk impacts including vegetation clearance, soil erosion, dust, noise, traffic disruptions, occupational safety, and community safety. Requires an ESIA and ESMP covering design, construction, and operation phases to identify, mitigate, and manage environmental and social risks.	Yes

OS2 – Labour and Working Conditions	Relevant due to engagement of skilled and unskilled labour. Ensures safe and healthy working conditions, fair employment terms, protection against child and forced labour, and inclusion of grievance mechanisms. Focus on contractor camps, local labour use, and occupational health and safety compliance.	Yes
OS 3 – Resource Efficiency and Pollution Prevention and Management	Ensures sustainable use of construction materials (gravel, bitumen, water, fuel) and prevents environmental pollution from dust, noise, wastewater, and emissions. Applies to soil and water protection near rivers, streams, and settlements.	Yes
ESS 4 – Community Health, Safety and Security	Addresses risks to surrounding communities from traffic, dust, noise, communicable diseases, and worker-community interactions. Requires traffic management, road safety measures, public awareness campaigns, and security arrangements for vulnerable road users (children, elderly, livestock keepers).	Yes
OS 5 – Land Acquisition, Restrictions on Access to Land and Land Use and Involuntary Resettlement	Applicable where land acquisition, temporary access restrictions, or loss of structures/crops occurs. Requires preparation and implementation of a Resettlement Action Plan (RAP) or Abbreviated RAP to ensure fair compensation and livelihood restoration prior to works.	Yes
OS 6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources	Relevant due to potential impacts on rivers, escarpments, farmland, and roadside vegetation. Requires controlled vegetation clearance, erosion control, protection of watercourses, and restoration of disturbed areas to minimize impacts on biodiversity and habitats.	Yes
OS 7 – Vulnerable Groups	Ensures that women, elderly, persons with disabilities, youth, and low-income households are included in project consultations, compensation, and employment opportunities. Special measures ensure safe access and equitable benefits for these groups.	Yes

OS 8 – Cultural Heritage	Addresses potential impacts on cultural, historical, or archaeological resources, including sacred sites or graves. Requires identification of such resources and implementation of chance-find procedures during construction.	Yes
OS 9 – Financial Intermediaries	Not applicable because the project is being directly implemented by the Kenya National Highways Authority (KeNHA) and does not involve financing through a financial intermediary institution.	No
OS 10 – Stakeholder Engagement and Information Disclosure	Requires ongoing, meaningful engagement with affected communities, local leaders, county authorities, and stakeholders throughout the project lifecycle. Promotes transparency, grievance redress, and local acceptance of the project.	Yes

The safeguard policies aim to systematically manage and mitigate environmental and social risks and impacts arising from AfDB-financed projects, ensuring the protection of human health and the environment while supporting risk reduction and the sustainable delivery of project activities.

3.6.1 Alignment of AfDB and Government of Kenya (GoK) Polices relevant to this ESIA

Kenyan legislation and AfDB safeguards are generally well aligned, particularly on environmental assessment, pollution control, and labour standards. However, AfDB safeguards place stronger emphasis on livelihood restoration, biodiversity connectivity, and social risk management.

Table 3-5 AfDB and Government of Kenya (GoK) Polices

Item	Kenya Legislation	AfDB Safeguards	Gaps
Environmental and Social Assessment	Under EMCA, all the proposed road projects fall under the Second Schedule and are required to undergo an ESIA study during project design and the development of an ESMP.	Under OS 1, all projects classified as Category 1 require an Environmental and Social Assessment during project implementation, leading to the development of Environmental and Social Management Plans (ESMPs) to guide mitigation of anticipated social and environmental impacts.	None
Public Consultations and Disclosure	EMCA requires that all ESIA studies undergo public consultations and disclosure	OS 1 requires that all ESIA studies undergo public consultations and disclosure,	None

	during the ESIA process. The Constitution of Kenya (2010) also guarantees public participation and consultation.	ensuring stakeholders are informed and can participate in the process.	
ESIA Disclosure	NEMA publishes the ESIA report to allow concerned citizens to forward their comments and concerns regarding the project.	The AfDB publishes the ESIA report on its website as part of public disclosure. The borrower also advertises the ESIA on its own website to ensure public accessibility.	None
Resettlement and acquisition of land	The Constitution of Kenya (2010), the Land Act (2012), and the National Land Commission Act provide the legal framework for compulsory land acquisition for public purposes. The legislation requires prompt, just, and full compensation prior to acquisition and provides procedures for valuation, consultation, grievance redress, and compensation of affected landowners and persons with recognized interests in land.	OS 5 (land Acquisition, Restrictions on Access to land and land use, and Involuntary Resettlement) seeks to avoid involuntary resettlement wherever feasible and minimize it where unavoidable. Where displacement occurs, affected persons must be compensated at full replacement cost and assisted in improving or at least restoring their livelihoods and living standards to pre-project levels. The standard also requires meaningful consultation, livelihood restoration, support to vulnerable groups, and establishment of effective grievance mechanisms.	Kenyan legislation focuses primarily on compensation for affected assets and land rights, whereas AfDB OS 5 places additional emphasis on avoidance and minimization of displacement, livelihood restoration, support to vulnerable groups, compensation at full replacement cost, assistance to informal occupants, and post-resettlement monitoring. Where gaps exist, the project should apply the requirements of AfDB OS 5.

3.7 International Treaties and Conventions

International treaties and conventions are legally binding agreements under international law through which States and international organizations assume obligations. Regardless of their titles, such instruments require Parties to comply with agreed commitments, guided by the principle of *pacta sunt servanda* (agreements must be respected). Kenya has ratified several international treaties that are relevant to the proposed road project and which inform environmental and social safeguards applicable during project planning and implementation, as summarized in the table below.

Table 3-6 International Treaties and Conventions

International Treaty / Convention	Relevance to the Proposed Road Project
Vienna Convention for the Protection of the Ozone Layer (1985)	Requires the project proponent and contractor to minimize emissions that contribute to ozone depletion and greenhouse gases, particularly from asphalt plants, construction equipment, and fuel use throughout the project lifecycle.

Montreal Protocol on Substances that Deplete the Ozone Layer (1987)	Obligates the contractor to avoid and control the use of ozone-depleting substances (ODS) in construction activities, machinery, and maintenance operations.
United Nations Framework Convention on Climate Change (UNFCCC), 1992	Guides the integration of climate change considerations into the project, requiring reduction of greenhouse gas emissions through efficient equipment use, fuel management, and environmentally responsible construction practices.
Paris Agreement (2016)	Supports Kenya's commitment to reduce greenhouse gas emissions by 32% by 2030, requiring regular maintenance of construction equipment and adoption of low-emission practices during road construction and operation.
CITES Convention (1975)	Relevant due to the presence of wildlife along the project corridor. Requires prevention of illegal trade, poaching, or disturbance of protected wild fauna and flora during project implementation.
Convention on Biological Diversity (CBD)	Requires conservation of biodiversity and sustainable use of biological resources. The project must identify and protect species of conservation importance and implement mitigation measures in liaison with the Kenya Wildlife Service (KWS).

3.8 Conclusion

The proposed project is guided by an extensive national policy, legal, and institutional framework, complemented by applicable international treaties and the African Development Bank's Integrated Safeguards System. The review confirms that the project is subject to mandatory environmental and social assessment and identifies key regulatory, safeguard, and institutional requirements that will inform the preparation and implementation of this ESIA, ESMP and RAP.

CHAPTER 4: BASELINE ENVIRONMENTAL AND SOCIAL SETTING

4. BASELINE ENVIRONMENTAL AND SOCIAL SETTING

4.1 Physical Environment

The proposed project roads are located entirely within Elgeyo Marakwet County and traverse areas that exhibit broadly similar environmental, social, and climatic conditions along much of the corridor.

4.1.1 Topography

The project area is divided into three distinct topographic zones, namely the Highlands, the Elgeyo Escarpment, and the Kerio Valley, which are clearly differentiated by the prominent Elgeyo Escarpment. Within this varied physiographic setting, the three project road sections traverse different topographic zones as described below.

The Biretwo–Arror–Chesongoch (B126) Road traverses both the Elgeyo Escarpment and the Kerio Valley, descending from an elevation of approximately 1,276 m above sea level at Biretwo Junction to about 1,072 m above sea level at Chesongoch Centre. The road alignment is characterized by steep gradients, sharp horizontal curves and rolling terrain along the escarpment section, before transitioning onto the Kerio Valley floor, where the terrain becomes relatively gentler. Vegetation along this corridor transitions from semi-tropical and montane species on the escarpment slopes to dry thorn bush and sparsely vegetated landscapes within the lower Kerio Valley.

The Nyaru–Kapkayo (B124) Road is located predominantly within the Highlands zone, starting at an elevation of approximately 2,200 m above sea level near Nyaru and descending to around 1,850 m above sea level at Kapkayo, as it approaches the escarpment. This section is characterized by fertile volcanic soils, relatively reliable rainfall, and rolling to steep terrain with winding alignments. The area is susceptible to landslides and slope instability, particularly in sections close to the escarpment where cut-and-fill earthworks are required.

The Kimwarer–Emsea (B122) Road runs predominantly through the Kerio Valley, with its alignment beginning at approximately 1,150 m above sea level at Kimwarer and rising gradually to about 1,400 m above sea level near Emsea, where it connects to the escarpment edge and the Iten–Kabarnet Road. This corridor traverses semi-arid to arid valley terrain, characterized by alluvial soils, sparse vegetation cover, and seasonal drainage channels, and is therefore prone to periodic flooding, drought conditions, and localized slope instability.

Table 4-1 topographical classification of road sections

Road Section	Primary Topographic Zone	Secondary Zone	Elevation Range (approx.)	Terrain Characteristics
B126	Kerio Valley	Kerio Valley	1,276 m – 1,072 m	Dry valley floor, steep escarpments, sharp curves, drought-prone conditions

B124	Highlands	Escarpment	2,200 m – 1,850 m	Rolling to steep terrain, fertile soils, winding sections, landslide-prone areas
B122	Kerio Valley	Kerio Valley	1,150 m – 1,400 m	Dry valley floor, steep escarpments, sharp curves, drought-prone conditions

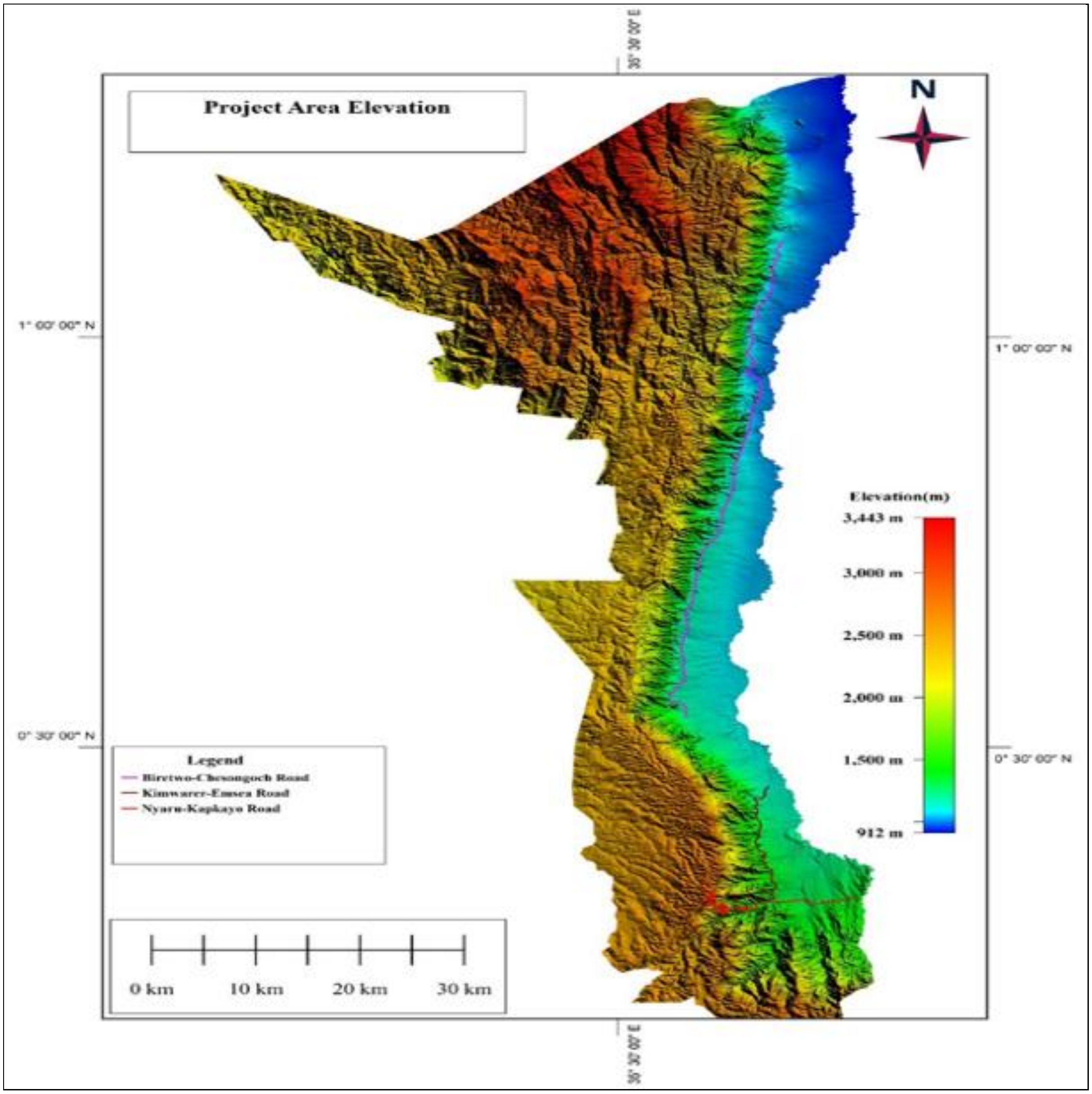


Figure 4-1: Topographical features along the Project Roads

Terrain along Nyaru- Kapkayo road

Terrain along Biretwo- Chesongoch road

Plate 4-1: Illustration of terrain of the project area

4.1.1.1 Biretwo – Arror – Chesongoch Slopes

The proposed road upgrading alignment extends from Biretwo in the south to Chesongoch Trading Centre in the north, traversing a rugged escarpment landscape characterised by pronounced variations in slope expressed as percentage rise. The alignment closely follows the escarpment margin for much of its length, resulting in frequent transitions between very steep slope zones and comparatively gentler benches and low-lying areas. These variations in percentage rise are a key determinant of engineering design requirements, construction methods, drainage planning, and environmental risk management along the corridor.

From chainage 0+000 at Biretwo, the road enters Chepsigot sublocation, where the terrain is dominated by very steep slopes with percentage rises exceeding 63.9 percent and, in localized sections, extending into the highest mapped class above 88 percent. This initial section lies on the lower escarpment and is characterised by sharp relief and limited formation width. The high slope gradients increase susceptibility to erosion, slope instability, and concentrated surface runoff, necessitating careful cut-and-fill design, slope protection measures, and effective drainage control.

Between chainage 5+200 and approximately 12+000, as the alignment passes through Kabito and Kapter sublocations, steep to very steep slope conditions continue to prevail. Percentage rise values in this section are predominantly within the 38.4–63.8 percent and greater than 63.9 percent classes, with short intervening segments of moderate slopes ranging between 18.2 and 27.6 percent where the road follows narrow ridges or natural benches. The persistence of high slope gradients in this section presents ongoing challenges related to slope stability and sediment mobilisation during both construction and operation.

From chainage 12+000 to about 20+000, traversing Kessur and Rimoi sublocations, the terrain shows a gradual moderation in slope. Gentle to moderate slopes with percentage rises between 3.3 and 18.1 percent become more frequent, although these are interspersed with localized escarpment sections where slope rises again exceed 63.9 percent. These gentler zones provide relatively more stable conditions for road widening and drainage infrastructure, but adjacent steep slopes remain potential sources of runoff and erosion.

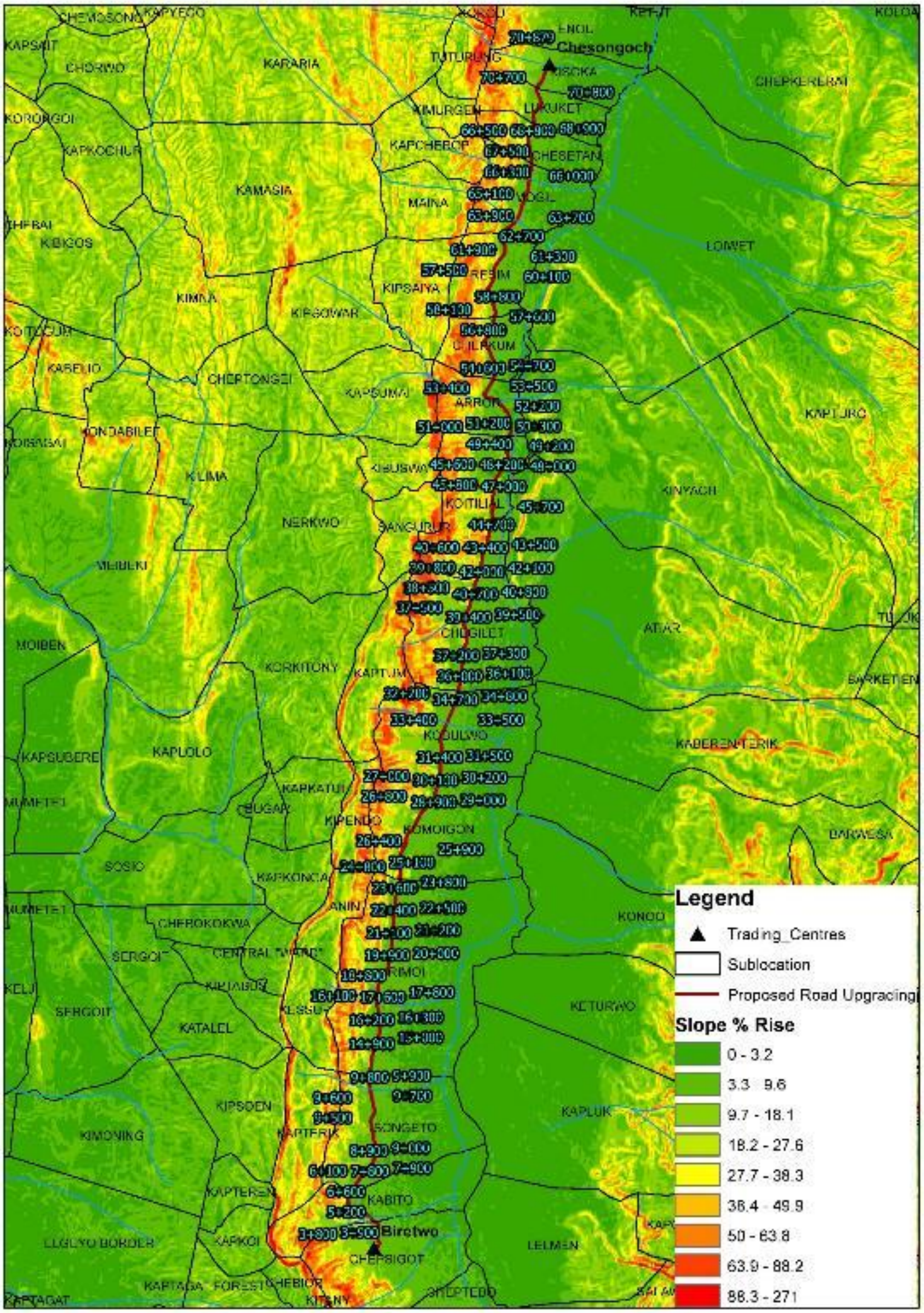
Between chainage 20+000 and 30+000, through Ann and Komoigon sublocations, the alignment continues along the escarpment edge, exhibiting alternating bands of moderate and steep slopes. Percentage rise values commonly fall within the 18.2–38.3 percent and 38.4–63.8 percent classes, with localized very steep zones exceeding 63.9 percent where the road crosses spurs and incised drainage lines. This pattern reflects a highly dissected terrain in which careful alignment design and drainage planning are required to minimise slope disturbance.

From chainage 30+000 to approximately 45+000, covering Kobulwo, Kaptum, and Chegilet sublocations, a marked contrast emerges between the steep western escarpment slopes and the gentler eastern lowland areas. While sections adjacent to the escarpment continue to exhibit high percentage rises exceeding 63.9 percent, the eastern side of the corridor increasingly transitions into gentle slopes of less than 9.6 percent. These flatter areas offer more favourable conditions for road expansion and associated infrastructure, although escarpment-related risks persist where the alignment closely follows the slope break.

Between chainage 45+000 and 58+000, passing through Kotilil and Kipsaya sublocations, the alignment again encounters a mix of moderate and steep slopes. Percentage rise values predominantly range between 18.2 and 49.9 percent, reflecting repeated transitions between relatively stable benches and steeper cut sections. This section is particularly sensitive to surface runoff concentration, underscoring the need for enhanced longitudinal drainage and adequately spaced cross-drainage structures.

From chainage 58+000 to approximately 66+000, within Resim, Vogil, and Maina sublocations, the road traverses some of the most challenging terrain along the alignment. Steep to very steep slopes are common, particularly where the corridor crosses deeply incised gullies and seasonal watercourses. Percentage rise values frequently exceed 63.9 percent, indicating elevated risks of erosion and slope instability that will require robust slope management and erosion control measures.

The final section, from chainage 66+000 to about 70+900, passes through Chesetan and Lukuket sublocations before terminating at Chesongoch Trading Centre. This section includes extensive areas of very steep terrain, with percentage rises commonly exceeding 63.9 percent and localized zones surpassing 88 percent, interspersed with narrow bands of moderate slopes. The combination of steep topography and increased human activity near the trading centre heightens the importance of slope stabilisation, effective stormwater management, and pedestrian safety measures. The alignment from Biretwo to Chesongoch is strongly influenced by escarpment geomorphology, with percentage rise emerging as a critical factor shaping engineering design requirements and environmental risk considerations along the proposed road corridor.


Chesongoch
Biretwo
Legend
Trading_Centres
Sublocation
Proposed Road Upgrading
Slope % Rise
0 - 3.2
3.3 - 9.6
9.7 - 18.1
18.2 - 27.6
27.7 - 38.3
38.4 - 49.9
50 - 63.8
63.9 - 88.2
88.3 - 271

4.1.1.2 Nyaru – Kimwarer – Kapkayo Slopes

Along the Kimwarer–Emsea road corridor, the slope characteristics follow a clear longitudinal pattern when described from Nyaru through Kimwarer to Kapkayo, reflecting a transition from rugged escarpment terrain to gentler upland landscapes.

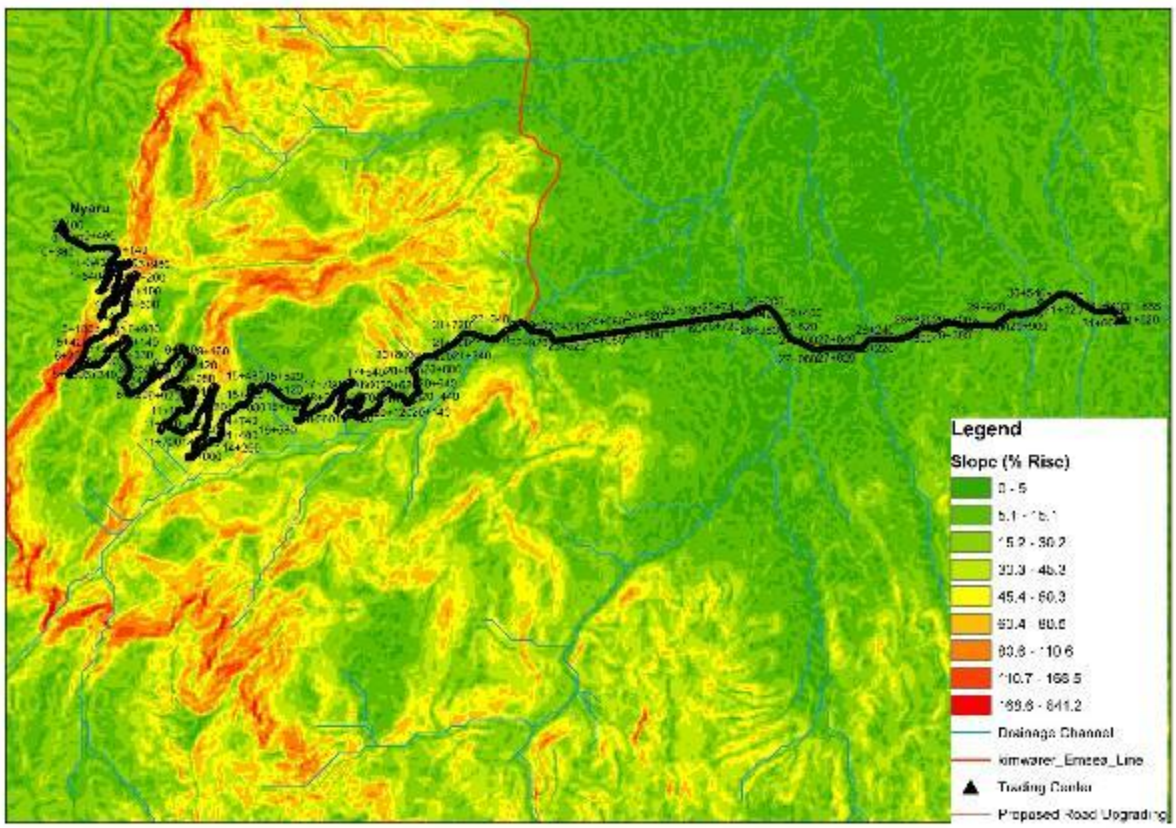
From Nyaru at the western end, around chainage 0+000, the road originates within a steep and highly dissected escarpment zone. Slopes in this section are predominantly steep to very steep, commonly exceeding 30 percent rise and locally reaching the highest slope classes indicated in the analysis. The alignment negotiates narrow ridges and deeply incised drainage lines, resulting in frequent sharp bends and abrupt elevation changes. These slope conditions indicate strong erosional processes, shallow and unstable soils, and rapid surface runoff. This section is geomorphologically sensitive and prone to slope instability, gullying, and high sediment delivery downslope, particularly where road cuttings intersect valley sidewalls.

Moving eastwards into the Kimwarer area, approximately between chainage 3+000 and 6+000, steep slopes remain dominant but begin to alternate with moderate slope segments. Escarpment features are still evident, although the terrain becomes slightly more open, with short stretches of gentler interfluves between steep valley sides. Localised steep slopes are most pronounced near drainage crossings and along spur slopes where the road follows natural contours. This zone remains sensitive to erosion and mass wasting, especially during periods of intense rainfall, but offers more scope for slope stabilisation compared to the upper escarpment section near Nyaru.

Beyond Kimwarer, from approximately chainage 6+000 to about 18+000, the road traverses a moderately undulating landscape. Slopes within this central section are largely within the 5–15 percent and 15–30 percent rise classes, indicating gentler terrain with fewer abrupt elevation changes. The alignment follows broader hillslopes and interfluves, with steeper slopes generally confined to stream crossings and isolated ridges. This section reflects a more stable geomorphic environment, although inadequate drainage design could still concentrate runoff and initiate localised erosion along embankments and cut slopes.

From approximately chainage 18+000 towards Kapkayo, extending to about chainage 31+000, the terrain becomes increasingly subdued. Slopes are predominantly gentle, commonly within the 0–5 percent and 5–15 percent rise classes, characterised by wide, shallow valleys and rolling surfaces. This section represents the least topographically constrained part of the corridor and poses a relatively low risk of slope failure. However, the gentle gradients coincide with larger contributing catchments, meaning that surface water accumulation and diffuse erosion may become important considerations if natural drainage pathways are obstructed.

The road corridor exhibits a pronounced west–east gradient in slope conditions, transitioning from very steep escarpment terrain at Nyaru, through steep to moderately sloping ground around Kimwarer, and finally into gently undulating terrain towards Kapkayo. The highest slope-related risks and erosion potential occur between Nyaru and Kimwarer, while the sections beyond Kimwarer towards Kapkayo present lower slope-related constraints but require careful surface water and drainage management to ensure long-term stability.



4.1.1.3 Kimwarer – Emsea Slopes

The Kimwarer–Emsea road section traverses a longitudinal escarpment transition zone characterised by pronounced slope variability, closely aligned to the regional topography and drainage structure. From Kimwarer northwards to Emsea, the road generally follows a narrow corridor between steep escarpment slopes to the west and relatively gentler dissected uplands to the east, resulting in alternating slope conditions along short chainage intervals.

From chainage 0+000 to approximately 3+000, immediately north of Kimwarer, the road passes through moderately steep terrain. Slopes along this section predominantly fall within the 15–30% rise class, with localized increases to 30–45% where the alignment skirts the base of escarpment spurs. These slopes are associated with incised side valleys and short, high-energy drainage lines that descend sharply from the western high ground toward the road corridor. The terrain here is inherently unstable under disturbance, with a high susceptibility to surface erosion if slope geometry is modified.

Between chainage 3+000 and 6+500, slope gradients increase markedly. This section coincides with the most dissected escarpment zone, where extensive areas west of the alignment exhibit slopes exceeding 45%, locally reaching 60–80% rise and, in isolated escarpment faces, exceeding 80%. Although the road alignment itself generally occupies slightly gentler benches within this landscape, frequent transitions occur where the road crosses the toes of steep slopes and narrow ridgelines. This segment represents a high-risk zone for slope instability, cut-slope failure, and rapid downslope sediment transport, particularly during intense rainfall events.

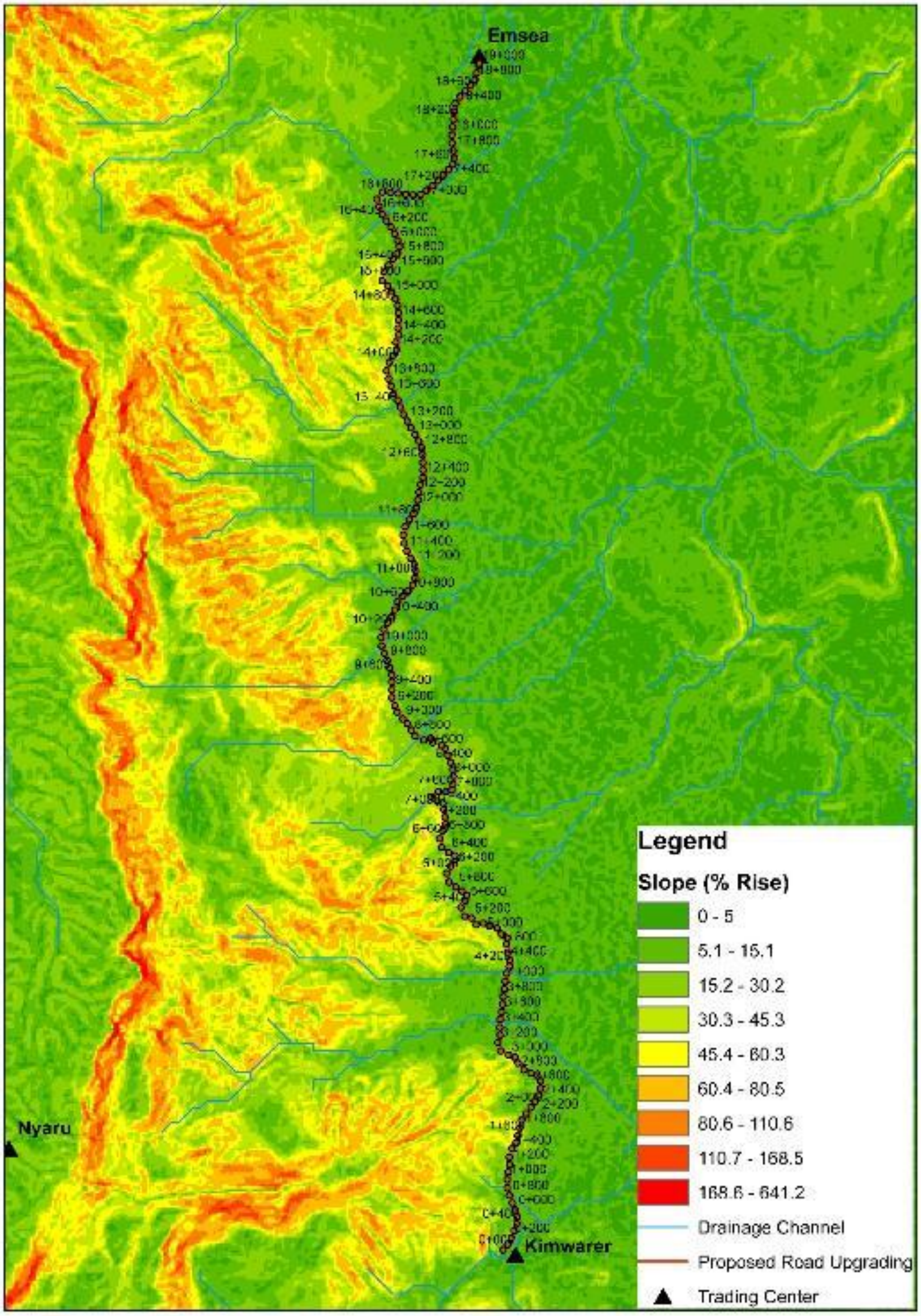
From chainage 6+500 to about 10+500, slope conditions become more variable but generally moderate. The road alternates between gently undulating sections with slopes below 15% and short stretches where gradients increase to 15–30%. These variations reflect the crossing of multiple sub-catchments draining eastward and westward, producing a rolling topography rather than continuous steep escarpment faces. While overall slope risk is reduced compared to the southern section, localized steep banks occur at drainage crossings and curve cuttings.

Between chainage 10+500 and 14+000, the road re-enters a zone of increased slope influence from the western escarpment. Slopes adjacent to the alignment frequently exceed 30%, with pockets of 45–60% rise evident immediately upslope of the road. The alignment here follows a sinuous path constrained by terrain, indicating limited flexibility in horizontal and vertical design. These slopes are structurally sensitive, and even minor realignments or widening will amplify erosion and shallow landslide risk if not carefully managed.

From chainage 14+000 to approximately 17+500, slope gradients gradually reduce as the road transitions away from the main escarpment zone. The dominant slope classes along and around the road fall within the 5–15% and 15–30% range, with steep slopes largely confined to more distant valley sides. Drainage density remains high, but relief is less extreme, resulting in comparatively lower geomorphic energy along the alignment.

From chainage 17+500 to Emsea at approximately 19+000, the road traverses relatively gentle terrain. Slopes are predominantly below 15%, with extensive areas in the 0–5% and 5–15% classes. The landscape here is more subdued, with broader interfluves and lower relief, although drainage channels remain well developed. This section presents the lowest slope-related construction risk along the Kimwarer–Emsea stretch.

The Kimwarer–Emsea section is dominated by moderate to very steep slopes between chainage 3+000 and 14+000, where the road interacts directly with the escarpment morphology. These sections will require careful geometric design, controlled slope cutting, and comprehensive slope stabilization measures to avoid triggering erosion, mass wasting, and downstream sedimentation.


Emsea
Nyaru
Kimwarer
Legend
Slope (% Rise)
0 - 5
5.1 - 15.1
15.2 - 30.2
30.3 - 45.3
45.4 - 60.3
60.4 - 80.5
80.6 - 110.6
110.7 - 168.5
168.6 - 641.2
Drainage Channel
Proposed Road Upgrading
Trading Center

4.1.2 Drainage System

4.1.2.1 Biretwo – Arror – Chesongoch Drainage System

The proposed road upgrading alignment runs from Biretwo in the south to Chesongoch Trading Centre in the north and traverses a landscape characterised by a dense drainage network, with several major drainage channels exhibiting long flow paths and relatively large upstream catchments. These larger channels are of particular importance as they have the capacity to convey substantial volumes of runoff during storm events and therefore represent key hydrological control points along the corridor.

From chainage 0+000 at Biretwo, within Chepsigot sublocation, the alignment crosses several short, steep seasonal channels draining directly off the escarpment. While these channels are numerous, they generally have limited upstream extent. However, between approximately chainage 3+800 and 5+200, within Kabito sublocation, one more continuous drainage channel with a longer downslope course is evident, collecting flows from multiple smaller tributaries upslope before crossing the road. This channel represents an early concentration point for runoff and warrants particular attention in drainage design.

Between chainage 5+200 and 12+000, as the road passes through Kabito and Kapter sublocations, the alignment intersects a number of drainage channels draining elongated catchments aligned along escarpment spurs. Notably, around chainage 7+800 to 9+500 in Kapter sublocation, a well-defined channel with a relatively long course drains a substantial upslope area before flowing eastwards. This channel is likely to carry significant discharge during heavy rainfall and should be considered a major cross-drainage location along this section.

From chainage 12+000 to about 20+000, traversing Kessur and Rimoi sublocations, the drainage pattern becomes more organised, with fewer but more pronounced channels. In particular, around chainage 16+000 to 18+800 within Rimoi sublocation, the alignment crosses a major drainage channel that drains a broad catchment extending upslope into the escarpment and downslope into the lowland areas. This channel has a visibly longer flow path compared to adjacent tributaries and represents one of the more hydrologically significant crossings in the southern half of the alignment.

Between chainage 20+000 and 30+000, through Ann and Komoigon sublocations, several drainage channels with extended courses intersect the road. Of particular note is the channel crossing near chainage 25+400 to 26+800 in Komoigon sublocation, which drains a wide upstream area and shows multiple converging tributaries. The size and connectivity of this catchment indicate a high potential for concentrated flows, especially during prolonged or intense rainfall events.

From chainage 30+000 to approximately 45+000, covering Kobulwo, Kaptum, and Chegilet sublocations, the alignment crosses some of the most prominent drainage features along the corridor. Around chainage 31+500 to 33+500 in Kobulwo sublocation, a major channel with a long, continuous course drains a substantial portion of the escarpment before crossing the road and flowing eastwards into broader valley systems. Similarly, near chainage 37+000 to 39+700 within Chegilet sublocation, another large drainage channel with a well-developed network of tributaries represents a significant runoff pathway and a critical location for cross-drainage infrastructure.

Between chainage 45+000 and 58+000, passing through Kotilil and Kipsaya sublocations, the drainage network remains active, with several moderate to large channels intersecting the alignment. The most notable occurs around chainage 47+800 to 49+900 in Kotilil sublocation, where a channel draining an elongated catchment crosses the road after collecting flows from multiple upstream gullies. This channel is likely to experience high peak flows and sediment transport during storm events.

From chainage 58+000 to approximately 66+000, within Resim, Vogil, and Maina sublocations, the alignment intersects some of the largest drainage channels along the entire route. In particular, between chainage 60+100 and 62+700 in Resim sublocation, a major channel drains a large escarpment catchment and shows a long, continuous course both upslope and downslope of the road. Another significant crossing occurs around chainage 63+700 to 65+900 within Vogil and Maina sublocations, where multiple tributaries converge upstream of the alignment, indicating a high-capacity drainage pathway.

The final section, from chainage 66+000 to about 70+900, passes through Chesetan and Lukuket sublocations before terminating at Chesongoch Trading Centre. This section is characterised by the convergence of several drainage channels as they approach the valley floor near the trading centre. Notably, between chainage 68+700 and 70+300 in Chesetan and Lukuket sublocations, one of the longest and most integrated drainage channels along the corridor crosses the alignment. This channel drains a large upstream catchment and conveys runoff towards the Chesongoch area, making it a critical location for robust drainage design, flood protection, and channel stabilisation measures.

While numerous minor channels intersect the road alignment, a smaller number of major drainage channels with long courses and large catchments occur at specific chainage locations. These channels represent the highest hydrological risk points along the Biretwo–Chesongoch corridor and should be prioritised for detailed hydrological analysis, appropriately sized cross-drainage structures, and enhanced erosion and outlet protection measures during the road upgrading process.

4.1.2.2 Nyaru – Kimwarer – Kapkayo Drainage System

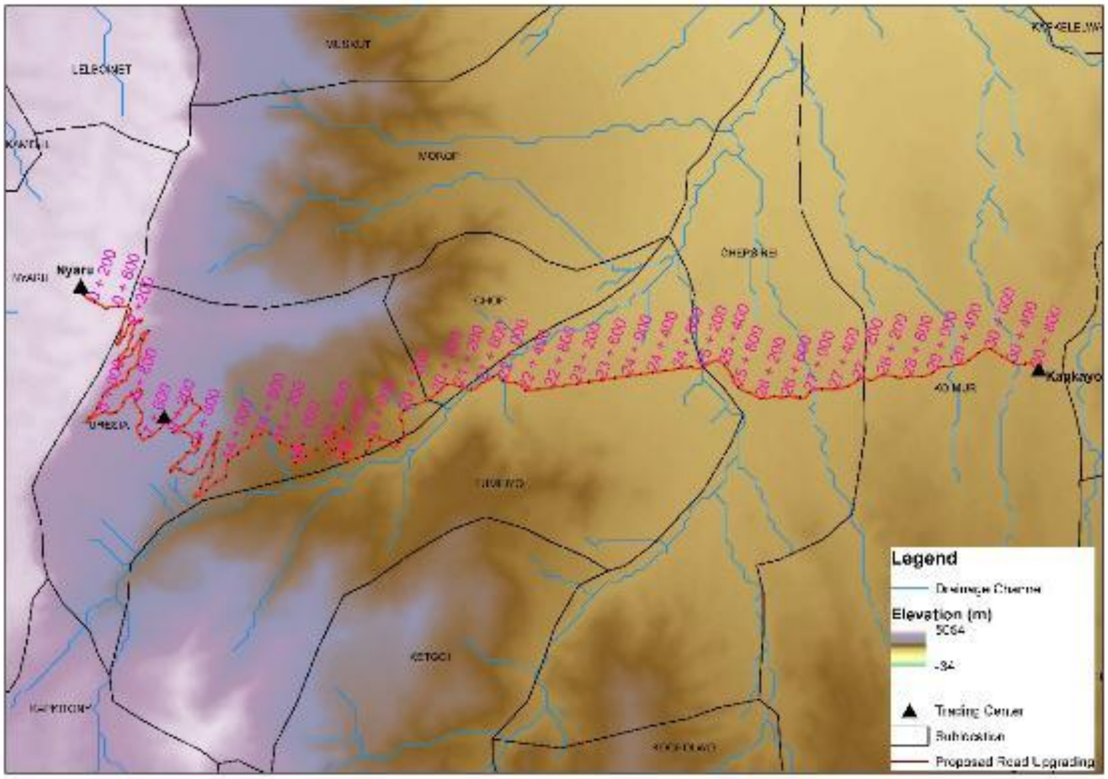
The drainage system along the Nyaru–Kapkayo road corridor is strongly structured by elevation, slope orientation, and the escarpment–lowland transition that characterises the landscape. The road alignment traverses a series of small to medium-sized catchments that drain predominantly from the higher-elevation western escarpment areas towards the lower-lying eastern plains, resulting in a dense network of first- and second-order drainage channels intersecting or closely paralleling the road.

In the western section near Nyaru and Turesia (approximately chainage 0+000 to 5+000), the road lies along steep to moderately steep terrain at the escarpment margin. This zone exhibits a high density of short, closely spaced drainage channels originating from the upper slopes. These channels are typically steep, narrow, and flashy, responding rapidly to rainfall events due to high relief and relatively thin soils. Catchments in this section are small but numerous, with short flow paths and high runoff velocities. Several channels intersect the road alignment at oblique angles, indicating a strong potential for concentrated surface runoff and erosion during intense rainfall events. The proximity of these headwater channels to the road increases sensitivity to any modification of natural flow paths.

Moving eastwards through the central section of the alignment across Chop and Tumeiyo sublocations (approximately chainage 5+000 to 18+000), the drainage network becomes more organised and less dense. Here, the road traverses gentler slopes and broader interfluves, where first-order streams coalesce into more defined second-order channels. Catchments in this zone are larger and more elongated, with longer flow paths and reduced channel gradients. Drainage channels tend to cross the road at fewer, more widely spaced points, often aligned with shallow valleys or depressions. Although runoff velocities are lower than in the escarpment zone, these channels convey larger cumulative flows, particularly during prolonged rainfall, and play an important role in sustaining seasonal soil moisture and downstream ecosystems.

In the eastern section towards Chepsirei, Koimur and Kapkayo (approximately chainage 18+000 to 30+000), the road lies within lower-elevation terrain characterised by gently undulating slopes and a more open drainage pattern. The drainage network here is dominated by widely spaced, low-gradient channels with broad contributing catchments. Many channels are ephemeral, flowing primarily during and shortly after rainfall events. Catchments are relatively larger and flatter, resulting in slower runoff but a higher likelihood of water spreading across floodplains or shallow depressions. The drainage channels in this section often run sub-parallel to the road before crossing it, reflecting the subdued relief and structural control of the landscape.

The drainage network along the road reflects a transition from steep, high-energy headwater systems in the west to lower-energy, dispersive drainage systems in the east. This gradient in catchment size, channel density, and flow dynamics has important implications for road upgrading. Western sections are particularly sensitive to erosion, channel incision, and blockage of small but numerous drains, while central and eastern sections are more prone to flow concentration, localised flooding, and alteration of natural drainage connectivity if culvert placement and sizing are not carefully aligned with existing catchment characteristics.



4.1.2.3 Kimwarer – Emsea Drainage System

The drainage system along the Kimwarer–Emsea road section is strongly controlled by the escarpment topography, with a dense network of short, steep headwater channels draining west–east and east–west into larger valley systems. The road alignment repeatedly intersects these channels, particularly where it follows the transitional zone between the steep escarpment face and gentler upland surfaces. As a result, drainage characteristics vary markedly along chainage, with several crossings associated with relatively large contributing catchments and high runoff energy.

From chainage 0+000 to approximately 2+500, immediately north of Kimwarer, the road crosses multiple first- and second-order channels draining from the western escarpment. These channels have short flow paths but steep gradients, producing flashy runoff responses during rainfall events. Although individual catchment areas are relatively small, the high relief and convergence of flow near the road increase erosion potential at culvert and side-drain discharge points. Drainage lines intersect the alignment at close spacing, indicating a high drainage density in this section.

Between chainage 2+500 and about 5+500, the road encounters several more laterally extensive drainage channels that drain broader escarpment catchments. Notable crossings occur around chainage 3+000–3+800 and 4+200–4+800, where channels originate high on the escarpment and collect flow from multiple tributaries before crossing the road. These channels represent some of the larger contributing catchments along the corridor and are likely to convey high peak discharges during intense rainfall. Their alignment perpendicular to the road increases the likelihood of concentrated flow and localized flooding if drainage structures are undersized.

From chainage 5+500 to approximately 8+500, drainage channels remain frequent but show greater variability in orientation and catchment size. Several channels draining from the east intersect the road around chainage 6+200–6+800 and 7+200–7+800. While these eastern catchments are generally less steep than those from the escarpment side, they extend over broader areas and can deliver sustained runoff volumes. The combined influence of moderate slopes and larger contributing areas makes these crossings sensitive to blockage and backwater effects during prolonged rainfall.

Between chainage 8+500 and 12+000, the road crosses a series of well-developed drainage lines with clearly defined upstream networks. Significant crossings occur around chainage 9+200–9+800 and 10+800–11+400, where channels draining sizeable sub-catchments converge near the alignment. These channels exhibit dendritic patterns upstream, indicating efficient runoff concentration. This section represents a transition zone where both escarpment-derived and upland-derived flows interact, increasing hydrological complexity and the risk of cumulative discharge impacts at road crossings.

From chainage 12+000 to about 15+500, drainage density remains high, but individual channels tend to be more widely spaced. Several channels with relatively large catchments cross the road around chainage 13+200–13+800 and 14+200–15+000. These channels drain elongated catchments extending upslope toward the escarpment crest, suggesting high runoff velocities and sediment transport potential. During peak flows, these channels are likely to exert significant hydraulic pressure on culverts and embankments.

Between chainage 15+500 and 18+000, the drainage network becomes more organized, with fewer but more clearly defined channels. Crossings around chainage 16+200–16+800 and 17+400–18+000 are associated with comparatively large, mature catchments draining the gentler upland areas toward the main valley systems. Although slope gradients here are lower than in the southern sections, the larger catchment areas mean that total discharge volumes can be substantial, particularly during prolonged rainfall.

From chainage 18+000 to Emsea at approximately 19+000, the road intersects fewer drainage channels, but those present are well established and drain broad areas of the surrounding landscape. These channels have lower gradients but wider contributing areas, resulting in slower-moving yet voluminous flows. The reduced slope limits erosive energy, but the risk of inundation and prolonged saturation around drainage crossings increases.

The drainage characteristics along the Kimwarer–Emsea section are defined by high drainage density, frequent road–channel intersections, and several crossings associated with large contributing catchments, particularly between chainage 2+500 and 15+500. These sections are hydrologically sensitive and will require careful drainage design to accommodate both high-energy escarpment flows and larger-volume upland runoff without altering downstream hydrological regimes.

4.1.3 Soil Texture

4.1.3.1 Biretwo – Arror – Chesongoch Soil Textures

The proposed road upgrading alignment extends from Biretwo in the south to Chesongoch Trading Centre in the north and traverses a heterogeneous soil landscape reflecting the transition from escarpment zones to adjoining lowland and valley systems. The spatial distribution of soil textures along the alignment has important implications for road foundation stability, drainage behaviour, erosion risk, and construction methods.

From chainage 0+000 at Biretwo, within Chepsigot sublocation, the alignment begins in an area dominated largely by loamy soils, with localized pockets of sandy soils occurring immediately adjacent to the escarpment break. These soils are generally well drained but are susceptible to erosion where vegetation cover is disturbed, particularly on sloping ground. The presence of loamy textures provides moderate bearing capacity but will require careful compaction and drainage control during road construction.

Between chainage 5+200 and approximately 12+000, as the road passes through Kabito and Kapter sublocations, loamy soils continue to dominate the corridor, with intermittent transitions into clayey soils on gentler benches and lower slope positions. These clayey zones tend to retain moisture for longer periods and may become plastic during wet conditions, increasing the risk of subgrade weakening if not properly treated. In this section, attention will be required to manage moisture ingress and ensure adequate sub-base preparation.

From chainage 12+000 to about 20+000, traversing Kessur and Rimoi sublocations, the alignment crosses a broader zone of sandy soils interspersed with loamy textures. The sandy soils, particularly evident around chainages 15+000 to 18+000, are associated with well-drained slope deposits and colluvial materials. While these soils facilitate rapid drainage, they are prone to erosion and loss of fine material, necessitating slope protection and appropriate surfacing measures.

Between chainage 20+000 and 30+000, through Ann and Komoigon sublocations, the road alignment transitions into areas characterised by alternating loamy and clayey soils. Clayey soils become more prominent in valley bottoms and gentle slopes, while loamy soils dominate elevated sections. These clay-rich zones may exhibit shrink–swell behaviour and reduced permeability, which could affect pavement performance if drainage is inadequate. Careful soil treatment and reinforcement may therefore be required in these sections.

From chainage 30+000 to approximately 45+000, covering Kobulwo, Kaptum, and Chegilet sublocations, the alignment traverses a distinct soil transition zone. Sandy soils are more prevalent along the escarpment-facing sections, while very clayey soils dominate the eastern lowland side of the corridor. The very clayey soils, particularly evident between chainages 37+000 and 42+000, are likely to have poor drainage characteristics and high moisture retention, increasing the potential for waterlogging and reduced bearing capacity during wet seasons.

Between chainage 45+000 and 58+000, passing through Kotilil and Kipsaya sublocations, the road crosses extensive areas of loamy soils interspersed with narrow bands of sandy and clayey textures. These mixed soil conditions reflect complex depositional processes along the escarpment margin. While loamy soils generally provide favourable construction conditions, the abrupt transitions between soil types will require localized adjustments in design and construction techniques to maintain uniform pavement performance.

From chainage 58+000 to approximately 66+000, within Resim, Vogil, and Maina sublocations, very clayey soils become increasingly dominant, particularly on the eastern side of the alignment. These soils are associated with broader valley floors and lower-gradient terrain and are characterised by low permeability and high moisture retention. Road sections in this area may be prone to saturation and deformation if drainage is inadequate, highlighting the need for effective sub-surface drainage and suitable subgrade improvement measures.

The final section, from chainage 66+000 to about 70+900, passes through Chesetan and Lukuket sublocations before terminating at Chesongoch Trading Centre. This section exhibits a combination of sandy soils along the escarpment edge and very clayey soils within the Chesongoch valley area. The convergence of different soil textures near the trading centre, combined with increased traffic and human activity, underscores the importance of tailored foundation design, effective drainage systems, and erosion control measures to ensure long-term road performance.The proposed Biretwo–Chesongoch road alignment traverses a complex mosaic of loamy, sandy, clayey, and very clayey soils. These variations are closely linked to topography and drainage patterns and will require site-specific geotechnical investigations and adaptive design approaches to manage differential settlement, moisture sensitivity, and erosion risks along the corridor.

4.1.3.2 Nyaru - Kimwarer - Kapkayo Soil Textures

The soil texture along the Nyaru–Kapkayo road alignment exhibits a clear spatial pattern that reflects underlying topography, drainage conditions and long-term land use, with important implications for road stability, drainage performance and adjacent ecological processes.

From chainage 0+000 at Nyaru through approximately 14+000, the road alignment traverses predominantly loamy soils, as indicated by the extensive loamy soil unit covering the western and central sections of the corridor. These loamy soils occur widely around Nyaru, Turesia and adjacent sublocations and are generally associated with moderate slopes and well-developed agricultural landscapes. Their balanced texture supports intensive smallholder farming and scattered settlements, and they provide relatively good infiltration and root penetration. Along this section, loamy soils also extend into adjacent areas beyond the immediate road corridor, supporting mixed cropping systems and agroforestry. However, their moderate erodibility means that road upgrading activities, particularly cut-and-fill operations and side drain excavation, could increase the risk of surface erosion and sediment transport into nearby drainage channels if not carefully managed.

Between approximately chainage 14+000 and 21+000, the alignment transitions into zones dominated by very clayey soils, particularly around Tumeiyo and the surrounding sublocations. These soils are extensive south of the road and occupy broad low-lying areas intersected by multiple drainage channels. Very clayey soils are typically characterised by poor drainage, high water-holding capacity and susceptibility to waterlogging during wet periods. Their distribution closely follows valley bottoms and gently sloping terrain, where runoff accumulates. Along this section, the proximity of the road to very clayey soils increases sensitivity to changes in drainage patterns, as road embankments and culverts can easily impede natural flow paths, leading to localized flooding or prolonged saturation of soils adjacent to the road.

From chainage 21+000 to approximately 30+800 towards Kapkayo, clayey soils become the dominant soil texture along the road alignment and in the adjacent landscape. These clayey soils are widespread across

Chepsirei, Koimur and Kapkayo sublocations and extend laterally beyond the road corridor. They are generally associated with gently undulating terrain and more extensive cultivation and grazing systems. While clayey soils offer relatively high fertility for certain crops, they are prone to compaction and reduced infiltration when disturbed. Road upgrading in these sections may therefore increase surface runoff and erosion along road shoulders, with downstream impacts on drainage channels and adjacent agricultural plots.

Sandy soils occur only in limited and localized patches, primarily away from the immediate road alignment and closer to peripheral sublocations. These sandy zones are relatively minor in extent and do not dominate any major section of the road corridor. Where present, sandy soils are likely associated with localized depositional environments or weathered parent material and support lighter vegetation cover. Although less extensive, these areas may be more vulnerable to erosion if exposed during construction due to their low cohesion.

The soil texture distribution along the Nyaru–Kapkayo road reflects a transition from loamy soils in the northern and central sections, through very clayey soils in mid-alignment valley areas, to predominantly clayey soils towards Kapkayo. Adjacent areas mirror this pattern, with soil texture closely aligned to drainage density and topographic position. This heterogeneity highlights the need for soil-specific road design and mitigation measures, particularly in very clayey and clayey sections where altered drainage and compaction could have pronounced effects on both road performance and surrounding ecological and agricultural systems.

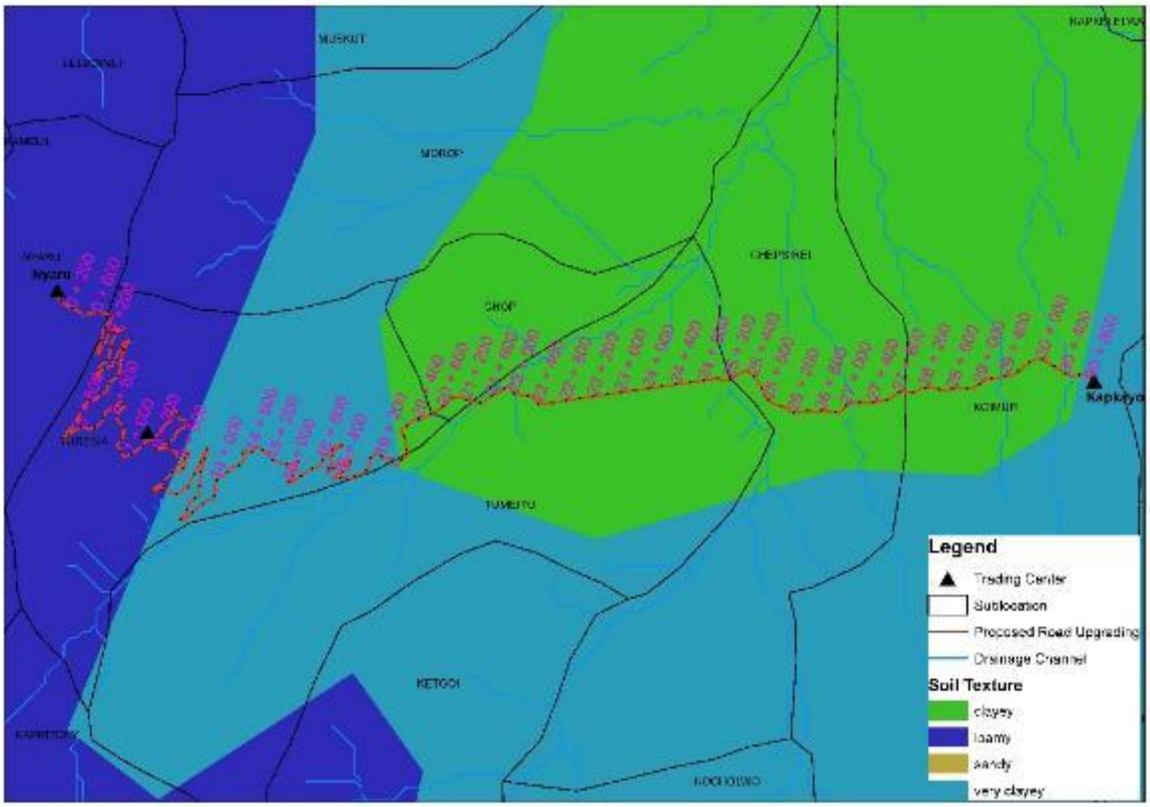


Figure 4-2: Soil Texture

4.1.3.3 Kimwarer – Emsea Soil Textures

The soil characteristics along the Kimwarer–Emsea road section show a clear spatial pattern that closely interacts with slope conditions, creating zones of varying geomorphological and ecological vulnerability along the alignment.

From chainage 0+000 to approximately 2+500 around Kimwarer, the road traverses predominantly clayey soils, with localized pockets of very clayey material. These soils occur on gently to moderately sloping terrain, but slope gradients increase rapidly toward the western escarpment. The clayey to very clayey textures have low permeability and high water retention capacity. When combined with moderate slopes, surface runoff will occur readily during rainfall events, increasing the likelihood of surface sealing, erosion at cut slopes, and instability at drainage outlets. This section is vulnerable to rill erosion and localized slumping where road widening disturbs natural soil structure.

Between chainage 2+500 and about 5+500, very clayey soils dominate the road corridor, particularly where the alignment runs close to the escarpment transition zone. Slopes in adjacent areas increase noticeably, especially on the western side where steeper gradients prevail. The combination of steep slopes and very clayey soils represents a high-risk zone for erosion and shallow landslides. These soils become highly plastic when wet, and road cutting will reduce shear strength, making this section particularly vulnerable to slope failure and sediment delivery into nearby drainage channels.

From chainage 5+500 to approximately 8+500, the road continues through extensive very clayey soil units, with some transitions into clayey soils toward gentler terrain on the eastern side. Slopes along the alignment are moderate but increase sharply away from the road toward the escarpment. In this section, runoff concentration from upslope areas will occur rapidly, while the low infiltration capacity of the soils will promote overland flow. Vulnerability here is associated with gullying at drainage crossings and progressive widening of erosion scars if drainage structures are not well protected.

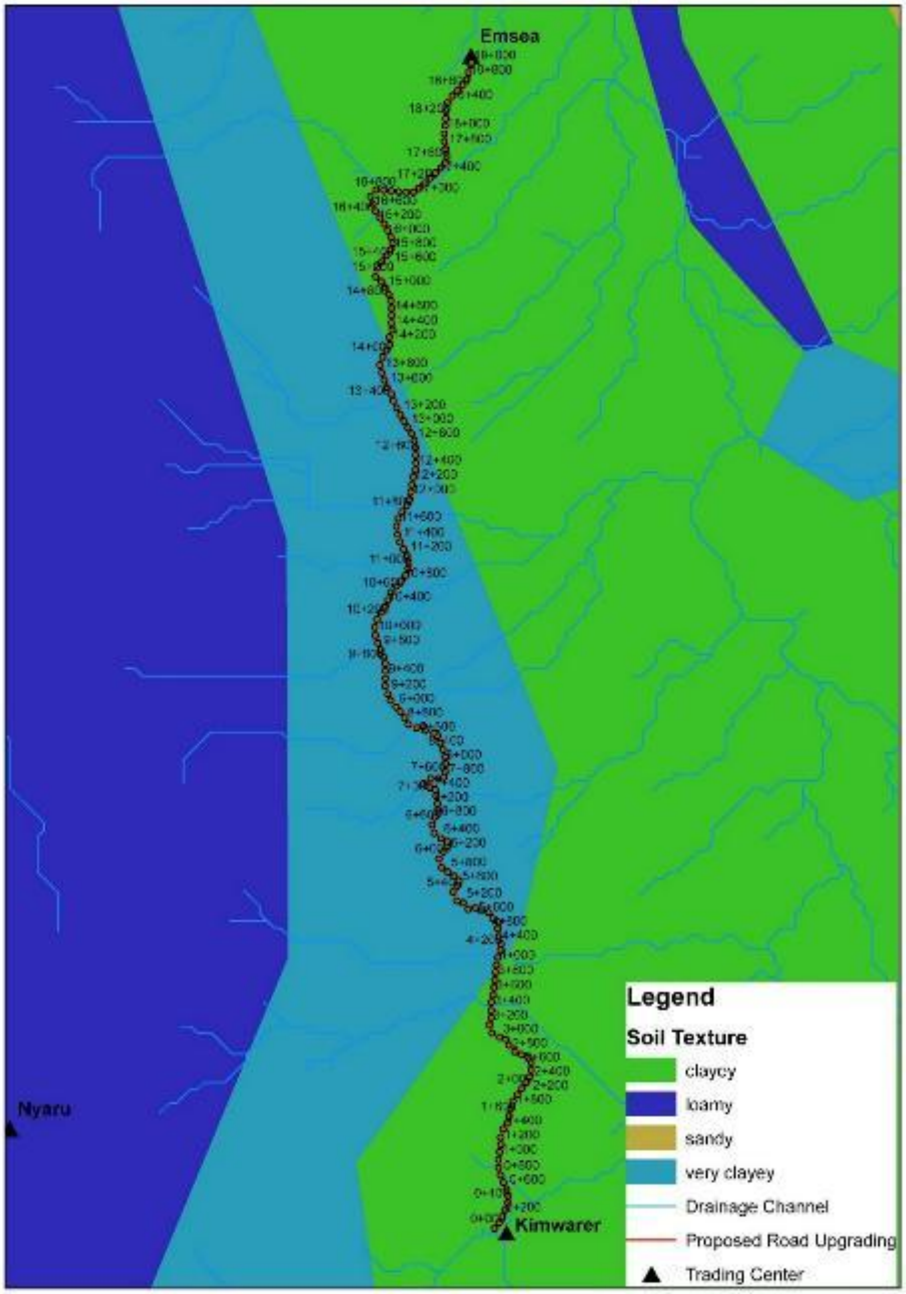
Between chainage 8+500 and about 12+000, clayey soils dominate, with fewer very clayey patches. Slopes along the road are generally moderate, but the surrounding landscape still shows strong relief. The interaction of clayey soils and moderate slopes suggests a continued risk of surface erosion rather than deep-seated failures. However, where the road intersects drainage lines around chainage 9+200–9+800 and 10+800–11+400, localized vulnerability increases due to soil saturation and undercutting during peak flows.

From chainage 12+000 to approximately 15+500, the soil pattern remains largely clayey, with isolated zones of very clayey soils. Slopes in this section fluctuate between gentle and moderate, but steep slopes occur immediately upslope of the road in several locations. The vulnerability here is linked to differential erosion, where road cuts expose subsoil horizons that are less cohesive. These conditions will promote sediment transport into downstream channels, particularly during prolonged rainfall.

Between chainage 15+500 and 18+000, the road traverses predominantly clayey soils on relatively gentler slopes compared to the southern sections. Although slope-related instability is reduced, the clayey texture still limits infiltration. Runoff accumulation over broader catchments will occur, leading to saturation of roadside soils. This section is vulnerable to pavement edge failure and long-term weakening of embankments due to persistent moisture retention.

From chainage 18+000 to Emsea at approximately 19+000, clayey soils continue to dominate, with slopes becoming gentler overall. Vulnerability in this section is lower in terms of mass wasting but remains moderate for waterlogging and slow deformation of embankments. Poor drainage performance in clayey soils may lead to prolonged soil saturation, affecting both road integrity and adjacent vegetation.

The highest vulnerability occurs where very clayey soils coincide with steep to moderately steep slopes, notably between chainage 2+500 and 8+500. In these sections, erosion, slope instability, and sediment mobilization will occur if soil disturbance is not carefully managed. Clayey soils on gentler slopes toward Emsea present lower but persistent risks related to runoff concentration and waterlogging. The interaction between soil texture and slope along the corridor highlights the need for slope-sensitive drainage design and soil stabilization measures tailored to specific chainage sections.



4.1.4 Climatic Conditions

The proposed project roads traverse Elgeyo Marakwet County, which has a cool climate and diverse topography, including Highlands, Escarpment, and Lowlands. Altitude ranges from 900 m to over 3000 m, resulting in variable rainfall (700–1700 mm) and temperature (18–28°C) along the corridor. The eastern Lowlands are more prone to droughts and floods, which may affect road stability and accessibility. These climatic and topographical conditions are critical for road design, drainage planning, erosion control, and construction scheduling, ensuring safe and durable infrastructure under local environmental conditions.

Climatology of the Project Areas

Based on the Köppen–Geiger Climate Classification, the areas traversed by the proposed roads fall within the tropical savanna climate zone. The climatic data presented below, extracted from the World Bank Climate Knowledge Portal, relates to the counties and areas crossed by the proposed road alignments.

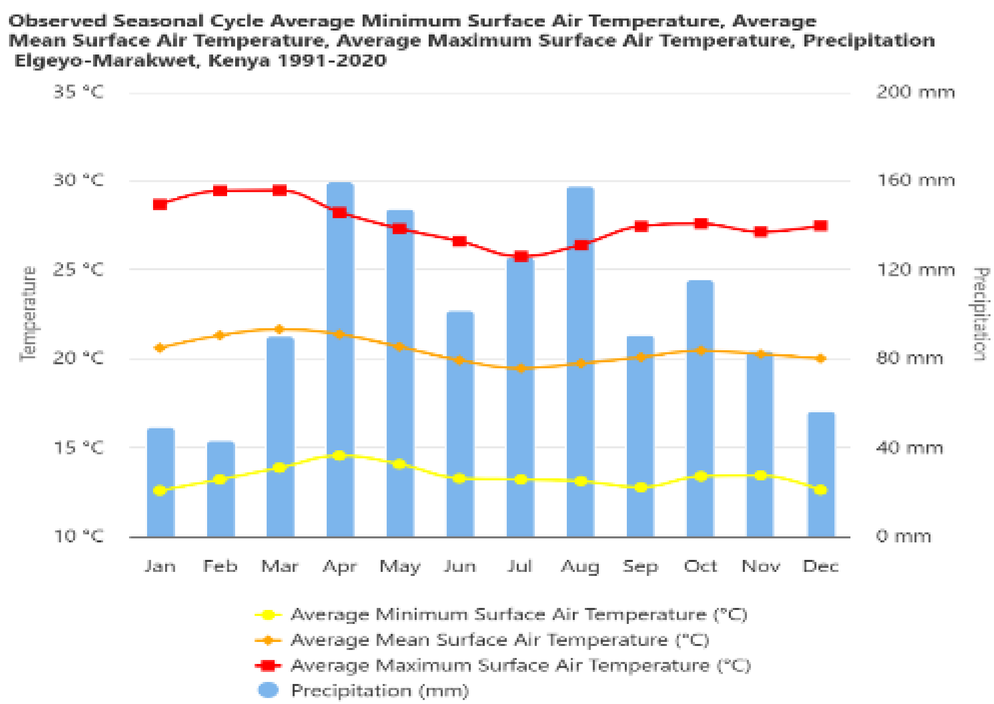


Figure 4-3:Elgeyo-Marakwet County: 1991–2020 Observed Climatology

Table 4-2 climatology of the project area

Category	Average Minimum Surface Air Temperature (°C)	Average Mean Surface Air Temperature (°C)	Average Maximum Surface Air Temperature (°C)	Precipitation (mm)
Jan	12.58	20.6	28.67	48.95
Feb	13.2	21.3	29.44	42.8
Mar	13.86	21.64	29.46	90.33
Apr	14.54	21.36	28.22	159.33
May	14.06	20.66	27.3	147.15
Jun	13.26	19.9	26.59	101.42
Jul	13.2	19.45	25.74	125.62
Aug	13.11	19.72	26.38	157.24
Sep	12.76	20.07	27.44	90.55

Oct	13.38	20.45	27.58	115.34
Nov	13.43	20.25	27.12	83.36
Dec	12.61	20.01	27.46	56.44

Source: https://climateknowledgeportal.worldbank.org/country/kenya/climate-data-historical

The ESIA cannot treat the corridor uniformly. The Kerio Valley sections are highly sensitive to erosion, dust, and hydrological disruption, while the Highlands and Escarpment sections are sensitive to slope stability, landslides, and sediment runoff. Work schedules and methods must be adapted to each zone—e.g. erosion control is critical in the Highlands during rains, while dust control and worker heat stress are priorities in the Valley. Drainage structures must be designed for extreme local variability, from high-volume runoff in the Highlands to intense flash floods in the arid Lowlands.

4.1.5 Mean Annual Precipitation

4.1.5.1 Biretwo – Arror – Chesongoch Mean Annual Precipitation

The Mean Annual Precipitation along the proposed road upgrading alignment varies considerably from the southern starting point at Biretwo to the northern terminus at Chesongoch trading center, reflecting a clear climatic gradient associated with topography and escarpment influence.

The Mean Annual Precipitation at the southern end of the alignment around Biretwo trading center, within Chesigot and Kabito sublocations (approximately chainage 0+000 to 5+000), falls within the higher rainfall zone, estimated at about 1,800–2,400 mm per annum. This section lies close to the wetter escarpment belt and is characterised by relatively high rainfall intensity, increasing the likelihood of surface runoff and erosion during peak rainy seasons.

The Mean Annual Precipitation gradually declines as the road progresses northwards through Songeto, Rimo, and Anin sublocations between approximately chainage 5+000 and 20+000. In this stretch, annual rainfall is generally within the range of about 1,200–1,800 mm, representing a transitional zone between the wetter southern highlands and the relatively drier interior areas. Rainfall remains sufficient to generate seasonal drainage flows, particularly along minor watercourses crossing the alignment.

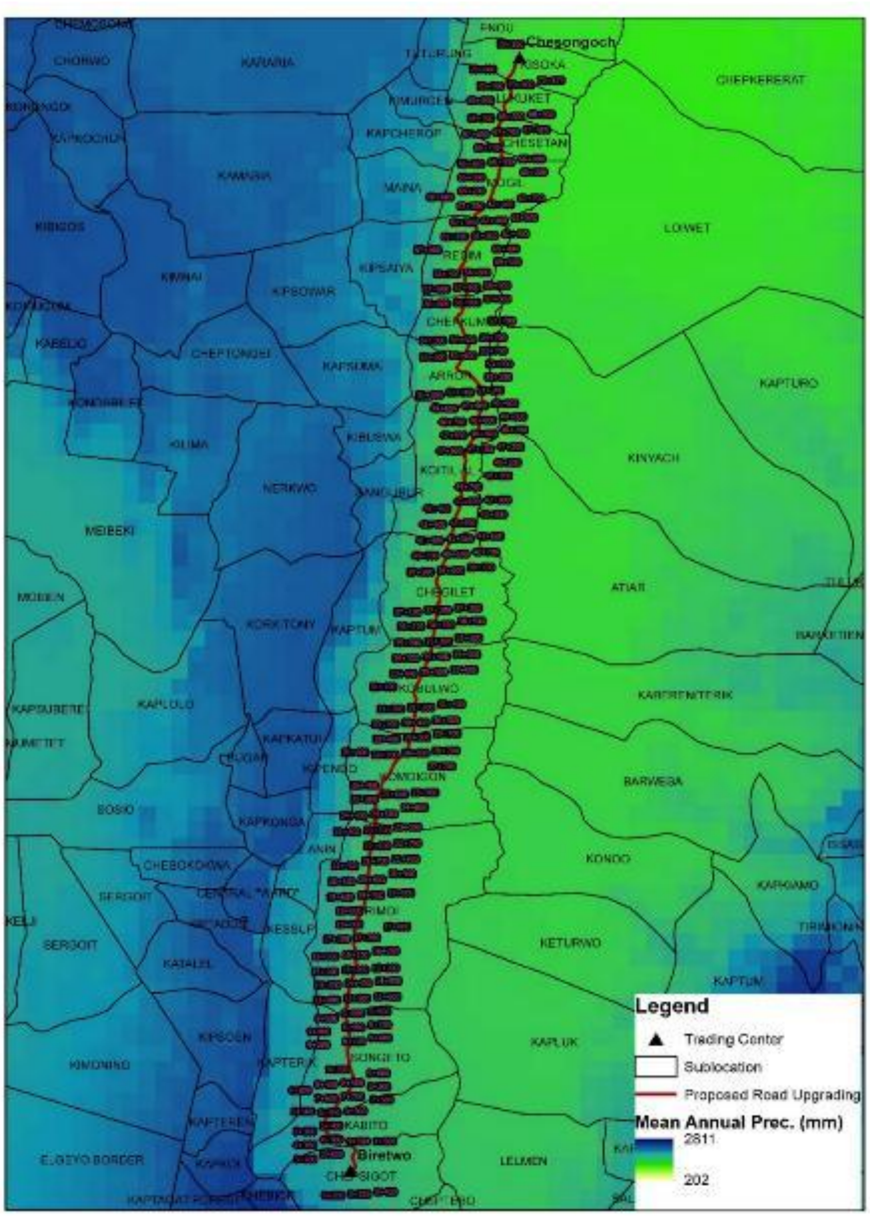
The Mean Annual Precipitation further reduces along the mid-section of the alignment passing through Komoigon, Kobulwo, and Chegilet sublocations, roughly between chainage 20+000 and 37+000. This section lies within an intermediate precipitation zone receiving approximately 900–1,300 mm annually. Rainfall here is more spatially variable, with localized higher values on the western side of the road alignment compared to the eastern side.

The Mean Annual Precipitation remains relatively moderate but slightly lower as the alignment continues through Koitilial, Sangurur, and Kiboswa sublocations between approximately chainage 37+000 and 50+000. Annual rainfall in this corridor is estimated to range from about 700–1,100 mm, reflecting the influence of drier lowland conditions to the east. Drainage design in this section should consider concentrated runoff from localized catchments rather than sustained high rainfall.

The Mean Annual Precipitation shows a modest increase again in the northern mid-alignment sections as the road traverses Aror, Cherkumei, and Resim sublocations from approximately chainage 50+000 to 65+000. Rainfall in these areas is generally within the range of about 1,000–1,400 mm per annum, influenced by localized topographic effects that enhance precipitation relative to adjacent lowland areas.

The Mean Annual Precipitation along the final stretch of the alignment from approximately chainage 65+000 to the endpoint at Chesongoch trading center, including Mogil, Chesetan, Kukei, Kisoka, and Enou sublocations, ranges from about 800–1,200 mm annually. Although this section is comparatively drier than the southern end of the road, rainfall levels remain adequate to generate surface runoff, particularly where drainage channels converge near the Chesongoch trading center.

The Mean Annual Precipitation distribution along the Biretwo–Chesongoch road alignment demonstrates a progressive decline from high rainfall conditions in the south to moderate and lower rainfall conditions in the north, with localized variability along the corridor. This spatial pattern has direct implications for drainage sizing, erosion control, and long-term road performance along the upgraded alignment.



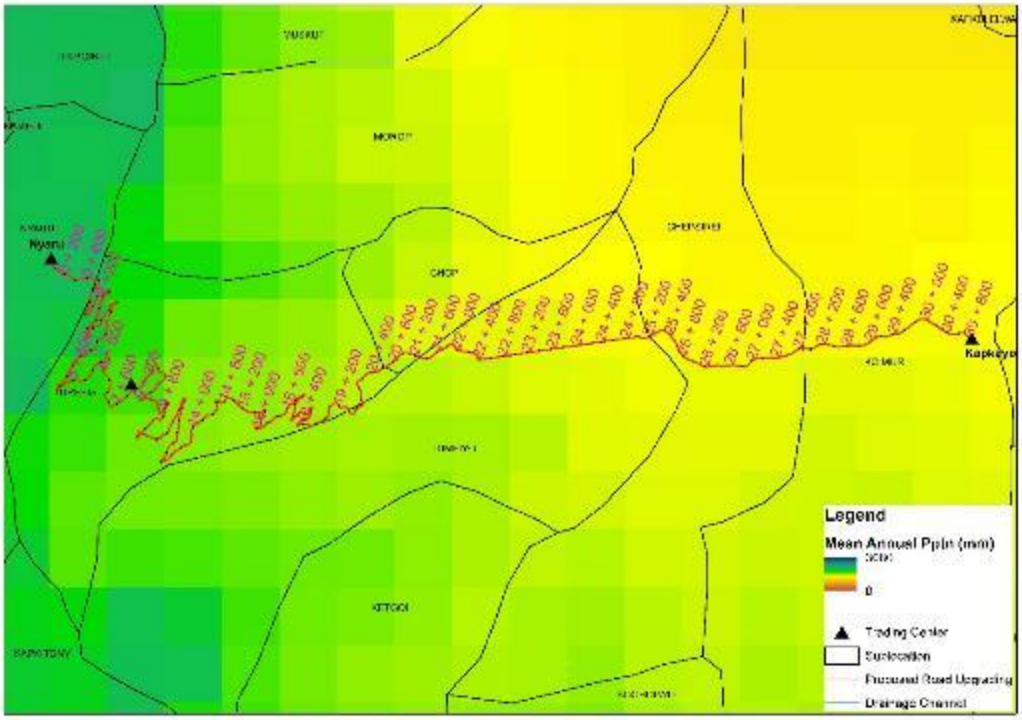
4.1.5.2 Nyaru – Kimwarer – Kapkayo Mean Annual Precipitation

The spatial pattern of mean annual precipitation along the Nyaru–Kapkayo road alignment shows a clear relationship with elevation and topographic position, reflecting strong orographic controls on local climate. From the western end near Nyaru, the road traverses relatively higher-elevation terrain associated with the escarpment and upper slopes of the Cherangany–Elgeyo landscape. This section coincides with comparatively higher mean annual precipitation, as indicated by greener precipitation classes on the map. The combination of elevated relief and windward positioning enhances moisture uplift, resulting in wetter conditions that support denser vegetation cover and more active drainage networks in sublocations such as Nyaru and Turesia, particularly along the early chainages close to 0+000–5+000.

Moving eastwards along the alignment through the mid-section of the road, roughly between chainages 6+000 and 15+000 within sublocations such as Turesia, Chop and parts of Tumeiyo, elevation gradually declines from the escarpment zone into more undulating mid-slopes and transitional lowlands. Correspondingly, mean annual precipitation shows a gradual decrease, shifting to moderate rainfall classes. Although rainfall remains sufficient to sustain rainfed agriculture and mixed woodland–farmland mosaics, the reduced elevation limits orographic rainfall enhancement. In these sections, drainage channels are present but tend to be more seasonal, and surface runoff is more influenced by localized slope breaks and soil properties than by high rainfall totals alone.

Further east towards Kapkayo, particularly beyond chainages of approximately 16+000 to 30+000 in sublocations such as Chepsirei, Koimur and areas adjacent to Kapkayo trading centre, the road lies within lower-elevation terrain characterized by gentler slopes and broader interfluves. This zone corresponds with lower mean annual precipitation values compared to the western highlands. The reduced elevation and leeward position relative to the escarpment limit moisture influx, resulting in drier climatic conditions. Vegetation in this section is more open, with increased dominance of agro-pastoral land use and scattered woody cover. Drainage features are fewer and often ephemeral, responding mainly to intense rainfall events rather than sustained seasonal flows.

hThe cross-analysis highlights a west–east gradient in which higher elevations near Nyaru are associated with higher mean annual precipitation, while lower elevations towards Kapkayo experience reduced rainfall. This precipitation–elevation relationship has direct implications for ecosystem distribution, soil moisture regimes, land use patterns, and sensitivity to road upgrading impacts. Sections of the road located at higher elevations and wetter zones are more prone to erosion, slope instability and hydrological alteration if drainage is poorly managed, whereas lower-elevation, drier sections are more sensitive to changes in surface runoff concentration and localized flooding due to limited natural drainage capacity.



4.1.5.3 Kimwarer – Emsea Mean Annual Precipitation

The mean annual precipitation along the Kimwarer–Emsea road section ranges from moderate to relatively high values, generally increasing northwards toward Emsea and westwards toward the escarpment-influenced zones. Based on the spatial precipitation surface, rainfall values along the corridor broadly range between about 1,200 mm and 2,800–3,080 mm per year, with clear spatial clustering of higher precipitation zones.

From chainage 0+000 to approximately 3+000 around Kimwarer, mean annual precipitation is relatively moderate, generally in the range of about 1,200–1,500 mm per year. This section lies within a transitional rainfall zone where precipitation is sufficient to sustain perennial and seasonal drainage channels. Vulnerability in this section is moderate, but rainfall at these levels will still generate runoff during intense storm events, particularly where clayey and very clayey soils limit infiltration.

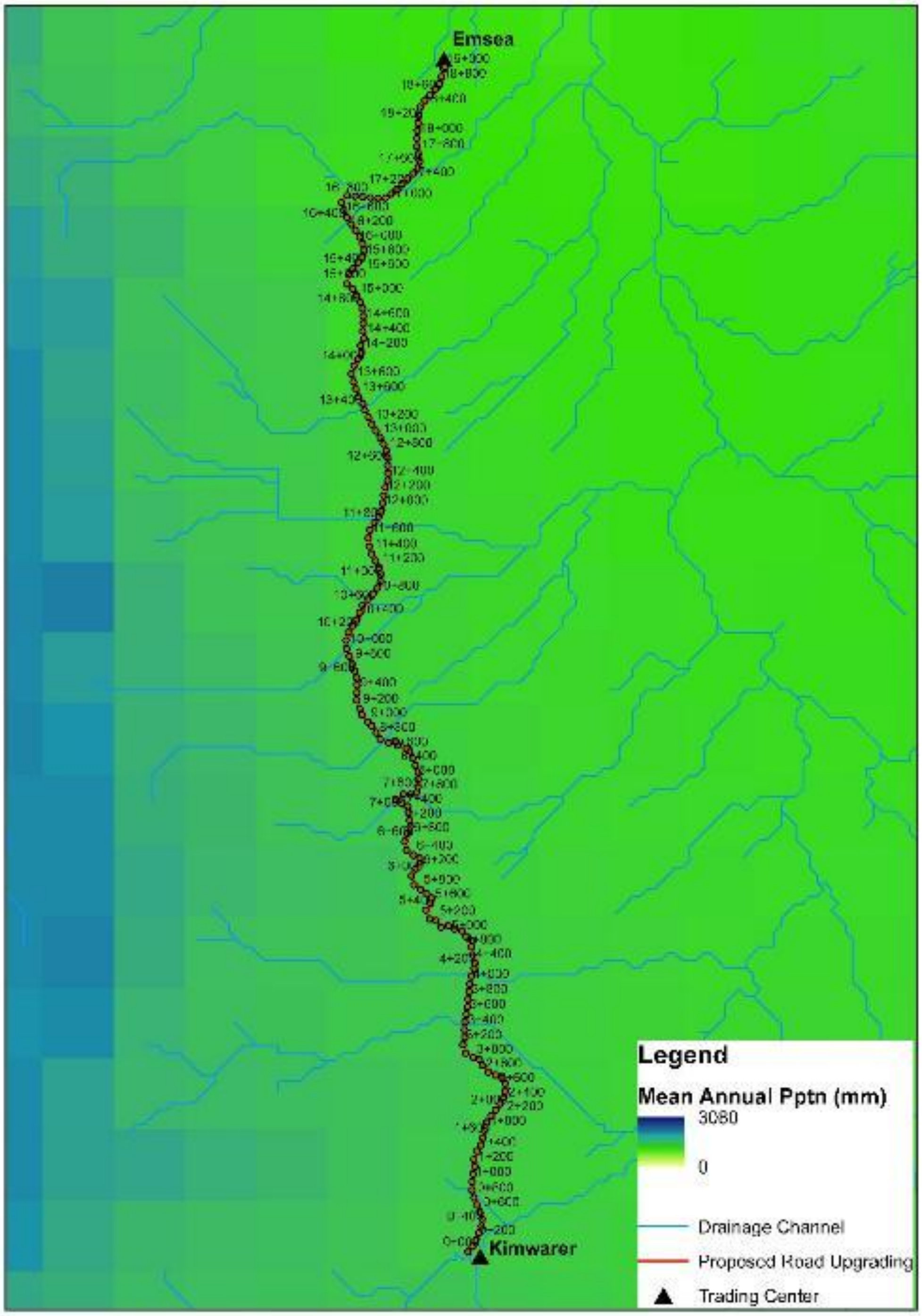
Between chainage 3+000 and about 7+500, precipitation increases to approximately 1,500–1,800 mm per year. This section coincides with an increase in drainage density and more frequent channel crossings. At these rainfall levels, surface runoff will occur more frequently, and the risk of slope wash, sediment transport, and culvert overtopping will increase, especially during prolonged or high-intensity rainfall events.

From chainage 7+500 to approximately 12+000, mean annual precipitation is consistently higher, typically ranging between about 1,800 mm and 2,200 mm per year. This zone represents one of the more rainfall-intensive sections of the corridor. The combination of higher precipitation, converging tributary channels, and locally steeper slopes means that erosion, embankment saturation, and downstream sedimentation will occur more frequently. Vulnerability in this section is high, particularly around major drainage crossings where runoff volumes from upstream catchments are substantial.

Between chainage 12+000 and about 16+000, precipitation remains relatively high but spatially uniform, generally in the range of about 2,000–2,300 mm per year. Although slopes in this section are more moderate, sustained rainfall at these levels will lead to prolonged soil moisture saturation. Vulnerability here is moderate to high, driven mainly by cumulative wetness rather than extreme peak flows, increasing the likelihood of gradual slope instability and weakening of road subgrade materials.

From chainage 16+000 to Emsea at approximately 19+000, mean annual precipitation reaches the highest values along the corridor, commonly exceeding 2,300 mm and locally approaching 2,800–3,080 mm per year. This section lies within a high-rainfall zone characterized by dense drainage networks and persistent soil moisture. Despite relatively gentler slopes compared to the escarpment zone, the high precipitation will maintain saturated ground conditions for long periods. Vulnerability in this section is therefore high, with increased risks of embankment instability, drainage congestion, and long-term maintenance challenges.

The most rainfall-vulnerable sections of the road occur between chainage 7+500 and 12+000 and from chainage 16+000 to 19+000, where mean annual precipitation commonly exceeds 2,000 mm per year. In these areas, the interaction of high rainfall, clay-rich soils, and concentrated drainage will amplify erosion, saturation, and sediment transport processes, making them priority zones for robust drainage design and erosion control interventions.



4.1.6 Mean Annual Temperature

4.1.6.1 Biretwo – Arror – Chesongoch Mean Annual Temperature

The Mean Annual Temperature along the proposed road upgrading alignment exhibits a clear spatial gradient from the southern end at Biretwo trading center to the northern terminus at Chesongoch trading center, reflecting variations in elevation and proximity to the escarpment and adjacent lowland areas.

The Mean Annual Temperature at the southern starting point around Biretwo trading center, within Chesigot and Kabito sublocations (approximately chainage 0+000 to 5+000), is relatively moderate, generally ranging between about 16°C and 19°C. This section lies closer to higher elevation zones, where cooler conditions prevail, contributing to lower average temperatures along this initial stretch of the alignment.

The Mean Annual Temperature gradually increases as the road progresses northwards through Songeto and Rimo sublocations between approximately chainage 5+000 and 15+000. In this section, mean annual temperatures typically range from about 18°C to 21°C, indicating a transition from cooler highland conditions toward warmer mid-altitude zones. Temperature variability here is moderate, influenced by both elevation and slope orientation.

The Mean Annual Temperature continues to rise along the alignment as it passes through Anin, Komoigon, and Kobulwo sublocations, roughly between chainage 15+000 and 30+000. In this mid-alignment corridor, mean annual temperatures are generally within the range of approximately 20°C to 23°C. These conditions reflect a balance between residual escarpment cooling effects to the west and warmer lowland influences to the east.

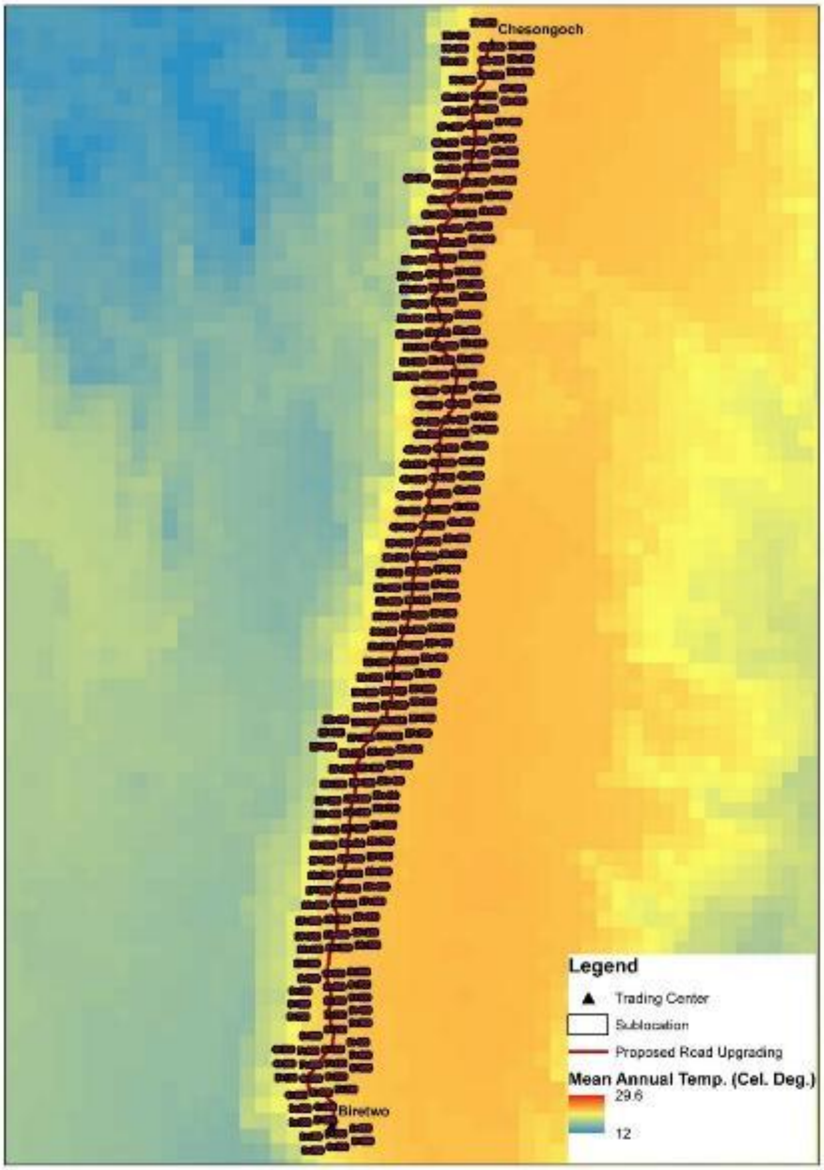
The Mean Annual Temperature becomes relatively higher along the section through Chegilet and Koitilial sublocations between approximately chainage 30+000 and 40+000. Here, temperatures typically range from about 22°C to 25°C, marking a clear transition into warmer climatic conditions. This section is influenced by reduced elevation and increased exposure to lowland thermal regimes.

The Mean Annual Temperature remains high but locally variable as the road traverses Sangurur, Kiboswa, and Aror sublocations between approximately chainage 40+000 and 55+000. Mean annual temperatures in this stretch generally fall within the range of about 23°C to 26°C. Localised cooling may occur in sections influenced by topographic shading or drainage corridors, but overall thermal conditions are warmer than in the southern sections.

The Mean Annual Temperature along the northern section of the alignment, extending through Cherkumei, Resim, Mogil, Chesetan, and Kukei sublocations from approximately chainage 55+000 to 65+000, ranges between about 24°C and 27°C. These areas lie within warmer climatic zones associated with lower elevations and more open landscapes.

The Mean Annual Temperature along the final stretch of the alignment from approximately chainage 65+000 to the endpoint at Chesongoch trading center, including Kisoka and Enou sublocations, reaches the highest values along the corridor, typically ranging from about 25°C to 29°C. This section is characterised by relatively warm conditions that reflect the influence of the adjacent lowland environment around Chesongoch trading center.

he Mean Annual Temperature distribution along the Biretwo–Chesongoch road alignment shows a progressive increase from cooler southern highland sections to warmer northern lowland zones, with localized variability driven by elevation and topographic effects. This gradient has implications for pavement performance, construction materials behaviour, and long-term maintenance considerations along the upgraded road corridor.



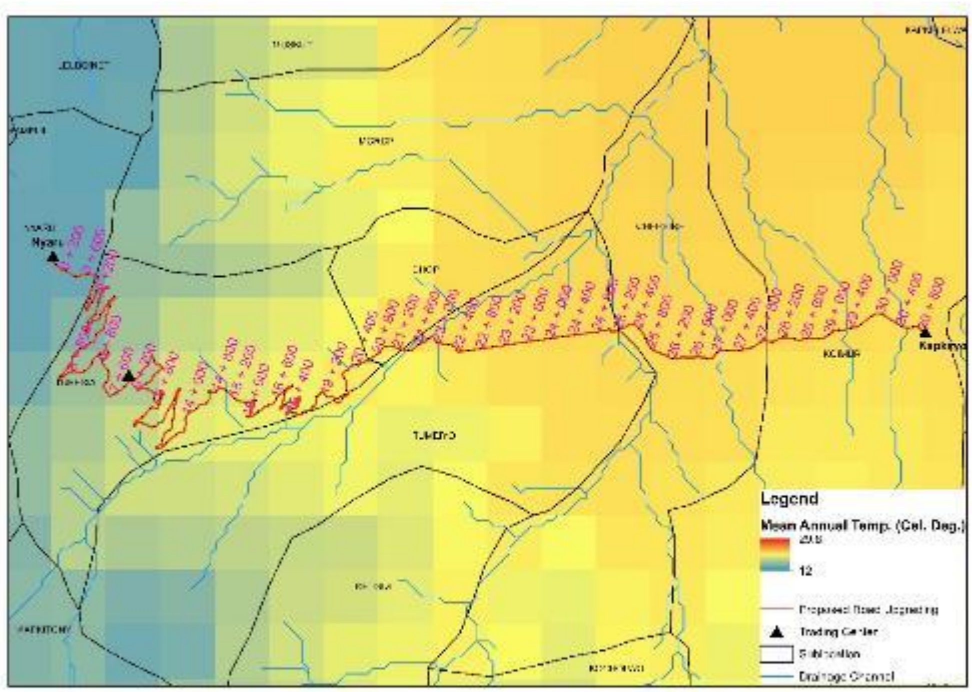
4.1.6.2 Nyaru – Kimwarer – Kapkayo Mean Annual Temperature

The spatial pattern of mean annual temperature along the Nyaru–Kapkayo road corridor shows a strong inverse relationship with elevation, reflecting the topographic control on local climate conditions. The western section of the alignment around Nyaru and the adjacent Turesia sublocation (approximately chainage 0+000 to 5+000) lies at relatively higher elevations along the escarpment margin. This section corresponds with lower mean annual temperatures, as indicated by cooler colour tones on the temperature surface. The cooler conditions are associated with elevated terrain, increased cloud cover, and enhanced orographic effects, which moderate daytime temperatures. These conditions support relatively dense vegetation cover, including mixed agroforestry systems and remnant natural vegetation, and contribute to higher soil moisture retention.

Moving eastwards from approximately chainage 5+000 through Chop and Tumeiyo sublocations (around 5+000 to 18+000), the road descends gradually into mid-elevation landscapes. This transition zone shows a moderate increase in mean annual temperature, coinciding with a gradual reduction in elevation. The terrain becomes more undulating, and temperature values increase slightly but remain within a moderate range due to the buffering influence of valley systems and drainage channels. These conditions support a mosaic of land uses, including smallholder cultivation interspersed with shrubland and grassland, where temperature variability influences crop choice, growing seasons, and vegetation structure.

Further east, from approximately chainage 18+000 to Kapkayo (around 30+000), within Koimur and Chepsirei sublocations, the elevation becomes relatively lower and more uniform. This section corresponds with higher mean annual temperatures, as shown by warmer colour gradients on the temperature map. The reduced elevation limits cooling effects, leading to warmer and more stable thermal conditions throughout the year. These warmer zones are associated with more open landscapes dominated by cultivated fields, grazing areas, and scattered woody vegetation. Higher temperatures in this section, combined with lower elevation, can increase evapotranspiration rates and place additional stress on soil moisture and vegetation, particularly during dry periods.

The cross-analysis indicates that elevation is a primary driver of temperature variation along the road alignment. Cooler, high-elevation sections near Nyaru contrast sharply with warmer lowland areas towards Kapkayo. This temperature–elevation gradient has direct ecological implications, influencing vegetation composition, habitat suitability for fauna, and the resilience of ecosystems to disturbance. In the context of road upgrading, sections transitioning rapidly from higher to lower elevations, particularly between Turesia and Chop sublocations, may be more sensitive to microclimatic alteration due to vegetation clearance and surface modification, potentially amplifying local temperature increases and associated ecological stress.



4.1.6.3 Kimwarer – Emsea Mean Annual Temperature

The mean annual temperature along the Kimwarer–Emsea road section shows a clear spatial gradient that is closely linked to elevation and topographic position, with warmer conditions occurring in the lower-lying southern sections and cooler conditions toward the higher-altitude northern sections near Emsea. Across the corridor, mean annual temperatures generally range from about 14–16 °C in the upper sections to approximately 22–26 °C in the lower sections, with localized warmer pockets approaching 27–29 °C in the lowest elevations.

From chainage 0+000 to approximately 3+000 around Kimwarer, mean annual temperatures are relatively high, typically ranging between about 24 °C and 26 °C, with localized pixels approaching 27–29 °C. This section lies at lower elevation and experiences warmer and more evaporative conditions. Vulnerability in this zone is moderate to high, as higher temperatures will increase evapotranspiration rates, reduce soil moisture retention, and intensify stress on roadside vegetation. When combined with road surface sealing and reduced infiltration, these temperatures will increase the likelihood of vegetation desiccation and dust generation during dry periods.

Between chainage 3+000 and about 7+500, mean annual temperatures gradually decrease to approximately 22–24 °C. This section represents a transition zone where temperature-driven stress is still evident but slightly moderated by increasing elevation. Vulnerability here is moderate, with thermal stress on plants and soil biota remaining significant, particularly where vegetation clearance will occur and where clay-rich soils are exposed.

From chainage 7+500 to approximately 12+000, mean annual temperatures further decline to around 20–22 °C. This zone experiences more moderate thermal conditions, which are generally favorable for vegetation growth and soil biological activity. Vulnerability related to temperature alone is lower in this section; however, interactions with high rainfall and slope conditions mean that indirect impacts such as erosion and waterlogging will still occur despite the relatively cooler temperatures.

Between chainage 12+000 and about 16+000, temperatures range mainly between 18–20 °C. These cooler conditions coincide with higher elevations and increased cloud cover. Vulnerability in this section is low to moderate in terms of thermal stress, but prolonged cool and moist conditions will favor soil saturation, potentially weakening road subgrade materials and affecting root stability of vegetation along embankments.

From chainage 16+000 to Emsea at approximately 19+000, mean annual temperatures are lowest along the corridor, typically between about 14–18 °C. This section lies within the coolest climatic zone of the road alignment. Direct temperature-related stress on biodiversity is low; however, the combination of cool temperatures and high precipitation will maintain high soil moisture levels. Vulnerability here is therefore driven less by heat stress and more by prolonged wetness, which will increase the risk of slope instability, reduced soil aeration, and changes in plant species composition toward moisture-tolerant assemblages.

the highest temperature-related vulnerability occurs in the Kimwarer section between chainage 0+000 and 3+000, where mean annual temperatures commonly exceed 24 °C and locally approach 27–29 °C. In contrast, sections beyond chainage 12+000, where temperatures fall below about 20 °C, are less vulnerable to thermal stress but remain sensitive to interactions between cooler temperatures, high rainfall, and terrain-driven processes.

4.1.7 Land use Types

4.1.7.1 Biretwo – Arror – Chesongoch Land use Types

The land cover pattern along and across the proposed road upgrading alignment from Biretwo to Chesongoch trading center reflects a gradual transition from intensively used agricultural landscapes to mixed agro-pastoral and semi-natural vegetation systems, strongly influenced by elevation, drainage density, and proximity to the escarpment.

The land cover at the southern end of the alignment around Biretwo trading center, within Chesigot and Kabito sublocations (approximately chainage 0+000 to 6+000), is dominated by smallholder agricultural land interspersed with homesteads and patches of riparian vegetation. Cultivated fields, mainly under annual crops, are evident along and west of the road, while narrow riparian strips with shrubs and scattered trees follow drainage channels east of the alignment. The road corridor here passes through a highly modified landscape with limited continuous natural vegetation.

The land cover transitions through Songeto, Rimo, and Anin sublocations between approximately chainage 6+000 and 20+000 into a mosaic of mixed cropland, fallow land, and grassland. Along the road alignment, cultivated plots alternate with open grass patches and settlement clusters. Across the chainage, the western side exhibits denser vegetation cover associated with higher moisture availability, including agroforestry plots and riparian thickets, while the eastern side shows more open grazing land with sparse shrub cover aligned with seasonal drainage lines.

The land cover in the mid-alignment section passing through Komoigon and Kobulwo sublocations, roughly between chainage 20+000 and 30+000, is characterised by a shift toward agro-pastoral land use. Along the road, cultivated land becomes less continuous and is increasingly interspersed with natural grassland and bushland. Across the alignment, the western upstream slopes retain denser vegetation, including woodland patches and shrub-dominated hillsides, whereas the eastern downstream areas are largely open rangelands with visible drainage corridors supporting narrow bands of greener vegetation.

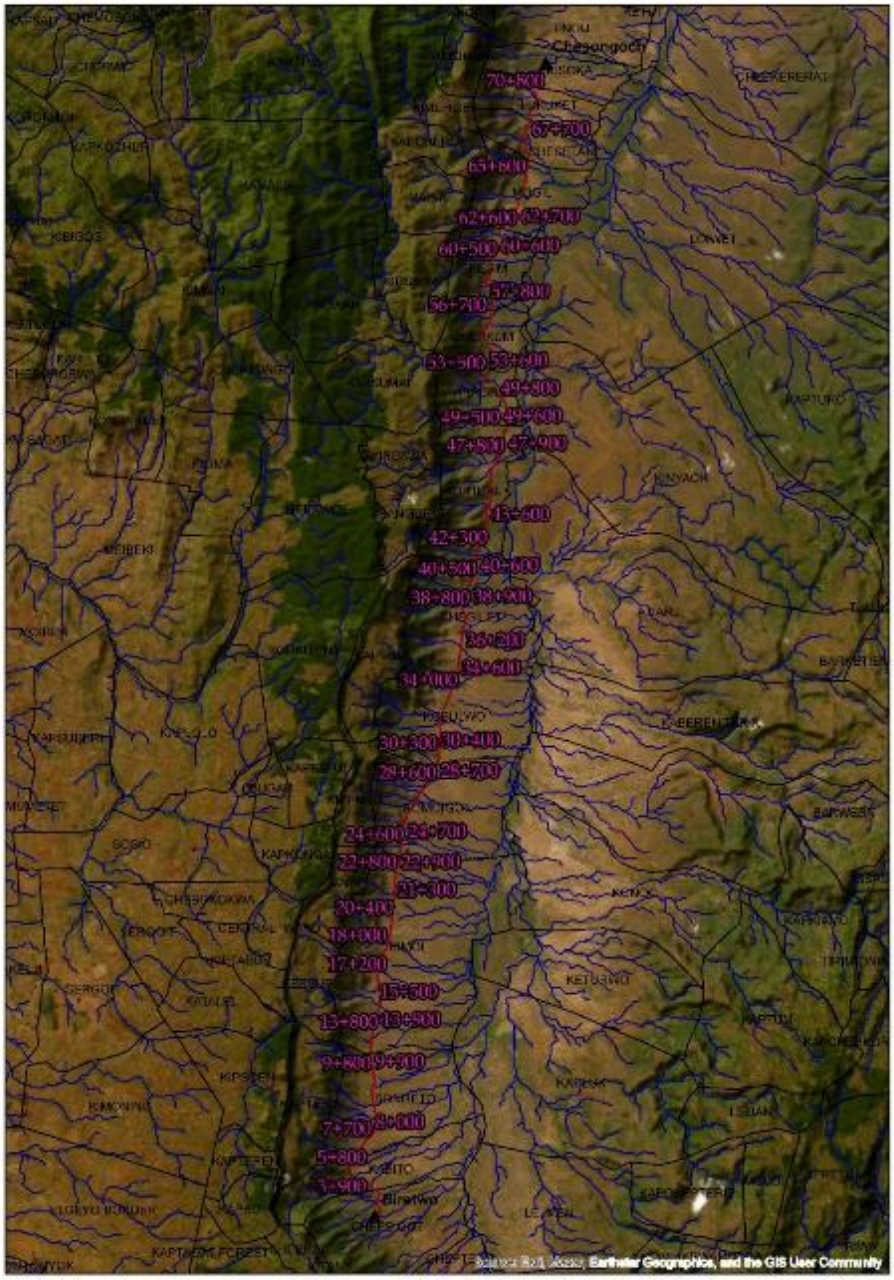
The land cover along the section through Chegilet and Koitilial sublocations between approximately chainage 30+000 and 40+000 is dominated by open grassland and shrubland with limited cultivation. The road corridor cuts through a landscape primarily used for grazing, with scattered homesteads and isolated cultivated plots near drainage lines. Across the chainage, the eastern side shows extensive rangeland with sparse woody vegetation, while the western side retains slightly denser shrub and woodland cover associated with escarpment-derived moisture.

The land cover across Sangurur, Kiboswa, and Aror sublocations from approximately chainage 40+000 to 55+000 reflects a mixed mosaic of shrubland, grassland, and localized cultivation. Along the alignment, vegetation cover is more continuous than in the southern sections, with fewer settlement clusters. Across the road, drainage channels support linear riparian vegetation features, while surrounding upland areas remain predominantly open grazing lands with scattered trees.

The land cover along the northern mid-section through Cherkumei and Resim sublocations between approximately chainage 55+000 and 60+000 shows increasing dominance of natural vegetation. Along the road, shrubland and grassland prevail, with cultivation largely restricted to valley bottoms and near permanent or seasonal watercourses. Across the chainage, the western side continues to support denser vegetation cover due to higher moisture retention, while the eastern side remains drier with more open rangeland characteristics.

The land cover along the final stretch of the alignment from approximately chainage 60+000 to the terminus at Chesongoch trading center, including Mogil, Chesetan, Kukei, Kisoka, and Enou sublocations, is predominantly semi-natural grassland and shrubland with limited agricultural activity. Along the road corridor, grazing land dominates, punctuated by riparian vegetation along well-defined drainage channels. Near Chesongoch trading center, land cover becomes more heterogeneous, with built-up areas, cultivated plots, and disturbed vegetation reflecting increased human activity.

The land cover along the Biretwo–Chesongoch road alignment demonstrates a clear south-to-north gradient from intensively cultivated agricultural landscapes to predominantly agro-pastoral and semi-natural rangeland systems. Across the chainage, a consistent pattern is observed where denser vegetation and woodland patches occur on the wetter western upstream slopes, while more open grassland and shrubland dominate the drier eastern downstream areas, strongly influenced by drainage patterns and slope gradients.



4.1.7.2 Kimwarer – Emsea Land use Types

The Kimwarer–Emsea road alignment traverses a heterogeneous landscape characterised by a gradual transition from settlement–agricultural mosaics at the lower chainages to more extensive semi-natural vegetation and mixed farming systems toward the upper chainages. Land cover and land use patterns along the corridor reflect strong interactions between topography, accessibility, soil conditions, and proximity to forested escarpment zones.

At the southern end around Kimwarer (chainage 0+000 to approximately 1+000), the road passes through a densely settled rural centre dominated by built-up areas interspersed with smallholder farms. Land use in this section is primarily residential and subsistence agriculture, with small plots of maize, beans, vegetables, and fruit trees surrounding homesteads. Riparian vegetation occurs locally along small streams crossing the alignment, while the immediate vicinity of the road shows signs of repeated disturbance, including cleared verges, compacted soils, and sparse grass cover.

Between approximately chainage 1+000 and 4+000, the landscape opens into an intensively cultivated smallholder agricultural zone. The dominant land cover consists of mixed cropland interspersed with scattered trees, hedgerows, and patches of fallow land. Farming systems are largely rain-fed, with irregular field boundaries reflecting customary land subdivision. Vegetation structure is semi-open, with shrubs and isolated indigenous trees retained for shade, fuelwood, or cultural value. Settlement density remains moderate, with homesteads dispersed along feeder paths branching from the road.

From around chainage 4+000 to 7+000, the alignment begins to interface more closely with the escarpment foothills. Land cover transitions into a mosaic of agroforestry systems, bushland, and remnant natural vegetation. Cultivated fields are still present but become smaller and more fragmented, interspersed with shrubs, secondary woodland, and grazing areas. This section shows increasing vegetation density on the upslope side of the road, reflecting reduced cultivation on steeper terrain and proximity to forested areas.

Between chainage 7+000 and 10+000, semi-natural vegetation becomes more prominent. The road corridor is flanked by a mix of shrubland, secondary woodland, and pockets of cultivated land concentrated on gentler slopes and valley bottoms. Tree cover increases, particularly on the western side where forested escarpment slopes dominate. Human settlement is more dispersed, with homesteads clustered in accessible pockets rather than continuously along the road. The land use pattern indicates a transition zone where agriculture, grazing, and natural vegetation coexist.

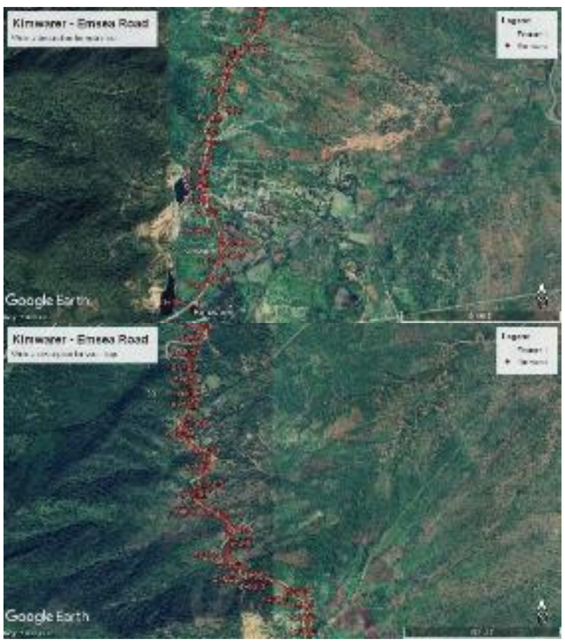
From approximately chainage 10+000 to 13+000, the alignment passes through predominantly semi-natural landscapes with limited cultivation. Land cover is characterised by bushland, woodland, and scattered farms, with cultivation mainly restricted to small clearings and valley bottoms. The vegetation structure is relatively intact compared to lower chainages, and the area shows fewer signs of intensive land transformation. This section reflects reduced accessibility and steeper terrain, which constrain extensive agricultural expansion.

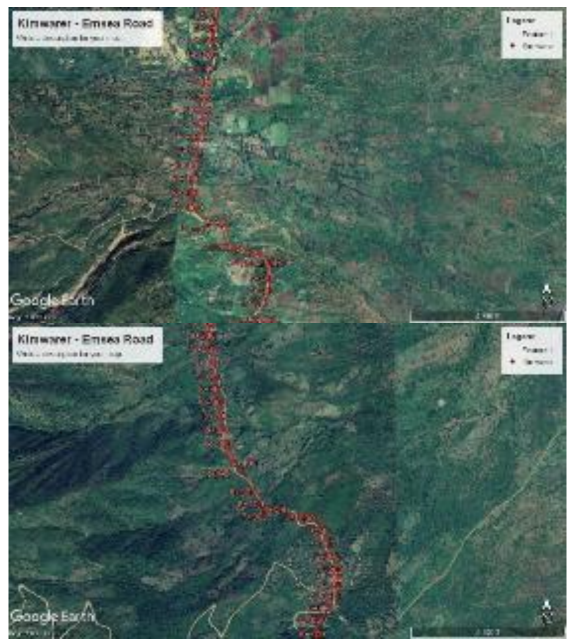
Between chainage 13+000 and 15+500, land use becomes more heterogeneous again, with a mix of smallholder agriculture, grazing areas, and remnant woodland. Cultivated plots are evident around clustered settlements, while surrounding slopes retain shrub and tree cover. The alignment intersects areas where farming encroaches into previously semi-natural vegetation, indicating ongoing land-use change driven by access and population pressure.

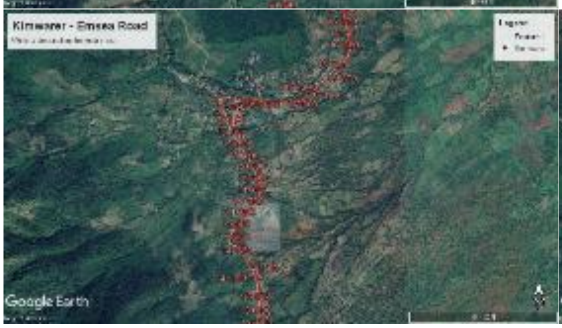
From chainage 15+500 to approximately 17+000, approaching Emsea, settlement density increases and agricultural land use becomes more pronounced. Mixed farming dominates, with cropland interspersed with homesteads, grazing patches, and tree-lined boundaries. Vegetation cover is moderately open, reflecting long-term human use, but significant tree cover remains in communal areas and along drainage lines.

At the northern terminus around Emsea (approximately chainage 17+000 to 17+961), the road connects to an established settlement node characterised by built-up areas, cultivated land, and road junctions. Land use is predominantly residential and agricultural, with visible infrastructure and higher levels of landscape modification compared to the mid-chainage sections.

The land cover and land use along the Kimwarer–Emsea road alignment reflect a gradient from densely settled agricultural landscapes through transitional agro-ecological mosaics to semi-natural escarpment-associated vegetation, before returning to mixed settlement and farming near Emsea. This variability has important implications for road upgrading, as ecological sensitivity, erosion risk, and land-use interactions differ markedly along the chainage and require location-specific management approaches.







4.1.7.3 Nyaru – Kimwarer - Kapkayo Land Use Types

The road alignment from Nyaru to Kapkayo traverses a heterogeneous landscape characterised by a gradual transition from intensively cultivated highland mosaics to more extensive agro-ecological and semi-natural systems, with several ecologically sensitive habitats occurring adjacent to the road corridor.

From chainage 0+000 at Nyaru through approximately 1+200, land use is dominated by dense smallholder agriculture interspersed with rural settlement. The landscape is typified by mixed subsistence farming plots, homesteads, local trading activities and scattered woodlots. Crops appear in small, irregular parcels, indicating long-established cultivation supported by relatively reliable rainfall and fertile soils. Natural vegetation is limited mainly to hedgerows, riparian strips along minor drainage lines, and isolated trees retained for shade or cultural value. Ecological sensitivity in this section is moderate, although riparian vegetation along small streams crossing the road provides localized habitat for birds, invertebrates and small mammals and should be considered critical micro-habitats vulnerable to drainage alteration during road upgrading.

Between chainage 1+200 and approximately 3+000, the road begins to skirt the edge of more continuous natural vegetation. Patches of closed to semi-closed woodland become increasingly prominent on the eastern side of the alignment, while cultivated land remains dominant on the western side. This zone functions as a transition between intensively used agricultural land and more intact vegetation blocks. The woodland patches, likely representing remnant indigenous forest or secondary regrowth, provide important habitat connectivity for birds, arboreal species and pollinators moving between forested hills and lower agricultural landscapes. The proximity of the road to these wooded areas makes this section ecologically sensitive, particularly where the alignment runs parallel to forest edges and drainage channels draining from the forest interior.

From approximately chainage 3+000 to 6+000, the alignment passes through a mosaic of agroforestry systems, open woodland and cultivated fields. Tree cover increases noticeably, with farms incorporating scattered indigenous trees and small forest patches. These areas likely support higher biodiversity compared to the more intensively farmed northern sections, including insect communities, reptiles and small mammals that utilise the mixed structure of crops and trees. Several drainage channels intersect the road in this section, creating narrow riparian corridors with relatively dense vegetation. These riparian strips constitute critical habitats, supporting aquatic macro-invertebrates, amphibians and wetland-associated bird species, and are particularly sensitive to changes in runoff, sediment load and channel modification.

Between chainage 6+000 and about 9+000, the road alignment increasingly penetrates areas of continuous woodland and bushland interspersed with fewer cultivated plots. Settlement density declines, and natural vegetation becomes more dominant on both sides of the road. This section likely forms part of a broader ecological matrix linking hill forests and valley systems, functioning as habitat for forest-edge species and as movement corridors for wildlife. The presence of intact vegetation adjacent to the road indicates a higher conservation value landscape, where road upgrading could result in habitat fragmentation, increased edge effects and greater human access pressure if not carefully managed.

From chainage 9+000 through approximately 14+000, the alignment crosses a landscape of mixed land use, with alternating stretches of cultivation, grazing land and woodland. Terraced fields and grazing patches suggest adaptation to sloping terrain, while tree cover remains moderate to high in places. Several valleys and drainage lines are evident, marked by greener vegetation and denser canopy cover. These valley bottoms and riparian zones represent critical habitats, supporting higher moisture availability, diverse plant assemblages and associated fauna. They are also likely to serve as dispersal routes for wildlife moving across the landscape, increasing their ecological importance relative to surrounding uplands.

Beyond chainage 14+000 to approximately 20+000, the road runs adjacent to more extensive blocks of natural vegetation, including woodland and possibly forested areas, particularly near administrative or sublocation boundaries. Agricultural activity persists but is more fragmented, indicating lower intensity land use. This section is ecologically sensitive due to the continuity of vegetation cover and the presence of multiple drainage channels that feed into larger downstream systems. These habitats support a wide range of species, from invertebrates and birds to larger mammals, and are vulnerable to indirect impacts such as altered hydrology, increased human access and gradual land-use change following road improvement.

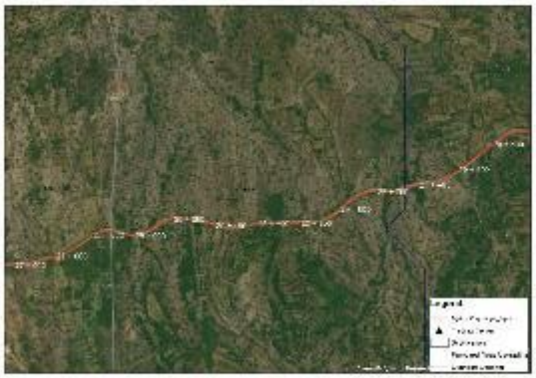
From chainage 20+000 to Kapkayo at approximately 30+800, the alignment transitions again into a mixed agricultural and settlement landscape around Kapkayo trading centre. Cultivated land becomes more prominent, with visible infrastructure and concentrated human activity near the road. However, even in this southern section, pockets of natural vegetation, riparian corridors and grazing lands persist, providing residual ecological functions. Wetland features and drainage channels near Kapkayo are particularly important habitats, supporting aquatic organisms and wetland-dependent bird species despite the surrounding human-dominated land use.


Legend


Legend


Legend


Legend



4.1.8 4Drainage and Hydrology

The project region exhibits a varied hydrological regime directly influenced by its pronounced topography. The highlands receive significant rainfall, generating substantial surface runoff that feeds numerous perennial rivers and streams, which then cascade down the steep Elgeyo Escarpment into the semi-arid Kerio Valley below. Within the valley, river flows are more seasonal and dependent on upstream catchment conditions.

For the Biretwo–Arror–Chesongoch (B126) road, spanning 72.0 km, the project encounters numerous significant watercourses that require careful engineering interventions. Major rivers along this alignment include the Mogul River at chainage 63+200, the Cheptarpich River at 65+700, and the Arror River at 51+400. Other notable crossings are at the Cherebut River (50+000), the Kipkata River (45+600), the Kilos River (39+800), the Chebitmoo River (37+100), and the Enou River (32+400). Additionally, the alignment traverses many smaller streams along its route through the escarpment and valley. The crossing of the Arror River is particularly critical, given its likely flow volume and its role in the local ecosystem. Successful passage of these water bodies will necessitate a combination of appropriately sized bridges for major rivers and strategically designed culverts for perennial and seasonal streams to ensure hydraulic efficiency, structural durability, and minimal disruption to aquatic habitats and landscape continuity.

For the Kimwarer–Emsea (B122) road, with a total length of 19.4 km, the key watercourse crossings are concentrated along the alignment within the valley. Significant crossings include the Chebloch River at chainage 18+400, the Chepta River at 13+800, and the Kapchepwor River at 10+400. These rivers, while potentially smaller in scale compared to the Kerio River system, are essential hydrological features that can experience significant seasonal flow variations. The engineering design for this road must account for these variations to prevent road overtopping or structural damage during rainy seasons. The implementation of adequately sized culverts or minor bridges at these locations is essential to maintain road access, ensure driver safety, and protect the integrity of the watercourses and their riparian zones from erosion and sedimentation caused by construction and road runoff.

For the Nyaru–Kapkayo (B124) road, the project corridor encounters a network of perennial and seasonal watercourses. Among these are the Kimwarer River (approximately Ch. 23+300) and the Chemoiben River (approximately Ch. 25+900), together with numerous other rivers and streams that traverse the steep slopes of the escarpment and highlands. This dense drainage network necessitates a comprehensive and integrated water management strategy incorporating bridges for major channels, appropriately sized culverts or drifts for smaller streams, lined drainage channels, and erosion control measures to safely convey stormwater runoff, minimise erosion, prevent gully formation, and protect the structural integrity of the road from water-induced slope failures. Effectively managing these frequent interactions with watercourses is critical for both the long-term durability of the road and the maintenance of the hydrological balance of the sensitive escarpment environment.

Biodiversity surveys confirmed that the Kimwarer River and Chemoiben River support ecologically important aquatic and riparian habitats. Aquatic and semi-aquatic invertebrate communities were well represented, reflecting the presence of perennial freshwater habitats and associated riparian vegetation. Recorded taxa included Planorbidae (ramshorn snails) and Bithyniidae (freshwater snails), which are characteristic of permanent freshwater ecosystems and contribute to nutrient cycling and aquatic food webs. Diverse Odonata (dragonflies and damselflies) were also recorded throughout the riparian corridor. As their larval stages depend on freshwater habitats, odonates are widely recognised as indicators of healthy aquatic ecosystems and good riparian habitat quality. Although no Critical Habitat or legally protected aquatic species were recorded at the proposed river crossings, both the Kimwarer and Chemoiben Rivers are considered environmentally sensitive because of their ecological functions, including the provision of aquatic habitat, maintenance of riparian biodiversity, support of downstream ecosystem processes, and delivery of ecosystem services to surrounding communities. Accordingly, the design incorporates bridge structures, appropriately sized drainage structures, erosion and sediment control measures, and protection of riparian vegetation to minimise disturbance to aquatic habitats and maintain natural hydrological connectivity.

Plate 4-2: Drainage along the road- Sample rivers and streams along the roads

4.1.9 Water Resources

The existing water supply for communities along the road corridors relies primarily on surface water from the numerous rivers and streams in the area, such as the Arror, Kimwarer, and Chemoiben rivers. Boreholes and other limited groundwater sources are used as a supplementary supply, particularly in areas where surface water is seasonal or less accessible. The availability of water varies seasonally and by elevation, with more reliable flows in the highland-fed streams compared to the seasonal. Protecting these water sources from sedimentation and contamination during construction is a critical environmental priority for the project.,

4.1.10 Solid and Liquid Waste Management

Based on observations along the corridor, the existing road sections are generally clean with no significant waste accumulation observed. Residents manage their waste effectively through domestic reuse, including feeding organic kitchen scraps to livestock and utilizing dry agricultural vegetation for soil conditioning. Effluent is handled through pit latrines, with no raw sewage observed along the roadways. Waste management challenges are concentrated in urban centers and settlement areas along the routes, such as near markets in towns like Biretwo, Arror, Nyaru and Emsea, where organic matter, plastics, polythene, and paper are commonly found. The corridor lacks formal solid waste management systems or sewage disposal infrastructure.

Road construction activities will introduce additional waste streams into this context. Construction will generate spoil earth materials, vegetation debris from clearing, general municipal-type waste from worker camps, and hazardous wastes such as used oils, solvents, and chemical containers. The existing local waste management capacity is insufficient to handle these new volumes, requiring the project to establish its own on-site management mechanisms. Spoil materials represent a significant unique waste stream; their management will focus on maximizing reuse within the project, such as in embankments or as processed aggregate-to minimize off-site disposal.

4.1.11 Geology and Soils

Elgeyo-Marakwet County features diverse geology with ancient basement systems and volcanic flows. The most predominant geological formation in the region is volcanic rocks. They extend northwards along the Rift Valley to Ethiopia border. These volcanic rocks border pockets of quaternary sediments and the Mozambique belt on the west. The highland areas boast fertile soils supporting agriculture, while the semi-arid Kerio Valley may have less fertile soils.

Most of the region is covered by rocky, stony and rugged lava with poor soil cover as result of washout during heavy rains draining towards Kerio valley basin. Most of the top soil along the escarpment has been carried away leading to excessive degradation of the escarpment, causing soil loss and subsequent deposition of the sediments into Lake Kamnarok and Kerio river.

Detailed Road-Specific Analysis

Biretwo–Arror–Chesongoch (B126): Located on the Kerio Valley bed, this road traverses the primary depositional zone for sediments eroded from the escarpment. Its geology is characterized by deep, unconsolidated quaternary alluvial and colluvial deposits of sand, silt, and clay. These soils are generally of low bearing capacity, poorly graded, and can be prone to settlement and erosion. Construction will require significant focus on subgrade improvement, likely involving soil stabilization (e.g., compaction, cement or lime treatment) and robust drainage systems to manage seasonal watercourses and prevent flooding or undermining of the roadbed. The challenge here is building a stable formation on weak, sedimentary soils.

Nyaru–Kapkayo (B124): This road cuts directly across the Elgeyo Escarpment, a zone dominated by the region's predominant steep and rugged volcanic rocks, primarily Miocene phonolites and basalts. It embodies the "rocky, stony and rugged lava" terrain with very shallow or absent soil cover on steep slopes. Construction here will be dominated by major rock excavation, requiring extensive cut slopes, controlled blasting, and sophisticated slope stabilization works (e.g., rock bolting, shotcrete, gabion walls) to ensure stability and prevent rockfalls. Drainage design is critical to manage rapid runoff, minimize erosion on cut slopes, and prevent water from infiltrating and destabilizing the rock faces.

Kimwarer–Emsea (B122): Also situated on the Kerio Valley floor, this road shares a similar geological context to B126, being underlain by deep quaternary sediments. A key distinction for this alignment, particularly near the Fluorspar mining area, is the presence of Fluorspar-influenced soils. These soils may exhibit specific geotechnical properties, such as potential chemical reactivity, unusual plasticity, or low density, requiring targeted site investigation and specialized stabilization techniques. General construction challenges include working with weak, alluvial subgrades prone to erosion and ensuring adequate drainage to handle flash floods and sediment-laden runoff from the adjacent escarpment. Special attention must be paid to the sections with Fluorspar soils to ensure long-term pavement performance.

A Geotechnical Investigation Study was undertaken for all three road sections to support the engineering design. The study characterised subsurface conditions, slope stability, foundation requirements and geotechnical hazards, including the Fluorspar-influenced soils along the B122 alignment. The findings informed the design of slope stabilisation measures, drainage systems, erosion protection works and pavement foundation treatments incorporated into the project.

Soil type along Biretwo-Arror- Chesongoch road

Soil type along Nyaru- Kapkayo road

Soil type along Kimwarer- Emsea stretch

Plate 4-3: Soil type along the project area

The geology and soils baseline confirms that the project faces Category 1 (High Risk) geotechnical and erosion impacts. The Escarpment requires a Slope Stability and Rockfall Management Plan; the Valley requires a Soil Stabilization and Sediment Control Plan.

Landslide Susceptibility

A Landslide Susceptibility Mapping Study undertaken for the project area confirmed that the Elgeyo Escarpment, particularly along the Nyaru–Kapkayo (B124) alignment, is an area of high landslide hazard. Historical landslide events within Elgeyo Marakwet County have resulted in fatalities, property damage and temporary road closures, highlighting the inherent instability of the escarpment terrain during periods of intense rainfall.

Most recently, a rainfall-induced landslide occurred at Chesongoch in November 2025, approximately 0.5 km beyond the northern end of the proposed Biretwo–Arror–Chesongoch (B126) road. Although the landslide occurred outside the project footprint, the resulting mudslide crossed the existing road and temporarily disrupted transport, demonstrating the susceptibility of the wider project area to rainfall-induced slope failures. While the incident was outside the project limits, it provides recent evidence of the geohazard conditions that characterise the surrounding escarpment landscape.

The susceptibility assessment identified **slope gradients greater than 30°, high rainfall, and convex terrain curvature** as the principal factors contributing to landslide occurrence. Barren land, bushland and grassland were identified as the land cover types most susceptible to slope failure.

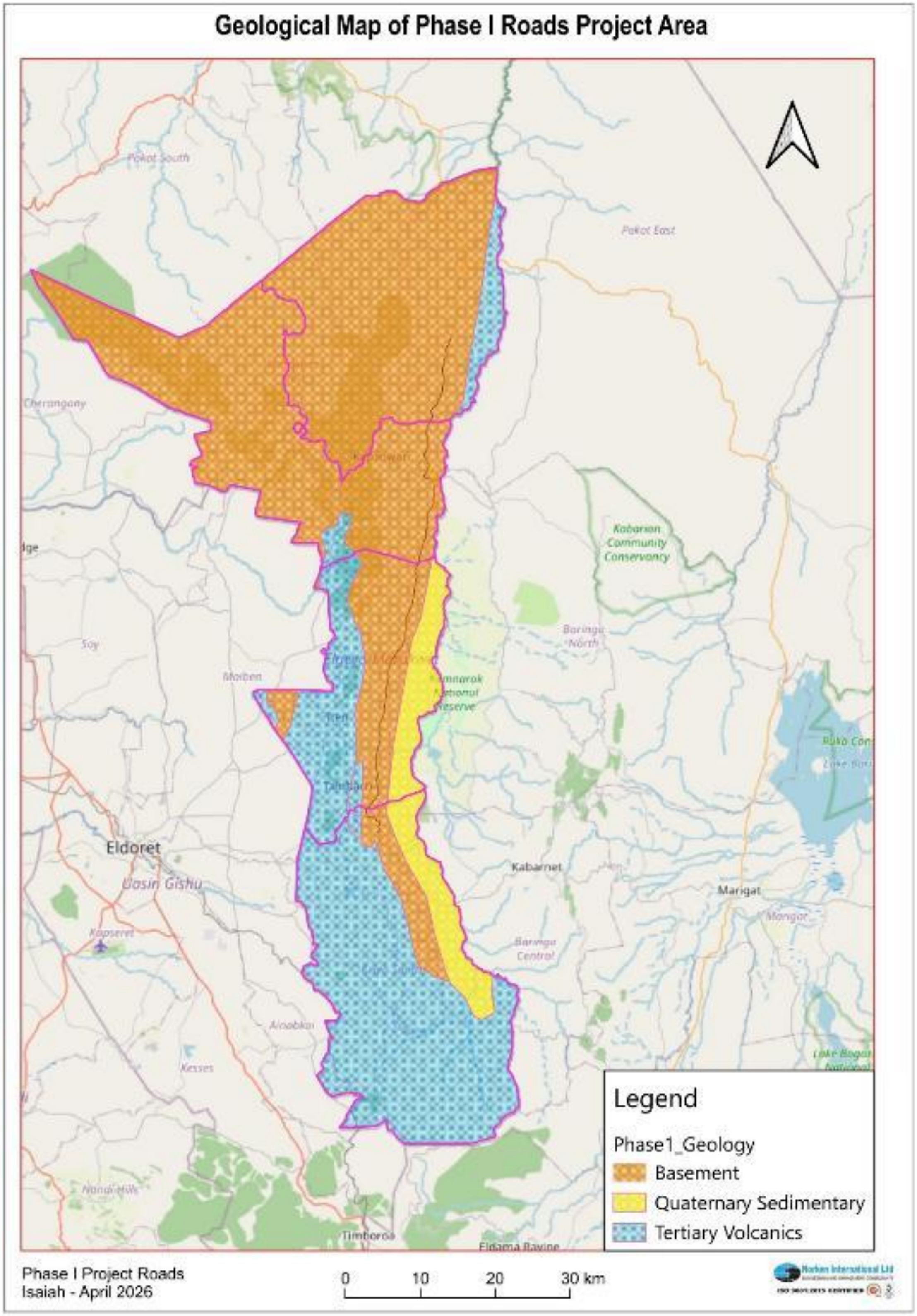


Figure 4-4: Geological Map of project area

4.1.12 Air Quality

Vast sections of the project traverse predominantly rural settings within Elgeyo Marakwet and Uasin Gishu counties. These areas are sparsely populated and are not characterized by major industrial or commercial activities that would significantly degrade ambient air quality. Consequently, existing air quality conditions along most sections of the project corridor largely reflect natural background levels.

The principal source of air pollution within the project area is the intermittent generation of dust arising from traffic movement on the existing gravel and earth road sections. Wind action over exposed surfaces, particularly in cleared agricultural lands and open valley sections, also contributes to short-term increases in suspended particulate matter. Within trading centres such as Biretwo, Arror, Nyaru, Kimwarer and Chesongoch, localized air quality impacts are mainly associated with vehicular movements, market activities, and resuspension of dust by wind, with no identified major point sources of atmospheric emissions.

During the construction phase, air quality impacts are expected to intensify temporarily due to excavation works, material handling, operation of construction machinery, haulage of materials, and increased traffic along the project roads. These activities are likely to elevate dust levels, which may affect nearby communities, roadside vegetation, livestock, surface water sources, and overall public health if not adequately managed. To establish a reliable reference point for impact assessment and mitigation, baseline air quality measurements will be undertaken prior to commencement of civil works and used for periodic monitoring throughout the construction period.

Air quality along the project corridor is further influenced by transport-related emissions, agricultural activities, and domestic fuel use, particularly in settled sections and town centres. Given the traffic volumes recorded along sections of the corridor including a notable proportion of heavy commercial vehicles vehicular emissions constitute a relevant source of air pollutants. The key pollutants associated with traffic along the project roads include carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), sulphur oxides (SO_x), and particulate matter ($PM_{2.5}$, PM_{10}), originating from fuel combustion, tyre wear, and road dust resuspension.

However, due to the open terrain, prevailing wind conditions, relatively low built-up density, and the presence of vegetation cover along much of the corridor, atmospheric dispersion is generally high. As a result, ambient pollutant concentrations are expected to remain low and within acceptable limits outside construction periods, provided appropriate mitigation measures are implemented during project execution.

4.1.13 Noise and Vibrations

Noise levels along the corridor is mainly ambient influenced by human settlement nature. Slight elevated levels are within markets and near urban centres where economic activities including workshops, commercial undertaking and entertainment points are located. Along the corridor, the main sources is vehicular traffic plying the corridor, and especially heavy trucks. The levels, however, are confined within the vicinity of the carriageway.

The main noise pollution is from the vehicles along the road, motorcycles, prayers from the churches, and human noise from traders and consumers during normal business hours.

The noise levels are extremely low throughout most of the road corridors save for areas close to the market centres, where the level increases, due to concentration of people, vehicles, motorcycles and businesses activities. There are a few key sensitive points such as schools located near the proposed project road, and this is expected to be critical during the construction and operation phases.

4.2 Biological Environment

4.2.1 Approach

Detailed assessment of the biological environment was undertaken employing an integrated, spatially explicit approach combining:

- Desk-based analysis of geospatial data (topography, drainage, climate, land cover).
- Field verification of ecological features, vegetation, and faunal indicators.
- Chainage-based segmentation of the road alignment, enabling precise location of impacts and mitigation.
- Indicator-based analysis using key species (e.g., *Ficus sycomorus*, termites, invertebrates) to infer habitat quality and ecosystem function.

4.2.2 Baseline Conditions

4.2.2.1 Ecological Context

The project corridor traverses landscapes ranging from semi-arid escarpment and bushland systems to riverine, floodplain, and wetland environments, particularly within the Kerio Valley and adjacent lowland areas. Ecological conditions are strongly influenced by terrain, drainage patterns, land use, and proximity to protected areas, notably Rimoi National Reserve.

Much of the roadside environment has been modified by grazing, cultivation, settlement expansion, and routine road maintenance. Nevertheless, the corridor retains ecologically functional elements, including drainage-line vegetation, woodland remnants, wildlife movement routes, and keystone tree species.

4.2.2.2 Vegetation and Habitat Types

a) B126: Biretwo – Arror – Chesongoch

Vegetation along the B126 corridor is dominated by dryland bushland, shrubland, and open grassland, interspersed with cultivated areas and settlements. Roadside vegetation is generally disturbed and characterized by pioneer species adapted to repeated clearing and grazing pressure.

Woody vegetation is most prominent on well-drained mid-slopes and interfluves, where thorny trees and shrubs provide structural habitat, soil stabilization, and forage. Riparian and drainage-line vegetation occurs intermittently, forming narrow but ecologically important corridors.

Riverine and seasonal stream environments support more moisture-dependent vegetation and represent localised zones of higher ecological sensitivity, particularly at drainage crossings and valley bottoms.

b) B124: Nyaru – Kapkayo

The B124 section traverses a more heterogeneous landscape comprising woodland, bushland, rocky slopes, and riverine habitats. Vegetation structure is generally more continuous than along B126, reflecting reduced disturbance in some areas and greater habitat complexity.

Rocky slopes and shallow soils support drought-adapted vegetation that is sensitive to physical disturbance and altered runoff. Localised moist habitats occur along drainage lines and shaded gullies, supporting specialised plant communities that are particularly sensitive to dust deposition and drainage modification.

c) B122: Kimwarer – Emsea

Vegetation along the B122 corridor reflects moister ecological conditions associated with rivers, wetlands, and floodplains. Habitats include riverine woodland, wetland vegetation, and forest-edge communities.

These environments are more sensitive to disturbance due to their reliance on stable hydrological regimes. Changes in drainage patterns, vegetation clearance, or sediment loads could result in disproportionate ecological effects if not carefully managed.

4.2.2.3 Fauna Overview

Faunal communities along the project roads broadly mirror vegetation patterns and habitat availability. Species composition varies from disturbance-tolerant fauna in drier sections to more diverse assemblages in riverine and floodplain environments.

a) Invertebrates as Ecological Indicators

Invertebrates were observed throughout the corridor and provide useful indicators of habitat condition at a screening level. Along B126, butterflies and pollinating insects were particularly evident in flower-rich areas between approximately Km. 18+000 and Km. 24+000, suggesting localized zones of higher floral diversity.

Specialist dragonflies and aquatic beetles were observed near flowing streams along B126, notably between Km. 28+000 and Km. 30+000, indicating relatively intact aquatic habitats sensitive to changes in water quality and hydrology.

b) Mammals and Large Wildlife

Of particular ecological significance is the seasonal movement of elephants associated with Rimoi National Reserve, which intersects sections of the B126 (Biretwo – Arror – Chesongoch) road. Elephant dispersal typically occurs between May and July, with animals utilizing well-drained slopes and avoiding waterlogged valley bottoms.

This movement pattern results in predictable human–wildlife conflict (HWC) hotspots, particularly where elephant routes intersect maize cultivation. Identified HWC hotspots along B126 occur at approximately:

- Km. 13+000 – 17+000
- Km. 21+000 – 24+000
- Km. 37+000 – 40+000
- Km. 49+000 – 51+000

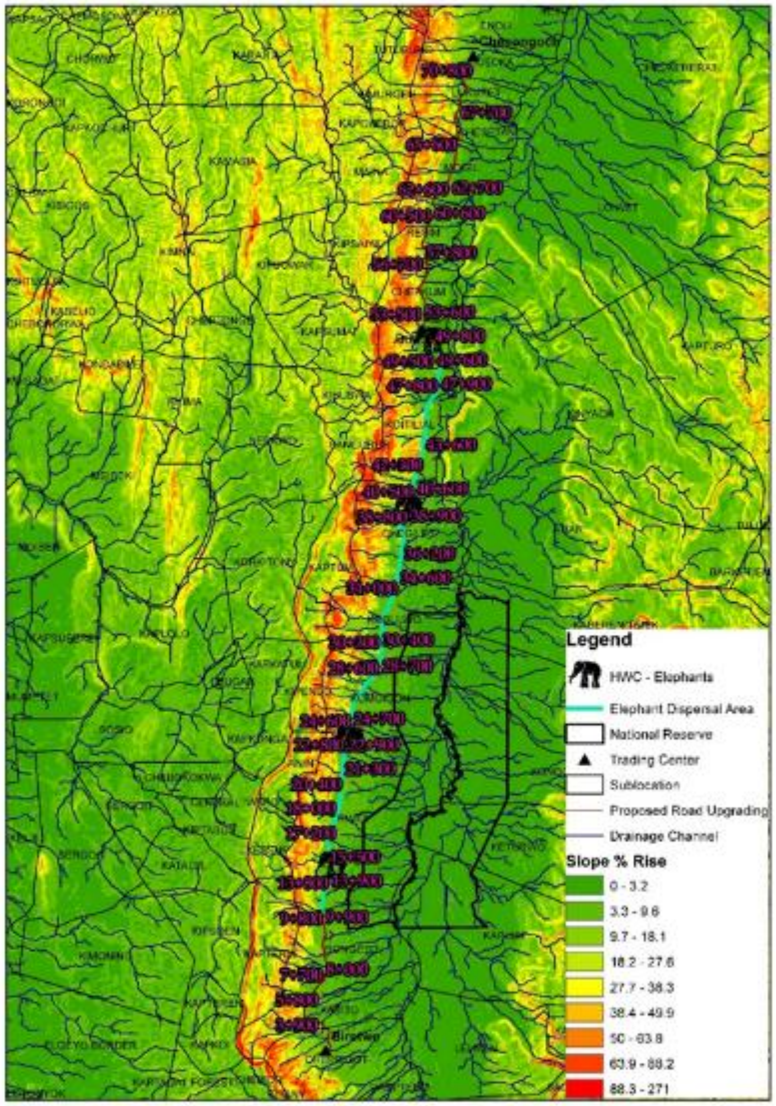


Figure 4-5 Functional wildlife corridors

4.2.2.4 Keystone Species: Ficus sycomorus

Ficus sycomorus (Sycamore Fig) was recorded at multiple locations along the B126 corridor, primarily associated with drainage lines, seasonal streams, and stable mid-slopes.

Notable occurrences were observed at approximately:

- Km. 16+000 – 18+000

- Km. 22+000 – 24+000
- Km. 38+000 – 41+000

The species typically occurs as isolated mature trees or small clusters and is widely recognised as a keystone species, providing year-round food resources, habitat structure, and microclimatic regulation. These trees also hold social and cultural value for local communities.

Loss of mature Ficus sycomorus individuals could have disproportionate ecological and social implications and therefore identifies micro-sites of elevated sensitivity.

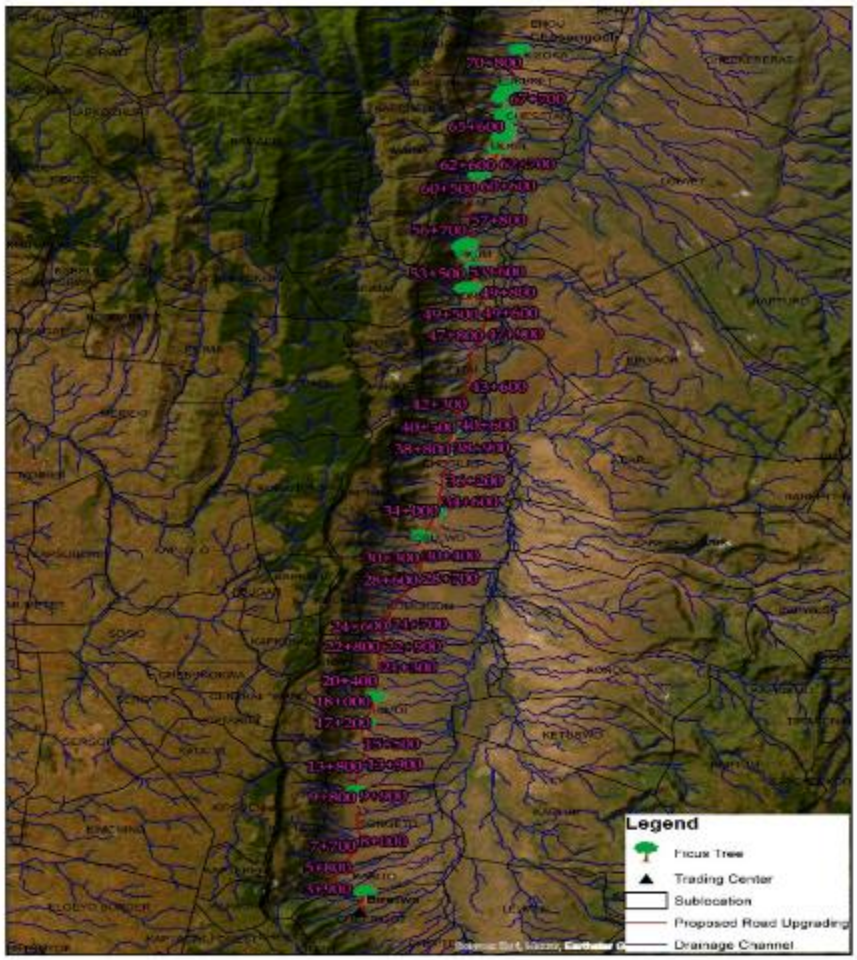


Figure 4-6 Ficus trees along the roads

4.2.2.5 Soil–Ecosystem Indicators: Termite Mounds

Concentrations of termite mounds were observed along **B126**, particularly on well-drained mid-slopes and interfluves at approximately:

- Km. 21+000 – 24+000

- Km. 37+000 – 40+000

These features indicate long-term soil stability and active ecosystem engineering processes. Areas with dense termite mound presence often coincide with productive vegetation and wildlife movement routes.

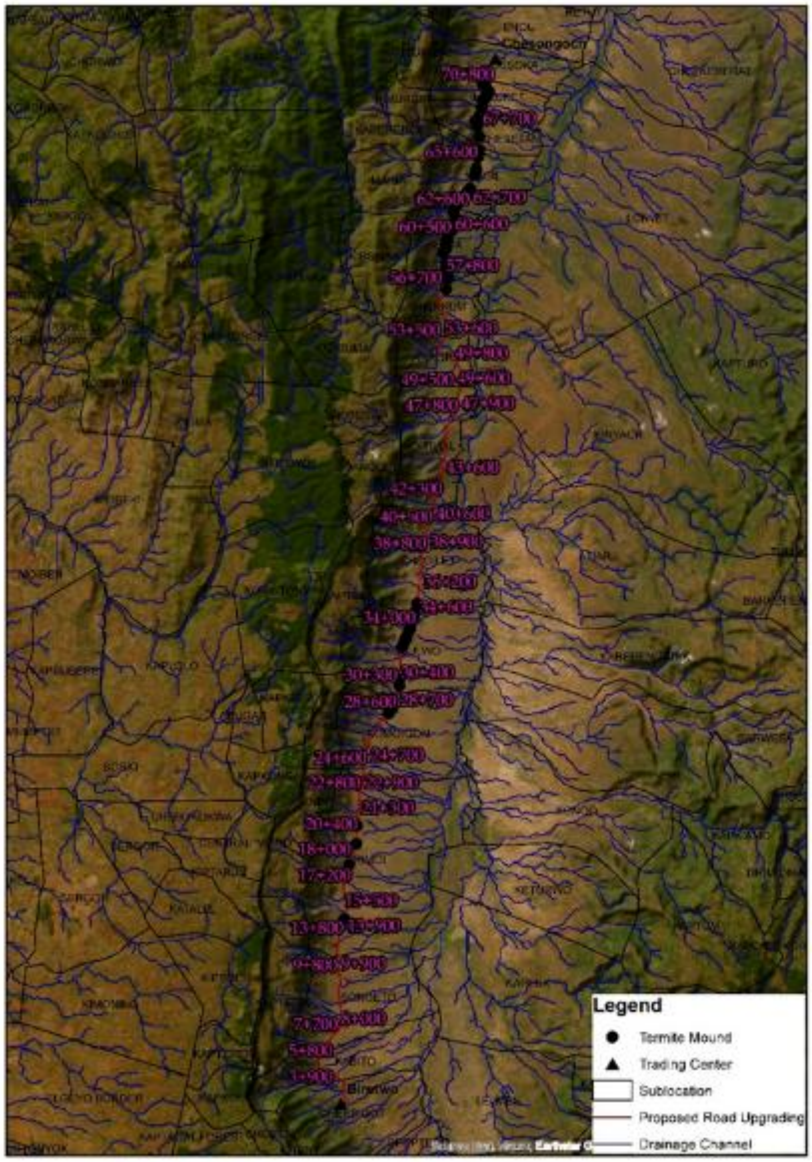


Figure 4-7 Areas with termites mound

4.2.2.6 Ecological Sensitivity Summary and Implications

The biological environment along the project corridor is modified but ecologically functional, with distinct spatial patterns of sensitivity. Key sensitive features identified include:

- River crossings and riparian zones, particularly along B126 (Km. 28+000 – 30+000);
- Elephant dispersal routes and associated HWC hotspots along B126;

- Mature Ficus sycomorus trees associated with drainage lines and stable slopes;
- Termite mound concentrations indicating stable and productive soils;
- Moist riverine and floodplain environments along B124 and B122.

4.2.3 Plant Diversity

4.2.3.1 Biretwo – Arror - Chesongoch Plants

This section is most strongly indicated by the dominance of disturbance-tolerant shrubs and invasive/exotic taxa typical of road edges, homesteads, fallows, and overgrazed sites. Asteraceae occur widely here as classic "pioneer" weeds that quickly colonize bare soils created by grading, borrow pits, and traffic, including *Ageratum conyzoides, Chromolaena odorata, Vernonia popeana, Xanthium strumarium,* and *Cirsium vulgare*. These species occur particularly in open sunny microsites, freshly disturbed soil, and along drainage outlets where sediment accumulates. Their ecology is linked to rapid seed production, wind dispersal, and strong competitive ability after disturbance, which make them early dominants following roadworks if topsoil is not managed.

Fabaceae occur as a major structural and functional family in this section, represented by dryland thorny trees and shrubs (Vachellia nilotica, V. seyal, V. etbaica, V. oerfota, V. hockii, V. elatior; Senegalia mellifera, S. senegal, S. laeta, S. brevispica) as well as herbaceous nitrogen-fixing pioneers (Crotalaria spp., Vigna spp., Sesbania keniensis, Senna obtusifolia, S. occidentalis, S. siamea). Woody acacias occur on well-drained soils, grazing lands, and savanna/wooded grassland edges where browsing pressure shapes regeneration, while Senna and Crotalaria occur in disturbed ground, fallows, and road verges. This family's ecological role is important for soil nitrogen inputs, forage/browse resources, and habitat structure, but it also includes aggressive invaders such as Prosopis juliflora, which form dense thickets, suppress understory plants, and alter water use and fire regimes if not controlled.

Apocynaceae in this section is strongly represented by drought-adapted, disturbance-tolerant shrubs (Calotropis procera, Calotropis gigantea), ornamental/escaped taxa (Catharanthus roseus), and succulent dryland taxa (Adenium obesum). These occur on hot exposed sites, shallow or compacted soils, and abandoned ground, and their latex and chemical defenses reduce herbivory, allowing them to persist as road-edge dominants. Where grazing is high and competing grasses are reduced, Calotropis often expand.

Cactaceae and Asparagaceae indicate dry, degraded, and frequently disturbed habitats. Opuntia spp. (O. elatior, O. ficus-indica, O. lasiacantha) and Agave (Agave angustifolia, A. sisalana) occur around homesteads, fences, and eroded slopes where their succulent physiology and vegetative propagation allow persistence. These taxa often increase following disturbance and should be treated as invasion-risk indicators along the corridor.

Solanaceae (*Solanum campylacanthum*, *S. hastifolium*, *S. villosum, S. scabrum*, S. *aculeastrum, Datura stramonium*) occur widely in disturbed soils, grazing lands, and farm margins, with some species being toxic or nuisance weeds. Their ecology is linked to bird-dispersed fruits and rapid colonization, meaning they expand following clearing unless revegetation is prompt.

Several wetland and riparian indicators in this broader section suggest local drainage-line habitats where water persists seasonally or permanently. Araceae (Pistia stratiotes) and Onagraceae (Ludwigia stenorraphe) occur in slow-moving water, pools, or swampy drains, while Vitaceae (Cissus quadrangularis, Cyphostemma adenocaule) occur on rocky slopes and thickets, often as climbers or succulent vines tolerant of dry conditions.

4.2.3.2 Nyaru – Kimwarer – Kapkayo Road Plants

This section is indicated by many dryland woody taxa and succulent/rocky-habitat plants, typical of warmer, more open vegetation where road widening create strong edge effects. Fabaceae again be dominant structurally through Vachellia and Senegalia spp., providing canopy and thorny thicket habitat. These woody legumes occur as scattered trees, bushland patches, and regeneration in grazed landscapes. Where Vachellia nilotica and V. seyal occur, they indicate heavier soils and drainage-line influence, while V. etbaica, V. oerfota, V. elatior, and Senegalia mellifera indicate drier bushland and more strongly disturbed grazing systems.

Asphodelaceae (*Aloe turkanensis, Aloe amicorum, Aloe tugenensis* listed as *Aloe archeri* in the genus/species columns) occur on rocky slopes, shallow soils, and well-drained ground. Their ecology is tightly linked to drought tolerance, slow growth, and specialized pollination, and they are vulnerable to physical removal, quarrying, and changes in runoff concentration that can cause localized erosion around rock habitats.

Selaginellaceae (*Selaginella kraussiana, S. yemensis, S. phillipsiana*) and bryophyte/liverwort components (Pottiaceae: Pseudocrossidium; Meteoriaceae: Papillaria; Ricciaceae: Riccia) suggest microhabitats with episodic moisture, shaded rock faces, seepage zones, or humid microsites near drainage lines and shaded gullies. These taxa are sensitive to dust deposition and hydrological changes; they decline where drainage is altered and fine sediments bury microhabitats.

Lamiaceae occur as aromatic herbs and *shrubs (Leucas hirundinaris, Premna resinosa, Plectranthus barbatus, Endostemon camporum, Ocimum spp.*). These plants typically occur in open woodland, rocky ground, and disturbed margins, often responding strongly to light availability and soil disturbance. They can be important for pollinators, and the family often rebounds after disturbance if soil is stable.

Rhamnaceae (*Ziziphus/Zizyphus spp., Lasiodiscus marmoratus*) occur in thickets and dry woodland edges, often on well-drained soils. *Ziziph*us shrubs/trees are important for birds and browsing mammals through fruit provision and thorny refuge structure, meaning their removal reduce food availability and nesting/roosting cover along the corridor.

Euphorbiaceae occur across dry and disturbed habitats (Euphorbia heterospina subsp. baringoensis; Euphorbia hirta; Acalypha; Tragia; Dalechampia; Ricinus communis). Many members are disturbance-adapted, with latex and chemical defenses that allow them to persist under grazing. Euphorbia and Ricinus frequently occupy eroding cut slopes and disturbed soil, acting as early colonizers but also indicating instability and degradation.

Poaceae form the matrix in open landscapes, with species such as *Hyparrhenia hirta, Loudetia simplex, Brachiaria ambigens, Melinis repens, Trisetopsis angusta,* and multiple “Gramineae” records. These grasses represent a mix of grazing-tolerant and disturbance-associated taxa; their ecological role is essential for soil cover, infiltration, and erosion control. Where grasses are removed and topsoil is lost, invasive forbs and shrubs increase rapidly.

4.2.3.3 Kimwarer – Emsea Road Plants

This section is indicated by the presence of families and genera characteristic of moister environments and forest/riverine systems. Podocarpaceae (Afrocarpus falcatus) strongly suggests highland or moist forest influence, typically occurring in cooler, wetter zones and often associated with remnant forest patches or planted/managed stands. This taxon is sensitive to fragmentation and edge effects; road widening increases drying at edges, introduce invasive weeds, and reduce regeneration if not buffered.

Orchidaceae (*Angraecum erectum, Polystachya adansoniae, Tridactyle furcistipes*) indicates specialized habitats such as moist woodland/forest edges, riverine trees, and shaded microhabitats. Orchids are highly vulnerable to habitat disturbance because they depend on specific microclimates and symbiotic fungi; dust, canopy opening, and tree removal will reduce their survival. Their occurrence implies that parts of this section retain higher structural complexity and microhabitat stability than the drier sections.

Rubiaceae (*Psychotria punctata, Anthospermum herbaceum, Heinsenia diervilleoides, Oxyanthus spp.*) is typical of understory shrubs and herbs in moist woodland and forest edges, and often indicates shaded habitats with more stable soils. These taxa decline where understory is cleared, drainage is redirected, or repeated maintenance keeps the verge open.

Annonaceae (Artabotrys spp., Lettowianthus stellatus) and Sapotaceae, Strombosiaceae (Strombosia), Violaceae (Rinorea brachypetala), Cannabaceae (Celtis), Rutaceae (Vepris nobilis, Vepris uguenensis, Zanthoxylum), Loganiaceae (Strychnos), Olacaceae and Icacinaceae all point to woodland/forest or riverine vegetation components. These families are associated with fruiting trees and lianas that support birds and mammals through food resources and cover, meaning their presence indicates habitat value beyond simple road-edge shrubland. Disturbance tend to simplify these habitats, replacing them with generalist weeds and grasses.

Balsaminaceae (Impatiens sodenii) and ferns (Aspleniaceae: Asplenium spp.; Pteridaceae: Aleuritopteris/cheilanthoid taxa) indicate moist shaded sites, seepage zones, and riparian edges. These occur where humidity remains relatively high and soils remain moist. Such habitats are particularly sensitive to altered drainage, increased sunlight exposure, and sedimentation; small changes in water routing can eliminate these microhabitats.

Aquatic and wet-riparian indicators (*Ludwigia stenorraphe*) further confirm that some areas in this section include slow water, stream margins, and wet drains. Where culverts, side drains, or diversions concentrate flow, these habitats shift upstream/downstream, causing loss at some points and new colonization at others, with knock-on effects for associated invertebrates and amphibians (even if not listed here).

4.2.4 Birds

4.2.4.1 Biretwo – Arror - Chesongoch Birds

Along the Biretwo–Chesongoch road section, woodland and bushland insectivores and generalists occur mainly where remnant shrubs, scattered trees, and rocky escarpment vegetation persist on slopes and along drainage lines. Muscicapidae are represented in woodland edges and rocky habitats where perches and shaded ground layers are available, particularly near escarpment faces and bushy road margins.

Cisticolidae are widespread in grassland–shrub mosaics and along disturbed road verges, reflecting variability in grass height and shrub density associated with grazing and cultivation. Macrosphenidae and Malaconotidae occur more locally in denser thickets and bush patches, especially where natural vegetation remains intact on steeper slopes or in less accessible areas. Dicruridae are relatively common due to their tolerance of disturbance, using exposed perches such as trees, fences, and utility poles along the road.

Seed-eaters and open-country birds dominate large portions of this section, particularly in farmland, grazing areas, and settlement zones. Estrildidae and Ploceidae are strongly associated with weedy margins, cultivated fields, and grasslands where seed availability fluctuates seasonally. Passeridae increase in abundance around homesteads and roadside activity, while Fringillidae and Emberizidae occur in open bushland and rocky grasslands where both seeds and insects are available.

Flower and nectar-feeding birds occur patchily along this section, mainly where flowering shrubs and trees are retained on slopes and around homesteads. Sunbirds track flowering phenology and are therefore sensitive to roadside clearing and vegetation removal, particularly on escarpment edges.

Fruit-dependent and large-tree-associated birds are relatively limited in this section due to the generally sparse distribution of mature trees. Where riverine strips or old woodland patches occur, Columbidae and occasional barbets may be present, but Musophagidae and Bucerotidae are less prominent, reflecting reduced canopy continuity.

Predators and scavengers are a conspicuous feature of this landscape. Accipitridae frequently exploit open slopes, escarpments, and grasslands for hunting, while using cliffs and large trees for nesting and roosting. Falconidae are associated with open airspace and rocky features, benefiting from the escarpment topography.

Water and riverine specialists are localized and occur mainly at stream crossings and valley bottoms. Kingfishers, wagtails, and occasional herons appear where surface water persists, but these assemblages are discontinuous and spatially restricted.

Open-air feeders and aerial guild species are strongly represented, particularly swifts and swallows that use cliffs, bridges, and open valleys for nesting and foraging. These birds exploit aerial insect abundance over escarpment slopes and cultivated fields.

Large terrestrial and savanna indicators such as guineafowl and francolins occur in open bushland and farmland margins, while ostrich presence, where recorded, reflects extensive open savanna conditions away from densely settled zones.


a)


b)


c)


d)


e)


f)

Plate 4-4: a) Pallid Harrier (Circus macrourus) (b) White-browed Coucal (Centropus superciliosus), (c) Black-headed Heron (Ardea melanocephala), (d) Common Fiscal (Lanius collaris), (e) Rüppell's starling (Lamprotornis purpuroptera), and (f) Red-cheeked

4.2.4.2 Nyaru – Kimwarer – Kapkayo Birds

The Nyaru–Kimwarer–Kapkayo road section supports a richer and more continuous assemblage of woodland and bushland insectivores and generalists due to greater retention of woody vegetation and riverine strips. Muscicapidae are widely distributed in woodland edges, forest margins, and shaded understorey habitats, indicating relatively intact vertical vegetation structure. Cisticolidae occur across grassland–shrub transitions and along forest edges, reflecting a mosaic of open and semi-closed habitats.

Macrosphenidae and Malaconotidae are well represented in dense thickets and riverine bush, where understorey complexity supports insect prey and nesting sites. Dicruridae remain common, particularly along woodland edges and semi-disturbed zones where open perches are abundant.

Seed-eaters and open-country birds are present but more spatially constrained than in the Biretwo–Chesongoch section. They occur mainly around farms, settlements, and cleared patches within the woodland matrix. Ploceidae and Estrildidae exploit seasonal seed availability, while Passeridae are associated with human habitation and infrastructure. Fringillidae and Emberizidae occur in open patches but are less dominant overall due to increased canopy cover.

Flower and nectar-feeding birds are a prominent component of this section, reflecting higher diversity and continuity of flowering trees and shrubs. Sunbirds are widely distributed in woodland, riverine forest edges, and forest–farm interfaces, contributing to pollination processes and responding quickly to changes in vegetation structure.

Fruit-dependent and large-tree-associated birds reach their highest representation in this section. Musophagidae, Columbidae, Ramphastidae, and Bucerotidae indicate the presence of mature trees, fruiting species, and nesting cavities. Hornbills and barbets, in particular, signal the ecological importance of retaining large trees and riverine corridors along this road.

Predators and scavengers occur throughout the section, with Accipitridae using open patches and woodland edges for hunting while nesting in tall trees or cliff features. Falconidae exploit open airspace along valleys and clearings, maintaining trophic balance within the system.

Water and riverine specialists are well represented along rivers and perennial streams. Kingfishers, herons, ibises, and wagtails occur along riparian zones, indicating relatively stable hydrological conditions and intact riverine vegetation. Open-air feeders such as swallows and swifts are common, nesting on bridges, buildings, and cliffs and foraging widely over woodland openings and watercourses.

Large terrestrial and savanna indicators occur mainly in more open peripheral zones, with guineafowl and francolins using woodland edges and cultivated margins.

a)

b)

c)

d)

e)

Plate 4-5: a) Grey Wagtail (Motacilla cinerea), b) Common Fiscal (Lanius collaris), c) Ring-necked Dove (Streptopelia capicola), d) Laughing Dove (Streptopelia senegalensis), and e) Speckled Mousebird (Colius striatus).

4.2.4.3 Kimwarer – Emsea Birds

The Kimwarer–Emsea section is ecologically distinct due to its association with valley bottoms, rivers, wetlands, and floodplain agriculture. Woodland and bushland insectivores and generalists occur primarily in narrow riparian strips and remnant bush patches. Muscicapidae and Malaconotidae are concentrated along riverine thickets, while Cisticolidae dominate grasslands and floodplain margins where vegetation structure varies seasonally. Macrosphenidae are restricted to denser riparian understorey habitats. Seed-eaters and open-country birds are abundant and widespread across floodplain farms, grasslands, and settlement areas. Estrildidae and Ploceidae exploit seasonal seed pulses in cultivated fields and wetlands, while Passeridae thrive around human activity. Fringillidae and Emberizidae occupy open grassland and farmland edges. Flower and nectar-feeding birds occur along riverbanks and homesteads where flowering plants persist, but their distribution is more linear and restricted compared to the Nyaru–Kapkayo section. Fruit-dependent and large-tree-associated birds are largely confined to riparian corridors, where mature trees provide fruit resources and nesting sites. Their presence highlights the ecological importance of maintaining these linear woodland strips within an otherwise open landscape. Predators and scavengers are common over open floodplains, with Accipitridae hunting over grasslands and wetlands and Falconidae exploiting open airspace. These species reflect high prey availability associated with wetland–agricultural mosaics. Water and riverine specialists form the dominant avifaunal group in this section. Kingfishers, herons, ibises, storks, ducks, hamerkop, and wagtails are strongly associated with rivers, wetlands, and floodplain habitats, indicating permanent or seasonal surface water and high aquatic productivity. Open-air feeders are abundant, with swallows and swifts foraging over wetlands, rivers, and cultivated land, often nesting on bridges and nearby structures. Large terrestrial and savanna indicators occur mainly in drier peripheral zones, while guineafowl and francolins use grassland and cultivated margins adjacent to wetlands.

4.2.5 Invertebrate Species

4.2.5.1 Biretwo – Arror - Chesongoch Invertebrate Species

The invertebrate assemblage along the Biretwo–Chesongoch section reflects a predominantly dry to semi-dry landscape characterised by open bushland, rocky slopes, escarpment vegetation, cultivated margins, and localized drainage lines. Butterfly families such as Nymphalidae and Papilionidae are well represented, particularly species of Charaxes, Junonia, Vanessa, Papilio, Danaus, and Belenois. At family level, Nymphalidae are strongly associated with woodland edges, bushland, and rocky habitats where larval host plants and adult nectar sources persist. Charaxes species are especially indicative of mature shrubs and trees and often signal the presence of remnant woody vegetation along escarpment slopes and less disturbed road margins. Papilionidae similarly indicate woodland and bushland mosaics, with adults frequently observed along open tracks and flowering roadside vegetation.

Hesperiidae, represented by Eagris, Celaenorrhinus, Borbo, and Eretis, are characteristic of grassland–bushland interfaces and shaded understorey environments. Their occurrence reflects patchy grass cover interspersed with shrubs, often along road verges and fallow agricultural land. Pieridae, including Belenois and Eurema, dominate more open and disturbed habitats, indicating grassland, farmland, and roadside clearings where herbaceous host plants are abundant.

Pollinator families such as Apidae and Halictidae are consistently present, with Apis, Amegilla, Lipotriches, and Xylocopa reflecting the availability of flowering plants in both natural and modified habitats. Their presence suggests that roadside vegetation, fallows, and homesteads provide important nectar and pollen resources. Syrphidae are diverse and abundant in this section, indicating open habitats with flowering plants and agricultural activity. At family level, syrphids are important pollinators and biological control agents, with larvae often associated with aphid-rich vegetation or decaying organic matter in moist microsites.

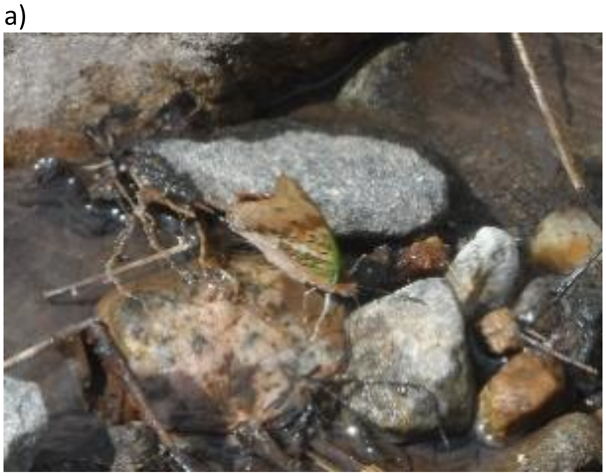
Agricultural and disturbance-associated insect families are also prominent. Tephritidae, represented by Dacus, Ceratitis, Parafreutreta, and Xanthorrachista, indicate cultivated areas and the presence of fruiting crops or wild host plants along farms and settlement zones. Pentatomidae and Reduviidae reflect agro-ecosystems and bushland environments, with predatory reduviids indicating functioning arthropod food webs.

Aquatic and semi-aquatic invertebrate families are limited but present where drainage lines occur. Bithyniidae, Planorbidae, and Raninidae reflect localized aquatic habitats such as streams, pools, and slow-flowing channels, while Culicidae indicate standing water in small pools, borrow pits, or poorly drained roadside depressions. Odonate families, including Libellulidae and Coenagrionidae, further reinforce the presence of temporary or permanent water bodies.

The invertebrate assemblage in this section reflects a dryland escarpment and agro-bushland system, with high representation of generalist butterflies, pollinators, agricultural pests, and disturbance-tolerant taxa, and localized aquatic indicators confined to drainage crossings.


a)


b)


c)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k)

l)

Plate 4-6: a) Butterflies gathered on the riverbank to puddle, b) Citrus Swallowtail (Papilio demodocus), c) Green-veined Charaxes (Charaxes candiope), d). African Blue Tiger (Tirumala petiverana), e) Guinea-fowl Butterfly (Hamanumida daedalus), f) Commo

4.2.5.2 Nyaru – Kimwarer – Kapkayo Invertebrate Species

The Nyaru–Kimwarer–Kapkayo corridor supports the most structurally complex invertebrate assemblage, reflecting greater habitat heterogeneity, including woodland, riverine vegetation, forest edges, and mixed farming systems. At family level, Nymphalidae are diverse and include several Charaxes species, which are strong indicators of mature woodland and forest-edge habitats. Their presence suggests continuity of woody vegetation and availability of larval host trees along this section. Junonia, Neptis, and Vanessa further reflect woodland clearings and semi-shaded habitats.

Papilionidae and Pieridae remain prominent, but their ecological signal differs from the drier sections. In this corridor, these families are more closely associated with woodland–farm interfaces, flowering shrubs, and riparian edges. Hesperiidae are well represented and indicate shaded grasslands, understorey vegetation, and forest margins, reinforcing the presence of structurally layered habitats.

Pollinator diversity is particularly high in this section. Apidae, Halictidae, and Syrphidae occur in large numbers, reflecting high floral diversity and resource continuity. Syrphidae are especially diverse at family level, indicating a mosaic of flowering plants, moist microhabitats, and agricultural systems that support both larval and adult stages. Their presence also signals ecological connectivity between natural vegetation and farmlands.

Predatory and soil-associated invertebrate families such as Formicidae, Reduviidae, and Laelapidae are more evident in this section, reflecting more complex trophic interactions and better-developed soil and litter layers. Ants of the family Formicidae indicate intact soil structure and resource availability, while mites in Laelapidae suggest functioning detrital and soil-faunal systems.

Aquatic and semi-aquatic invertebrate families are well represented due to the presence of rivers and perennial streams. Planorbidae and Bithyniidae indicate slow-moving or standing freshwater habitats, while Culicidae reflect shaded pools and vegetated water bodies. Odonate families are diverse and abundant, indicating good water quality and structurally complex riparian habitats.

Tephritidae remain present but are more evenly distributed across natural and cultivated habitats, reflecting a mix of wild host plants and agricultural crops. Their diversity in this section suggests a landscape where farming and natural vegetation coexist closely.

The invertebrate assemblage along the Nyaru–Kimwarer–Kapkayo section reflects a woodland–riverine–agricultural mosaic, with high diversity of forest-edge butterflies, pollinators, predators, soil fauna, and aquatic insects, indicating relatively high ecological integrity compared to the other road sections.


a)

b)

c)

d)

e)

f)

Plate 4-7: a) Green-Veined Charaxes (Charaxes candiope), b) Layman (Amauris albimaculata), c) Skimmer Dragonfly Family (Libellulidae), d) Potter Wap (Delta sp.), e) Tiny Grass Blue (Zizula hylax), and f) Round Winged Orange Tip (Colotis euippe).

4.2.5.3 Kimwarer – Emsea Invertebrate Species

The Kimwarer–Emsea section is strongly influenced by valley bottoms, rivers, wetlands, and floodplain agriculture, and this is clearly reflected in the invertebrate assemblage. Aquatic and semi-aquatic families dominate the ecological signal. Planorbidae, Bithyniidae, and Coenagrionidae indicate permanent or seasonal freshwater habitats such as rivers, streams, and wetlands. Libellulidae and other odonate families are particularly abundant and diverse, reflecting open water, emergent vegetation, and good sunlight penetration typical of riverine and floodplain systems.

Culicidae are common in this section, indicating standing water in floodplains, drainage channels, and agricultural landscapes. Their presence highlights the importance of water management and drainage in this corridor. Raninidae and other aquatic-associated taxa further reinforce the dominance of freshwater habitats.

Butterfly families such as Nymphalidae, Pieridae, and Papilionidae are present but are largely associated with riparian vegetation, wet grasslands, and cultivated margins rather than dry bushland or woodland. Danaus, Belenois, Eurema, and Junonia indicate open, sunlit habitats with abundant herbaceous vegetation and flowering plants along floodplain farms and riverbanks.

Pollinator families remain important, with Apidae and Syrphidae exploiting flowering crops, riparian vegetation, and fallow land. Syrphidae diversity suggests a strong link between wetland productivity, flowering plants, and biological control functions within agricultural systems.

Tephritidae are abundant in this section, reflecting intensive agriculture and the presence of fruiting crops and wild host plants in moist environments. Their high diversity indicates strong interactions between farming practices and invertebrate community composition.

Predatory and scavenging invertebrate families such as Formicidae, Reduviidae, and Noctuidae contribute to food-web structure and are associated with both natural wetlands and cultivated areas.

In summary, the Kimwarer–Emsea invertebrate assemblage reflects a wetland–riverine–floodplain agricultural system, dominated by aquatic insects, pollinators, and disturbance-associated taxa, with strong ecological dependence on water availability and riparian vegetation.

a) b) c) d)

Plate 4-8: a) African Common White (Belenois creona), b) Julia Skimmer (Orthetrum julia)

4.2.6 Mammal Diversity

4.2.6.1 Biretwo – Chesongoch Mammal Diversity

The mammal assemblage associated with the Biretwo–Chesongoch section reflects a predominantly dry to semi-arid escarpment and bushland landscape, with rocky slopes, open savanna, and scattered woodland. At family level, Bovidae dominate the ecological signal, particularly taxa associated with open grassland, bushland, and rocky terrain, including gazelle-like forms, small antelopes such as Madoqua, and mixed feeders such as Tragelaphus and Kobus. These groups indicate a landscape capable of supporting both grazing and browsing strategies, consistent with a mosaic of grasses, shrubs, and scattered trees. Within this open escarpment system, Elephantidae are also present and represent an important component of the large mammal assemblage, using this section as part of a wider dispersal and seasonal movement landscape rather than as a permanent residence area.

Elephant presence along the Biretwo–Chesongoch road section is closely linked to seasonal rainfall patterns and landscape drainage characteristics. During the wet season, elephants move into the upper escarpment and well-drained bushland areas where soils are firmer and forage availability improves, while avoiding waterlogged lowlands downstream. The open savanna interspersed with woody vegetation provides suitable browsing resources, and the escarpment terrain offers relatively dry movement routes that align with traditional elephant pathways. This seasonal use brings elephants into proximity with cultivated areas, particularly during periods when maize and other crops are present, contributing to crop damage but historically with limited escalation to severe human–wildlife conflict.

Equidae and Giraffidae, where present, further support the interpretation of open savanna and bushland with sufficient forage and visibility, conditions that are also compatible with elephant movement and foraging at a landscape scale.

Carnivore families such as Canidae, Felidae, and Hyaenidae indicate a functional trophic structure within open landscapes, relying on wide hunting ranges and relatively open terrain. The presence of Hyaenidae and large felids suggests the availability of medium to large herbivore prey, including both wild ungulates and, seasonally, elephants that shape vegetation structure and indirectly influence prey distribution through habitat modification.

Small mammal families including Muridae, Gliridae, Hystricidae, and Leporidae reflect rocky habitats, grasslands, and bushland soils, often associated with burrowing or crevice-using species. Procaviidae, including Procavia and Dendrohyrax, are particularly indicative of rocky escarpments and cliff faces, which are characteristic features of this road section and contribute to habitat heterogeneity alongside elephant-modified vegetation patches.

The mammal assemblage in the Biretwo–Chesongoch section reflects a dry escarpment–savanna system structured around open habitats, rocky refugia, and pastoral land use, with the presence of elephants highlighting the role of this corridor as a seasonal dispersal and movement zone for large megaherbivores within the broader landscape.

Plate 4-9: The African multimammate rat (Mastomys sp.)

4.2.6.2 Nyaru – Kimwarer – Kapkayo Mammal Diversity

The Nyaru–Kimwarer–Kapkayo corridor exhibits the highest ecological complexity in terms of mammal families, reflecting a landscape of woodland, riverine forest, forest edges, and mixed agriculture. Bovidae remain important but shift toward taxa associated with browsing and mixed feeding, including forest-edge and woodland antelopes such as Cephalophus, Tragelaphus, and Pseudotragus, indicating denser vegetation and greater vertical structure.

Cercopithecidae are particularly significant in this section, including genera such as Cercopithecus, Colobus, Chlorocebus, Papio, and Theropithecus. These primates are strongly associated with riverine forest, woodland canopies, forest edges, and gallery forests, and their presence indicates the availability of tall trees, continuous canopy patches, and reliable water sources. Colobus and Cercopithecus, in particular, signal relatively intact woody habitats and ecological connectivity along riparian corridors.

Elephantidae, including Loxodonta use of this landscape as a movement and foraging corridor linking woodlands and riverine systems. Their presence underscores the importance of large-scale connectivity and access to water and woody vegetation.

Bat families such as Pteropodidae, Hipposideridae, Rhinolophidae, Nycteridae, Molossidae, and Vespertilionidae are diverse, reflecting a structurally complex landscape offering roosting sites in trees, caves, riverbanks, and buildings, as well as abundant insect and fruit resources. Fruit bats of the family Pteropodidae indicate the presence of fruiting trees within woodland and riverine habitats.

Rodent diversity is also high, with Muridae, Nesomyidae, Cricetidae, and Spalacidae reflecting varied niches from forest floor and grassland to wetlands and burrowing systems. This diversity points to intact soil structure, litter layers, and vegetation heterogeneity.

In summary, the Nyaru–Kimwarer–Kapkayo section represents a woodland–riverine–forest edge system with strong signals of primates, large herbivores, bats, and diverse small mammals, indicating high ecological value and functional connectivity.

4.2.6.3 Kimwarer – Emsea Mammal Diversity

The Kimwarer–Emsea section is ecologically shaped by valley bottoms, rivers, wetlands, and floodplain systems, and this is clearly reflected in the mammal assemblage. Hippopotamidae are a defining family in this section, indicating permanent water bodies and slow-moving rivers. Semi-aquatic carnivores within Mustelidae, including otter-like taxa, further reinforce the dominance of aquatic and riparian habitats.

Suidae are prominent in this corridor, particularly Potamochoerus and related taxa, which are closely associated with riverine thickets, wetlands, floodplains, and agricultural mosaics. Their presence reflects dense cover, moist soils, and abundant food resources in riparian zones. Bovidae remain important but are dominated by species tolerant of wetter grasslands and floodplain environments, such as Kobus and Tragelaphus.

Primates, particularly Chlorocebus and Papio, are characteristic of this section, exploiting riverine vegetation, farms, and forest edges. Their adaptability reflects a landscape where natural habitats and human land use are closely interwoven. Rodent families such as Muridae, Nesomyidae, and

Thryonomyidae are strongly associated with wetlands, tall grasses, and floodplain agriculture, indicating high primary productivity and dense ground cover.

Bat diversity remains high, especially within Vespertilionidae and Pteropodidae, reflecting the abundance of insects, fruiting trees, and roosting sites near water. The presence of Orycteropodidae and Spalacidae indicates friable soils suitable for burrowing, often associated with moist floodplain conditions.

The Kimwarer–Emsea mammal assemblage reflects a riverine–wetland–floodplain system, dominated by water-dependent mammals, riparian specialists, and adaptable generalists, with strong sensitivity to hydrological changes and land-use modification.

Plate 4-10: Vervet Monkey (Chlorocebus pygerythrus)

4.2.7 Herpetofauna

4.2.7.1 Biretwo - Arror - Chesongoch Herpetofauna

The herpetofauna assemblage along the Biretwo–Chesongoch road section reflects a dry to semi-arid escarpment and bushland environment characterised by rocky slopes, shallow soils, open savanna, and limited surface water. Amphibian diversity in this section is dominated by families tolerant of temporary or seasonal water availability, particularly Bufonidae. Species within Amietophrynus and Poyntonophrynus are well adapted to arid and semi-arid conditions, breeding opportunistically in ephemeral pools formed after rainfall and surviving prolonged dry periods through burrowing or sheltering in rocky crevices. The presence of Ptychadenidae and Pyxicephalidae further reflects reliance on seasonal wetlands and rain-filled depressions rather than permanent aquatic systems.

Reptile families in this section strongly reflect open, rocky, and bushland habitats. Agamidae, including Agama species, are characteristic of rocky outcrops, road embankments, and open ground where basking opportunities are abundant. Scincidae and Lacertidae occupy grassland edges, rocky substrates, and disturbed roadside habitats with loose soils. Lamprophiidae and Colubridae are well represented and indicate structurally heterogeneous bushland with adequate prey availability, particularly small mammals and amphibians. Testudinidae, especially Stigmochelys pardalis, are typical of open savanna and bushland and reflect relatively undisturbed ground surfaces and forage availability. Varanidae, particularly *Varanus albigularis*, indicate dry woodland and savanna environments with sufficient prey and nesting opportunities in friable soils.

The herpetofauna of the Biretwo–Chesongoch section is indicative of a dry escarpment–savanna system, with species adapted to seasonal moisture, rocky refugia, and open basking habitats, and relatively low dependence on permanent water bodies.


a)


b)

Plate 4-11: a) Leopard Tortoise (Geochelone pardalis) and b) Nile Monitor (Varanus niloticus)

4.2.7.2 Nyaru – Kimwarer – Kapkayo Herpetofauna

The Nyaru–Kimwarer–Kapkayo corridor supports the highest ecological diversity of herpetofauna, reflecting a mosaic of woodland, riverine habitats, wetlands, and forest edges. Amphibian families such as Hyperoliidae, Phrynobatrachidae, Pipidae, and Ptychadenidae are strongly represented, indicating the presence of permanent or semi-permanent water bodies, swampy margins, and moist microhabitats. Hyperolius and Kassina species are closely associated with vegetated wetlands and grassland–water interfaces, while Xenopus species are fully aquatic and signal permanent water bodies such as rivers, ponds, and dams.

Reptile diversity in this section reflects both arboreal and aquatic habitat availability. Chamaeleonidae, including Chamaeleo and Trioceros, indicate structurally complex vegetation with shrubs and trees suitable for arboreal movement and foraging. Colubridae and Lamprophiidae show high diversity, reflecting a range of microhabitats from forest edges and thickets to open woodland. Natricidae and Pelomedusidae are closely linked to rivers, wetlands, and slow-moving waters, indicating strong hydrological connectivity.

The presence of *Varanus niloticus* highlights the importance of large river systems and riparian corridors in this section. Testudinidae and Trionychidae further reinforce the role of stable soils and aquatic habitats along floodplains. Typhlopidae indicate well-developed soils and leaf litter layers, while Viperidae such as Causus resimus are associated with moist grasslands and forest edges.

This assemblage characterises the Nyaru–Kimwarer–Kapkayo section as a key herpetofaunal zone driven by water availability, vegetation complexity, and habitat connectivity.

4.2.7.3 Kimwarer – Emsea Herpetofauna

The Kimwarer–Emsea road section is dominated by riverine, wetland, and floodplain environments, and this is clearly reflected in the herpetofauna composition. Amphibian families with strong aquatic affinities, including Pipidae, Ptychadenidae, Phrynobatrachidae, and Hyperoliidae, are prominent and indicate permanent water bodies, marshes, and seasonally flooded grasslands. Species of Xenopus and Ptychadena are particularly indicative of standing and slow-moving waters, while Phrynobatrachus species reflect moist ground and shallow wetland margins.

Reptile families in this section show a strong aquatic and riparian signal. Varanidae, especially *Varanus niloticus*, are closely associated with rivers and wetlands. Natricidae and Pelomedusidae further emphasise the importance of aquatic habitats, while Trionychidae indicate soft substrates and deeper water bodies. Colubridae and Lamprophiidae remain present but are largely associated with riparian vegetation, floodplain grasslands, and cultivated areas near water.

Testudinidae persist in drier patches within the floodplain mosaic, while Scincidae and Gekkonidae occupy disturbed areas, farms, and settlement edges. The occurrence of Typhlopidae and burrowing reptiles reflects moist, friable soils typical of floodplain environments.

The Kimwarer–Emsea herpetofauna assemblage represents a water-dependent riverine and wetland system that is highly sensitive to hydrological alteration, drainage modification, and changes in floodplain connectivity.

4.2.8 Ficus sycomorus Distribution along Biretwo – Arror - Chesongoch Road

The distribution of *Ficus sycomorus* along the Biretwo–Chesongoch road corridor reflects both its ecological requirements and its long-standing role as a keystone species in dryland and escarpment ecosystems. This species is ecologically adapted to environments with reliable sub-surface moisture, deep alluvial or colluvial soils, and relative long-term landscape stability. Its presence along the corridor therefore marks zones of sustained ecological function, particularly along drainage lines, mid-slopes, and stable interfluves.

From Biretwo trading center through Chesigot and Kabito sublocations, approximately between chainage 0+000 and 6+000, Ficus sycomorus occurs as isolated, mature individuals close to drainage lines and lower mid-slope positions. Ecologically, these trees indicate locations where soil moisture persists below the surface even during the dry season. Their extensive root systems access deep groundwater and bind soil layers, reducing erosion along drainage margins. In this intensively used agro-pastoral landscape, these trees function as refugia for biodiversity, providing shade, nesting sites, and a dependable fruit source that supports birds, bats, and small mammals when other resources are scarce.

Between Songeto and Rimo sublocations, roughly from chainage 7+000 to 13+000, the occurrence of Ficus sycomorus becomes more frequent and spatially coherent. Trees in this section are positioned near ephemeral and seasonal drainage features that recharge during the rainy season but remain relatively dry at the surface. Ecologically, Ficus sycomorus is known for asynchronous fruiting, meaning individual trees may bear fruit at different times of the year. This trait makes them particularly valuable for sustaining frugivorous bird communities across seasons, contributing to seed dispersal and maintaining broader vegetation diversity in the surrounding landscape.

A notable concentration of Ficus sycomorus is observed between chainage 13+000 and 17+000 within Songeto and Rimo sublocations. Here, trees are located on well-drained mid-slopes and stable soils, conditions that allow the species to reach large sizes and long lifespans. Ecologically, these large figs act as structural habitat features, supporting nesting raptors, cavity-nesting birds, and diverse insect assemblages. Their fallen fruits and leaf litter enrich surrounding soils, enhancing nutrient cycling and promoting localized patches of higher vegetation productivity.

Between chainage 21+000 and 24+000, within Anin and Komoigon sublocations, Ficus sycomorus is strongly associated with drainage crossings and moisture-retaining slope breaks along the road alignment. The presence of mature individuals in this section reflects decades of uninterrupted growth, suggesting relative stability of these microhabitats despite surrounding land use. Ecologically, fig trees are well documented as keystone food resources in African landscapes, providing critical forage for birds, primates, ungulates, and bats. In this corridor, they likely support both resident and migratory bird species, especially during periods when other fruiting trees are absent.

From Komoigon through Kobulwo and Chegilet sublocations, approximately between chainage 24+000 and 36+000, Ficus sycomorus becomes more scattered but remains consistently tied to riparian corridors and gentle slope transitions. In these areas, the trees contribute to bank stabilization and regulation of microclimates along drainage lines. Their dense canopies reduce evapotranspiration and moderate temperature extremes, creating favourable conditions for understory vegetation and soil organisms. This ecological function enhances overall landscape resilience, particularly during prolonged dry periods.

A further cluster of Ficus sycomorus occurs between chainage 37+000 and 40+000 within Chegilet and Koitilial sublocations. These trees occupy mid-slope zones that remain relatively dry and stable during the rainy season, aligning with known wildlife movement routes. Ecologically, figs often act as focal points for animal activity, drawing birds and mammals that in turn facilitate seed dispersal of other plant species. This process supports vegetation regeneration and maintains ecological connectivity across fragmented habitats.

Between chainage 49+000 and 51+000, within Aror sublocation, Ficus sycomorus is present near drainage convergence zones and gently sloping terrain. Here, the trees serve as important dry-season refuges and feeding sites for wildlife moving away from wetter valley bottoms. Their ability to withstand periodic drought while maintaining fruit production underscores their role as a stabilising ecological element in variable climatic conditions.

Further north, from Resim through Mogil, Chesetan, Kukei, Kisoka, and toward Chesongoch trading center, approximately between chainage 51+000 and 70+800, Ficus sycomorus occurrences are fewer and largely restricted to well-established drainage systems. Increased human activity and land modification in this section appear to limit regeneration, making existing trees particularly important. Ecologically, the loss of mature fig trees in such landscapes can result in disproportionate declines in bird and wildlife diversity, given their keystone status.

The distribution of Ficus sycomorus along the Biretwo–Chesongoch corridor highlights areas of sustained moisture availability, soil stability, and ecological continuity. As a keystone species, Ficus sycomorus supports complex food webs, enhances soil fertility, stabilises drainage systems, and provides critical habitat for a wide range of species. Protecting these trees during road upgrading is therefore essential to maintaining ecosystem function, biodiversity, and ecological resilience along the corridor.

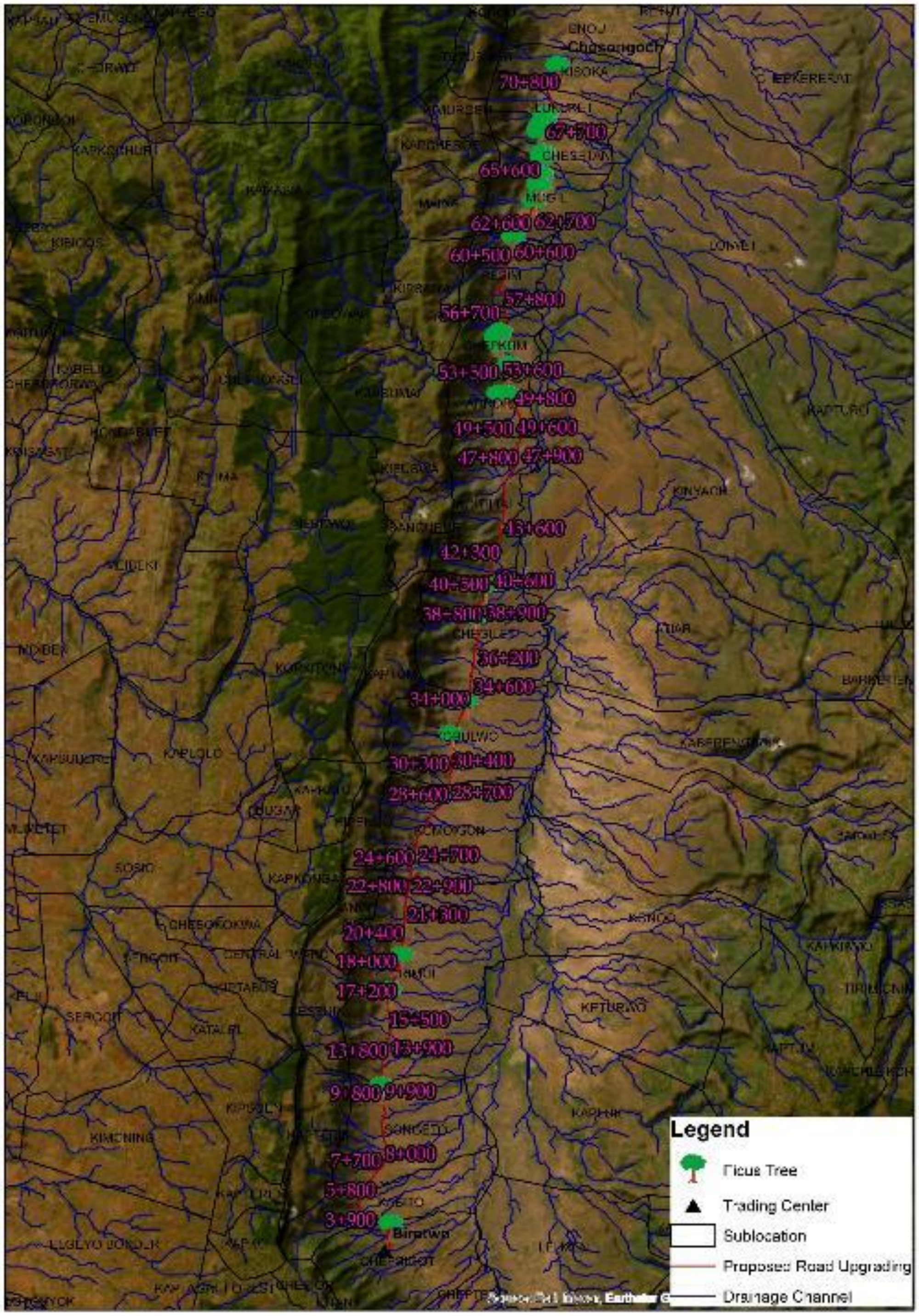


Figure 4-8: Ficus sycomorus Distribution along Biretwo – Arror - Chesongoch Road

4.2.9 Termite Habitat along Biretwo – Arror - Chesongoch Road

The distribution of termite mounds along the Biretwo–Chesongoch road corridor shows a clear spatial pattern linked to terrain position, soil drainage, and vegetation structure, making termites a useful ecological indicator of relatively stable, well-drained environments along the escarpment landscape. Termite mounds are not evenly distributed along the alignment but occur in distinct clusters that correspond with specific chainage sections and sublocations.

Plate 4-12:Termite mound (Macrotermes sp.) nest with tall open-chimney for venting heat generated by colony, in the lowland semi-arid sections of Biretwo-Arror-Chesongoch road

From Biretwo trading center through Chesigot and Kabito sublocations, approximately between chainage 0+000 and 6+000, termite mounds are sparse and largely absent. This section lies close to wetter valley bottoms and areas with higher drainage density, where soils are periodically waterlogged during the rainy season. Such conditions are generally unfavourable for long-term mound construction, as excessive soil moisture disrupts termite nest stability and ventilation.

Termite mound occurrence increases gradually from Songeto through Rimo sublocations, roughly between chainage 7+000 and 13+000. In this section, mounds begin to appear on gently sloping ground and mid-slope positions where soils are better drained and less prone to seasonal saturation. The presence of termite mounds here indicates improved soil aeration and relatively stable surface conditions compared to downstream low-lying areas.

A notable concentration of termite mounds is observed between chainage 13+000 and 17+000 within Songeto and Rimo sublocations. These mounds are primarily located on interfluves and upper mid-slopes adjacent to the road alignment. The soils in this zone are well-drained and structurally stable, supporting long-term termite colonies. Ecologically, this reflects an environment with moderate disturbance, sufficient organic matter input from surrounding vegetation, and limited prolonged flooding.

Between chainage 21+000 and 24+000, within Anin and Komoigon sublocations, termite mound density increases further and forms a distinct belt parallel to the road. This area corresponds with relatively dry ridges and gently undulating terrain that remains firm during the rainy season. Termite presence here suggests soils with good infiltration capacity and sustained sub-surface moisture balance, conditions that also make these areas attractive to elephants during wet periods. The coincidence of termite mounds and elephant movement corridors highlights the role of termites as indicators of dry-season refugia and structurally resilient landscapes.

From Komoigon through Kobulwo and Chegilet sublocations, approximately between chainage 24+000 and 36+000, termite mounds remain frequent but are unevenly distributed. They tend to cluster on convex slope positions and away from active drainage channels. This spatial pattern indicates termite avoidance of areas prone to concentrated runoff and erosion, and preference for stable ground where vegetation cover supports continuous organic inputs.

A particularly strong presence of termite mounds is recorded between chainage 37+000 and 40+000 within Chegilet and Koitilial sublocations. In this section, mounds are aligned along mid-slope zones that form transitional areas between steep upstream escarpment faces and gentler downstream terrain. Ecologically, this reflects zones of long-term soil stability, where erosion rates are low enough to allow mound persistence over decades. These areas often support more productive grassland and shrubland vegetation, enhanced by termite-driven soil mixing and nutrient cycling.

Between chainage 49+000 and 51+000, within Aror sublocation, termite mounds occur in well-defined clusters on gently sloping, well-drained ground east of the road alignment. Their presence here indicates relatively dry soil conditions during the rainy season and limited surface waterlogging. This aligns with local observations that both wildlife and livestock favour these areas during wet periods, reinforcing the role of termites as indicators of favourable habitat conditions.

Further north, from Resim through Mogil, Chesetan, Kukei, and toward Chesongoch trading center, approximately between chainage 51+000 and 70+800, termite mounds remain present but become more dispersed. Their distribution follows ridgelines and upper slope positions rather than valley bottoms, reflecting increasing aridity and reduced organic input toward the northern sections. Near Chesongoch, mound density decreases where human activity and land disturbance are higher, suggesting sensitivity of termite colonies to intensive land use.

Termite mounds along the Biretwo–Chesongoch corridor function as reliable ecological indicators of well-drained soils, long-term surface stability, and moderate disturbance regimes. Their spatial coincidence with dry mid-slope zones, elephant dispersal routes, and relatively productive vegetation highlights their role in shaping ecosystem processes such as soil formation, nutrient cycling, and vegetation structure. Areas with high termite mound density therefore represent ecologically resilient landscapes that warrant careful consideration during road upgrading, as disturbance to these zones could disproportionately affect soil function and habitat quality.

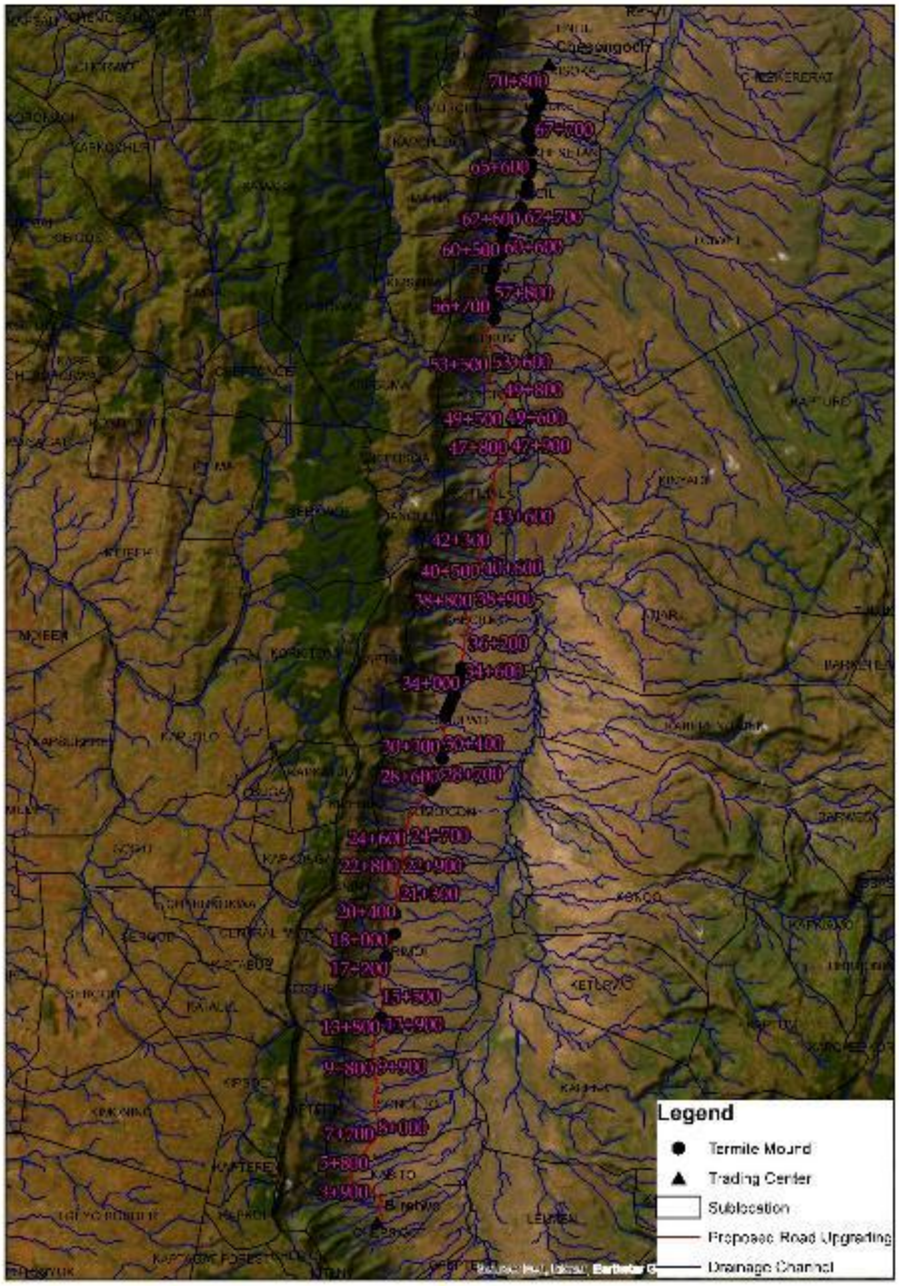


Figure 4-9: Termite Habitat along Biretwo – Arror - Chesongoch Road

Mitigation Measures

Termite habitats within the Biretwo–Chesongoch corridor represent a critical ecological component of the semi-arid landscape, functioning as ecosystem engineering systems that regulate soil structure, enhance water infiltration, and influence vegetation distribution patterns. Termite mounds are long-lived and spatially stable features that depend on well-drained soils and relatively undisturbed conditions. Road upgrading activities are unlikely to remove termite habitats solely through direct clearing; however, they can significantly degrade habitat suitability through indirect mechanisms such as soil compaction, alteration of surface runoff pathways, and increased erosion. These changes can extend beyond the immediate road footprint, particularly where drainage systems concentrate water flows or where heavy machinery disturbs mound clusters, resulting in broader landscape-level impacts on termite populations.

High-risk areas for termite habitat disturbance have been identified along chainages 13+000–17+000 (Songeto–Rimo), 21+000–24+000 (Anin–Komoigon), 37+000–40+000 (Chegilet–Koitilial), and 49+000–51+000 (Aror), where mound densities are likely to be higher and where terrain and soil conditions favour termite activity. In these zones, mitigation measures should aim to preserve mound integrity, maintain natural soil processes, and prevent hydrological disruptions that could destabilise termite colonies.

To minimise direct disturbance, mound-dense areas should be avoided when locating construction camps, spoil disposal sites, borrow pits, and material storage areas. Site selection for these facilities should be guided by pre-construction ecological surveys to identify and map termite mound clusters, ensuring that high-density areas are excluded from intensive use. This approach should reduce the risk of widespread physical destruction of mound systems and preserve key ecological functions.

Drainage design within these chainage sections should prioritise the dispersion of runoff rather than concentration. Drainage outlets should be configured to spread water over broader areas using energy dissipation structures such as level spreaders, stone pitching, or vegetated outlets. Direct discharge of concentrated flows onto termite mound fields should be avoided, as this can lead to mound erosion, waterlogging of soils, and collapse of colony structures. Maintaining diffuse flow patterns will help preserve the well-drained conditions required for termite survival.

Large termite mounds located within approximately 20 metres of the road corridor should be identified and designated as no-disturbance micro-sites during construction. These mounds should be physically demarcated and protected from machinery movement, excavation, and material deposition. Their preservation is important not only for maintaining termite populations but also for sustaining the microhabitats and soil heterogeneity they create, which support a range of plant and animal species.

Rehabilitation of disturbed areas should focus on restoring soil conditions that are suitable for termite recolonisation and activity. Salvaged topsoil should be carefully stripped, stored, and reapplied to maintain soil microbial communities and organic content. Revegetation should utilise native grass species and locally adapted vegetation to stabilise soils, reduce erosion, and recreate the conditions necessary for termite mound re-establishment over time. Avoidance of excessive soil compaction during rehabilitation should be emphasised, as compacted soils can limit termite activity and reduce infiltration capacity.

In addition, construction practices within high-risk areas should minimise repeated heavy machinery movement, particularly outside designated working zones, to reduce unnecessary soil compaction. Where temporary access tracks are required, these should be rehabilitated promptly after use to restore soil structure and ecological function.

Mitigation measures for termite habitats should adopt a landscape-scale perspective, recognising that termite systems operate beyond individual mounds and are closely linked to soil and hydrological processes. By avoiding disturbance in mound-dense areas, maintaining diffuse drainage patterns, protecting key mound structures, and restoring soil conditions after construction, the proposed measures should preserve termite-mediated ecosystem functions and reduce the risk of cascading ecological impacts across the Biretwo–Chesongoch corridor.

4.2.10 Elephant Dispersal Areas along Biretwo – Arror - Chesongoch Road

Elephant dispersal along the Biretwo–Arror–Chesongoch road corridor is strongly influenced by seasonal rainfall patterns, topography, slope stability, drainage conditions, vegetation structure, and ecological connectivity associated with the escarpment landscape adjoining Rimoi National Reserve. The dispersal system forms part of a broader landscape-level ecological network linking Rimoi National Reserve on the western side of the Keiyo River with Kapnarok National Reserve and surrounding community grazing and woodland areas on the eastern side. Although the Keiyo River creates a major topographic and hydrological barrier in some locations, elephants continue to utilise crossing zones, escarpment slopes, ridges, and relatively well-drained movement pathways that maintain functional connectivity between these protected and community-managed ecosystems. This connectivity is ecologically important because it supports seasonal movement, access to forage and water resources, genetic exchange, and broader ecosystem resilience across the escarpment landscape.

During the rainy season, particularly between May and July, elephants are reported to move out of Rimoi National Reserve and disperse eastwards and southwards across the road alignment, selectively using relatively well-drained and less waterlogged terrain. These movements are most evident along sections of the road located near the escarpment break and within moderately sloping areas with good surface drainage. The movement behaviour demonstrates the importance of terrain stability, vegetation productivity, and hydrological conditions in shaping wildlife distribution and habitat use patterns within the project landscape.

From Biretwo trading centre through Chesigot and Kabito sublocations, approximately between chainage 0+000 and 6+000, elephant movement is limited and largely transient. Although this section lies near the southern extent of the wider dispersal system, high drainage density and localised wet conditions during the rainy season appear to discourage prolonged elephant occupancy. Movements within this zone are primarily associated with passage rather than feeding or temporary habitat use.

Elephant dispersal becomes more pronounced further north through Songeto, Rimo, and Anin sublocations, approximately between chainage 6+000 and 20+000. In this section, elephants are frequently observed crossing the road from the western side while moving away from wetter downstream areas toward relatively drier and gently sloping terrain east of the alignment. Seasonal cultivation of maize fields within these areas coincides with increased elephant movement and feeding activity, contributing to recurrent human–elephant conflict incidents during the rainy season. The ecological conditions within this zone therefore create both important foraging habitat and conflict-sensitive interfaces between wildlife and agricultural land use.

Between Komoigon and Kobulwo sublocations, approximately chainage 20+000 to 30+000, the road corridor intersects a major elephant dispersal route linking Rimoi National Reserve, the Keiyo River ecosystem, Kapnarok National Reserve landscapes, and adjacent community lands. This area is characterised by moderate slopes, relatively well-drained soils, scattered woodland vegetation, and reduced drainage saturation compared to lower downstream valley bottoms. During sustained rainfall periods, elephants preferentially utilise these drier ridges and mid-slope areas while avoiding waterlogged depressions and saturated drainage corridors. The ecological functionality of this landscape therefore depends not only on habitat availability but also on the maintenance of movement connectivity across the escarpment system.

Further north through Chegilet, Koitilial, Sangurur, and Aror sublocations, approximately between chainage 30+000 and 50+000, elephant dispersal is frequent and spatially consistent. Multiple known crossing points occur where elephants move eastwards across the road alignment following topographic routes that provide relatively firm ground during wet periods. These movement pathways correspond with areas of moderate slope, lower drainage convergence, and relatively intact vegetation structure. The persistence of these crossing areas indicates that they represent established ecological corridors and functional dispersal routes that are likely to remain important throughout the operational life of the road project.

From Resim through Mogil, Chesetan, Kukei, Kisoka, and up to Chesongoch trading centre, approximately between chainage 50+000 and 70+800, elephant dispersal continues but becomes increasingly localised and terrain-dependent. Movements in this section are associated with drier upper slopes and interfluves, particularly where the road alignment runs parallel to drainage systems rather than directly intersecting valley bottoms. During periods of intense rainfall, elephants appear to avoid poorly drained downstream plains and instead utilise elevated and relatively stable terrain as movement routes and temporary refuge areas.

The elephant dispersal system described above is directly relevant to the biodiversity indices and ecosystem sensitivity discussions presented in Section 4.2.13 because areas supporting repeated elephant movement also tend to exhibit elevated ecological functionality, vegetation heterogeneity, woodland persistence, and ecosystem connectivity. These areas contribute significantly to habitat integrity, landscape resilience, and ecosystem service provision within the broader escarpment ecosystem. Consequently, the dispersal zones identified in this baseline section correspond closely with the sensitive ecological areas discussed in the Impact Assessment sections, particularly in relation to habitat fragmentation, wildlife movement disruption, road mortality risk, vegetation disturbance, hydrological alteration, and increased human–wildlife conflict.

The ecological importance of the Rimoi–Kapnarok linkage across the Keiyo River therefore has direct implications for project planning, impact assessment, and biodiversity mitigation design. Road upgrading activities within identified dispersal and crossing zones may increase habitat fragmentation, restrict wildlife movement, alter drainage conditions, and intensify wildlife–vehicle interactions if not appropriately managed. Consequently, these sections require targeted mitigation measures including protection of key crossing points, maintenance of ecological connectivity, minimisation of vegetation clearance within sensitive movement corridors, installation of fauna-friendly drainage and crossing structures, speed-calming measures, warning signage, and long-term biodiversity monitoring. These mitigation and monitoring requirements are further elaborated within the Impact Assessment and Biodiversity Management Plan sections of this report.

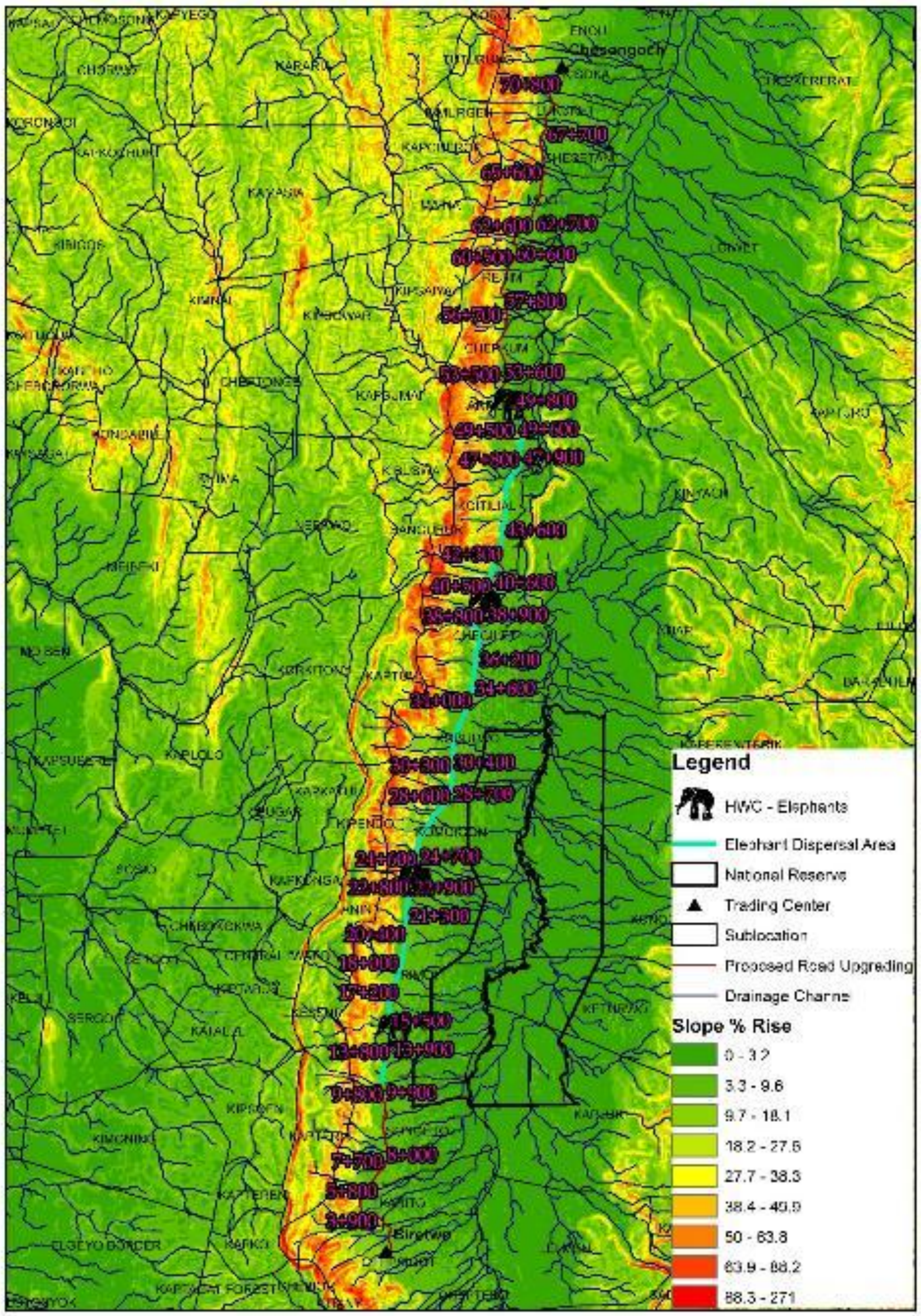


Figure 4-10: Elephant Dispersal Area along Biretwo – Arror - Chesongoch Road

4.2.11 Human Wildlife Conflict Areas along Biretwo – Arror - Chesongoch Road

Human–wildlife conflict along the Biretwo–Chesongoch road corridor is spatially concentrated in specific chainage sections where elephant dispersal routes intersect cultivated land on relatively dry, well-drained terrain during the rainy season. Based on field mapping, community accounts, and the elephant crossing analysis, the most affected sections are between chainage 13+000–17+000, 21+000–24+000, 37+000–40+000, and 49+000–51+000. These areas consistently experience crop damage during the May–July period when maize is present, although no loss of human life has been recorded.

Between chainage 13+000 and 17+000, within Songeto and Rimo sublocations, human–elephant conflict is recurrent and seasonal. This section lies immediately east of the escarpment edge, where elephants cross the road from Rimoi National Reserve and move onto mid-slope agricultural land. During the rainy season, downstream valley bottoms become wet and muddy, prompting elephants to favour the relatively dry, gently sloping maize fields along this section. The concentration of smallholder farms close to established elephant movement paths results in repeated crop raiding incidents, particularly at night.

The section between chainage 21+000 and 24+000, largely within Anin and Komoigon sublocations, represents one of the most pronounced HWC hotspots along the corridor. Here, the road cuts across a key dispersal route connecting the Reserve to surrounding agro-pastoral landscapes. The terrain consists of well-drained slopes and interfluves that remain firm during periods of high rainfall. Maize cultivation is common in this zone during the long rains, making it highly attractive to elephants moving out of wetter downstream areas. Crop damage in this section is frequent and spatially concentrated, with elephants repeatedly using the same crossing points across seasons.

Between chainage 37+000 and 40+000, within Chegilet and Koitilial sublocations, human–elephant conflict is closely linked to the interaction of slope and drainage patterns. This section lies along a transition zone where steep upstream catchments discharge toward gentler downstream land. During the rainy season, elephants avoid saturated drainage corridors and instead move along drier ridges and mid-slopes adjacent to the road. These routes coincide with cultivated plots, particularly maize fields established on well-drained soils, resulting in localized but persistent crop damage. The predictability of elephant movement in this section makes it a key area of concern.

The section between chainage 49+000 and 51+000, within Aror sublocation, forms another significant HWC hotspot. This area lies close to a convergence of elephant dispersal paths and cultivated land on relatively dry terrain. During periods of sustained rainfall, elephants moving away from wetter lowland areas cross the road at this point and access maize fields situated on gentle slopes. Although settlement density is lower than in southern sections, the presence of seasonal crops within established movement corridors leads to repeated crop losses during the May–July period.

These four chainage sections represent the core human–elephant conflict zones along the Biretwo–Chesongoch road corridor. They share common characteristics: proximity to elephant dispersal routes from Rimoi National Reserve, relatively dry and well-drained terrain during the rainy season, and the presence of maize cultivation during peak elephant movement periods. These sections should therefore be prioritised for targeted mitigation measures, including early-warning systems, community crop-protection strategies, and road-related interventions that account for predictable elephant crossings.

4.2.12 Vehicle-Wildlife Collision along Biretwo-Arror-Chesongoch Road

Wildlife–vehicle collisions are a major ecological impact of road infrastructure, occurring when animals attempt to cross roads that fragment their natural habitats. These collisions result in substantial wildlife mortality, particularly among large mammals with wide movement ranges, as well as reptiles and birds that use road surfaces for basking, feeding, or scavenging. In many landscapes, roadkill constitutes one of the most significant human-induced causes of wildlife deaths, disproportionately affecting slow-moving species and those with low reproductive rates (van der Ree et al., 2015; Grilo et al., 2020).

Upgrading roads from gravel pavement to tarmac further intensifies collision risks by allowing higher vehicle speeds, increasing traffic volumes, and enabling continuous day-and-night use. Improved surfaces reduce driver reaction time and increase collision severity, while enhanced night-time traffic elevates risks for crepuscular and nocturnal species. Tarmac surfaces also retain heat, attracting reptiles, and road widening, vegetation clearing, and drainage improvements increase habitat fragmentation and wildlife crossing frequency, thereby amplifying mortality rates (Rytwinski et al., 2016; van der Ree et al., 2015).

Temporal factors compound these impacts, as wildlife–vehicle collisions vary by both season and time of day. Collision rates often peak at dusk, night, and dawn when many mammals are most active and driver visibility is reduced. Wet seasons further increase risk through heightened wildlife movement and poor driving conditions, while dry seasons attract animals to roadside resources and warm road surfaces. The interaction between upgraded road characteristics, seasonal wildlife behavior, and night-time or low-light conditions can therefore substantially elevate collision risk unless time-specific mitigation measures are implemented (Ascensão et al., 2019; Grilo et al., 2020).

Plate 4-13: Road kill of a Spotted Owl flying low while returning from morning hunt with a rodent prey

4.2.13 Biodiversity Indices

4.2.13.1 Plants

Plant communities along the project corridor showed high taxonomic diversity and ecological heterogeneity, with 137 taxa, Shannon diversity index (H’) of 4.228, Simpson diversity index (1−D) of 0.967, and evenness (J) of 0.859. These values indicate a highly diverse flora with low species dominance, although several disturbance-associated and invasive species strongly influence vegetation composition and ecosystem condition.

The flora is characterised by invasive and disturbance-tolerant species such as *Opuntia elatior*, *Prosopis juliflora*, *Calotropis procera*, *Calotropis gigantea*, *Lantana camara*, *Chromolaena odorata*, and *Solanum campylacanthum*, indicating ecological disturbance, land degradation, and increasing invasion pressure within parts of the corridor. These species are particularly associated with disturbed roadside areas, grazing lands, and settlement interfaces where they may suppress native vegetation regeneration and alter habitat quality.

At the same time, the vegetation contains ecologically important native woody species including *Acacia nilotica* subsp. *subalata*, *Acacia mellifera* subsp. *mellifera*, and *Acacia senegal* var. *senegal*, which contribute to soil stabilisation, nitrogen fixation, browse provision, carbon storage, and habitat structure. Succulent and xeromorphic taxa such as *Aloe turkanensis*, *Aloe tugenensis*, *Aloe amicorum*, *Caralluma acutangula*, *Caralluma arachnoidea*, and *Huernia keniensis* further indicate the presence of specialised rocky and dryland microhabitats of elevated ecological sensitivity.

The vegetation assemblage includes invasive shrubs and cacti, dryland trees and shrubs, grasses, succulents, climbers, forbs, and disturbance-responsive herbs, reflecting strong ecological variability across the landscape. These vegetation patterns align with the broader ecosystem discussions presented in preceding sections, particularly the riparian systems, escarpment habitats, woodland patches, and elephant dispersal corridors associated with the Rimoi–Kapnarok ecosystem linkage across the Keiyo River. Areas with relatively intact woody vegetation and higher habitat heterogeneity are therefore likely to support greater faunal diversity, ecological connectivity, and ecosystem resilience.

From an ESIA perspective, the biodiversity indices and vegetation patterns identified in this section are directly relevant to the Impact Assessment and Biodiversity Management Plan sections because they highlight ecologically sensitive areas vulnerable to vegetation loss, habitat fragmentation, invasive species spread, erosion, and disruption of ecological connectivity. Consequently, mitigation measures should prioritise selective vegetation clearing, protection of sensitive rocky and riparian habitats, conservation of native woody vegetation, invasive species containment, rehabilitation using native dryland species, erosion control, and long-term biodiversity monitoring during construction and operation phases.

Taxa	Richness (S)	Shannon (H’)	Simpson (1−D)	Evenness (J)
Plants	137	4.228	0.967	0.859
Invertebrates	71	4.007	0.972	0.940
Birds	392	5.484	0.994	0.918
Mammals	73	3.337	0.933	0.778
Reptiles	37	3.329	0.953	0.922
Amphibians	16	1.854	0.742	0.669
Herpetofauna combined	53	3.152	0.905	0.794
Multi-taxa overall	726	5.911	0.996	0.897

4.2.13.2 Invertebrates

4.2.13.2 Invertebrates

The invertebrate dataset recorded 71 taxa, with a Shannon diversity index (H’) of 4.007, Simpson diversity index (1−D) of 0.972, and a high evenness value (J) of 0.940, indicating a highly balanced and functionally diverse assemblage. High evenness within the invertebrate community suggests the absence of dominance by a few outbreak species and reflects relatively broad ecological functionality across the landscape.

The assemblage included syrphid flies, fruit flies, butterflies, bees, mosquitoes, ants, assassin bugs, and other ecologically important insect groups. Prominent taxa included *Melanostoma infuscatum*, *Asarkina eremophila*, *Apis mellifera*, *Belenois creona*, *Eagris sabadius astoria*, *Papilio demodocus*, *Papilio rex*, *Nezara viridula*, *Odontomachus haematodus*, and several *Dacus* and *Ceratitis* species. These taxa collectively represent multiple ecological functions including pollination, herbivory, predation, decomposition, flower visitation, and pest activity.

Taxonomic uniqueness is particularly evident within the butterfly assemblage, including *Papilio rex*, *Charaxes eupale latimargo*, *Charaxes druceanus obscura*, and *Aphnaeus jefferyi*, which indicate habitat heterogeneity and the presence of ecologically sensitive Lepidoptera supported by woodland, riparian, and edge habitats. The abundance of *Dacus* and *Ceratitis* species is also important because it directly links biodiversity patterns with agro-ecological productivity and crop pest management within surrounding agricultural landscapes.

These findings align with the broader ecosystem discussions presented in earlier sections, particularly those relating to riparian vegetation, woodland structure, escarpment habitats, and vegetation heterogeneity associated with the Rimoi–Kapnarok ecosystem linkage across the Keiyo River. Areas with diverse vegetation structure and intact edge habitats are likely to support higher invertebrate diversity, pollination services, trophic interactions, and ecosystem resilience.

From an ESIA perspective, the invertebrate biodiversity indices are directly relevant to the Impact Assessment and Biodiversity Management Plan because they identify ecologically important habitats vulnerable to vegetation clearing, habitat simplification, pesticide exposure, invasive species spread, and reduction of floral and host-plant resources. Consequently, mitigation measures should prioritise conservation of edge vegetation, maintenance of floral diversity, protection of host plants, minimisation of unnecessary pesticide use, rehabilitation using native flowering species, and long-term monitoring of pollinator and butterfly communities. Given the coexistence of pollinators such as *Apis mellifera* alongside crop-associated fruit flies, mitigation should emphasise ecological intensification and integrated pest management rather than reliance on chemical control alone.

4.2.13.3 Birds

Birds were the richest taxonomic group recorded, with 392 species, Shannon diversity index (H′) of 5.484, Simpson diversity index (1−D) of 0.994, and evenness (J) of 0.918. These values indicate an exceptionally species-rich and ecologically balanced avifaunal assemblage associated with a heterogeneous landscape containing multiple habitat types, vegetation strata, and trophic opportunities.

Frequently recorded species included *Pycnonotus barbatus*, *Lamprotornis purpuroptera*, *Plocepasser mahali*, *Dicrurus adsimilis*, *Terpsiphone viridis*, *Streptopelia capicola*, *Uraeginthus bengalus*, *Colius striatus*, *Turtur chalcospilos*, and *Eurocephalus ruppelli*, reflecting a mosaic of shrubland, wooded edges, open habitats, riparian systems, and human-modified landscapes. Ecological and taxonomic distinctiveness is further demonstrated by species such as *Bucorvus abyssinicus*, *Balearica regulorum*, *Apaloderma narina*, *Poicephalus meyeri*, *Bycanistes subcylindricus*, and raptors including *Buteo augur*, *Aquila rapax*, and *Circaetus* species, which indicate the presence of structurally complex habitats and relatively intact ecological functions.

Functionally, the avifauna includes insectivores, granivores, nectarivores, frugivores, scavengers, and predators, demonstrating a highly interconnected trophic system. These bird diversity patterns align with the broader ecosystem discussions presented in preceding sections, particularly the woodland patches, riparian corridors, escarpment habitats, and ecological connectivity associated with the Rimoi–Kapnarok ecosystem linkage across the Keiyo River. Areas with structurally diverse woody vegetation and intact riparian habitats are therefore likely to support elevated avifaunal diversity, nesting habitat availability, and ecological resilience.

From an ESIA perspective, the high bird diversity and habitat heterogeneity indicate that the project area is sensitive to vegetation removal, nesting disturbance, habitat fragmentation, noise impacts, and degradation of wooded and riparian habitats. Consequently, mitigation measures should prioritise retention of structurally diverse vegetation, protection of riparian and nesting habitats, minimisation of prolonged disturbance in ecologically sensitive areas, and scheduling of vegetation clearance outside peak breeding periods where feasible. Additional mitigation attention should focus on habitats likely to support hornbills, cranes, parrots, raptors, and other disturbance-sensitive species through targeted habitat protection, restoration, and long-term avifaunal monitoring during construction and operational phases.

4.2.13.4 Mammals

The mammal assemblage recorded 73 taxa, with a Shannon–Wiener diversity index (H′) of 3.337, Simpson's diversity index (1−D) of 0.933, and Pielou's evenness (J) of 0.778. These values indicate moderate species diversity with relatively higher dominance compared to birds, reptiles, and invertebrates, suggesting that while species richness is substantial, certain adaptable or generalist taxa exert stronger ecological influence within the landscape.

Representative species included *Cercopithecus mitis*, *Colobus guereza*, *Chlorocebus aethiops*, *Atilax paludinosus*, *Bdeogale jacksoni*, *Epomophorus minor*, *Epomophorus labiatus*, *Scotoecus hirundo*, *Scotophilus dinganii*, *Myotis tricolor*, *Rhinolophus eloquens*, *Nycteris hispida*, *Tachyoryctes ruddi*, *Procavia capensis*, and *Xerus rutilus*. These species reflect a functionally diverse mammalian community spanning arboreal, terrestrial, insectivorous, frugivorous, omnivorous, and small predator guilds.

The mammal assemblage indicates a heterogeneous landscape composed of woody vegetation, open habitats, rocky refugia, riparian systems, and drainage-linked habitats. Primates such as *Cercopithecus mitis* and *Colobus guereza* indicate structurally complex arboreal habitats, while bat species including *Scotoecus hirundo*, *Scotophilus dinganii*, and *Myotis tricolor* reflect productive insect communities and the availability of suitable roosting habitats. Small mammals and rodents further indicate habitat complexity, soil integrity, and microhabitat diversity. These patterns align with broader ecological signals observed in the bird, invertebrate, and reptile assemblages, particularly within woodland, riparian, escarpment, and ecologically connected habitats associated with the Rimoi–Kapnarok ecosystem linkage across the Keiyo River.

The relatively lower evenness within the mammal community suggests localized dominance by some disturbance-tolerant or adaptable species, potentially reflecting anthropogenic influence, habitat modification, or uneven resource distribution within parts of the corridor. Nevertheless, the assemblage demonstrates the importance of habitat connectivity, vegetation structure, and resource availability in maintaining ecological function and faunal diversity across the project landscape.

From an ESIA perspective, these findings are directly relevant to the Impact Assessment and Biodiversity Management Plan because mammals are particularly vulnerable to habitat fragmentation, vegetation clearance, disturbance, road mortality, and disruption of movement corridors. Mitigation measures should therefore prioritise protection of riparian and woody corridors, maintenance of ecological connectivity, minimisation of habitat fragmentation, reduction of noise and artificial lighting near roosting and foraging habitats, and conservation of key microhabitats such as mature trees, rocky outcrops, and drainage systems. These measures will support mammal diversity while reinforcing broader ecosystem functions and cross-taxa biodiversity conservation objectives identified throughout the ESIA.

4.2.13.5 Reptiles

The reptile dataset contained 37 taxa, with H′ = 3.329, 1−D = 0.953, and J = 0.922, indicating a fairly diverse and very even reptile assemblage for the number of records available. Frequently occurring taxa include *Crotaphopeltis hotamboeia*, *Hemidactylus angulatus*, *Trioceros bitaeniatus*, *Lycophidion capense*, *Agama lionotus*, *Causus resimus*, *Trachylepis quinquetaeniata*, *Duberria lutrix*, *Dasypeltis scabra*, and *Varanus niloticus*. This combination points to a habitat mosaic containing open basking spaces, rocky refugia, moist microhabitats, edge habitats, and wetland-associated or drainage-associated zones. Taxonomic distinctiveness is visible in species such as *Trioceros bitaeniatus*, which signals structurally complex vegetation, and *Stigmochelys pardalis*, which adds a large-bodied terrestrial reptile component. Ecologically, the reptile assemblage spans insectivores, egg-eaters, small-vertebrate predators, aquatic-edge users, and generalist lizards. For ESIA interpretation, reptiles are especially sensitive to microhabitat loss through clearing, compaction, rock removal, and drainage alteration. Mitigation should therefore include retaining rock piles and coarse shelter features where safe, minimizing unnecessary stripping of edge vegetation, protecting drainage-line vegetation, and designing works to reduce mortality in areas used by monitors, chameleons, tortoises, and snakes.

4.2.13.6 Amphibians

The reptile assemblage recorded 37 taxa, with a Shannon diversity index (H′) of 3.329, Simpson diversity index (1−D) of 0.953, and evenness (J) of 0.922, indicating a moderately diverse and highly even reptile community. The assemblage reflects a heterogeneous habitat mosaic comprising open basking areas, rocky refugia, structurally complex vegetation, moist microhabitats, edge habitats, and drainage-associated or wetland-linked environments.

Frequently recorded species included *Crotaphopeltis hotamboeia*, *Hemidactylus angulatus*, *Trioceros bitaeniatus*, *Lycophidion capense*, *Agama lionotus*, *Causus resimus*, *Trachylepis quinquetaeniata*, *Duberria lutrix*, *Dasypeltis scabra*, and *Varanus niloticus*. Taxonomic distinctiveness is evident in species such as *Trioceros bitaeniatus*, which indicates structurally diverse vegetation and relatively intact habitat complexity, while *Stigmochelys pardalis* contributes an important large-bodied terrestrial reptile component. Functionally, the reptile assemblage includes insectivores, egg-eaters, small vertebrate predators, aquatic-edge users, and habitat generalists, demonstrating diverse trophic interactions and ecological roles.

These reptile diversity patterns align with broader ecosystem characteristics described in earlier sections, particularly woodland patches, rocky escarpments, riparian habitats, drainage systems, and ecologically connected habitats associated with the Rimoi–Kapnarok ecosystem linkage across the Keiyo River. The occurrence of habitat-sensitive reptiles further indicates the importance of microhabitat diversity, vegetation structure, and intact refuge sites in maintaining biodiversity within the project landscape.

From an ESIA perspective, reptiles are particularly vulnerable to microhabitat disturbance caused by vegetation clearing, soil compaction, rock removal, drainage alteration, and increased road mortality. Consequently, mitigation measures should prioritise retention of rocky shelter features where safe, minimisation of unnecessary edge vegetation removal, protection of drainage-line and riparian vegetation, and implementation of measures to reduce mortality of monitors, chameleons, tortoises, and snakes during construction and operation. These actions will help maintain habitat integrity, ecological connectivity, and broader ecosystem functions identified across other faunal groups within the ESIA.

4.2.13.7 Herpetofauna (Reptiles + Amphibians)

When reptiles and amphibians are combined, the herpetofaunal assemblage records 53 taxa, with a Shannon diversity index (H’) of 3.152, Simpson diversity index (1−D) of 0.905, and evenness (J) of 0.794. These values indicate a moderately diverse assemblage with lower evenness than reptiles alone, largely due to the dominance of wet-associated amphibian species such as *Amietophrynus regularis*. The combined herpetofaunal dataset is ecologically important because it captures both structural and hydrological habitat quality across the project landscape.

Key indicator species include *Amietophrynus regularis*, *Xenopus laevis*, *Phrynobatrachus acridoides*, *Ptychadena mascareniensis*, *Crotaphopeltis hotamboeia*, *Hemidactylus angulatus*, *Trioceros bitaeniatus*, and *Varanus niloticus*. Amphibians primarily reflect moisture availability, hydroperiod stability, drainage condition, and water quality, while reptiles are more strongly associated with structural cover, basking areas, rocky refugia, and vegetation complexity. Together, these taxa indicate a landscape mosaic containing riparian systems, drainage-linked habitats, rocky microhabitats, edge vegetation, and structurally heterogeneous dryland environments.

The herpetofaunal patterns align with the broader ecosystem discussions presented in preceding sections, particularly those relating to riparian habitats, drainage systems, escarpment environments, woodland structure, and ecological connectivity within the Rimoi–Kapnarok ecosystem linkage across the Keiyo River. Their occurrence therefore reinforces the ecological importance of maintaining hydrological integrity, habitat heterogeneity, and microhabitat connectivity across the project corridor.

From an ESIA perspective, herpetofauna provide one of the most sensitive early-warning indicators of microhabitat degradation, drainage disruption, vegetation simplification, soil disturbance, and water-quality decline. Consequently, mitigation measures should prioritise protection of drainage-line and riparian vegetation, minimisation of unnecessary vegetation clearing and soil compaction, retention of rocky shelter features where feasible, maintenance of natural drainage connectivity, and reduction of construction-related mortality in habitats used by amphibians, chameleons, tortoises, monitors, and snakes. Long-term monitoring of herpetofaunal communities should also be incorporated into the Biodiversity Management Plan to assess ecosystem condition and habitat recovery during construction and operational phases.

4.2.14 Multi-Taxa Integrated Biodiversity

Across all cleaned datasets, the combined assemblage recorded 726 taxa, with a Shannon diversity index (H’) of 5.911, Simpson diversity index (1−D) of 0.996, and evenness (J) of 0.897, indicating exceptionally high biodiversity and strong cross-taxa balance. This integrated biodiversity pattern is driven largely by highly diverse bird and plant communities but is ecologically reinforced by the coexistence of woody dryland vegetation, invasive and disturbance-associated flora, pollinators, crop-associated invertebrates, diverse bird assemblages, bats, primates, reptiles, and amphibians.

Important cross-taxa indicators include *Prosopis juliflora* and *Opuntia elatior* as signals of vegetation transformation and ecological pressure; *Apis mellifera* as a key pollination species; *Pycnonotus barbatus*, *Lamprotornis purpuroptera*, and *Buteo augur* as indicators of trophic structure and habitat heterogeneity; *Cercopithecus mitis* and *Colobus guereza* as indicators of arboreal and structurally complex habitats; and *Amietophrynus regularis* together with *Xenopus laevis* as indicators of hydrological integrity and wet habitat condition.

The combined biodiversity patterns indicate a heterogeneous landscape containing woodland patches, riparian systems, rocky escarpments, open dryland habitats, drainage-linked environments, and human-influenced areas. These patterns align with broader ecosystem discussions presented in preceding sections, particularly ecological connectivity associated with the Rimoi–Kapnarok ecosystem linkage across the Keiyo River. The coexistence of multiple trophic and functional groups demonstrates the importance of vegetation structure, habitat heterogeneity, hydrological integrity, and ecological connectivity in sustaining biodiversity and ecosystem resilience within the project landscape.

From an ESIA perspective, the integrated biodiversity results indicate that the project area contains both high ecological value and localized ecological pressure associated with disturbance, invasive species expansion, habitat modification, and fragmentation. Consequently, mitigation measures should prioritise maintenance of ecological connectivity, protection of riparian and woody habitats, invasive species management, minimisation of unnecessary vegetation clearance, restoration using native dryland species, protection of hydrological systems, and long-term biodiversity monitoring across taxa to maintain ecosystem integrity and ecological function throughout project implementation and operation.

4.2.15 Functional Diversity and Ecological Roles Across Taxa

The table below presents a functional perspective of biodiversity within the study area by linking major taxa to their ecological roles and representative species. Beyond species richness, it highlights how different organisms contribute to ecosystem processes, structure, and resilience, providing a broader ecosystem-based understanding of biodiversity within the project landscape.

Plant communities include dryland woody legumes, grasses, succulents, herbs, climbers, and invasive shrubs and cacti. Species such as *Acacia nilotica* subsp. *subalata* and *Acacia mellifera* subsp. *mellifera* contribute to nitrogen fixation, soil stabilisation, browse provision, and habitat structure, while grasses such as *Hyparrhenia hirta* support grazing systems. Climbers like *Cissus quadrangularis* enhance structural complexity, whereas invasive species such as *Prosopis juliflora* and *Opuntia elatior* indicate ecological pressure and vegetation transformation. Overall, plant functional diversity reflects adaptation to semi-arid conditions and forms the ecological foundation for higher trophic levels.

Invertebrate communities include pollinators, herbivores, predators, decomposers, and pest-associated taxa. Pollinators such as *Apis mellifera* and *Amegilla atrocincta* support plant reproduction, while species such as *Dacus bivittatus* and *Ceratitis venusta* influence agricultural productivity and pest dynamics. Predatory taxa including *Odontomachus haematodus* contribute to ecological regulation and food-web balance. These functions demonstrate the importance of invertebrates in pollination, nutrient cycling, decomposition, and ecosystem stability.

Bird assemblages perform multiple ecological functions including insect control, seed dispersal, pollination, scavenging, granivory, and predation. Species such as *Dicrurus adsimilis* contribute to insect regulation, *Plocepasser mahali* influences seed dynamics, and frugivores such as *Poicephalus meyeri* facilitate seed dispersal. Nectarivores such as *Cinnyris venustus* support pollination processes, while raptors including *Buteo augur* occupy upper trophic levels and indicate ecosystem health. Wetland-associated species such as *Balearica regulorum* further reflect hydrological and habitat diversity within the landscape.

Mammals encompass a broad range of ecological roles including seed dispersers, herbivores, insectivores, carnivores, and trophic regulators. Primates such as *Cercopithecus mitis* and *Colobus guereza* contribute to seed dispersal and arboreal ecosystem dynamics, while bats such as *Scotoecus hirundo* regulate insect populations. Rodents including *Praomys jacksoni* influence soil processes and vegetation dynamics, whereas carnivores such as *Bdeogale jacksoni* contribute to prey regulation. Herbivores such as *Tragelaphus spekii* shape vegetation structure through grazing and browsing.

Reptiles function as predators, grazers, basking specialists, and indicators of habitat complexity. Species such as *Agama lionotus* and *Trioceros bitaeniatus* reflect vegetation structure and microhabitat quality, while snakes such as *Crotaphopeltis hotamboeia* and larger reptiles like *Varanus niloticus* contribute to predation and nutrient cycling. Tortoises such as *Stigmochelys pardalis* further influence vegetation structure through grazing activity.

Amphibians are strongly associated with water availability, drainage condition, and habitat moisture. Species such as *Xenopus laevis* and *Ptychadena mascareniensis* depend on aquatic and seasonal wet habitats, making them important indicators of hydrological integrity and environmental quality. Their sensitivity to drainage alteration and moisture changes highlights their importance in assessing ecosystem condition.

These functional diversity patterns align with broader ecosystem discussions presented in preceding sections, particularly woodland habitats, riparian systems, escarpment environments, drainage-linked habitats, and ecological connectivity associated with the Rimoi–Kapnarok ecosystem linkage across the Keiyo River. The coexistence of multiple trophic and functional groups demonstrates a structurally complex and ecologically resilient landscape where key ecosystem processes such as pollination, seed dispersal, predation, decomposition, grazing, and nutrient cycling remain active.

From an ESIA perspective, the high functional diversity across taxa indicates that biodiversity management should not focus solely on species protection but also on maintaining ecological processes and ecosystem functionality. Consequently, mitigation measures should prioritise maintenance of ecological connectivity, protection of riparian and woody habitats, invasive species management, minimisation of habitat fragmentation, protection of drainage systems and microhabitats, restoration using native species, and long-term biodiversity monitoring to sustain ecosystem integrity and resilience throughout project implementation and operation.

Table 4-3: high functional diversity across taxa

Taxa	Functional groups represented	Examples
Plants	dryland woody legumes, invasive shrubs/cacti, succulents, herbs/forbs, grasses, climbers	Acacia nilotica subsp. subalata, Acacia mellifera subsp. mellifera, Prosopis juliflora, Opuntia elatior, Aloe turkanensis, Hyparrhenia hirta, Cissus quadrangularis
Invertebrates	pollinators, flower visitors, herbivores/pests, predators, decomposer-linked taxa	Apis mellifera, Amegilla atrocincta, Melanostoma infuscatum, Dacus bivittatus, Ceratitis venusta, Odontomachus haematodus, Nezara viridula
Birds	insectivores, granivores, frugivores, nectarivores, raptors, wetland-associated species	Dicrurus adsimilis, Plocepasser mahali, Poicephalus meyeri, Cinnyris venustus, Buteo augur, Balearica regulorum
Mammals	primates, bats, rodents, carnivores, insectivores, small/medium herbivore-associated taxa	Cercopithecus mitis, Colobus guereza, Scotoecus hirundo, Praomys jacksoni, Bdeogale jacksoni, Crocidura montis, Tragelaphus spekii
Reptiles	basking lizards, arboreal reptiles, snakes, monitors, tortoises	Agama lionotus, Trioceros bitaeniatus, Crotaphopeltis hotamboeia, Varanus niloticus, Stigmochelys pardalis
Amphibians	aquatic frogs, puddle breeders, toads, seasonal wetland indicators	Xenopus laevis, Ptychadena mascareniensis, Tomopterna cryptotis, Amietophrynus regularis

4.2.16 Indicator species matrix

The table below presents indicator species identified from the dataset and links them to specific ecological conditions, habitat characteristics, and environmental pressures within the study area. Indicator species provide important insight into ecosystem condition because they reflect underlying ecological processes, habitat quality, hydrological integrity, and disturbance dynamics beyond simple species occurrence.

Within plant communities, species such as *Prosopis juliflora* and *Opuntia elatior* indicate invasive spread, vegetation transformation, and ecological disturbance associated with altered grazing pressure and land-use change. In contrast, *Aloe turkanensis* and *Aloe tugenensis* indicate the persistence of specialised rocky and xeric habitats where natural environmental conditions remain relatively intact. Native woody species including *Acacia nilotica* subsp. *subalata* and *Acacia senegal* var. *senegal* reflect stable dryland vegetation structure and contribute to soil stabilisation, browse availability, and ecosystem functionality. Together, these indicators reveal a landscape containing both ecological resilience and localized disturbance pressure.

Invertebrate indicators reflect key ecological processes and agro-ecological interactions. *Apis mellifera* indicates functional pollination networks and the availability of flowering resources, while *Dacus* and *Ceratitis* species indicate agricultural influence and potential pest pressure within cultivated landscapes. These taxa demonstrate the dual role of invertebrates in supporting ecosystem services while also signalling disturbance and land-use interactions.

Bird indicators provide insight into trophic structure, habitat continuity, and hydrological conditions. Raptors such as *Buteo augur* indicate a functioning prey base and relatively intact trophic structure, while *Balearica regulorum* reflects the presence and sensitivity of wetland and seasonally moist habitats. Species such as *Poicephalus meyeri* and *Bycanistes subcylindricus* indicate woody habitat continuity and structurally complex vegetation, reinforcing the importance of woodland and riparian habitats in maintaining avifaunal diversity.

Mammal indicators further highlight the importance of vegetation structure and habitat connectivity. Arboreal primates such as *Cercopithecus mitis* and *Colobus guereza* indicate relatively intact tree cover and woodland structure, while bats including *Scotoecus hirundo* and *Scotophilus dinganii* reflect productive insect communities and suitable roosting habitats. These relationships demonstrate strong ecological linkages between vegetation structure, invertebrate abundance, and mammalian diversity.

Reptile indicators provide insight into microhabitat quality and environmental stability. *Trioceros bitaeniatus* is associated with intact shrub and tree structure as well as stable microclimatic conditions, while *Varanus niloticus* reflects the integrity of wetland and drainage-edge habitats. Amphibian indicators such as *Xenopus laevis* and *Ptychadena mascareniensis* are strongly associated with aquatic and seasonal wet habitats and therefore indicate hydrological integrity and water availability. In contrast, *Amietophrynus regularis* reflects greater tolerance to disturbance and variable environmental conditions.

These indicator species patterns align closely with broader ecosystem discussions presented in preceding sections, particularly woodland habitats, riparian systems, escarpment environments, drainage-linked habitats, and ecological connectivity associated with the Rimoi–Kapnarok ecosystem linkage across the Keiyo River. The coexistence of sensitive habitat specialists alongside invasive and disturbance-tolerant species demonstrates a landscape containing both high ecological value and areas under ecological pressure.

From an ESIA perspective, the indicator species framework provides an important basis for impact assessment, biodiversity monitoring, and adaptive management. The findings highlight the need to maintain habitat heterogeneity, ecological connectivity, riparian integrity, woody vegetation structure, and hydrological stability while controlling invasive species expansion and minimizing habitat disturbance. Consequently, mitigation measures should prioritise protection of sensitive habitats, maintenance of ecological corridors, restoration using native species, invasive species management, and long-term biodiversity monitoring using indicator taxa to track ecosystem condition and ecological change during project implementation and operation.

Table 4-4: Indicator species from dataset

Taxa	Indicator species from dataset	What it indicates
Plants	Prosopis juliflora	Invasion pressure, vegetation transformation
Plants	Opuntia elatior	Invasive spread, disturbed dryland habitat
Plants	Aloe turkanensis / Aloe tugenensis	Specialized rocky/xeric microhabitats
Plants	Acacia nilotica subsp. subalata / Acacia senegal var. senegal	Dryland woody structure, browse, soil stabilization
Invertebrates	Apis mellifera	Pollination function, flowering resource availability
Invertebrates	Dacus spp. / Ceratitis spp.	Agro-ecological pest pressure, fruit resource linkage
Birds	Buteo augur	Trophic structure, prey base
Birds	Balearica regulorum	Wetland/seasonally moist habitat sensitivity
Birds	Poicephalus meyeri / Bycanistes subcylindricus	Woody habitat continuity
Mammals	Cercopithecus mitis / Colobus guereza	Arboreal habitat quality, tree cover continuity
Mammals	Scotoecus hirundo / Scotophilus dinganii	Flying insect prey base, roost/edge habitat continuity
Reptiles	Trioceros bitaeniatus	Shrub/tree structure, microclimate stability
Reptiles	Varanus niloticus	Wetland/drainage edge integrity
Amphibians	Xenopus laevis / Ptychadena mascareniensis	Aquatic and seasonal water persistence
Amphibians	Amietophrynus regularis	Widespread disturbance-tolerant wet-season response

4.3 Social and Economic Baseline Conditions

4.3.1 Overview

This section looks at the social economic terrain of the project areas, focusing on a wider scope at the County level providing linkages across different socio-economic sectors that provides key inputs and insight on the economic aspect of the project area and not ignoring the region (North Rift region) and its neighbouring counties that plays a major role in the socio-economic distribution of key aspect toward the project. The section will focus on the demographic, economic activities, settlement patterns, water and sanitation, education, health and safety, gender issues, Security and Land Tenure and Use patterns characteristics among other cross cutting issues within the project area and the region as a whole with a respect to providing a picture of the baseline socio-economic situation.

The chapter will focus on the No.3 Sub Counties which are Kerio Valley, Keiyo South and Keiyo North where the Phase 1 roads transverse as well as Elgeyo Marakwet County.

4.3.2 Administration

Elgeyo Marakwet County is located in Kenya's Rift Valley region. It borders West Pokot to the north, Baringo to the east, Uasin Gishu to the west, and Trans Nzoia to the northwest. The county is divided into five sub-counties Keiyo North, Keiyo South, Kerio Valley, Marakwet East, and Marakwet West featuring striking ecological contrasts between the Kerio Valley, the highland escarpments, and the plateau. The county's geography ranges from semi-arid lowlands to fertile highlands, influencing settlement, livelihoods, and economic activities.

The proposed Phase 1 project will be largely transverse Elgeyo Marakwet County which cover three sub-counties, which are: Keiyo North, Keiyo South and Kerio Valley. Each of these sub-counties is further divided into 6 wards, with 18 locations and over 35 sub locations.

Table 4-5 Administration of the Project Area

County	**Sub-County**	**Ward**	**Division**	**Location**
Elgeyo Marakwet	Keiyo Valley	Sambirir	Chesongoch	Murkutwo
				Chechan
				Mon
				Kibaimwa
				Chesetan
				Kiptumbur
		Arror	Tunyo	Arror
				Chesuman
	Keiyo North	Emsoo	Central	Keu
				Kabulwo
		Tambach	Soy North	Kiptulong
				Kamongich
	Keiyo South	Soy North	Soy	Chepsigot
				Epuke
				Kibargoi
		Soy South	Soy	Chemoiboin
				Soy
				Nyaru

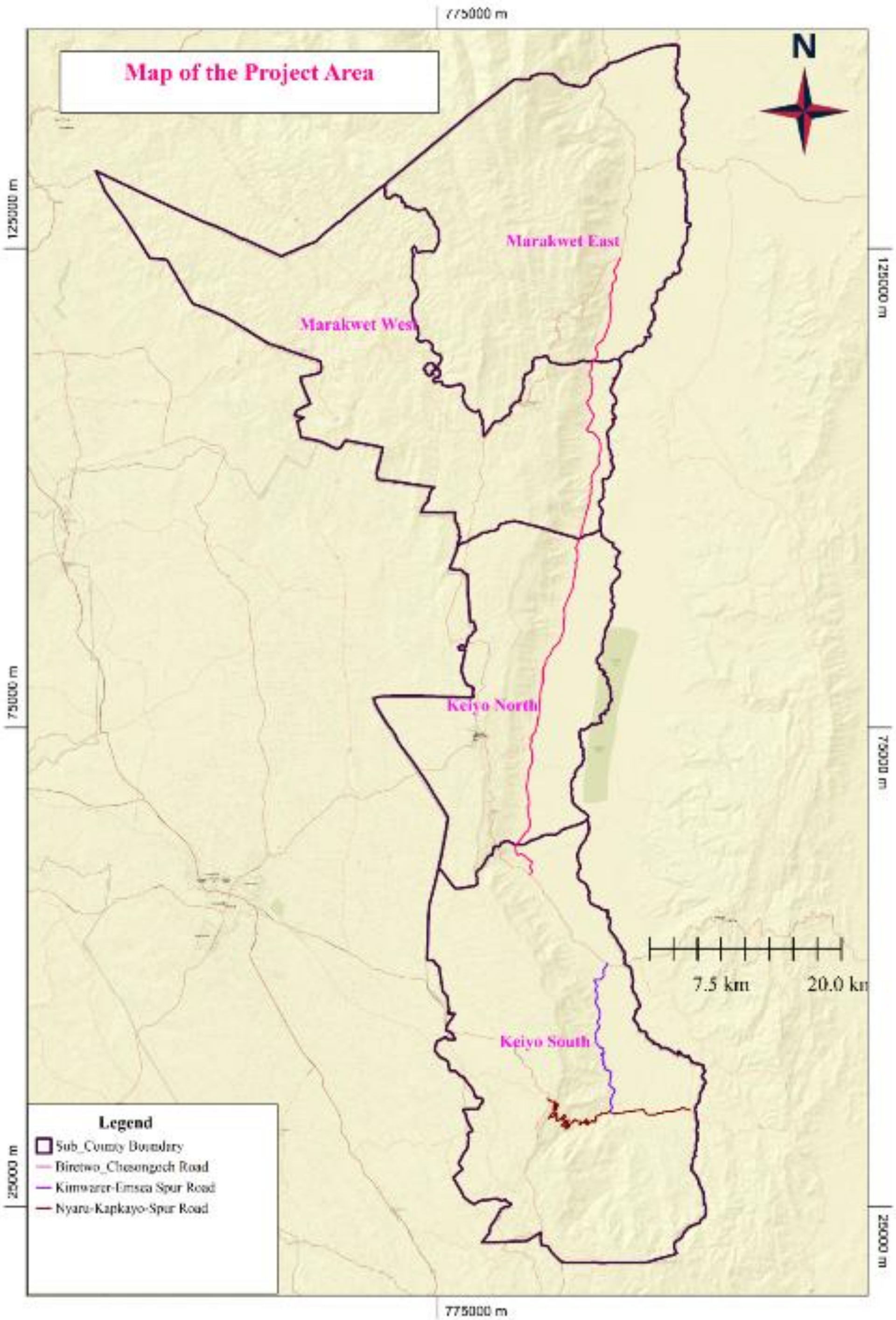


Figure 4-11: Illustration Map for the project area.

4.3.3 Demographic Data

The proposed road corridor is characterized by a diverse population comprising various ethic grouped including the Marakwet, Keiyo's, Pokot, Sabot, Tugen, Nandi and Terik communities. Settlements observed are disperse yet interconnected with small centers such as Murkutwa, Chesetan, Arror, Cheliget, Kabulwo, Rimoi, Biretwo, Emsea, Kimwarer, Turesia, Kapkayo, Nyaru among others which serve as socio – economic zones. The proposed road construction is expected to impact settlements positively by improving accessibility, connectivity and fostering economic growth.

Although currently the area has low population density of 612 Km^2 (KNBS 2019) it is anticipated it will increase to 702Km^2 by the year 2027. Hence, the improvement of the road to bitumen standards will lead to population influx into this area during construction and operation phases. It is also expected that human settlements and land use activities that are currently undertaken along the road corridor will increasingly move closer to the road. The land value will also increase as the road construction gets underway and correspondingly, speculative land acquisition and disputes are expected to increase

Table 4-6 :Population Distribution and Density by Sub-County

Sub County	2019 (Census)			2022 (Projection)			2025 (Projection)		2027 (Projection)	
	Area (Km^2)	Population	Density	Area (Km^2)	Population	Density	Population	Density	Population	Density
Keiyo North	541.0	99,176	183	541.0	106,180	196	109,202	202	111,147	205
Keiyo South	889.7	120,750	134	889.7	129,921	144	134,170	150	137,405	153
Marakwet West	804.6	137,513	171	804.6	148,638	185	154,529	192	158,696	197
Marakwet East	784.3	97,041	124	784.3	103,831	132	110,678	141	114,999	147
Total	**3029.6**	**454,480**	**612**	**3029.6**	**488,300**	**658**	**509,119**	**685**	**522,247**	**702**

Source: KNBS 2019

4.3.4 General Socio-Economic Characteristics

Elgeyo Marakwet County is characterized by a predominantly agricultural rural driven economy supported by mixed farming, livestock rearing, and vibrant honey production, with complementary livelihood activities such as small-scale trading, transport services, and emerging tourism. The population is mainly concentrated in the productive highlands while the semi-arid Kerio Valley hosts pastoral and irrigated farming communities, with access to health, education, water, and infrastructure varying significantly by altitude, thereby influencing strained income levels, service delivery, and overall vulnerability among households, particularly women, youth, and marginalized groups.

Within the proposed road corridor where Phase 1 corridor lies, the livelihoods are diverse and intricately tied to the rural setting and small trading centres. It was observed that agriculture plays central role, where farming activities like crop cultivation of millet, maize, sorghurm, beans, traditional vegetables among others and livestock rearing of cattle, sheep, goats and chicken and beekeeping serve as a common source of income for the population. Subsistence farming is prevalent, with households growing crops for personal consumption, while others engage in small scale commercial farming.

Apart from agricultural practices the communities along the project corridor are supported by small businesses, informal trade and small-scale commercial processing plants which are heavily supported by the Kerio Valley Development Authority and Non-Governmental Organizations (NGO's) such as World Vision; Some of these initiatives observed were beekeepers, fruit value addition with market centres spread along the route such as Chesetan, Arror, Biretwo, Emsea, Nyaru and Kapkayo among others acting as vital hubs for commercial activities. The improvement of the proposed road to Bituminous standards will enhance road connectivity which translates to access to markets, facilitate transportation and stimulate economic activities of local communities.

Plate 4-14: Sample Photos of Arror, Nyaru, Biretwo and Emsea junctions as trading centres within the proposed road corridor.

- **Settlement and Housing Patterns**

Settlement and housing patterns in Elgeyo Marakwet are strongly influenced by its varied topography, climatic conditions, and livelihood systems. The highland areas such as Nyaru which are more fertile, cooler, and better served by infrastructure exhibit high population concentration, with households living in clustered homesteads near farms, trading centres, schools, and social amenities. In contrast, the Kerio Valley and escarpment zones of Biretwo – Arror – Chesongoch – Emsea- Kimwarer – Kapkayo route have scattered and low-density settlements, reflecting the semi-arid environment, pastoral livelihoods, and limited access roads.

Housing structures range from a mix of permanent dwellings in form stone, brick, or timber with iron-sheet roofing to semi-permanent and traditional structures where some households still use mud-walled houses, thatched roofs, and extended homestead arrangements. Trading centres such as Biretwo, Nyaru, Kimwarer, Emsea feature mixed residential, commercial housing, with rental units, small shops, and dense settlements developing around project road corridor.

Settlement patterns are defined by terrain, land productivity, proximity to water sources, security and livelihood strategies, creating a clear distinction between the denser highland settlements and the dispersed homesteads of the Kerio Valley communities.

Plate 4-15: Illustration of Housing and Settlement Patterns

4.3.5 Land Tenure and Use

Article 61 of the Constitution of Kenya, states that all land in Kenya belongs to the people of Kenya collectively as a nation, as communities and as individuals, thus in Kenya, land ownership is categorized as public, community, or private, with land tenure systems including freehold (indefinite ownership) and leasehold (limited term, often 99 years). Community land is held by local communities under traditional systems and held in trust by the County Government on behalf of the said communities while private land is owned by individuals or companies.

Land tenure within the proposed project corridor is shaped by a mix of customary/communal, private, and public ownership systems, influenced by cultural practices, historical traditional settlement patterns, and the county's diverse topography. It was reported that currently majority of the land is predominantly under individual freehold tenure, where households own and cultivate small to medium parcels for crop farming, dairy production, and homestead development. These areas have undergone significant land subdivision (land adjudication process) currently, resulting in relatively smaller family holdings and more permanent settlement patterns.

In contrast, the Kerio Valley and escarpment zones are characterized by communal (government scheme ownership in areas around Flourspar) and customary land tenure, with larger, less formally demarcated tracts used for pastoralism, communal grazing, beekeeping, and mixed subsistence farming. Customary land rights, clan-based stewardship, and seasonal mobility influence access and land utilization in these lowland areas, with formal titling currently being taken up by the community. Public land in the areas including forests, national reserves/parks(Rimoi National Reserve) ,riparian zones, and protected catchments are managed by national and county government agencies, often forming critical water and biodiversity conservation zones.

Land use along the project corridors is predominantly characterized by extensive tree cover, particularly along the escarpment and mid-altitude zones, reflecting forested and wooded landscapes. Crop cultivation is the next dominant land use, mainly concentrated in the highland areas where favourable climatic and soil conditions support intensive agriculture. Grasslands and shrub/scrub areas are common within the Kerio Valley and transitional zones, supporting livestock grazing and mixed agro-pastoral systems. Built-up areas occupy a relatively small proportion of the corridors and are largely confined to trading centres and linear settlements along existing roads, while bare land and surface water occur only in localized pockets. , The observed land use patterns indicate ongoing pressure from agricultural expansion, infrastructure development, and population growth, with implications for forest resources, grazing areas, and ecologically sensitive landscapes.

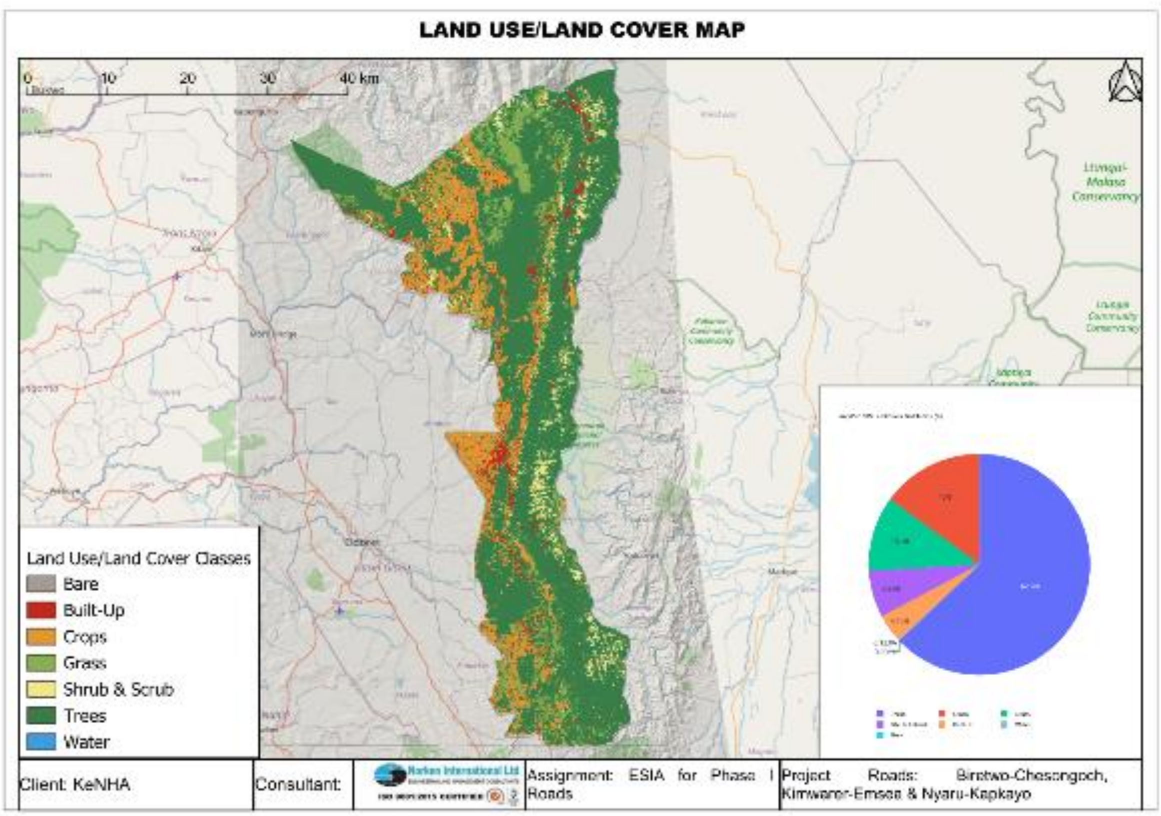


Figure 4-12: Illustration of land use and land cover

The development of the proposed road corridor to bituminous standards is expected to influence existing land use patterns and tenure arrangements by increasing accessibility, stimulating demand for land, and accelerating shifts from predominantly rural or agricultural uses to more commercial, residential, and infrastructure related developments. These changes may create pressure on customary and informal tenure systems, potentially prompting land subdivision, formalization of ownership, and increased land value, thereby affecting how this community's access, use, and security to their land.

Plate 4-16: Illustration of Sample of Land Use within the Project Areas

4.3.6 Education and Literacy Levels

Education is one of the indicators of a population's potential for social economic development and culturally the more educated a person is the more economically productive they are. Elgeyo Marakwet County has shown strong enrolment trends, with recent figures of the year 2024/2025 indicating around 116,460 primary pupils (more boys than girls) and 34,306 secondary students (more girls than boys), supported by county initiatives like ECDE funding, leading to increased preschool attendance and decent transition rates to secondary school. Only about 18.4 % of residents aged 15 plus years have reached secondary school or higher, which is below the national level, indicating gaps in educational progression beyond primary schooling. Literacy in the county is relatively low, with only about 48.5 % of the population aged 3 years and above able to read and write. Male literacy is slightly higher (~49.8 %) than female literacy (~47.4 %) this indicates historical barriers affecting women and girls like early marriage and limited access to schooling. (*KNBS/KIPPRA 2023-2024*).

Education inequalities in Elgeyo Marakwet region are significant, impacting access to quality education and opportunities for students, especially those from vulnerable backgrounds. These inequalities are rooted in factors like poverty, regional disparities, lack of resources, inadequate infrastructure such as inaccessible roads, terrain among others leading to lower educational attainment in rural areas compared to urban regions.

The improvement of the proposed road project will enhance connectivity which eventually will ease access to educational institutions and reduce travel time across the sub counties and other counties, thereby supporting school attendance and retention, especially in more remote areas. It is expected that the improvement of the road infrastructure will ultimately enhance educational equity by facilitating access to literacy centres and skills development programs fostering increase in community literacy levels and provision of both skilled and semi-skilled labour to the project.

Plate 4-17: Illustration of Learning Institutions within the Project Area

It was observed during the site visits that most schools are located along the road corridor (see table below on sample of selected schools), further some of these schools have structures (toilets, gates and fences) constructed within the road construction corridor and may have to be adjusted to pave way for the works.

Table 4-7: Sample of Schools within the road corridor

Project Road	Chainage (Km)	Institution
Nyaru-Kapkayo	7+000	Turesia Primary School
	15+540	Kewapmwen Primary School
	26+000	Kerio Valley NYS and Chepsirei Primary School
Kimwarer- Emsea	0+500	Kimwarer Primary Schol
	0+800	Kenya Flourspar Primary School
	3+600	United Soy Secondary School
	3+800	Sesia Primary School
	6+900	Muskut Primary School
	12+100	Menone Primary School
	13+600	Kapsoo Primary School

Project Road	Chainage (Km)	Institution
	16+500	Emsea Primary School
	16+700	St. Augustine Boys High School
Biretwo-Chesongoch	0+400	Walabei Primary School
	2+100	Kaptubei Primary School
	10+700	?
	15+300	Rimoi Primary School
	23+500	Kiptoro Primary School
	26+600	Matany Primary School
	30+200	Kabulwo Secondary School
	30+900	Kabulwo Primary School
	34+000	St. Andrew Chegilet Secondary School
	35+300	Chegilet Primary School
	37+400	Kermuk Primary School
	39+200	Kilos Primary School
	47+300	Koitilial Primary School
	50+400	St. Benedict School of Peace Arror and St. Benedict Arror Secondary School
	53+000	Chepkum Primary School
	54+000	Barsumbat Primary School
	56+000	Chesuman Primary School
	57+800	Tunyo Primary School
	60+200	Kipyebo Primary School
	61+300	KapKeny Primary School
	62+900	Mogil Primary School
	65+300	Chesetan Primary School
	67+700	Kombases Primary School
	70+100	Chechan Primary School
	70+500	Queen of Peace Secondary School

4.3.7 Health

The health sector in Kenya is constitutionally mandated to provide curative, preventive, promotive and rehabilitative health services, implement public health policies and statutes as well as support medical emergency services. There are clear and consistent linkages in the performance and priorities of the healthcare sector through the project area and despite challenges, the County has collectively aligned their health strategies with national priorities particularly the pursuit of Universal Health Coverage (UHC).The county of Elgeyo Marakwet has taken significant steps toward expanding health insurance coverage with efforts to register general population alongside vulnerable and low income households into the Social Health Insurance Fund (SHIF) at a rate of 45% uptake.

Elgeyo Marakwet County has an estimated number of No. 131 broad network of health facilities that support its health service delivery, including primary, secondary, and referral care these facilities include public, faith-based, and private institutions supporting preventive, promotive, and curative services across all sub-counties. As per the Kenya Demographic Health Survey (KDHS) the estimated average distance to the nearest health facility is approximately 3.7 Km, the most prevalent diseases reported are both communicable and non-communicable diseases which include Upper respiratory infections, (36.2 %) Skin diseases (12.7 %), Diarrheal diseases (8.5 %), Pneumonia (5.3 %), Typhoid and malaria though in lower proportion, but contribute to disease burden.

The main referral hospital in operation is Iten county referral hospital. This hospital can handle dialysis, surgeries, special services though access to this facility remains a challenge due the poor nature of the exiting road, distance and the high transportation costs ranging from ksh.1000 to 2000 around trip depending on the mode of transportation. There are other different level 4,3,2 and 1 health facilities which are operational though some require modern equipping with trauma centres, maternity wings, wards among other various requirements and a few missionaries led and private clinics and facilities along the corridor.

Existing health facilities along the proposed road include among others: St. Teresa Mission Hospital at Chesongoch, Mogil Health Center, Arror Health Centre, Chegilet, Biretwo, Emsea, Fluorspar, Nyaru and dispensaries.

The proposed road improvement project is expected to enhance transportation infrastructure, making it easier for residents to access healthcare services. This could improve maternal and child health and support community well-being. During construction, health risks associated with the influx of workers such as waterborne diseases or potential HIV/AIDS and GBV exposure will be mitigated through measures like safe water provision, sanitation facilities, and awareness programs for both workers and local communities. The project is likely to strengthen health service delivery, improve emergency response, and support broader public health outcomes across the counties.

4.3.8 Water Resources and Supply

Water resources and supply in Elgeyo Marakwet County are largely shaped by the county's varied topography, climate, and settlement patterns. The county is endowed with several permanent and seasonal rivers, notably the Kerio River, Arror River, Kimwarer River, Kipcheptem River and its tributaries originating from the Elgeyo Escarpment, which constitute among the main surface water resources, particularly for communities in the Kerio Valley. Upland areas benefit from relatively higher rainfall and rely on springs, streams, and protected shallow wells, while lowland areas experience recurrent water scarcity due to arid and semi-arid conditions and high evaporation rates. The County has reported that it targets to increase the proportion of households with access to clean and potable water from 33% to 40% (CIDP 2023-2027), however this has been a challenge due to untimely project execution, community conflict in water resource sharing and land issues, price dynamics, low volume flows of water as well as dry boreholes.

During the site observation and community engagements it was reported that water supply is provided through a mix of piped water schemes, community owned gravity systems, boreholes, shallow wells, water pans, and rainwater harvesting, with piped water coverage remaining limited to specific households and urban centers. Rural households predominantly depend on unimproved sources, especially during dry seasons, leading to long distances (estimated to be 2.5Km to the nearest water source) to water points and increased vulnerability for women and children.

Despite the presence of natural water resources, access to reliable, safe, and adequate water supply remains a challenge, with seasonal shortages, infrastructure limitations, and water quality concerns continue to affect socio-economic activities and public health outcomes across the county. The ESIA therefore recommends the road project must prioritize sustainable water use management practices to safeguard the quality and availability of water for local communities. As well as preserving the ecological integrity of these rivers and natural springs is important.



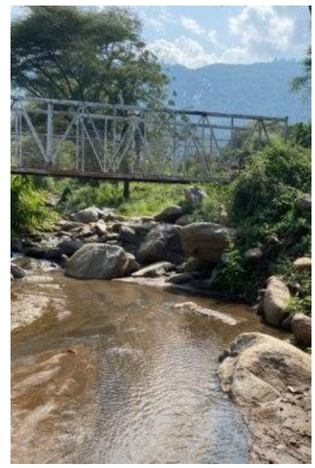


Plate 4-18: Illustration of Water Resources

4.3.9 Transport and related Infrastructure

The primary road system in Kenya consists of international trunk roads (Class A), national trunk roads (Class B) usually managed by KeNHA, inter-county and rural access (Class C, D, E and F) managed by KeRRA and county roads under the County Governments. According to the 2023 Countrywide Road Inventory and Condition Survey, Kenya's road network comprises of approximately 239,122km including 25,410km paved roads. The same reports indicates that road users consist of passenger traffic at 80% and 76% of freight traffic.

In Elgeyo Marakwet, the County Government reported of increasing the total network especially to inaccessible areas, hence the total road network increased from 2,060.6 KM to 3,207 KM surpassing the target by 182 KM; this is largely attributed to the opening of additional 755 KM of new feeder roads. The length of the all-weather road network increased from 1,496.2 KM to 1,885 KM representing a 26% increase. This increase is because of the upgrade of an additional 149 KM to bitumen standards and the graveling of 1,418 KM of roads to motorable status (CIDP 2023-2027).

Major transport corridors such as the Eldoret–Iten–Tambach–Kapsowar road, Eldama Ravine - Eldoret road, Timboroa-Kapchorwa among others and link roads such the proposed phase 1 project roads connect market centres facilitate movement of people, agricultural produce, and services.

Related infrastructure includes classified and unclassified road networks, trading centres, bus stops, informal stations, roadside shelters, footpaths, river crossings, and limited street lighting in urban centres such as Arror, Biretwo, Nyaru and Emsea. In the Kerio Valley and escarpment areas, rugged terrain and seasonal rivers constrain transport access, with reliance on earth and gravel roads that are vulnerable during rainy seasons especially the Biretwo- Chesongoch(B126) and B124 roads. It was observed that the public transport is mostly road based and is largely provided by privately operated matatus, minibuses, buses, motorcycles (locally known as boda bodas), and taxis, which serve both intra-county and inter-county travel.

Within the project area, most roads comprise earth and gravel surfaces that are vulnerable to erosion and washouts, especially at seasonal rivers (laggas/drifts). During rainy periods, many sections become impassable, disrupting mobility, access to markets, schools, and health facilities. Dust, loose surfaces, lack of signage, and poor roadside conditions also pose road safety risks, particularly for motorcycles.

Transport services are limited and largely informal, dominated by motorcycles (*Boda Bodas)* and few public vehicles (matatus and personal cars) with occasional pickups and trucks used for passengers and goods. Most times formal public transport is minimal due to rough terrain of the current road, community reported movement is occasionally constrained by high transport costs, long travel times, and frequent vehicle breakdowns leading to high costs of repair and maintance.

In general terms, public transport and associated infrastructure play a critical role in supporting livelihoods, access to education and health services, and integration with regional markets, though challenges remain in road condition, coverage and accessibility to critical public institutions, improvement of the proposed corridor will drastically reduce this burden.

4.3.10 Energy Sources and Communication Network

The availability of affordable and reliable energy sources ensures economic, social development and improved quality of life. In a typical household setting in Kenya energy is needed for cooking, heating and lighting of households and sometimes running of machines such as for pumping water and cutting of animal's feeds such as Napier grass. Energy sources reported and observed in the project area includes biomass fuels such as firewood and charcoal, biogas, fossil fuels, petroleum products such as kerosene, diesel, solar energy and electricity from the national grid. The choice of energy use depends on several factors including cost, income levels, the availability, and cultural preferences.

The communication network is supported by mobile phone coverage from major service providers, radio and television broadcasting, and expanding internet services, though connectivity and reliability vary across the escarpment and remote valley areas.

The electricity coverage increased from 30.38% to 41.23% following connection of an additional 10,749 HHs to electricity. The significant increase is attributed to the last mile connectivity project funded by the national government. Streetlighting within the trading centres also increased from 60% to 85%, contributing to more trading hours and a more secure business environment. (CIDP 2023-2027).

To support the county's goal to ensure more households are connected and served the proposed road improvement will strengthen linkages and enhance access to energy and communication infrastructure by easing movement for installation, operation, and maintenance of power and telecommunication facilities, supporting service expansion, improved connectivity, and overall socio-economic development in the project area.

Plate 4-19: Illustration on Energy Sources and Communication Network

4.3.11 Tourism and Cultural Sites

Elgeyo Marakwet County hosts a range of tourism and cultural sites centred on its scenic landscapes and rich cultural heritage. Key attractions include the Kerio Valley escarpment, Torok Waterfalls, Arror Falls, and panoramic viewpoints around Iten, which is also internationally known as a high-altitude training hub for elite athletes. The Rimoi National Reserve a key conservation and tourism site located along the Biretwo – Arror- Chesongoch Corridor which is situated in the Kerio Valley along the Kerio River. The reserve is known for its diverse wildlife, including elephants, buffaloes, antelopes, and bird species, as well as scenic landscapes, riverine ecosystems, and cultural significance to local communities.

Additionally, significant cultural heritage sites, including traditional Keiyo and Marakwet homesteads, initiation and ritual sites, sacred forests, and community cultural centres that reflect indigenous knowledge, customs, and social practices do exist. These natural and cultural assets support eco-tourism, sports tourism, and cultural tourism, contributing to local livelihoods and offering opportunities for further development with improved accessibility and infrastructure.

4.3.12 Security and Public Safety

Security conditions along the proposed road project corridor in Elgeyo Marakwet County are generally stable, particularly within trading centres and densely settled highland sections, but remain relatively fragile in some remote stretches, especially towards the Kerio Valley leading to government declared ‘disturbed’ area status in 2023. Historically, the county has experienced incidents of banditry, cattle rustling, and inter-communal conflicts associated with competition over grazing land, livestock theft, and the presence of illegal firearms. In recent years, enhanced multi-agency security operations, community policing initiatives, and voluntary disarmament programmes have contributed to improved security and reduced frequency of violent incidents. Local administration, community elders, and peace committees play a central role in maintaining order and resolving disputes at the community level.

During the road construction phase there might be cases of potential security-related risks, including increased movement of people and goods, labour influx, temporary camps, and heightened interaction between workers and host communities. These project dynamics may elevate risks of petty crime, traffic-related accidents, and social tensions, including gender-based violence (GBV) if not adequately managed. While baseline security conditions are improving, targeted security coordination, community engagement, and traffic and worker management measures will be required to safeguard communities and project personnel during construction and operation.

Upon completion, upgrading the proposed road corridor to bituminous standards is expected to significantly enhance accessibility, and further improving the capacity and response time of security personnel to volatile areas. The improvement of accessibility will speed up response to crime and insecurity, contributing to enhanced public safety along the project corridor.

4.3.13 Gender and Cultural Issues

The county's main gender issues are contained under the customary practices where the male vests ownership and control of productive assets. Women in the project area are faced with a number of challenges including inadequate access to credit, technical skills, multiplicity of roles for women and inadequate access to education and training. The traditional delineation of labour persists with women assuming the entire responsibility for childcare, provision of food, water and firewood collection and the general maintenance of the homestead among others. Other forms of gender issues that are rampant in these communities include but not limited to; discrimination against women and girls, harmful practices such as child abuse, female genital mutilation (FGM), early and forced marriages.

It has been reported that the prevalence rate of Female Genital Mutilation (FGM) declined from 30% in 2015 to 18.4% in 2022 against a 10% target. This can be attributed to anti-FGM sensitization campaigns rolled out across the county. On the other hand, Sexual Gender Based Violence (SGBV) among women in the county is 13.1% which is slightly higher than that of men which stands at 6.1% as of 2022. This can be associated with the patriarchal nature of most communities in the county (CIDP 2023-2027). Kenya's Sexual Offenses Act provides for the prevention and protection of all persons from harm, from sexual acts including sexual assault, rape, defilement, sexual harassment and child prostitution. It also provides for access to justice and psychological support even though there are challenges in the execution of this act at the community level.

It was informed during consultations that Gender based Violence (GBV) and other forms of abuse are still rampant in the project corridor and in some cases normalized even though not well documented, this has been attributed to stigma influenced by cultural norms which prevents GBV survivors from speaking openly about their experiences and often keeps them from reporting such cases to the local administration or police gender desk. It was reported during the KII and Focus Groups Discussions whereby the findings from these studies indicate that gender-based violence (GBV) is a significant concern within the project area, as highlighted by women and youth and inputs from the Police Gender Desk interviews. Common forms of GBV include domestic violence, child neglect and abuse, and cases of defilement, particularly affecting school-going girls and boys, early and forced marriages, economic exploitation, and safety risks/threats when accessing essential resources like water and firewood. Although reporting has improved due to increased awareness, many incidents remain under-reported due to fear of stigma, retaliation, and scattered settlement patterns within communities. Women emphasized the need for interventions such as sensitization programs, economic empowerment, safer access to resources, and strengthened reporting and response system

Further, it was reported that the institutional response mechanisms exist but are constrained. The Police Gender Desks are operational yet underfunded and lack resources, with limited staffing, inadequate training in survivor-centred approaches, lack of private reporting spaces, and logistical challenges such as transport limitations and accessibility to households. Access to forensic and medical services is also difficult, and referral systems for survivor support remain weak and inconsistent. General Community level vulnerabilities such as insecurity, unemployment, and cultural settings further exacerbate GBV risks. Women, children, adolescent girls, female-headed households, and pastoralist families are the most at risk groups.

During construction, the road project will endeavour to prevent an increase in gender-based violence (GBV) through the implementation of clear social safeguard measures, including a Code of Conduct for all workers prohibiting Gender Based Violence (GBV), Sexual Exploitation and Assault (SEA), and Sexual Harassment and Exploitation (SHE), supported by mandatory induction and regular awareness training. It is recommended that the project will prioritize local labour recruitment, reduce the influx of outside workers, and ensure adequate worker supervision and controlled camp management, including restrictions on movement and drug and alcohol use. A confidential and accessible grievance redress mechanism (GRM) will be established for reporting GBV cases, with clear referral pathways to health, psychosocial, and legal support services. In addition, the project will engage communities through sensitization on GBV risks and rights, collaborate with local administration and service providers, and ensure compliance monitoring to promptly address any incidents during construction.

4.3.14 Baseline Social and Economic Impact Assessment

The socio-economic survey was undertaken to establish baseline conditions within the project's area of influence and provide information for assessing potential environmental and social impacts, identifying vulnerable groups, and developing appropriate mitigation and enhancement measures. The survey generated data on demographic characteristics, livelihoods, access to social services, community infrastructure, land use, vulnerability, and community perceptions regarding the proposed project. A representative sample of households was selected using a stratified sampling approach to ensure adequate representation of different geographic areas, socio-economic groups, and potentially vulnerable populations. The survey was carried out between 8th April to 21st April 2026 a total number of 236 households along the road corridor were interviewed against an estimated population of 60,000 people.

3. **Data Collection Process**

All socio-economic household survey data was collected digitally using KoboCollect, a free open-source mobile data collection platform. The survey questionnaire was programmed into the KoboToolbox platform using XLSForm syntax, enabling the implementation of skip logic, mandatory field constraints, response validation, and automatic GPS coordinate capture at the point of each interview.

KoboCollect enabled real-time, paperless data capture directly in the field. Completed questionnaires were automatically uploaded to a secure, password-protected KoboToolbox server upon internet connection, with offline functionality ensuring uninterrupted data collection in areas with limited connectivity. All data was stored and managed in accordance with Kenya's Data Protection Act (2019) and the KeNHA Data Protection Policy.

Key features of the deployment included automatic GPS coordinate capture linking each respondent to a precise location, built-in skip logic guiding enumerators through the questionnaire, drop-down response lists to minimise transcription errors, photographic documentation of affected structures, automatic date and time stamping of each interview, and offline data storage with synchronization upon reconnection to the internet. Data was exported from Kobo Toolbox in Excel format for subsequent cleaning, analysis, and reporting.

4. **Locally Trained Enumerators**

All field data collection activities were carried out by a team of locally recruited and trained enumerators. The use of local enumerators leveraged their familiarity with the community, proficiency in local languages including Kalenjin dialects, and cultural competence — all essential for building rapport with respondents and ensuring high-quality data collection.

A total of No.16 enumerators was recruited from within the project area communities, with an equal gender balance of 4 male and 4 female enumerators. This ensured that female PAPs, particularly female household heads, were interviewed by female enumerators in line with gender-sensitive data collection best practice. Enumerators were selected based on local language proficiency, prior field research experience, and strong interpersonal communication skills. All enumerators underwent training before the commencement of field data collection and a supervised field pre-test to validate the questionnaire and build enumerator confidence.

Findings from the household socio-economic survey were triangulated with information obtained through various stakeholder consultation methologies including key informant interviews and focus group discussions , as well as baseline field observations and relevant secondary data sources outlined in this section. This approach enabled validation of key findings, enhanced the relialbility and consistency of the data collected, and provided a comprehensive understanding of the socio-economic conditions and potential project impacts within the proposed project road corridor.

The results of the baseline socio-economic impact assessment are detailed below;

4.3.15 Demographic Characteristics

This section presents the demographic characteristics of household surveyed within the project areas or locations as presented in section 4.2 above. The findings are based on data collected from No.236 households surveyed along the proposed project corridor during the socio- economic baseline assessment, hence the results present a cumulative profile of the project beneficiaries.

4.3.15.1 Household Representative

The results illustrate that the majority of respondents were household heads (76%), followed by spouses of household heads (14%). Smaller proportions included sons/daughters of the household head (4%) and other relatives (3%). Very few respondents were sons/daughters-in-law (1%), siblings (1%), and grandchildren (1%), while parents of household heads (0%) were least represented. The findings show that most information was provided directly by household heads.

The results indicate that the majority of households in the study area are male-headed (78%), while female-headed households account for 22%. This suggests a dominance of male leadership in household decision-making structures within the community and a patriarchal society. The presence of a notable proportion of female-headed households also reflects the existence of gender diversity in household leadership, which may be influenced by factors such as migration, widowhood, or single-parenting.

Further, it was reported that most households consist of 4–6 persons (43%), indicating moderately large family sizes.

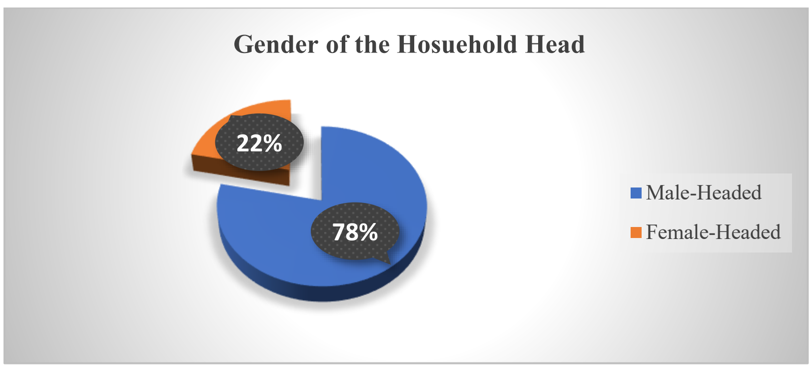


Figure 4-13: Gender representation at the household level.

Disability Status: In terms of disability status, the results indicate that the vast majority of households (96%) reported no persons living with disability (PLWD), while only 4% reported having at least one household member with a disability. This suggests a low reported prevalence of disability within the community, though it may also reflect underreporting or identification challenges. The data indicates a community with limited reported cases of disability as supported by the key informant interviews held with the County Social Development Officer who affirmed that community tends not to report such cases and other incidents, they hide the PWDs.

4.3.15.2 Project Awareness

All respondents (100%) participated in the public participation meeting held within their locations.. The findings show that a large majority (95%) had previously heard about the proposed road project before the stakeholder engagement meetings, while only 5% were not aware. This indicates a high level of prior proposed project road awareness within the community.

The findings show that public meetings (45%) are the leading source of information, followed by local leaders (31%), highlighting the importance of community-based communication channels. Media contributes a moderate share (19%) and other 5% sources play minimal role. Project awareness is primarily driven by public participation forums and local leadership, with limited contribution from formal and external channels.

Stakeholder Meeting Attendance: Most respondents, (80%) reported attending project stakeholder engagement meetings, showing strong participation in the consultation process. However, (19%) had not attended, indicating a small gap in access or reach. Stakeholder engagement was high, though some gaps in inclusivity remain. Mobilization through the local administration such as chief remained the most preferred channel (31%), followed closely by posters (29%) and others like Churches (16%) and local radio stations (15%) also play important roles in information sharing, while SMS (9%) is the least preferred method, but still contribute as a supplementary communication method.

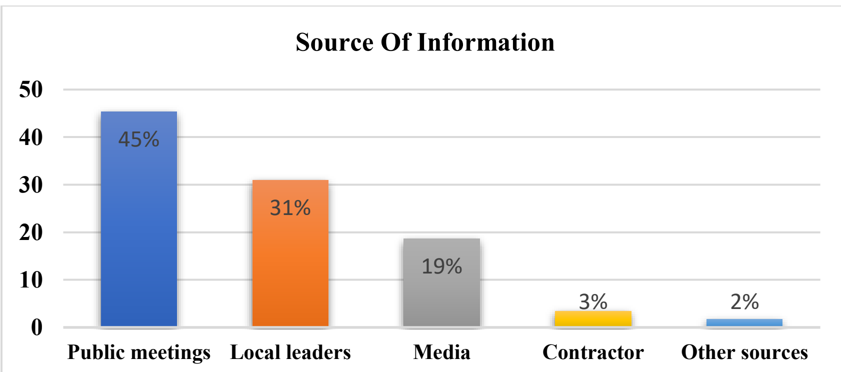


Figure 4-14: Project awareness sources of information and attendance

4.3.16 Land Ownership, Tenure and Use

Most respondents (64%) own land, indicating a strong prevalence of individual land tenure. Communal ownership is also significant at 29%, reflecting shared or community-based land systems. A small proportion rent land (4%), while 3% others are inherited. This suggests that land tenure in the project area is largely well captured under the main categories of land tenure systems such as private(titled), communal, and rented systems. Inheritance is the dominant mode of land acquisition (64%), indicating strong reliance on family lineage for land ownership hence, less acquisition through market or formal allocation systems.

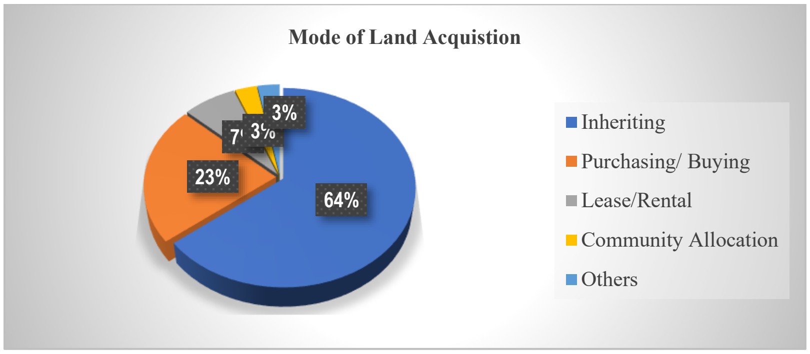


Figure 4-15: Methods of Land Acquisition and Ownership

Most households reported owning small land parcels, with 42% having less than or equal to 1 acre and 39% owning between 1.1 and 3 acres. Only a small proportion (13%) have 3.1–5 acres, while very few households own more than 5 acres (6%). This indicates a predominance of small-scale land ownership in the project area. It was reported that while formal documentation is widespread, a considerable share of land remains under less secure tenure arrangements with a proportion with title deeds (31%) and allotment numbers (31%) are the most common forms of land ownership documentation.

Land Use: Land in the study area is predominantly used for farming (78%), indicating that agriculture is the main economic activity and source of livelihood for most households. Business activities account for 15%, showing some diversification into commercial land use. A small proportion of land is used for rental or lease purposes (2%), other minor use such as and mining (0.1%).

Crop farming is the most dominant agricultural practice (66%), indicating that most households are primarily engaged in crop production with a mixture of maize, beans, vegetables, grains, fruit trees like mangoes, papayas, bananas and drought resistant crops like sorghum and millet. Livestock farming follows at 42%, showing strong integration of mixed farming systems. Poultry keeping accounts for 24%, while bee keeping is the least practiced activity (5%). The findings show that agriculture in the area is largely mixed, with a strong emphasis on crop and livestock production.

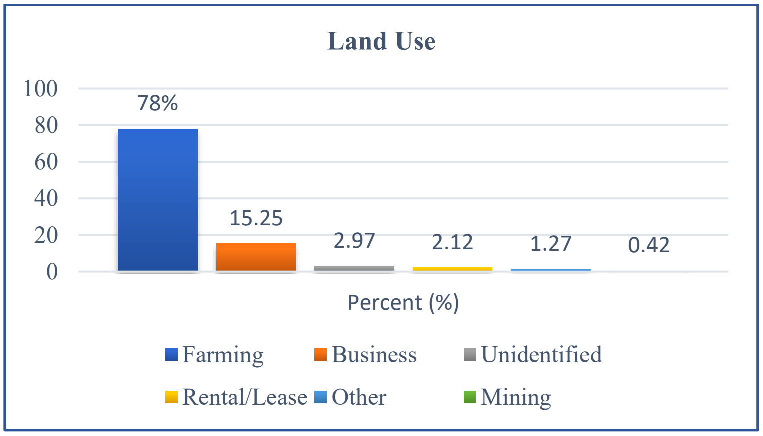


Figure 4-16: Illustration of Land Use Patterns

4.3.17 Access to Water, Energy, Sanitation and Waste Management

Primary Source of Drinking Water: River water is the dominant source of drinking water (49%), indicating high reliance on natural surface water. Piped water is the second most common source (31%), reflecting some access to improved water infrastructure. Other sources such as springs (6%), boreholes (4%), wells (3%), and communal pumps (3%) contribute modestly to water supply. Rainwater harvesting (2%) and purchased water from vendors (1%) are least used. The findings show that while improved water sources exist, a significant proportion of households still depend on river water.

Main Energy Source for Lighting: Solar lighting systems (40%) are the most frequently used energy source for household lighting, indicating strong uptake of off-grid renewable energy solutions. Connection to electricity follows at 27%, showing moderate access to the national grid. Traditional energy sources such as wood (13%) and torches (11%) remain significant, reflecting continued reliance on non-electric lighting in some households. Charcoal and other minor sources (paraffin, candles, biogas, and batteries) collectively account for 8%. The findings show a transition towards cleaner energy, though traditional lighting methods are still widely used.

Type of Sanitation Facilities: Pit latrines are the most commonly used sanitation facility (86%), indicating widespread reliance on basic sanitation systems. Open defecation is still practiced by 12% of households, highlighting gaps in access to sanitation. Flush toilets connected to septic tanks (6%) and improved ventilated pit latrines (3%) are less common, reflecting limited access to improved sanitation facilities. The sanitation is largely basic, with a need for improved facilities.

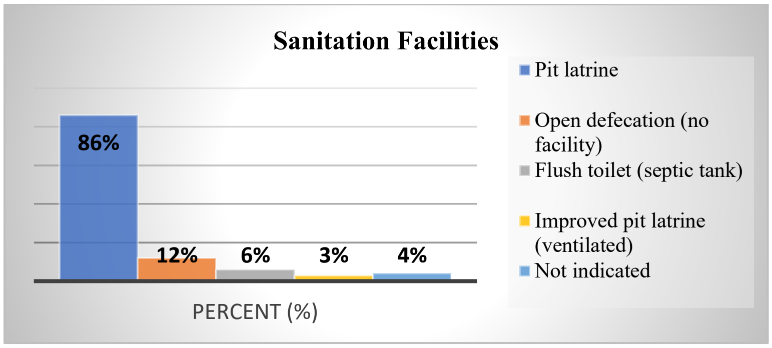


Figure 4-17: Type of Sanitation Facility Used in the Households

Waste Generation and Management: Food waste (46%) and animal waste (46%) are the most commonly generated types of solid waste, indicating that most households produce organic waste linked to domestic and agricultural activities. The household waste is largely organic, with a smaller proportion of inorganic waste. Burning (37%) is the most common method of solid waste disposal, followed by composting (33%) and reusing (31%), indicating that households use a mix of disposal and recycling practices. Burying (22%) is also practiced, but to a lesser extent. While some environmentally friendly practices like composting and re-use are evident, burning remains widely used.

Figure 4-18: Community Waste Management Practises.

4.3.18 Livelihoods and Income Sources

Farming is the main source of livelihood (56%), indicating that most households depend on agriculture. Livestock farming (20%) is also significant, showing a strong presence of mixed farming systems. Self-employment (9%) and business (5%) contribute to income diversification, while formal and informal employment (4%), casual labor (3%), and trading (2%) play smaller roles. The livelihoods are largely agriculture-based with limited formal employment opportunities. The findings showed that the majority of households (73%) earn between Ksh 0-10,000 per month, indicating generally low-income levels within the project area. The results suggest that most households fall within the low-income bracket attributing to high poverty levels.

Secondary income Sources: It was reported that farming (21%) was the most common supplementary activity, followed by business (16%) and trading (11%). Livestock-related activities accounted for 6%, while casual work contributed 2% that is working in farmlands and grazing. Formal employment as a secondary source was minimal (1%). Other diverse activities such as marketing, small shops, transport services, and skilled labor collectively accounted for 15%. The results suggest that households rely on a mix of small-scale and informal income-generating activities to supplement their primary livelihoods.

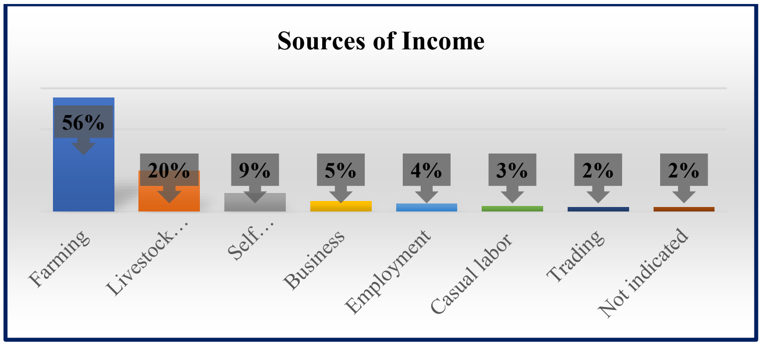


Figure 4-19: Community Waste Management Practises.

Lowest Income Months: January is the most frequently reported month of lowest income (40%), followed by June (13%). Other months, such as February (8%) and March–July (each about 3%), are less commonly mentioned. About 20% of respondents reported multiple months, mainly within the January–March period, reflecting prolonged seasonal income challenges. Additionally, some respondents highlighted increased expenses, particularly in January due to school fees and household costs, and farm input costs during planting seasons (March–April). The low-income periods are concentrated in the early part of the year and mid-year seasons this exhibits a recurring vulnerability pattern not random income fluctuations indicating strong links between household economics and agricultural seasons.

4.3.19 Education, School Attendance and Literacy Levels

The findings indicate that most households have between 2 and 3-5 school aged and school going children, with 42% and 34%, respectively, falling into these categories. Similarly, the number of children currently in school is also concentrated in these ranges, very few households reported more than 8 children, and only a small proportion exceeded 12. The results show a close alignment between the number of school-aged children and those currently enrolled in school, suggesting relatively high school attendance rates among households, with only minor gaps recorded for no attendance.

School Attendance: The households reported school attendance is mainly constrained by school fees (25%), followed by distance to school (19%) and sickness (12%). Environmental challenges such as floods and landslides account for 3%, while early marriage, household responsibilities, and insecurity each contribute a very small proportion (1%). A significant number of respondents either gave unspecified responses (22%) or did not indicate a clear reason (28%). The financial constraints and accessibility remain the key barriers to school attendance within the project areas. The households reported that access to educational financial support is limited for most households, though a significant minority are benefiting from bursary or scholarship programs.

Distance travelled /covered and Time Taken: The results show that most primary schools are located within 0-5 km (91%), indicating high accessibility. Secondary schools are also largely within 0-5 km (81%), though a notable proportion fall within 5-10 km (14%) this are reported to be outside the project areas. Tertiary institutions are mostly far from households, with 49% located beyond 50 km and only 13% within 0-5 km. Access to education decreases with higher levels of learning, with tertiary institutions being the least accessible. The findings suggest that school accessibility is generally good, with most learners living relatively close to their schools especially for primary and secondary school compared to tertiary institutions. Households reported that most learners either walk or rely on motorbikes to access schools (mostly primary and secondary schools within the community) and other public service vehicles for those outside the project areas.

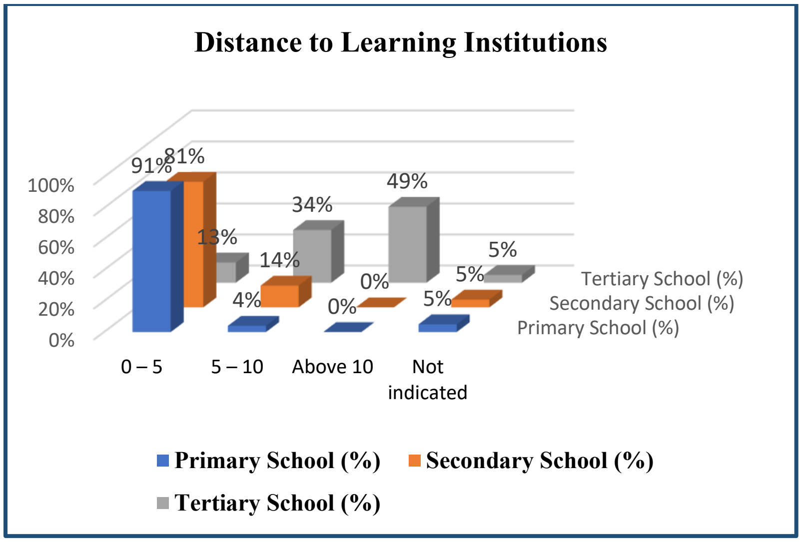


Figure 4-20: Distance to Learning Institutions

Key Road Safety Concerns: The households indicated road safety concerns for children traveling to school and presented safety challenges. The main concerns include speeding motorbikes, road conditions, inadequate road design or signages, flooding and river crossing hazards, and inadequate road safety measures such as bumps and signages. Hence there is need to create awareness and sensitization on road safety to the schools particularly during construction and period monitoring during implementation.

4.3.20 Health and Nutrition

It's reported that most households access nearby dispensaries (61%) those are level 1 while a smaller proportion rely on health centres (33%) level 2 – 4 and others accessing level 5 more of referral hospitals. This shows that primary healthcare services in the area are mainly provided through lower-level facilities. Examples of commonly mentioned facilities include Rimoi, Songeto, Tunyo Dispensary, Lukuget Dispensary, Chesetan Dispensary, Kabulwo Dispensary, and Sego, which represent the dispensary category (level 1&2). Health centres include facilities such as Biretwo Health Centre, Emsea Health Centre, Flourspar Health Centre, and Chegilet, while a few respondents also mentioned higher-level facilities such as Arror Mission Hospital and Iten County Referral Hospital. The results suggest that most households depend on dispensaries for routine healthcare, with health centres serving as secondary points of care and referral hospital being less frequently accessed.

Distance travelled and mode of transportation: The findings show that most households live close to health facilities, with half of the respondents (50%) located within 2-5 km and 37% within 0-1 km. Only a small proportion (6%) is more than 5 km away. This indicates relatively good physical access to healthcare services for most households. Most households reported walking to health facilities and use of motorbikes and public service vehicles where necessary due to the short distances covered for primary healthcare.

Common illnesses reported: Malaria accounts for the largest share of reported illnesses (43%), indicating it is the dominant health concern in the community. Waterborne diseases (26%) and upper respiratory tract infections (20%) also contribute significantly, highlighting the influence of poor water, sanitation, and environmental conditions on health outcomes other illnesses such as malnutrition (4%) and lower tract infections (3%) make up a smaller proportion, while conditions like eye infections, HIV/AIDS, STDs, and cancer each contribute about 1–2%. The findings show that communicable diseases form the bulk of the disease burden, with malaria being the most significant contributor.

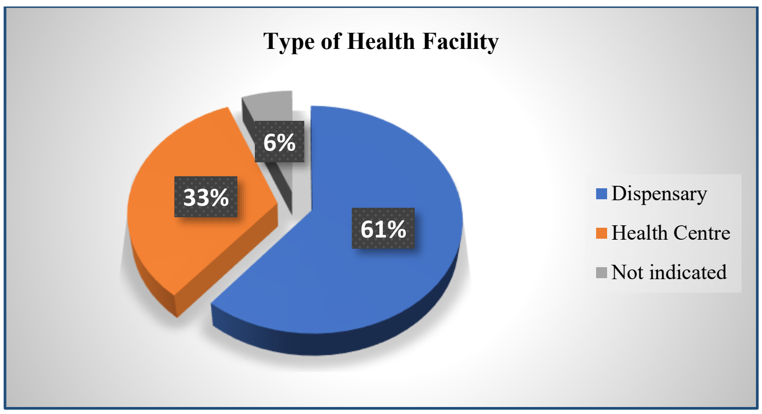


Figure 4-21: Type of Health Facility Within the Project Areas

Challenges in accessing healthcare: The results show that the most significant challenge is lack of drugs and staff at (32.15%), followed by distance to health facilities (23.67%) and poor inaccessible roads (20.12%), indicating that both service availability and physical access are key barriers. Cost of healthcare (16.96%) also remains a major constraint for households. Less frequently reported challenges include environmental factors like landslides (2.37%), insecurity (1.78%), and others (2.96%), though these still affect access in specific situations such as finances. The healthcare access is mainly constrained by shortages in services, long distances, and weak infrastructure such as roads and under equipped facilities.

4.3.21 Expected Effect of Proposed Road on Mobility and Transport Costs

Community reported that the proposed road will mainly improve mobility and accessibility (43%), making movement easier and more convenient. They also indicated that it will lead to reduced transport costs (32%) due to better road conditions and more efficient transport services. Economic benefits (11%) were highlighted, including improved market access, trade, and job opportunities. Reduced travel time and improved efficiency (9%) were also mentioned, with expectations of faster travel. A small proportion (4%) noted improvements in safety and social services, while a few respondents (2%) mentioned negative effects such as land loss and displacement. The findings show strong expectations of improved mobility and reduced transport costs following development of the proposed road to bituminous standards.

4.3.22 Gender, Vulnerability and other Social cultural Issues

Presence of vulnerable persons in the household

Among households with vulnerable persons, respondents most frequently mentioned the elderly (37%) as the main vulnerable group. This was followed by widows and widowers (16%) and persons with disabilities (11%). Chronically ill individuals (9%), including those with conditions such as diabetes, were also reported. The women headed households (8%) were identified as vulnerable due to their socio-economic responsibilities. Other responses (19%) included mixed or less specific categories such as people with disability, old age, sickness, and orphan-related vulnerability. Additionally, vulnerable groups identified in the ESIA process within the project corridor included women-headed households, elderly persons, person with disabilities (PWDs). These groups face compounded challenges related to poverty, limited mobility, restricted access to services, and weak participation in decision – making processes. Further, women-headed households are particularly vulnerable due to limited land ownership and livelihood diversification. The ESIA team used Free, Prior, and Informed Consent (FPIC) principles in consultation with vulnerable groups in accordance with OS 7 and in determination to develop project benefits as outlined in the Vulnerable Peoples Plan.

Presence of Sacred/Cultural/Burial Sites

Respondents reported that most households (84%) indicated there are no sacred, cultural, or burial sites near the road corridor. It was reported that the dominant features are burial sites and graves (73%) though they are within the homestead. Impact on ancestral burial sites in case of land acquisition was raised, others raised issues related to compensation and cultural rituals, noting that exhumation or relocation would require community rituals and compensation to affected families. Religious institutions such as churches (16%) were also identified along the corridor, while sacred or shrine sites (11%) were mentioned in a few locations though mostly situated deep in the valleys or escarpments.

4.3.23 Needs Analysis of the Household

Most respondents identified poor road conditions, transportation difficulties, inadequate health care, and limited access to agricultural inputs as major challenges faced by the community. These issues were frequently reported, indicating a strong relationship between infrastructure, service accessibility, and household livelihoods. Respondents also noted that water scarcity, limited market access, unreliable electricity, and unemployment significantly affect their well-being. Conversely, issues such as illegal land use and the availability of farmland were not widely regarded as major concerns. The findings indicate that while many challenges are prevalent and severe, their impacts vary across households.

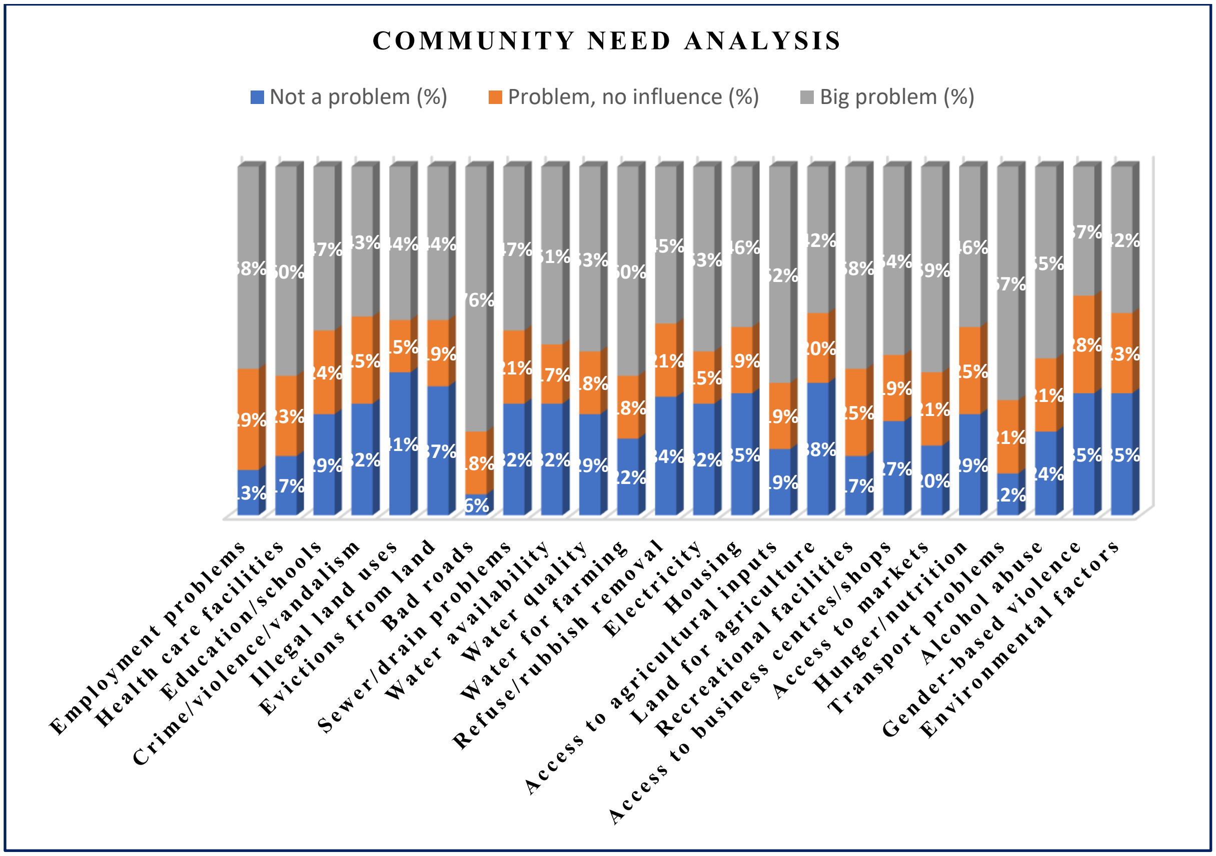


Figure 4-22: Figure 4 22 Community Needs Analysis

Respondents confirmed unanimous support for the project at 100%, indicating strong community acceptance of the proposed road construction. Regarding positive impacts associated with the improvement of the road, the respondents emphasized economic development (34%), particularly job creation, business growth, and improved livelihoods. They also highlighted the need for infrastructure improvements (26%), including better access roads, bridges, culverts, and drainage systems. In addition, transport improvements (15%) were noted, focusing on easier movement and reduced transport costs. Social services (14%), such as water supply, healthcare, education, and electricity, were also prioritized. Other respondents stressed community engagement and inclusion (7%), ensuring local participation in project activities, while a smaller proportion (4%) mentioned environmental and safety measures to safeguard communities against anticipated impacts.

CHAPTER 6: STAKEHOLDER CONSULTATION AND PUBLIC PARTICIPATION

5. STAKEHOLDER CONSULTATION AND PUBLIC PARTICIPATION

5.1 Background and Introduction

The Public Participation and Consultation process is a legal requirement by the Government of Kenya (GOK) and a mandatory procedure as stipulated in the Constitution and also by EMCA 1999 and EMCA (amendment), 2015 section 58, on Environmental and Social Impact Assessment (ESIA) for the purpose of achieving the fundamental principles of sustainable development. AfDB's Environmental and Social Operational Safeguard 10 & OS 7 (ESS OS 10& OS 7) therefore recognizes the importance of open and transparent engagement between project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social (E&S) sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.

Stakeholder engagement and consultation process in the ESIA process is undertaken to disseminate information to interested and affected parties, stakeholders, to solicit their views and consult them on Environmental, Social, resettlement and compensation issues surrounding the proposed project. Early consultation helps to manage public expectations concerning the impacts of a project and its expected benefits. Successive consultations are important as they provide opportunities for the Client (KeNHA) and respective community have inclusiveness in decision making process. Kenyan Legislation have laid emphasis on the need for meaningful, continuous consultation and disclosure of project activities at every level of project cycle.

Public participation ensures that due consideration will be given to public values, concerns and preferences when decisions are made. Hence, the stakeholder engagement process undertaken was beneficial in this way:

- The project team obtained local and traditional knowledge that may be useful for decision-making,
- Facilitating in consideration of alternatives, mitigation measures and alternatives
- Ensuring that important impacts are not over-looked and benefits are maximized with adverse impacts mitigated,
- Reducing conflict through the early identification of contentious issue,
- Provides opportunity for the public to influence project design in a positive manner,
- Improve transparency and accountability of decision-making, and
- Increase public confidence in the ESIA/RAP process.

In consultation with the Vulnerable Peoples (VPs) Free, Prior and Informed Consultations (FPIC) were undertaken in alignment with AfBD ESS OS 7 in all engagements and project preparation stgaes. The stakeholder engagement methodology for the VPs wthin the project corridor was designed to promote inclusive, transparent, and culturally appropriate engagement throughout the project life cycle. The approach ensured that vulnerable groups were provided with timely, relevant and understandable information about the project, its potential impacts , benefits, mitigation measures , and were give adequate opportunities to express their views, concerns , and preferences. Feedback obtained through these consultations informed project planning, design, impact assessment, mitigation measures even during project implementation, ensuring that the interests and concerns of vulnerable peoples are adequately considered and addressed. (A separate Vulnerable Peoples Plan (VPP) was developed)

5.2 Objectives of the Stakeholder Engagement Process

Stakeholder consultation is generally useful for gathering environmental and social data, understanding likely impacts, gender and cultural settings, determining community preferences, selecting project alternatives, and designing viable and sustainable mitigation measures. Stakeholder consultation during ESIA study process main aim is to disseminate information to interested and affected parties (PAPs), solicit their views and consult on sensitive issues. The specific aims of the Public Consultation and Participation process during the ESIA study were as follows;

- To inform the local people, leaders and other stakeholders about the proposed improvement of the road corridor to bituminous standards.
- To sensitize the community about the project and potential impacts on people and livelihoods.
- To promote project ownership by the KeNHA and beneficiaries in order to minimize conflicts;
- Obtain opinions and suggestions from the directly/indirectly affected persons on the Project impacts and recommendation of appropriate measures to mitigate them and later incorporate to the ESIA/RAP Study Report
- Obtain opinions and suggestions on the Project Concepts, Designs, etc. and therefore minimize conflicts and delays in implementation;
- To facilitate the development of appropriate and acceptable entitlements options;
- To increase long term Project sustainability and ownership; and
- To reduce problems of institutional coordination, especially at the different governments' levels through partnerships.

5.3 Legal Requirement Guiding Stakeholder Engagement Process

5.3.1 GOK National Requirements

5.3.1.1 The Constitution of Kenya, 2010

Consultation and Public Participation (CPP) is a mandatory requirement for proposed projects as entrenched in the Constitution of Kenya, 2010, and in the EMCA 1999 (amended 2015) section 58, by achieving sustainable development. Part III Section 17 of the Environmental (Impact Assessment and Audit) Regulations of 2003, further requires that all ESIA studies incorporate public consultation to ensure all parties interested in the proposed project are informed of anticipated project impacts and benefits, and that their views, concerns, and recommendations are incorporated in project planning, design, construction, operation, and decommissioning phases. The CPP process is further supported by the Kenya Public Participation Bill of 2018 further supports the CPP process.

5.3.1.2 The Environmental and Management Coordination Act- Legal Notice 32

Legal Notice 32 of 2019 titled "The Environmental (Impact Assessment and Audit) (Amendment) Regulations, 2019 public participation and consultation requirements states that the Proponent will:

(i) Seek the views of persons who may be affected by the project in consultation with the Authority (NEMA);
(ii) Publicize the project and its anticipated effects and benefits by erecting posters in strategic public places informing the affected parties and communities of the proposed project;
(iii) Hold public meetings with the affected parties and communities to explain the project and its effects, and to receive their oral or written comments.

(iv) Ensure that appropriate notices are sent out at least one week before the meetings and that the venue and times of the meetings are convenient for the affected communities and the other parties concerned.
(v) Publish a notice on the proposed project in a newspaper that has a nationwide circulation and announce in both official and local languages on a radio station with nationwide coverage.

Upon submission of the ESIA report to NEMA, the Authority shall, within fourteen days of receiving the report, invite the public to provide oral or written comments. If deemed necessary, the Authority may then hold a public hearing based on these comments.

5.3.2 AfDB Requirements

AfDB Operational Safeguard 10 (OS10) – Stakeholder Engagement and Information Disclosure require borrowers to carry out structured, inclusive, and continuous stakeholder engagement for projects with significant environmental and social risks. As reflected in AfDB guidance, "the nature, scope, and frequency of stakeholder engagement will be proportionate to the nature and scale of the project, and its potential risks and impacts." Early in project preparation, all affected and interested stakeholders, including vulnerable or marginalized groups, must be identified, and a Stakeholder Engagement Plan (SEP) developed. The SEP defines who will be engaged, how and when engagement will occur, how information will be disclosed in accessible languages and formats, and how feedback will be gathered and addressed. Engagement must be meaningful, culturally appropriate, and ongoing, ensuring stakeholders have genuine opportunities to understand the project and influence decisions.

OS10 also requires timely disclosure of relevant project information, including potential impacts, proposed mitigation measures, implementation timelines, and contact points for further engagement. A project-level Grievance Redress Mechanism must be established to receive and resolve complaints in a transparent and accessible manner. Stakeholder engagement must continue throughout implementation, with regular updates to stakeholders, monitoring of concerns, and adaptive responses where needed. All engagement activities, feedback received, and how stakeholder input informed project decisions must be properly documented and reported to demonstrate an effective and responsive engagement process.

5.4 Stakeholder Identification, Mapping and Analysis

Stakeholders are persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively. Stakeholder mapping is done to understand the interest and influence of different stakeholders in the project and their varied expectations.

5.4.1 Stakeholder Categories

For the proposed road project stakeholders include the following categories of persons or institutions:

A. Primary Stakeholders/Affected Parties: These are groups that will be directly affected (positively or negatively) by the project.

- The Project Proponent- KeNHA and the Ministry of Roads and Transport (MoRT)
- Immediate residents/ community members who may be affected by project activities directly such as
  - Pastoral Communities,
  - Affected Households
  - Businesses and Traders
  - Public institutions in the vicinity of the project

- Project-affected people: Individuals, households, and businesses directly impacted by land acquisition and project activities
- Project Area Administration Personnel, i.e., National Government Administrative Officials (NGAOs), i.e., Deputy County Commissioner, Assistant County Commissioners, Chiefs, Assistant Chiefs, Village / Council of Elders
- Community-based organizations, and local women and youth groups
- National and local government bodies that are responsible for infrastructure development, and economic and social welfare
- Vulnerable and Marginalized Groups: Including women, youth, elderly, persons with disabilities, and minority ethnic groups

B. **Secondary Stakeholders/ Interested Parties:** These groups are interested in the project but are indirectly impacted by the project.
   - Institutions, groups, and individuals who are involved in approving/implementing aspects of the project:
     - County Government of Elgeyo Marakwet and its various departments
     - National Government Parastatals such as NEMA, WRA, NLC, NDMA, NMK, etc.
   - Academic institutions
   - The local healthcare facilities
   - The local security agencies
   - NGOs active in the area

5.4.2 Stakeholder Mapping and Analysis

The stakeholder analysis process sought to prioritize identified stakeholders based on: interests and expectations in relation to the proposed project; required levels of participation for each stakeholder throughout the project lifecycle; degree of influence of each stakeholder group to the direction and success of the proposed project; interrelationships between different stakeholders and the convergence/divergence between their interests and expectations.

'Interest' measures the degree to which stakeholders are likely to be affected by the project and the degree of interest/concern they have in or about it.

'Power/Influence' refers to the leverage a stakeholder may have in relation to decisions either taken by or affecting the project and the degree to which they can affect project success/failure.

Table illustrates the recommended stakeholder communication strategy based on their level of influence/power and interest in relation to the proposed project.

Table 5-1: Communication strategy based on the stakeholder power/ interest matrix

Increasing level of interest	Some interest to significant interest	✓ Treat fairly, honor commitments made to these stakeholders, and principally endeavor to keep them satisfied insofar as balance of costs and benefits allow	✓ Strategic threat or opportunity - invest in engagement processes to understand concerns and develop solutions. Engage closely, develop strong relationship and influence actively
	No interest to little interest	✓ Low priority - provide access to general channels of information and feedback and monitor regularly	✓ Keep involved and informed, but ensure balance between the concerns of high influence stakeholders and those of people actually impacted by decisions
		No influence/power to little influence/power	Some influence/power to significant influence/power
	Increasing level of influence/power		

Power/Interest Rating Colour Scale

Green	**Very Low**
Yellow	**Low**
Orange	**Moderate**
Red	**High**

Scale for Categorizing Influence/Power and Level of Interest

Category	**1-2**	**3-4**	**5-7**	**8-10**
Influence/Power	**Very Low**	**Low**	**Moderate**	**High**
Level of Interest	**Very Low**	**Low**	**Moderate**	**High**

Table 5-2 presents the findings of the stakeholder analysis for the proposed project. This is a live matrix that will be updated before the commencement of and during every phase of the proposed Biretwo -Arror- Chesongoch(B12) road and associated spur roads(B124).

Table 5-2: Stakeholder Analysis

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
National Regulatory Bodies and Government Agencies	- Ministry of Transport & Infrastructure	- Enhanced connectivity - Improved transportation	9	9	Throughout the project lifetime	- **Official Letters** - **One on one meetings** - **Contractual Agreements**
	- Kenya National Highways Authority (KeNHA)	- The contracting Authority for the project - In charge of national trunk roads i.e., Class A & B roads	8	6	Throughout the project lifetime	- **Official Letters** - **One on one meetings** - **Workshops**
	- National Environment Management Authority (NEMA)	- Issues environmental-related permits (EIA License) and monitors compliance of operations - Inspects and monitors impact of the project on the environment - Grants or withdraws permits (such as EIA license, Effluent Discharge License)	8	6	Throughout the project lifetime	- **Environmental and Social Impact Assessment Report** - **Annual Environmental Audits**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
		- Impose measures (Improvement Orders) to fulfil legal obligations				
	- Directorate of Occupational Safety and Health Services (DOSHS)	- Issue Workplace Registration certificate to the EPC Company - Registers the upgrade works site as 'construction site'	7	4	Throughout the project lifetime	- **Annual OSH Audits** - **Official Letters** - **Workshop**
	- National Transport and Safety Authority	- Development and implementation of Road safety strategies	6	4	Throughout the project lifetime	- **Traffic Management Plans** - **Official Letters** - **Technical meetings** - **Workshop**
	- National Land Commission	- Land acquisition and resettlement planning - Manage public land on behalf of the national and county Governments. - Initiate investigations in the event of land injustice and recommend appropriate redress. - Monitor land use planning	6	4	Pre-Construction Phase	- **Official Letters** - **Technical Meetings** - **RAP Study**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
	- Kenya National Police Service	- Traffic Management Plan - Enforcement of traffic laws and regulations - Enforcement of general security	7	4	Throughout the project lifetime	- **Traffic Management Plans**
	- National Museums of Kenya	- Conservation of the natural environment - Interest in the conservation of archeological and cultural heritage sites (such as Rimoi National Reserve)	3	5	Pre-Construction Phase	- **Consultation Meetings** - **Development of Chance Find Procedures**
	- Water Resources Authority	- Confirm riparian boundaries & water abstraction conditions - Compliance with the Water Act - Buffer for major rivers within the project area	7	5	Throughout the lifetime of the project	- **Application for abstraction permits** - **Follow up approval of permits**
	- National Drought Management Authority (NDMA)	- Integration of drought/climate risk in the project	4	6	Pre-construction phase	- **Official Letters** - **Consultation meetings** -
Ministry of Interior and Coordination of National Government	- County Commissioner (Elgeyo Marakwet) - Deputy County Commissioner (Kerio	- Are Representatives of local communities that fall within their jurisdiction.	3	5	Pre-construction and construction phases	- **Official Letters** - **Tele conversations** - **Consultation Meetings**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
(National Government Administrative Officers)	Valley, Keiyo South and Keiyo North) - Assistant County Commissioner - Area Chiefs for the affected locations - Assistant Chiefs for the affected sub-locations - Council of Elders /Opinion Leaders from various settlements within the project area	- Concerned with community development and participation. - Facilitate community mobilization for engagement - Make security arrangements for project teams during fieldwork				- **Key Informant Interviews (KIIs)** - **Scheduled Public Barazas/ community meetings**
County Government of Elgeyo Marakwet	- Ministry of Roads, Transport and Public Works	- Liaison with National Agencies (KeNHA) in planning and design of transport systems - Road design to enhance the efficient transportation of people and goods. - Ensures integration with county roads and feeder networks - Promotes road safety near settlements, markets, and schools	7	8	Pre-construction and construction phases	- **Official letters** - **One-on-one meetings** - **KIIs** - **Design approvals** - **Workshop**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
		- Protect existing and planned county infrastructure				
	Ministry of Tourism, Culture, Natural Resources & Climate Change	- Manages natural resources and environmental conservation - Protect wildlife habitats and sensitive ecosystems - Safeguard cultural and archaeological heritage sites - Oversee vegetation conservation and land restoration - Promote climate-resilient infrastructure planning	4	5	Pre-construction and construction phases	- **Emails** - **Official letters** - **One on one meetings** - **KIIs** - **Workshop**
	Ministry of Lands, Physical Planning and Urban Areas	- Oversee land administration and tenure matters - Manage wayleave acquisition and compensation processes - Align the project with county spatial and urban plans - Address settlement and structure impacts	7	8	Pre-construction phase	- **Official letters** - **One-on-one meetings** - **KIIs** - **Design approvals** - **Workshop**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
		- Prevent unplanned ribbon development along the highway				
	Ministry of Health and Sanitation	- Compliance with the Public Health Act - Sanitary requirements for the workers - Welfare of labour force (medical conditions, ergonomics, etc) - Monitor communicable disease risk from labour influx	5	5	Pre-construction and construction phases	- **Official letters** - **Key Informant Interviews** - **Workshop** - **Worker Ergonomic Reports** - **EHS audit reports**
	Ministry of Education, Sports & Social Protection	- Social protection programs for vulnerable groups, i.e., children, the disabled, the elderly, and minorities - School safety near the road corridor	4	3	Pre-construction Phase	- **Official letters** - **KIIs** - **One-on-one meetings** - **Workshop**
	Ministry of Agriculture, Livestock Development & Fisheries Kerio Valley Development Authority	- Protection of pastoral livelihoods, rangeland systems, and fish value chains - Improved market access	5	5		- **Official letters** - **KIIs** - **One-on-one meetings** - **Workshop**
	Ministry of Trade, Gender, and Youth Affairs	- Local economic inclusion and social equity	5	8		- **Official letters** - **KIIs**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
		- Enterprise development and promotion of trade - Addresses GBV risks linked to labor influx - Supports skills development and livelihood opportunities				- **One-on-one meetings** - **Workshop**
	County Governor, Members of the County Assembly (MCAs):	- Represent the people in development matters (views/opinions/proposals) - Interested in the economic improvement of their areas of jurisdiction - Get political Mileage	7	5	Throughout the project lifetime	- **Official Letters** - **Public Baraza Meetings** - **One on one meetings**
Politicians	The Governor, Member of Parliament	- Get political Mileage - Economic improvement of their areas of jurisdiction	6	7	Pre-construction, Construction, and Operation Phases	- **One-on-One Meetings** - **Workshops**
- **Contractors & Sub-Contractors**	• TBD	- In charge of the design of the proposed toll optimization and upgrade works. - Cooperation with Govt. agencies and all other stakeholders	7	9	Throughout the project lifetime	- **One on one meetings** - **Official Letters** - **Formal Meetings**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
		- Compliance with the Kenya's construction and E&S laws and regulations - Successful completion of the project				
Utility Service providers (ICT, Water and Sanitation, electricity etc.	- Kenya Power - ICT service providers	- Relocation of their utilities from the proposed project upgrade ROW	4	6	Pre-construction, Construction	- **Emails** - **Focus Group Discussions (FGDs)** - **KIIs**
Affected Communities	Men, women, youth, community representatives) - Vulnerable groups e.g. - the elderly, disabled, women/widows, children/orphans, etc.	- Available job and business opportunities - First priority for locals in employment - Gender considerations in labour recruitment - General impact of the project on the community and its environment - Economic improvement of the area - Beneficiaries of CSR programs - Project Grievance Mechanism	8	9	Throughout the project lifetime	- **Official Letters** - **Phone** - **One on One Meetings** - **Formal Meetings** - **Media Announcements**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
Business Community	- Business owners/operators/traders operating close to the road	- Information sharing on the anticipated impacts on their businesses and timelines/duration for planning purposes. - Available opportunities for business	6	8	Preconstruction and construction phases	- **FGDs** - **Public Barazas** - **Surveys and questionnaires**
Affected Institutions (Workplaces, schools, churches, health centers, etc.	- Members who use or access land and resources in the project area - The general public in the areas of influence	- Information sharing on the impact of the project to the community and its environs. - The local population will be interested in the available job opportunities related to the project.	3	6	Throughout the project lifetime	- **Public Posters** - **FGDs/KIIs** - **Public Meetings/Barazas** - **Media announcements** - **Surveys and questionnaires** - **Project website (with information about the proposed additional works, including project updates, meeting schedules, and a way for stakeholders to provide feedback).**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
Road Users/Transporters	- Motorists (both private, public, and/or commercial) who commute on the road	- Give feedback on their road user experience. - Give recommendations on how to improve the road's efficiency and road-user experience	8	8	Throughout the project lifetime	- **Public Posters** - **FGDs** - **BID** - **Formal public meetings** - **Media announcements** - **Surveys and questionnaires**
CSOs/NGOs that have an interest in the project - **Have direct interest in the proposed activities' social and environmental aspects and that are able to influence the proposed activities directly or through public opinion.** - **May also have useful data and insight that could be incorporated in the**	- Clan leaders - World Vision - Kenya Redcross -	- Insights on pastoralist livelihoods, grazing patterns, and livestock migration routes that may be affected by the road; - Help identify potential risks of conflict over land, water, and pasture during construction; - Provide data on existing community resilience programs, especially those funded by donors; - Collaborate on mitigation measures to safeguard pastoralist interests. - Leverage clan networks to mobilize pastoralist	4	9	Pre-construction and construction phases	- **Emails** - **Official letters** - **Formal meetings** - **Workshops** - **Website**

Stakeholder Group	Stakeholders	Area of interest	Influence/Power	Level of Interest	Periods of Active Engagement	Method of communication
design stage to minimize project impacts		communities for meaningful participation				
	- Churches in the project areas such as the Catholic and AIC churches that support the community initiatives.	- Understand potential social impacts on vulnerable groups supported by the church; - Assess risks of inter-community tensions during construction	**3**	**4**		- Emails - Official letters - Formal meetings - Workshops - Website

5.4.3 Methodology for Stakeholder Engagement Process

Stakeholder engagement process used a mix of participatory methods and structured approaches to sensitize, inform, consult, and actively involve stakeholders at different levels within the project area. These methodologies integrated participatory, inclusive, and context sensitive techniques to promote meaningful engagement and ensure that the views of all stakeholders particularly vulnerable and marginalized groups are effectively captured and considered in decision-making.
The stakeholder engagement activities were undertaken concurrently to support ESIA and RAP processes as well as address PAP issues, general ESIA consultations targeted a broad range of stakeholders, including national and county government agencies, local administration, community leaders, civil society organisations, utility providers , bussinesses , public and private institutions, community members and potential PAPs. These consultations focused on obtaining views regarding the project rationale, anticipated environmental and social impacts , community concerns, mitigation measures, and opportunities / social benefits associated with project implementation.

RAP consultations specifically targeted potential PAPS through socio-economic surveys , asset inventories one on one household interviews during which verification of affected assets was undertaken and informing them onthe process of compensation and livelihood restoration measures.

The stakeholder engagement methodologies below were used in the various consultation phases:

a) Key Stakeholder Entry Level/leaders meeting
b) Community mobilization meetings/ Baraza
c) Focus Group Discussions
d) Key informants' interviews
e) Baseline Socio Economic Survey

5.4. 4 Introduction of the Project During Preliminary Stage

Consultations for the proposed road project were initially initiated from February 2024 during the needs assessment stages of the Biretwo-Arror Chesongoch Road by KeNHA, and since then the consultations have taken a continuous approach throughout the project phases. The stakeholder engagement process for the proposed project begun in the year 2024 led by the client (KeNHA) and have since been continuous. The consultant team begunpreliminary ESIA/RAP consultation process in the Month of August 2025, followed by a several phases of stakeholder engagements at different levels.

The preliminary phase consultations of this were with key stakeholder/leaders' meetings in the month of December 2025 respectively and Phase two was with the general community members and project affected persons within the proposed alignment in the month of April and May 2026 to ensure inclusive participation, effective information sharing, and incorporation of stakeholder concerns into project planning and mitigation measures.

The team undertook preliminary entry level meeting with key stakeholders and leaders in all the No.5 sub-counties and No.7 consultation meetings were held with the main objective being to sensitize and create awareness among the leaders through whom the message of the project implementation was to reach the grassroots in preparation of the ESIA/RAP study activities including community meetings with project affected persons and general community, cadastral surveys and pegging of the corridor, socioeconomic studies, gender assessment studies and valuation of affected properties. The response and support of the project was very overwhelming with the leaders committing to mobilize the communities towards cooperating with the consultant into the design phase exercise and project construction thereafter. The key leaders meeting attendance was as below; (See Appendix 3 list of attendance and Minutes of the meeting)

Table 5-3: Attendance of Key Stakeholders and Leaders Meetings(gendered)

S/No	Sub-County	Meeting Venue	Male (M)	Female (F)	Intersex (I)	Total
1.	Kerio Valley	Arror Community Library	32	13	0	45
2.	Keiyo South	Biretwo-Child Fund Board Room	18	8	0	26
3.	Keiyo South	Muskut- Asst. Chief Office	54	12	0	66
4.	Keiyo South	Nyaru- Chief's Office	35	19	0	54
5.	Keiyo South	Kamwosor- Community Hall	25	6	1	32
6.	Kesses	Kesses-DCC Office Hall	20	15	0	35
7.	Ainabkoi	Ng'arua-RCEA Church Hall	75	33	0	108
Total			**259**	**106**	**1**	**366**

5.4.3.2 Objectives of Preliminary Stakeholder Engagement Process

The main aim of having preliminary entry level meetings with the key leaders and locational stakeholders was the assumption that these are the decision makers that inform policy implementation regarding their department's position on the project and the community in general. The discussions were open-ended to allow freedom of expression and to permit the respondents to discuss any information that would be useful to the project. The objective of this meeting was also to get information from an institutional point of view. The list of participants included both National Government and County Government officers (who were majorly departmental heads together with other key opinion leaders in the communities were involved to enhance inclusivity

5.4.3.3 Key Emergent Issues and Concern from the Preliminary Meetings

While detailed minutes of the meetings proceedings are in the Appendix 3 this section outlines the key issues that emerged from preliminary sensitization and awareness meetings, concerns, clarifications and opinions registered. These are summarised in the matrix below;

Table 5-4: Summary of Key Issues, Concerns and Clarifications

	Issue	Focal Areas	Concerns and Opinions	Responses and Clarification
	Landownership and Documentation	All Corridor	▪ Challenges in securing landownership documentation. ▪ Government to consider assisting the PAPs in processing.	✓ Compensations will only be paid to bona fide landowners as proved through official ownership documentation ✓ Compensation will only be done on legal landownership documents ✓ Complete transactions on land (transfers on sales, inheritance processes, etc.)
			Delays in transfers of landownerships upon sales	✓ Landowners to finalize land transfers to the buyers ✓ Buyers assist, where possible, original landowners obtain title deeds
			High costs of succession processes	✓ Families have been encouraged to commence succession process where required ✓ Seek assistance from the County Administration in the succession process
			Family disputes on landownership	RAP process is not a conflict resolution forum families to sort out internal conflicts and disputes before actual compensation.
		Kesses	▪ Clarification on how landowners under the scheme ownership will be compensated	PAPs to give opportunity for RAP assessments and await guidance from the Government during implementation of the project.
	Vulnerability Issues	All Corridor	▪ Assisting the vulnerable persons in the succession processes and obtaining	✓ Community educations and livelihoods restoration programmes will be integrated into the RAP/ESMP Implementation process.

	Issue	Focal Areas	Concerns and Opinions	Responses and Clarification
			landownership documents due to the related costs ▪ Desire for a livelihood restoration program on the compensation process. ▪ Inclusion of the Vulnerable and women in the project	✓ Stakeholder engagement is a continuous process through various functions and platforms. ✓ A gender assessment study will be undertaken with recommendations of how they will be supported and included.
	Benefits and opportunities	All Corridor	▪ Employment opportunities, especially for the youth ▪ Criteria used to recruit construction workers. ▪ Indirect employment opportunities foreseen in the project. ▪ Use of local suppliers to the project with construction materials.	✓ This aspect was fully addressed and community informed to ensure they are eligible for employment, by having the right skills and national identification cards. ✓ Most casual labour will be sourced from the community and the third gender rule will apply. ✓ However, assured of employment at various levels through the project cycle ✓ Collaboration between the project management and the leadership
			Corporate Social Responsibilities (CSR)	✓ CSR is NOT an obligation but good practices ✓ Contractor(s) and KeNHA to consider CSR Policies and available resources through the project cycle ✓ Communities may prepare wish-lists to guide relevance of any possible CSR initiative. ✓ All requested CSR activities were recorded and reported for consideration by KeNHA during implementation.

	Issue	Focal Areas	Concerns and Opinions	Responses and Clarification
			▪ Bus station and boda-boda sheds	✓ Bus Stations will be provided based on functionality, economic potential and operations efficiency among other design parameters ✓ Areas to install Boda Boda sheds will also be mapped and included during project implementation.
	Livelihood Restoration Measures	Major trading centres	▪ Roadside Markets and Markets ▪ Consideration for Livelihood Restoration Measures for roadside traders	✓ Requests for improvement of roadside markets and local market centres. ✓ Loss of business will be compensated and alternative livelihood restoration measures will be recommended where appropriate.
	Valuation and Compensation of affected land	All Corridor	Compensation factors – Land, plants, trees, building structures, amenities	✓ Valuation process considers the land and all improvements on it ✓ Compensation based on market rates but also guided by comparable rates and replacement rates.
			▪ Title holders are deceased parents and succession not undertaken. ▪ What happens to the compensation?	✓ No compensation will be paid out without landownership documents (title deeds). ✓ Affected families are advised to commence the Succession Process early to avert a crisis and disappointments.

	Issue	Focal Areas	Concerns and Opinions	Responses and Clarification
			Partial severances – land and building structures	✓ RAP valuation assessments take records as they are ✓ Land acquisition process to make decision on criteria for full or partial land-take and buildings ✓ The decision on economic viability of balance portions will be determined at the point of land acquisition by the NLC.
			Cultural replacement and compensation – Grave yards	✓ The cost of relocation is considered, mostly to cater for facilitation of cultural activities.
			▪ Public Institutions – schools, health facilities, etc. ▪ Public land – road reserves, railway reserves, public forests and conservations areas	✓ Public institutions are handled on replacement basis ✓ Institutions will be engaged by KeNHA and NLC on utilization of public land and reserves for the project
			Wondering whether one can use their private Valuers for comparison	The official report will be from the KeNHA and NLC.
			What will happen to land where there are ongoing court cases?	✓ The RAP Implementation will not resolve land dispute matters –compensations will be held by the Government awaiting resolutions. ✓ Affected families should commence early measures to resolve their differences
			What is the mode of payment for lost property, cash, bank, Mpesa.	At the point of land acquisition, the options will be floated to the PAPs.

	Issue	Focal Areas	Concerns and Opinions	Responses and Clarification
			Roles of lawyers and other agents in assisting PAPs	PAPs advised to be wary of conmen in form of agents and/or lawyers through the compensation process
			How delayed compensations will be handled	Appropriate measures will be in place to mitigate unprecedented delay through the RAP Implementation process
			Improvements after the valuation process has been undertaken	✓ Valuation constitutes the thresh-hold of development. ✓ Valuation results are valid for 24 months after which the process will be reviewed.
			What happens to the residual PAPs – homes' ambiences, land use activities, access roads, livestock, schools, religious premises, etc.	✓ Specific reparation and corrective measures to residual PAPs to be formulated for consideration
	Special public utilities	Water, power and communication lines	Water supply lines, power lines, sanitation facilities, communication lines, etc.	All public service lines and utilities are to be relocated in collaboration with respective services providers.
			Access roads crossings	✓ All major roads crossing the corridor will be preserved and provided with appropriate culverts or overpasses. ✓ Other may be re-routed to be combined into common crossings

	Issue	Focal Areas	Concerns and Opinions	Responses and Clarification
	Survey Issues		▪ Extend of acquisition in terms of width.	✓ The survey maps will be prepared after the cadastral survey work that will also pick parcel boundaries, ✓ Factors and parameters that determines the final alignment will communicate in the detailed design stage.
	Topography management	Kimwarer-Nyaru route, Fluorspar – Kamwosor	Risks associated with cut-sections – safety, slope erosions and degradation	✓ The design team will ensure they integrated measures to prevent further environmental degradation. ✓ Sections with small elevations requiring cuts takes more land ✓ Slope protection initiatives to be instituted as stated in the ESMP ✓ Reforestation and soil retention activities have been recommended in the ESIA Report.
			Curves and bends	✓ The bends are designed to achieve design curvatures with minimal social and environmental implications.
	Biodiversity	All Corridor	Preservation and conservation of key bird species in Kesses Dam Sanctuary. Support in reforestation of trees along the corridor which will be cut	✓ Biodiversity studies are being undertaken to map these sensitive areas and proposed mitigation measures will be forming part of the ESMP. ✓ KeNHA have a programme for tree planting in place.

	Issue	Focal Areas	Concerns and Opinions	Responses and Clarification
	Project Timelines	All Corridor	Commencement of the actual construction	✓ Stakeholders were informed that currently the project is at design stage. ✓ Continuous stakeholder engagement will undertaken to keep them inform each project cycle.
	Health and Safety	All Corridor	Community expressed a concern about contractors leaving open excavation and unfinished works which possess a danger. Installation of safety devices such as bumps, signages, rubble strips, especially around schools and animal crossing section. Installation of road diversion	✓ Technical team will ensure appropriate road signages are installed. ✓ Alternative routes will be provided during construction and addressed through the traffic management plan under the ESMP. ✓ The project RRESIA will address mitigation measures for such and will be implemented through monitoring of the ESMP. ✓
	Grievances Gender Based Violence	All Corridor	How will the project handle grievances in the project, cases of GBV and sexual harassment from the contractor. Cases might increase during project implementation	✓ A Grievance Redress Mechanism Committee will be formed at locational level ensure issues are solved as efficiently as possible. ✓ This committee will be comprised of community members and local administration, further the report will develop as detailed GRM strategy. ✓ All workers will sign mandatory code of conduct
	Waste Management Storm Water	All Corridor	• Community members wanted the contractor to ensure he does dump waste appropriately and doesn’t channel storm water into their farms.	✓ The consultant informed the participants that it’s the responsibility of the contractor to identify a location and build a waste management segregation point, where waste

	Issue	Focal Areas	Concerns and Opinions	Responses and Clarification
				can be accumulated before it is collected by the County's waste handlers. ✓ The ESIA license for project also comes with such conditions imposed on the contractor.
	Material sites	All Corridor	• Restoration of borrow sites after use	• The community was informed the project committees should follow up with the contractor to ensure compliance as per the agreement with the landowners. • The NEMA license issued to the contractor also has conditions of rehabilitation of material sites. • Communities to ensure they have clear terms with the contractor on issues depth and width of borrowing
	Pollution	All Corridor	• Contractor to ensure dust on active construction sites is managed. • Noise and vibration levels maintained	• ESMP has addressed mitigation measures to ensure the environmental negative impacts are mitigated. • Air quality, noise and vibration measurement will be monitored periodically to ensure the community is safeguarded.
	Project Acceptance	All Corridor	• Support and Need for the project	• Stakeholder confirmed and affirmed support for the project and requested to immediate implementation. • All were in support of the project.

5.4.4 Key Informant Interviews

Preliminary stakeholder consultations, reconnaissance surveys, and baselined assessment identifed several project specific issues that required detailed information from individuals and institutions with knowledge , statutory responsibiliites , or direct influence on affected communiites.While general community meetings provided broader community perspective, they did not adequatley address and capture techinical, institutional, land administration, servcie delivery and sector specific concerns and need. Key stakeholders in the Elgeyo County, Sub Counties and Community level were identified and consulted with the objective of establishing the existing environmental, social - economic conditions, gather institutional and community needs within the proposed project area and linkage to the neighbouring areas. This was done through visits to various National, County, Sub County government, NGO's, CBOs offices and other community groups such as farmers groups, transport and market groups. Effort was made to collect all information relevant to the project and recommendation incorporated into the ESMP for monitoring during each of the project cycles.
The following stakeholders were engaged and one -on -one interviews held;

(i) County Governor -Elgeyo Marakwet
(ii) County Commissioner -Elgeyo Marakwet
(iii) County Director of Environment, Climate Change and Forestry
(iv) Kenya Wildlife Service
(v) CEC – Education
(vi) County Director – Education and Vocational Training
(vii) County Land Registrar
(viii) County Director of Lands
(ix) County Social Development Officer
(x) Kerio Valley Development Authority
(xi) Sub - County Public Health Officer
(xii) Sub County Children Officer
(xiii) Sub-County/Police Desk Gender Officer
(xiv) Sub County Administrators
(xv) Ward Administrators
(xvi) Market /Business community representatives
(xvii) St. Teresa Mission Hospital – Chesongoch
(xviii) Transporters Associations (public service vehicles, boda-bodas)
(xix) Key opinion leaders such as clan council elders
(xx) NGO's and CBO's (World Vision) among others.

The KII were used to complement information gathered through public consultations, household surveys, and focus group discussions (FDGs) by providing that technical, administrative, and local content insights necessary for the ESIA, RAP studies and design decisions. Summary of KII outcomes and recommendations has been outlined in the table below;

Table 5-5: Thematic Analysis of KII Key Issues, Concerns and Proposed Recommendations

Theme	Key Concern/issues raised	Proposed Recommendation
Land acquisition	• Delay in compensation might lead to disputes • Lack of land ownership documents might lead to conflict and delayed compensation	• Early disclosure and grievance mechanism to be developed • County Registrar to be consulted on land demarcation and adjudication. • NLC will disclose compensation awards as per constitution.
Dust and noise	• Health risk to communities	• Dust suppression and monitoring of noise levels during construction. • Contractor to work during the day
Road safety	• Risk to school children • Risk to pastoralism	• Speed bumps and crossings near schools • Road Safety Awareness to extend to schools and general community
Livehood disruption	• Loss of business income	• Market relocation and support programs • Provision of employment opportunities during construction
GBV/SEA risks/ Child Abuse	• Increased vulnerability might occur especially to VMGs	• GBV Action Plan and awareness • Develop a Child Protection Plan and awareness
School dropout risks	• Increased school going student might drop out to seek employment leading to early marriages and teen pregnancies	• GBV Action Plan and awareness to be extended to schools • Develop a detailed labour management Plan
Water use conflict	• Over abstraction of community water might result to water use conflict • Protection of community springs and water point	• Contractor to apply for water use abstraction permit. • Contractor to have his own water source for construction
Community liaison officer	• To be sourced within the community to ensure grievances are resolved on time.	• Request will be recommended to KeNHA
Employment opportunities	• Local community to be give first priority	• Local content as per guidelines is 70% casual labour.
Local Supply of construction materials	• Local community to be considered in provision of raw materials such as sand, murram	• Recommendation was noted.
Material sites	• Contractor to ensure material sites are restored after removal of murram	• Contractor to develop a material Site restoration and rehabilitation plan. • ESMP will recommend appropriate mitigation measures.

Theme	Key Concern/issues raised	Proposed Recommendation
Corporate Social Responsibility (CSR)	• Requests for a clear CSR component benefiting host communities; desire for CSR initiatives that deliver long-term economic and social value	• CSR priorities will be identified in consultation with community leaders and local authorities to ensure initiatives align with local development needs. • All CSR requests were noted and reported in a separately in this report.
Health	• Need to improve/equip the current facilities to cater for the increased labour influx • Risk of increase in communicable such as HIV/AIDS, STI, cholera • Risk of increase in drug and alcohols use • Improved road will ease transport costs for referral and emergency cases.	• HIV/AIDs, Drug use and Alcohol Abuse programme to be institutionalised. • Request For Improvement of Health Facilities Was Noted.
Improved livelihoods and income	• Improvement of the road will increase business and incomes for the locals • Tourism will resume especially for Rimoi National Reserve and need for improvement of the access road to the gate.	• These key positive impacts were noted especially on improved livelihoods and incomes brought about by accessibility and increased number of tourists.
Access Roads	• If the project could at least improve access roads to key institutions like schools and other access roads linking Iten and Baringo counties	• Request was noted for inclusion into the list of social requests attached.

5.4.5 Community Engagement Meetings/Barazas

The consultant team carried out number eight (8) meetings forming part of the community consultative meetings /barazas with both the general community and potential project affected persons from the three sub counties traversed by the proposed road corridor. This community and PAPs meetings took place between 8th April -18th April 2026 whereby a total of No.1497 (F=580, M= 917) as presented in the gender disaggregated table below.

In preparation for community and PAPs meetings process, the consultant developed a structured engagement schedule that was outlining the proposed meeting dates, locations, and sequence of consultations along the corridor. To support coordination at the local level, the consultants formally engaged the County Commissioner (CC) for Elgeyo Marakwet County and the respective Deputy County Commissioners (DCC) for the three sub counties both of whom had been consulted earlier during the project inception phase. Introductory letters were submitted to their offices together with the public participation schedule to facilitate mobilization of meetings at the locational level and secure administrative support.

Each meeting covered a defined project section and brought together stakeholders from the surrounding villages, locations and sub –locations. This approach ensured that communities residing within the project's area of influence had a representation and opportunity to receive project information and in return provide feedback and concerns in regards to the anticipated environmental and social impacts. The table below illustrated the distribution and schedule of the commuity meetings.

Table 5-6: Illustration of Geographical Distribution of the Community Meetings along the Road Corridor

Sub-County	Ward	Division	Location	Meeting Date	Meeting Venue
Keiyo Valley	Sambirir	Chesongoch	Murkutwa	8th April 2026	Kibaimwa Chiefs camp
			Chechan		
			Mon		
			Kibaimwa		
			Chesetan		
			Kiptumbur		
	Arror	Tunyo	Arror	10th April 2026	Arror Ward Admins office
			Chesuman		
Keiyo North	Emsoo	Central	Keu	11th April 2026	Keu Chiefs Camp
			Kabulwo		
	Tambach	Soy North	Kiptuilong	13th April 2026	Rimoi chiefs Camp
			Kamongich		
Keiyo South	Soy North	Soy	Chepsigot	14th April 2026	Biretwo Market
			Epke		
			Kibargoi	16th April 2026	Emsea-Kibargoi Chiefs Camp
	Soy South	Soy	Chemoibon	17th April 2026	Kapkayo Chiefs camp
			Soy	18th April 2026	Kimwarer Market
			Nyaru		

The NGAO officers played a critical role in mobilizing communities by notifying residents of the planned meetings and encouraging their participation across the various social groups. Follow up communication was undertaken to ensure that mobilization efforts were on track.Additionally, the DCC formally invited the county government officials who included the Sub County administrators, Ward Administrators and Members of County Assembly (MCA) who are representatives of specific areas within the project corridor and who later attended the community consultation meetings. Following these preparatory activities, public participation meetings were successfully conducted across the identified locationsproviding a platform for the general community to share their views, concerns, and expectations regarding the proposed road project.

Table 5-7: Community Engagement Meetings Gender Disaggregated

Elgeyo-Marakwet County			Number			%	
Date	**Sub-County**	**Meeting Venue**	**Male**	**Female**	**Total**	**M%**	**F%**
8th April 2026	Kerio Valley	Kibaimwa Chiefs camp	164	306	470	34.89	65.11
10th April 2026	Kerio Valley	Arror Ward admins office	62	15	77	80.52	19.48
11th April 2026	Keiyo North	Keu Chiefs Camp	115	19	134	85.82	14.18
13th April 2026	Keiyo North	Kamongich/Rimoi chiefs Camp	178	82	260	68.46	31.54
14th April 2026	Keiyo South	Biretwo Maket	145	90	235	61.70	38.30
16th April 2026	Keiyo South	Emsea-Kibargoi Chiefs Camp	134	34	168	79.76	20.24
17th April 2026	Keiyo South	Kapkayo Chiefs camp	70	11	81	86.42	13.58
18th April 2026	Keiyo South	Kimwarer Market	49	23	72	68.06	31.94
Total			**917**	**580**	**1497**	**61.25**	**38.74**

During the Barazas the consultant presented the proposed project road design components, ESIA, Gender Assessment (GA) process and Resettlement Action Plan (RAP) procedure to the local community as well as potential PAPs and in addition, feedback and suggestions from the community members and inputs for inclusion in the ESIA/RAP report and ESMP were noted. Additionally, the meetings were conducted in English and Kiswahili languages and interpreted to the local language where necessary. It is important to note that, in addition to the community meeting engagement process, Locational Grievance Redress Mechanism Committees (LGRMCs) were established through the nomination of members in each location, and separate focus group discussions were held with women, men, and youth respectively.

5.4.6 Findings of Community Engagement and Consultation Meetings

The table below presents a collective summary of the issues raised by participants and the responses provided by the Consultant during the community engagement meetings. Detailed minutes for each location are included in Appendix 3 of this report.

Table 5-8: Summary of Key Community Engagement and Consultation Issues Raised and Responses

No.	Issue / Concern Raised by Participants	Response Provided by Consultant / Project Team
1.	Concerns regarding land acquisition and potential loss of ancestral land.	• Land acquisition will be undertaken in accordance with the Resettlement Action Plan (RAP), consistent with national legislation and the African Development Bank's safeguard requirements. All affected persons will be identified, and compensation and livelihood restoration measures will be implemented prior to displacement through NLC.
2.	Lack of designated livestock crossing points, posing risks to animals and road users	• The project design will incorporate appropriate livestock crossing points and related safety features, informed by community consultations and Road Safety Awareness creation will be emphasized.

No.	Issue / Concern Raised by Participants	Response Provided by Consultant / Project Team
3.	Increased risk of gender-based violence (GBV), Sexual harassment and exploitation, together with Child Abuse associated with influx of construction workers	• The Contractor will implement a GBV Action Plan, Child Protection Strategy, including Codes of Conduct for workers, awareness programs, confidential reporting mechanisms, and referral pathways aligned with national systems and AfDB requirements. • Local residents and youth will be prioritized for unskilled and semi-skilled jobs during construction, subject to contractor requirements and labour laws.
4.	Limited employment opportunities for local youth	• The project will promote local employment opportunities through fair and transparent recruitment processes, with preference given to qualified local labor in line with applicable labor laws and AfDB standards at 70%.
5.	Potential soil erosion and landslides due to construction activities in steep terrain	• The project will integrate erosion control and slope stabilization measures into design and construction, including drainage management, climate resilience and structural interventions, in accordance with the Environmental and Social Management Plan (ESMP).
6.	Disruption of roadside businesses and livelihoods during construction	• Temporary economic displacement will be addressed in the RAP, including compensation and livelihood restoration measures for eligible affected persons, in line with AfDB safeguard requirements.
7.	Dust emissions affecting nearby households and vulnerable populations	• The Contractor will implement mitigation measures as outlined in the ESMP, including dust suppression, traffic management, and continuous monitoring to minimize health impacts.
8.	Risk of exclusion of vulnerable and marginalized groups from consultations and project benefits	• The project will ensure inclusive stakeholder engagement through targeted consultations and implementation of measures to enhance participation and benefit-sharing for vulnerable and marginalized groups, consistent with AfDB operational safeguards.
9.	Road safety concerns, particularly for school-going children and other vulnerable road users	• Road safety measures will be incorporated into project design and implementation, including signage, speed calming infrastructure, and community awareness programs, in line with a recommendation to have a Road Safety Awareness Program for the project.

No.	Issue / Concern Raised by Participants	Response Provided by Consultant / Project Team
10.	Potential disruption of water sources and irrigation infrastructure	• The project will avoid or minimize impacts on water resources through careful design such as installation of access culverts. Where impacts are unavoidable, affected infrastructure will be restored or improved in consultation with users/community.
11.	Community Liason Officers to be recruited from the community.	• Request was noted and the recommendation has been outlined in the ESMP.
12.	Raised concern about elephants in the region and some roaming the households/road corridor.	• The consultant acknowledged the presence of elephants, noting the project's proximity to Rimoi National Reserve. Mitigation measures will include wildlife warning signage, speed reduction zones, designated crossing points, and community sensitization to reduce human-wildlife conflict and vehicle collisions. Consultation with Kenya Wildlife Service (KWS) will also be undertaken for collaboration on appropriate mitigation measures.
13.	Community requested for several Access roads linking to markets, public infrastructure like schools, hospitals and other areas.	• Access roads to public institutions such as schools, health facilities, and markets will be assessed during the detailed design phase. Feasible improvements within the project scope will be considered. This request will also be submitted to KeNHA for consideration during construction.
14.	Concern: There was a massacre in 1992, and the victims were buried along the road corridor. Inquired whether there will be a cost for exhumation and reburial. (at Sambirir Ward)	• The project acknowledges the sensitivity of this concern. Any gravesites identified within the road corridor will be handled with dignity and respect. The cost of exhumation and reburial, including cultural or religious rites, will be borne by the project in accordance with Kenyan law through RAP.
15.	Materials be sourced from the community and proper rehabilitation of the borrow sites	• The project will prioritize sourcing of materials such as sand, ballast, and gravel from the community where quality, quantity, and timely supply can be met. Specific arrangements will be discussed with local suppliers during implementation. Material Sites rehabilitation and restoration measures will be incorporated in the ESMP.

No.	Issue / Concern Raised by Participants	Response Provided by Consultant / Project Team
16.	Community members raised concerns regarding the need to improve nearby hospital and health facility services, noting that improved road access alone may not address existing gaps in healthcare infrastructure as well as serving the expected population influx during construction.	• While acknowledging the importance of health service delivery, it was clarified that the road project does not include direct interventions in the health sector infrastructure. However, the project is expected to generate indirect positive impacts by improving physical access to health facilities, reducing transport time for patients, and enhancing emergency referral systems. The issue was documented and will be communicated to relevant County Government health authorities and KeNHA for consideration in their respective investment planning frameworks.
17.	Requested access culverts for access to households, proper drainage systems.	• Access culverts will be provided where necessary to maintain connectivity to homes, farms, and institutions. However, not every home may receive a dedicated culvert. Design decisions will be based on engineering standards, safety, and hydrological requirements. • Proper drainage systems will be designed as per the Hydrological studies are being conducted to ensure adequate drainage structures, including side drains, culverts, and bridges, are incorporated into the design to prevent flooding and erosion. • Box culverts will be considered where hydrological and topographical conditions require them, particularly in areas with high water flow or where access for livestock and vehicles is needed.

Chesetan Market- Sambirir Ward

Arror Ward Administrator grounds-Arror Ward

Kabulwo Chief's Camp – Emsoo Ward

Rimoi Chief Grounds – Tambach Ward

Biretwo Market – Soy Ward

Emsea Chief's Grounds – Soy North

KapKayo Market – Soy South Ward

Kimwarer Market – Soy South Ward

Plate 5-1: Illustration of the Community Participation and Consultation Process Conducted Along the Proposed Road Corridor in April 2026

5.4.7 Focus Group Discussions

During preliminary stakeholder consultations, community entry meetings, and baseline socio-economic assessments , it was observed that certain stakeholder groups had distinct experiences, vulnerabilities,and concerns that need to be addressed in smaller groups settings.In addition, some social issues required a more participatory and interactive engagement approach to faciliate open discussions and capture group specific perspectives.

FGDs information was crucial in supporting triangulation of the community meetings and KIIs information. A structured focused discussions questionnaire was used to gather detailed input on gender-specific needs, environmental, social, safety concerns, perceptions, potential exclusion and inclusion issues, benefit sharing, that pertain to the proposed road project. In this view, the team conducted a total of No.32 FGDs with an average of 30 minutes to specific groups(4 groups) who were local leaders, youth, women, men and each group incorporated the elderly, vulnerable and people with disability for each of the eight meetings held across the proposed corridor Each group comprised of number 10 participants though some forums they were more due to high numbers of attendance at the community meetings/baraza. The FDGs venues and locations have been highlighted on section above for community engagement meetings

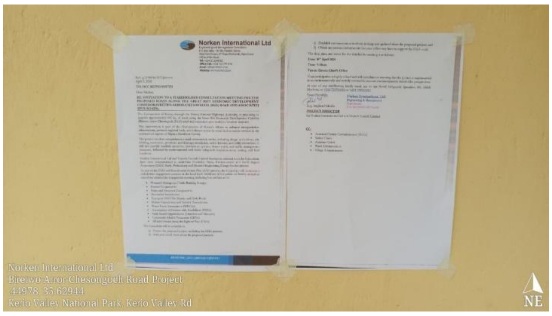
The discussions areas were as below;

- Women/men-only FGDs to explore barriers to participation and access to resources.
- To capture community perspectives, collective views, perceptions and experiences from specific groups.
- To understand social dynamics and community norms.
- To understand community environmental and social risks and mitigation measures.
- To assess project awareness and perceptions, attitudes on the proposed road project.
- To promote inclusive participation, this supports equity and inclusion into the project design.
- To validate and complement other data collected in the community meetings and KII.

The FDGs provided a platform for participants to discuss issues collectively and validate information obtained through baseline household surveys and general community meetings, and identify gender specific needs/concerns and recommendations that will influence and inform the ESIA,RAP and design proccess.

Male FGD Session

Women FGD Session



Display of Community Meeting Notices

Youth FGD Session

Plate 5-2:Plate 5 2 Illustration of the Community Focus Group Discussions Held within the Project Areas.

Analysis of Focus Group Discussion

Focus Group Discussions (FGDs) were conducted with men(male), women(female) and youth to obtain qualitative information on community perceptions, anticipated project impacts, proposed mitigation measures and stakeholder expectations. The discussions were guided by a structured FGD questionnaire administered through KoboToolbox. Completed KoboToolbox FGD records are provided in Annex 3, while the key findings from the discussions are summarised in Tables 5-8 to 5-10.

Table 5-9: Summary of Male Focus Group Discussion Key Findings

No.	Category	Key issues, Expectations and proposed recommendation
1.	Land & Compensation	• Land acquisition and compensation concerns, especially ancestral and community land to be dealt with at the clan level. • Fear of delayed payment or compensation due to lack of land ownership documents and issues of successions.
2.	Livelihoods	• Employment opportunities during construction local community to be given first priority. • Labour influx might lead to increased cases of HIV/AIDS, STIs hence need for creation of awareness.
3.	Safety and Health	• Inadequate Road safety features, training and awareness might lead to increased traffic accidents during construction and operation of the project. Hence the men in the community requested for adequate creation of awareness especially to school going children. • Increased accident risk along construction zones • Traffic Management Plans and safety awareness to be implemented
4.	Improved Security	• Response time from the police or other security agencies will be prompt due to the improved road and accessibility.
5.	Loss Livelihoods	• During construction disruption of access to farms and grazing areas might be restricted
6.	Environmental Management	• Increase in dust and noise pollution causing increase in respiratory diseases.
7.	Grievance Redress Mechanism	• Need for the project to employ/source community Liasson officer from community to hasten resolution of grievances.

Table 5-10: Summary of Women Focus Group Discussion Key Findings

No.	Category	Key issues, Expectations and proposed recommendation
1.	GBV/Social Risks	• Risk of gender-based violence (GBV) due to influx of workers • Increase in number of schools drop outs to join workforce • Increase in number of early marriages and teen pregnancies. • Increase in HIV/AIDs, STI prevalence hence need for awareness during construction.
2.	Livelihoods / Gender Inclusion	• Limited participation of women in employment opportunities during construction.
3.	Road Safety	• Increased road safety risks for children and pedestrians • Traffic Management Plans and safety awareness to be implemented
4.	Livelihoods	• Disruption of access to water points, farms or firewood collection areas, may increase burden on women daily activities.

5.	Health / Environment	• Health concerns including increased dust emissions may increase cases of respiratory diseases.
6.	Grievance Redress Mechanism	• Inclusion of women into the Grievance redress committees

Table 5-11: Summary of Youth Focus Group Discussion Key Findings

No.	Category	Key issues, Expectations and proposed recommendation
1.	Livelihoods	• Employment and apprenticeship opportunities for the youth • Local youth to be given first priority in both skilled and unskilled job opportunities.
2.	Economic Opportunities	• Increase in new Business opportunities (suppliers, transport, services) for the community especially youth.
3.	Road Safety	• Increase in Road safety risks for motorbike riders (boda-boda) especially during project operation. • Need for road safety awareness creation and targeted training. • Traffic Management Plans and safety awareness to be implemented.
4.	Social Risks /GBV	• Drug and alcohol abuse risks linked to construction workforce • Need for awareness creation Programme • Risk of gender-based violence (GBV) due to influx of workers • Increase in number of schools drop outs to join workforce • Increase in number of early marriages and teen pregnancies. • Increase in HIV/AIDs, STI prevalence hence need for awareness during construction.
5.	Capacity Building	• Consideration to be given on the job skills training and skills opportunities

In general, the Focus Group Discussions demonstrated clear differences in priorities across gender, Men largely emphasised land, livelihoods, and safety concerns; women highlighted social risks, health, and household impacts; while youth focused on employment, economic opportunities, and social behaviour risks.

5.4.8 Gender Considerations and Participation in Stakeholder Consultations

In line with the African Development Bank Integrated Safeguards System (Operational Safeguard 1), gender considerations were integrated into the stakeholder consultation process to identify differentiated project risks, impacts, and participation levels among women, men, youth, and vulnerable groups along the project corridor.

In line with AfDB OS 1, the gender analysis adopts an inclusive approach that considers the intersection of gender with vulnerability. This includes women and men from vulnerable groups identified during stakeholder consultations, including women-headed households, persons with disabilities (PWDs), the elderly, youth, and households affected by land tenure or succession challenges. These groups may face additional barriers to participation, access to information, compensation, employment opportunities, and grievance redress, and may experience project impacts differently.

5.4.9 Gender Participation Overview

A total of 365 stakeholders participated in the stakeholder consultations conducted in December 2025. Of these, 259 participants (71%) were men and 106 participants (29%) were women. Women were represented in all consultation locations, although their participation was consistently lower

than that of men. Female attendance varied by location, with relatively higher participation observed in Ainabkoi, Nyaru, and Kesses, and lower participation in Muskut and Kamwosor.
The participation pattern reflects the predominance of male representation within local administrative and land governance structures, which formed a significant portion of the invited stakeholders. Nevertheless, the presence of women across all meetings provided valuable insights into gender-specific concerns related to the project.

5.4.10 Gender-Differentiated Issues Identified

Women and community representatives highlighted several gender-related concerns during consultations. These included the need for fair and timely compensation, particularly for women-headed households and other vulnerable groups who may be affected by unclear land ownership, succession challenges, or informal land use arrangements.
Safety and mobility were repeatedly emphasized, especially for children, women traders, pedestrians, and livestock, due to increased traffic and construction activities. Participants stressed the importance of pedestrian crossings, traffic calming measures, and maintaining safe access to schools, health facilities, markets, and water points during construction.
Livelihood concerns were also raised, particularly regarding potential disruption to roadside trading activities, where women form a significant proportion of those affected. Communities called for inclusive and transparent local employment opportunities during construction, with explicit consideration of women, youth, and vulnerable groups.

5.4.11 GBV, Child Protection, and Worker Conduct

In several consultation sites, stakeholders raised concerns related to gender-based violence, child protection, and worker behaviour during construction. Participants emphasized the need for Codes of Conduct for workers, community sensitization, HIV/AIDS awareness, and accessible grievance redress mechanisms to prevent and respond to potential social risks associated with labor influx.

5.4.12 Gender-Responsive Community Priorities

Community-identified CSR priorities reflected gender-responsive needs, including improved health facilities, water supply interventions, access roads to schools and social institutions, street lighting in trading centres, and education-related support. These priorities align with women’s roles in caregiving, household welfare, and local economic activities.

5.4.13 Implications for Project Design and Implementation

The gender-related issues and participation patterns identified through stakeholder consultations will inform the Gender Analysis, Resettlement Action Plan (RAP), and Environmental and Social Management Plan (ESMP). In accordance with AfDB OS 1, stakeholder engagement will continue throughout the project lifecycle, with targeted measures to enhance women’s participation and ensure that gender-differentiated impacts, including those affecting vulnerable groups and PWDs, are appropriately addressed during project design, construction, and operation.

A separate Gender Assessment Analysis Report has been developed that details all the key issues and gaps that would be envisaged during project implementation and how they will be addressed.

5.4.14 Summary of Corporate Social Responsibility Requests from Stakeholders.

The following table 5-10 summarizes the Corporate Social Responsibility (CSR) requests raised during the key stakeholders’ consultation meetings for the proposed Great Rift Economic Development

Corridor, covering No.3 Sub-Counties that is Keiyo North, Keiyo South, Kerio Valley were the Phase 1 project lies.

The requests reflect the needs and priorities of local communities, including infrastructure, health, education, water, environmental conservation, and livelihood restoration support. The community was informed during the meetings that their requests would be forwarded to the KeNHA for assessment and consideration.

Local communities and the County Government have jointly identified over 120 social infrastructure requests along the 70 km main road and two planned spur roads. These have been grouped into 15 investable categories across key locations: Murkutwa, Arror, Emsea, Kapkayo, Nyaru, Biretwo, Kiwmarer, Emsoo, Tambach and the Governor's priority areas.

Table 5-12: Categories of Requested Social Infrastructure

Category	Description
1. Health	Hospitals, dispensaries, maternity wings, health center upgrades
2. Education	Schools, dormitories, boarding facilities, TVET, teachers' college, special school
3. Water & Sanitation	Boreholes, piped water, springs, pan dams, irrigation canals
4. Markets & Trade	Modern markets, cooling plants, cold storage, cattle dip, revolving funds
5. Value Addition & Industry	Mangoes, meat, potatoes, groundnuts, coffee processing factories/plants
6. Access Roads & Bridges	Feeder roads, link roads, town roads, security roads, bridges
7. Digital Infrastructure	Fibre optics, ICT infrastructure, street/security lighting
8. Sports & Recreation	Football fields, stadiums, sports training facilities
9. Tourism	Chebloch Gorge tourism center, Rimoi National Reserve access, bridge to Kapnorok
10. Governance & Security	DCC's office, police station, security lighting, materials testing lab
11. Livelihoods & Environment	Youth skilling, scholarships, environmental restoration, irrigation, pan dams

Table 5-13: Location Specific Corporate Social Responsibility Requested from the Key Stakeholders Meeting

Venue	Request
Murkutwa (Sambirir Ward)	1. A dormitory at Chesetan Primary School 2. Access Road linking Elgeyo -Marakwet and Baringo County 3. Market at Murkutwa 4. DCC's Office 5. Improvement of feeder roads in the area 6. Boys' dormitory at Queen of Peace School 7. Drilling of boreholes in Mon 8. Football field for Mogil Primary School 9. Access roads to schools along the corridor 10.
Arror	1. Upgrading of Kapchemutwa dispensary include a maternity wing 2. Construction of modern market at Arror Ward 3. Value addition projects: mangoes factory and meat processing facility 4. Fiber optic along the corridor 5. Police station 6. Additional roads: a. Arror-Koitilial -Katee- 16km

Venue	Request
	b. Chegilet-Kapchelal-Chebiemit-Anin – 33km c. Rimoi Access Road – 10km d. Tunyo-Sisya-Kapsowar- 10km e. Security road: Chesiy- Loposho-Bridge-Kipnai- 15km 7. Water boreholes 8. Water spring at Arror 9. TVET 10. Construction of classes at Kapsawach Primary School
Governor's Office	1. Access roads: a. Chegilet-Kapchelal-Chebiemit-Road b. Kabulwo c. Muskut-Simiti-Cheroget d. Access roads to institutions e. Town roads within centres: Biretwo, Arror, Chesongoch and Nyaru 2. Modern markets at Biretwo, Arror, Chesongoch and Nyaru 3. Modern Hospitals: a. 1no. fully equipped hospital in Arror, Chegilet and Muskut and consider including a maternity wing b. Upgrading referral hospital in Iten and Kapsowar 4. Livelihoods a. Irrigation canals and pan dams at Biretwo, Kabulwo, Kimwarer and Arror 5. Youth skilling programs and institutions along the project corridor 6. In-built fiber optic along the corridor 7. Environmentally friendly livelihood programme: environmental restoration of the escarpment; training of the locals on how to grow crops on the escarpment without damaging the environment 8. Value addition- mangoes factory for mangoes at Arror and Chesongoch 9. Value addition- potatoes factory at Nyaru 10. Modern girls boarding school at Chesongoch, Chesetan and Kimwarer 11. Boreholes or pipe water to schools in the project area 12. Access road to Rimoi National Reserve 13. Materials testing laboratory in the county 14. Establishment of sports training facility 15. Construction of a bridge connecting Rimoi National Reserve and Kapnorok Reserve in Baringo County
Emsea	1. Upgrading of a dispensary at Emsea to be a health center and should include a maternity wing 2. Access Roads: a. Emsea-Kaptere b. Emsea -Muskut c. Access to Emsea Secondary and Primary Schools 3. A Market at Emsea 4. Chebloch Gorge Tourism Centre 5. Upgrade Emsea Secondary School to be a boarding school 6. Upgrade a stadium at Emsea 7. Develop ICT infrastructure

Venue	Request
	8. Security lighting at Emsea 9. Bitumen road to the Technical and Vocational Education Training facility 10. Construction big parking at Chebloch gorge 11. Fiber optic along the corridor 12. Drill boreloes in every location 13. Extend the tarmac to institutions along the road 14. 1no. Mangoes factory 15. 1no. link road from the valley (Muskut) to Chepkorio 16. Street lighting at Emsea and every centre 17. Improve cattle dip at Emsea 18. Improve Kapsoo primary by building two dormitories, dining hall and kitchen 19. Cooling plants for fruits and milk 20. Pave access roads at the divisional head quarters 21. Improve Muskut hospital 22. Construct a bridge at Melwo 23. Provide revolving fund for women 24. Scholarship for youth 25. Cold storage facility for Tomatoes 26. Improve Melon boys school 27. Improve access road from Changach to Kapsoo 28. Establish teachers' training college in Emsea 29. Improve Chepsigot special school 30. Drill 4 no. boreholes at Sego, Melo primary, Emsea
Kapkayo	1. Fiber optic especially at Chepsirei where is a school and National Youth Service College 2. A hospital with a maternity wing 3. Access roads: a. Chemoibon-Kachalwo b. Kapkayo-Kachalwo 4. Development of Kapkayo Market 5. Stadium and ICT at the TTI 6. Lighting at Koimur centre 7. Boarding facility at Koimur Primary School 8. improvement of health facility at Kapkayo or improvement of fluorspar health centre 9. piped water to Kapkayo market- the water can come from the river or borehole 10. security improvement at TTI 11. Value addition for groundut- frying and packaging 12. Coffee plant at kippokpo
Nyaru	1. Installation of Fibre optics 2. Health centres. Level 2 dispensary to be upgraded to say level 4, and to include a maternity wing 3. Schools. Build a Special pry school and preferably to be a boarding school. 4. Construction of a modern Market

Venue	Request
	5. Construction of Kalwal access rd. The area is a coffee growing zone 6. Construction of a Potatoes cooling plant 7. Provision of a training field for youth 8. Scholarships for students 9. Collecting shades for farmers along the road.
Tambach /Rimoi areas	1. Upgrading of schools' laboratory, classrooms, 2. Upgrade Rimoi Dispensary 3. Borehole in the area 4. Planting of trees- All Corridor 5. Tarmac all feeder roads to the farms near river Kerio 6. Tarmac Nyawar Rimoi road joining the main road to Iten-its apx 10km 7. Upgrade Donge to Tambach road 8. Next to the Rivers 9. Street lights at Rimoi center 10. Sponsorships for their children & support the VMGs
Biretwo	1. Walbei primary School improvement of the facilities such as laboratory, gate 2. Completion of Biretwo community hospital- need a mortuary, wards, maternity ward & water tanks 3. Market- County Government have already allocated funds for this 4. Borehole at Chepsigot special school 5. Tree planting All Corridor especially in schools 6. 2km Biretwo town roads 7. Access road to Chepsigot chief's office 8. Access road to Katubei primary & secondary school 9. Kapchelimo- Kalwal access road 10. Walbei primary School improvement of the facilities such as laboratory, gate 11. Competition of Biretwo community hospital- need a mortuary, wards, maternity ward & water tanks 12. County Government have already allocated funds for this 13. Borehole at Chepsigot special school 14. All Corridor especially in schools 15. 2km Biretwo town road 16. Access road to Chepsigot chief's office 17. Footbridge to Access Road to Kaptubei primary & secondary school Kapchelimo- Kalwal access road ICT center at Biretwo Bursaries for collage & university students Build Biretwo police station Social hall at Biretwo
Baringo/Emon (Community Neighboring Kapkayo)	1. Emon School facilities to be improved 2. AIC Mogura school equipped with boarding facilities 3. Mogura and Kapkewa Health Center to be equipped with maternity wing and other wards 4. Streetlighting at the market 5. All corridor

Venue	Request
	6. Improve River Kiptunoi Bridge and access road 7. Box Culvert at River Mogura 8. Levelling of Chamblus playing ground 9. At Mogura and Kapkewa health center
Emsoo Ward Community	1. Improvement of school facilities such as equipping of Laboratory, supply of electricity 2. Fruit Collection Center 3. Construction of water pans/boreholes in some areas 4. All Corridor for tree planting 5. Tarmacking of Chegilet- Kapchelal- Chebiemit, Tungo- Kapsowar, Kabulwo- Barwesa 6. Installation of Fibre Optic 7. Construction of a parking bay/rest area at Kabulwo Market 8. At the Kabulwo Market


Left Frame :The project valuer explaining the process of compulsory land acquisation to stakeholders at Kamwosor and the Right Frame illustrates an ongoing discussion at Kessess Sub County Hall.


Left Frame: Shows community members and leaders at Muskut Chief's Office and Righ Frame: Illustrates a community leader raising a concern on the proposed road project at Nyaru – Kimwarer section.

The above illustrations show the Area Member of Parliament for Ainabkoi Hon.Samuel Chepkonga sharing his views and concerns to the community members at Ng'arua area.

Plate 5-3: Illustration of Preliminary Key Stakeholders Meetings held in December 2025

CHAPTER 6: ALTERNATIVES TO THE PROJECT

6. ALTERNATIVES TO THE PROJECT

This chapter presents an assessment of the alternatives considered during the planning and design of the proposed Roads Improvement Project. The analysis is undertaken in accordance with the African Development Bank (AfDB) Integrated Safeguards System (ISS) and applies the mitigation hierarchy of avoidance, minimization, mitigation, and restoration. The purpose of the alternatives analysis is to identify a project option that delivers optimal socio-economic benefits while minimizing adverse environmental and social impacts. The alternatives evaluated include the "No Action" scenario, upgrading of the existing road alignment, development of a new road alignment, alternative transport modes, construction materials and technology options, as well as climate-resilient and road safety design alternatives.

6.1 "No Action" Alternative

Under the "No Action" alternative, the project road would remain in its current condition as an earth-surfaced road, subject only to periodic grading and routine maintenance. This option would avoid immediate environmental and social impacts associated with construction activities such as vegetation clearance, material extraction, and temporary disruptions to communities. However, maintaining the status quo would perpetuate several existing challenges. The road would continue to experience seasonal inaccessibility, particularly during the rainy seasons, due to poor drainage, surface erosion, and localized flooding. Persistent dust emissions during dry periods would continue to affect public health, agricultural productivity, and roadside settlements.

In addition, the poor road condition would sustain high vehicle operating and maintenance costs, limit access to markets, schools, health facilities, and emergency services, and constrain economic opportunities for local communities. The lack of reliable transport infrastructure would also hinder the movement of agricultural produce and essential goods, thereby limiting income generation and livelihood diversification. During public consultations, stakeholders consistently expressed the need for road improvement to address safety, accessibility, and economic challenges. Consequently, the "No Action" alternative is considered not viable, as it fails to meet development objectives, community expectations, and regional connectivity goals.

6.2 Upgrading the Existing Alignment (Preferred Alternative)

The upgrading of the existing road alignment is the preferred project alternative. This option entails improving the current road corridor largely within the existing road reserve, with only minor horizontal and vertical realignments introduced where necessary to improve road geometry, drainage efficiency, and safety. The proposed improvements include the provision of a stabilized gravel wearing course, strengthening of weak or expansive subgrade sections, and the construction of appropriate drainage structures such as side drains, culverts, and floodways to manage surface runoff and reduce erosion.

Additional works under this alternative include the installation of road signage, traffic calming measures, and pedestrian warning features, particularly near schools, markets, and trading centres. Erosion control measures would be implemented on steep sections through slope protection and bioengineering techniques. This alternative offers significant advantages, including minimal land acquisition and displacement, reduced impacts on agricultural and grazing lands, a shorter construction period, and comparatively lower capital and maintenance costs. Importantly, it enjoys strong community acceptance, as it improves accessibility and safety while preserving existing settlement patterns. This alternative achieves a balance between improved mobility, safety, climate resilience, and environmental and social sustainability.

6.3 New Road Alignment Alternative

The new road alignment alternative would involve the development of an entirely new corridor separate from the existing road. While this option could allow for straighter alignments, improved design speeds, and potentially enhanced long-term performance, it presents significant environmental and social drawbacks. Establishing a new corridor would require extensive earthworks, vegetation clearance, and land acquisition, leading to increased resettlement and compensation requirements.

Furthermore, this option would likely result in impacts on natural vegetation, agricultural land, watercourses, and potentially cultural heritage sites, thereby increasing the project's environmental footprint. The need for additional environmental approvals and resettlement planning would significantly extend project timelines and costs. Community consultations indicated strong resistance to land take and displacement associated with a new alignment. Given the high financial, environmental, and social costs relative to the benefits, the new road alignment alternative is considered less desirable

6.4 Alternative Transport Modes

The Alternative modes of transport were also evaluated to determine their feasibility in meeting the project's objectives. Rail transport was considered impractical due to the absence of existing railway infrastructure in the project area and the high capital investment required. Water transport was ruled out because there are no navigable rivers or waterways within the corridor. Air transport was deemed unsuitable for routine passenger and freight movement due to its high operational costs and limited accessibility for rural communities. Pipeline transport was also considered inappropriate, as it cannot accommodate mixed passenger and goods transport needs. Given the terrain, settlement patterns, and travel demand, road transport remains the only feasible and appropriate mode for improving connectivity in the project area.

6.5 Construction Materials Alternatives

The project assessed the use of imported construction materials versus locally available materials. Imported materials, while sometimes offering uniform quality, would result in higher costs, longer delivery timelines, and increased greenhouse gas emissions associated with transportation. In contrast, the use of locally sourced materials such as gravel, sand, and aggregates was identified as the preferred option. Local sourcing reduces costs, supports local employment and enterprise development, strengthens local supply chains, and lowers transport-related emissions. All borrow pits and quarry sites will be managed in accordance with environmental best practices and rehabilitated after use to prevent long-term landscape degradation.

6.6 Technology Alternatives

Various construction and surfacing technologies were considered during project design. These included conventional gravel surfacing, mechanical stabilization of the wearing course, and the application of chemical dust suppressants in densely populated areas. The project also evaluated different drainage and erosion control technologies suitable for steep and flood-prone sections. Priority was given to proven, low-maintenance, climate-resilient technologies that can be implemented using locally available skills and equipment, thereby enhancing long-term sustainability and operational efficiency.

6.7 Climate-Resilient Design Variants

Several road safety enhancement options were evaluated to reduce accident risks during both construction and operation. These include the provision of speed humps and rumble strips in trading centres, improved sight distances at curves, reflective signage and edge markers, and pedestrian shoulders near schools, markets, and other sensitive receptors. The selected safety measures are designed to protect vulnerable road users while improving traffic flow and operational safety.

6.8 Road Safety Alternatives

The project assessed the use of imported construction materials versus locally available materials. Imported materials, while sometimes offering uniform quality, would result in higher costs, longer delivery timelines, and increased greenhouse gas emissions associated with transportation. In contrast, the use of locally sourced materials such as gravel, sand, and aggregates was identified as the preferred option. Local sourcing reduces costs, supports local employment and enterprise development, strengthens local supply chains, and lowers transport-related emissions. All borrow pits and quarry sites will be managed in accordance with environmental best practices and rehabilitated after use to prevent long-term landscape degradation.

6.9 Comparative Assessment of Alternatives

A comparative assessment of the alternatives was conducted using criteria such as land acquisition, resettlement requirements, environmental footprint, cost, safety, community acceptance, climate resilience, and economic benefits. The analysis demonstrates that the upgrade of the existing alignment performs best across most criteria, offering high economic and social benefits with relatively moderate environmental impacts and costs.

Table 6-1 Comparative Assessment of Alternatives

Criteria	No Action	New Alignment	Upgrade Existing (Preferred)
Land acquisition	None	High	Minimal
Resettlement	None	High	Low
Environmental footprint	Low	High	Moderate
Cost	Low	Very High	Moderate
Safety	Poor	Good	Good
Community acceptance	Low	Low	High
Climate resilience	Poor	Moderate	Good
Economic benefit	Low	Moderate	High

6.10 The Justification of the Preferred Alternative

The upgrading of the existing road alignment is recommended as the preferred alternative because it minimizes land take and resettlement, is cost-effective, and can be implemented within a relatively short timeframe. The option supports the use of local materials and labour, delivers immediate improvements in road safety and mobility, and enhances access to markets, social services, and emergency response. It also reduces dust emissions and erosion impacts in settlement areas while delivering strong economic returns and supporting regional connectivity.

6.11 The Justification of the Preferred Alternative

Following a comprehensive evaluation of all feasible alternatives, the improvement of the existing road corridor incorporating targeted realignments, enhanced drainage, a stabilized gravel wearing course, and road safety installations, emerges as the most practical and sustainable option. The preferred alternative promotes equitable access, stimulates local economic development, reduces travel times, and aligns with the AfDB Integrated Safeguards System and national environmental and social policy objectives.

CHAPTER 7: CLIMATE CHANGE SCREENING AND ADAPTATION

7. CLIMATE CHANGE SCREENING AND ADAPTATION

7.1 Introduction

This chapter presents the Climate Change Risk Assessment (CCRA) and adaptation strategy for the proposed upgrading of the B122 (Kimwarer–Emsea), B124 (Nyaru–Kapkayo), and B126 (Biretwo–Arror–Chesongoch) road corridors in Elgeyo Marakwet County.

The corridors traverse a highly dynamic physiographic system comprising steep escarpments, deeply incised river valleys, and transitional upland plains. These landscapes amplify climate sensitivity, particularly where short-duration, high-intensity rainfall interacts with unstable slopes, concentrated drainage pathways, and highly weathered volcanic soils.

This chapter builds on:

- Project description (Chapter 2)
- Baseline environmental conditions (Chapter 3)
- Stakeholder engagement (Chapter 4)
- Alternatives analysis (Chapter 5)
- Pavement design (Chapter 6)
- Hydrological investigations (Chapter 7)

7.2 Policy Context

The assessment complies with:

1. **International Safeguards**: The AfDB Integrated Safeguards System (ISS), specifically under Operational Safeguard 1. This safeguard mandates systematic climate risk screening, vulnerability mapping, and the explicit economic tracking of targeted "adaptation premiums" for all major infrastructure investments.
2. **National Legislation**: Kenya's **Climate Change Act (2016)** and the **Environmental Management and Co-ordination Act (EMCA, Cap 387)**. These statutes require integration of climate change vulnerability assessments into the statutory Environmental and Social Impact Assessment (ESIA) process.

7.3 Methodology

The assessment adopts a multi-layered, approach integrating climate science, GIS terrain modelling, and engineering vulnerability interpretation. The methodology is aligned with:

- PIARC Climate Change Adaptation Framework
- ROADAPT / RIMAROCC risk assessment approach

These frameworks ensure systematic integration of climate data into infrastructure planning through a structured hazard–exposure–vulnerability approach.

7.3.1 Data Sources

The following datasets were used:

- Historical climate records (1901–2024) from the World Bank Climate Knowledge Portal (CCKP)
- Gridded Climate Research Unit (CRU) datasets
- Downscaled climate projections from IPCC CMIP6 ensemble models (SSP2-4.5 and SSP5-8.5)
- FABDEM (bare-earth 30 m Digital Terrain Model)

7.3.2 Analytical Workflow

The assessment followed three integrated stages:

(1) Climate Trend Analysis
Observed and projected temperature and precipitation trends were analysed to establish baseline and future climatic conditions relevant to the 2030–2050 design horizon.

(2) Terrain-Based Exposure Modelling
Road alignments were segmented at 100 m intervals and intersected with slope, drainage proximity, and elevation derivatives from FABDEM to determine spatial exposure classes.

(3) Engineering Risk Mapping
Hazard, exposure, and vulnerability parameters were combined using a structured matrix approach consistent with PIARC/ROADAPT principles to generate qualitative risk classes.

7.4 Design Life and Planning Horizon

The proposed project roads are engineered for a 20-year operational design life extending from 2030 to 2050. Within this horizon, climate risk is dominated not by gradual change but by:

- Intensification of extreme rainfall events
- Increased frequency of convective storm systems
- Rapid geomorphic response in steep terrain environments

The assessment therefore prioritizes **event-driven hazards** over long-term climatic averages. Long-term centennial climate change signals (post-2050) are considered outside the primary engineering design envelope.

7.5 Climate Trends and Projections

7.5.1 Observed Climate Trends (1901–2024)

Historical meteorological data for Elgeyo Marakwet County indicate a sustained, long-term warming trend and an intensification of the hydrological cycle. Mean annual temperatures have increased by approximately 0.7°C–1.0°C since 1901, with an accelerated rate of warming recorded over the last three decades.

Historical precipitation profiles demonstrate high inter-annual and decadal variability, typical of the East African Rift Valley region. However, smoothed long-term time series indicate a structural upward shift in baseline precipitation. Total mean annual rainfall has expanded from a historical baseline of approximately 1,050 mm/year to over 1,500 mm/year in recent decades.

The dominant signal is not uniform rainfall increase but a shift toward higher intensity, shorter duration storm events, which significantly increases erosion and flood risk in steep terrain.

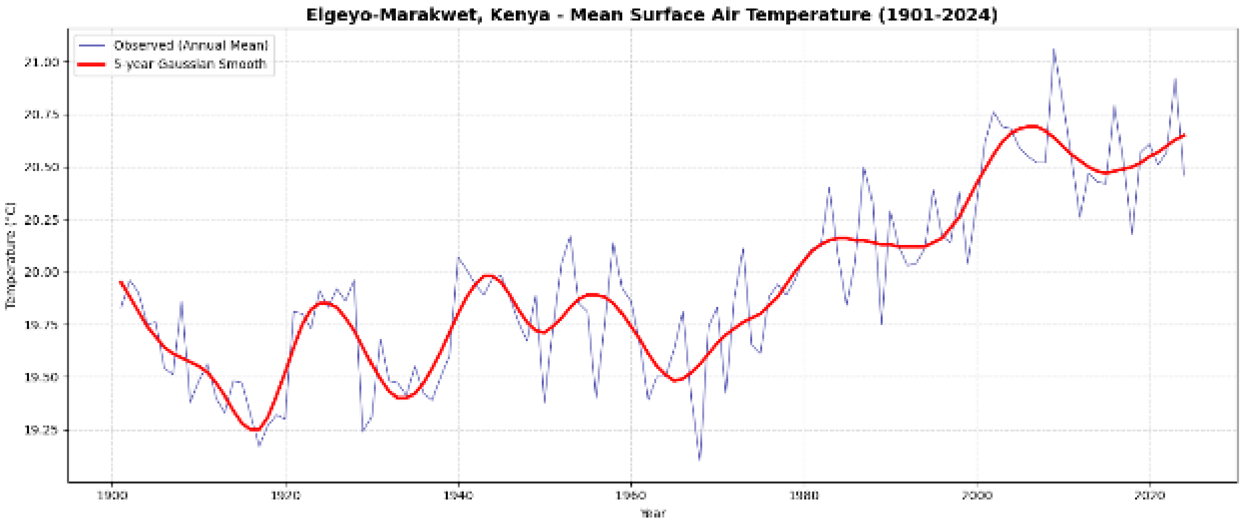


Figure 7-1: Observed Annual Average Surface Air Temperature for Elgeyo Marakwet County(1901-2024)

Data source: World Bank Climate Change Knowledge Portal (CCKP); analysis and visualization by author.

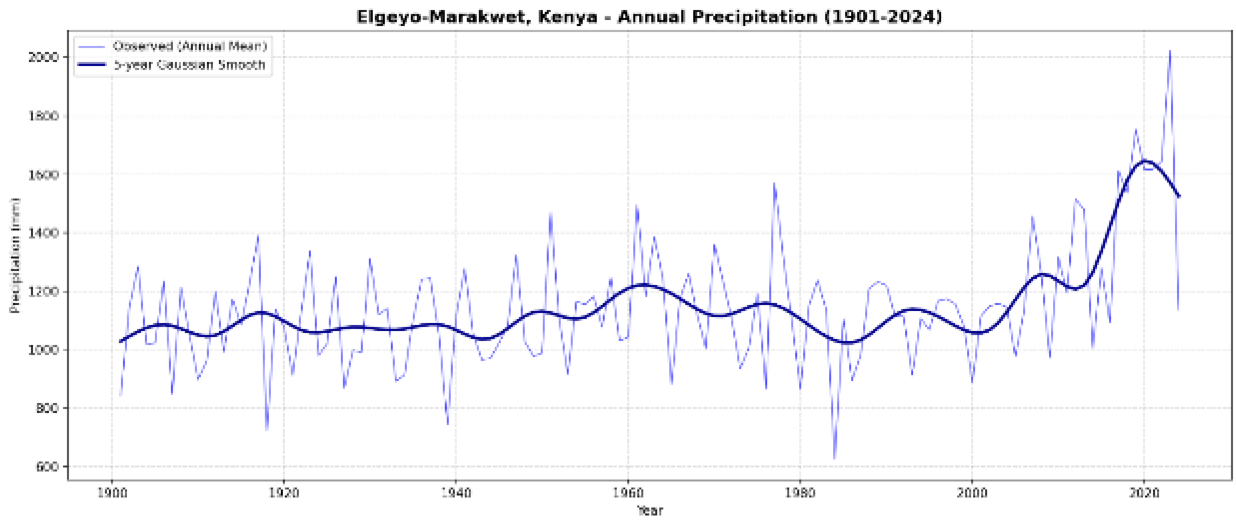


Figure 7-2: Observed Annual Precipitation for Elgeyo Marakwet County (1901–2024)

Data source: World Bank Climate Change Knowledge Portal (CCKP); analysis and visualization by author.

7.5.2 Future Climate Projections (2030–2050)

Downscaled multi-model climate ensembles project a continuous escalation of both thermal and hydrological variables across Elgeyo Marakwet County over the 20-year asset design life:

- **Temperature Projections**: Mean annual temperatures are projected to increase by **+1.0°C to +1.5°C** by 2050 across all evaluated emission pathways (SSP2-4.5 to SSP5-8.5). The frequency of extreme heat days—where ambient temperatures on the lower valley floor exceed 38**°C** is projected to increase significantly.
- **Precipitation Projections**: Mean annual rainfall is projected to experience a modest baseline increase of +5% to +15% (high uncertainty) by mid-century, though model variance remains high. The most consistent climate signal across the ensembles is the intensification of extreme

rainfall events. Short-duration, high-return period storms (the 25-year and 50-year events) are projected to intensify by **10% to 20%** in total volumetric discharge, driven by a higher frequency of severe storm events.

These projections confirm that hydro-climatic extremes are the dominant design driver.

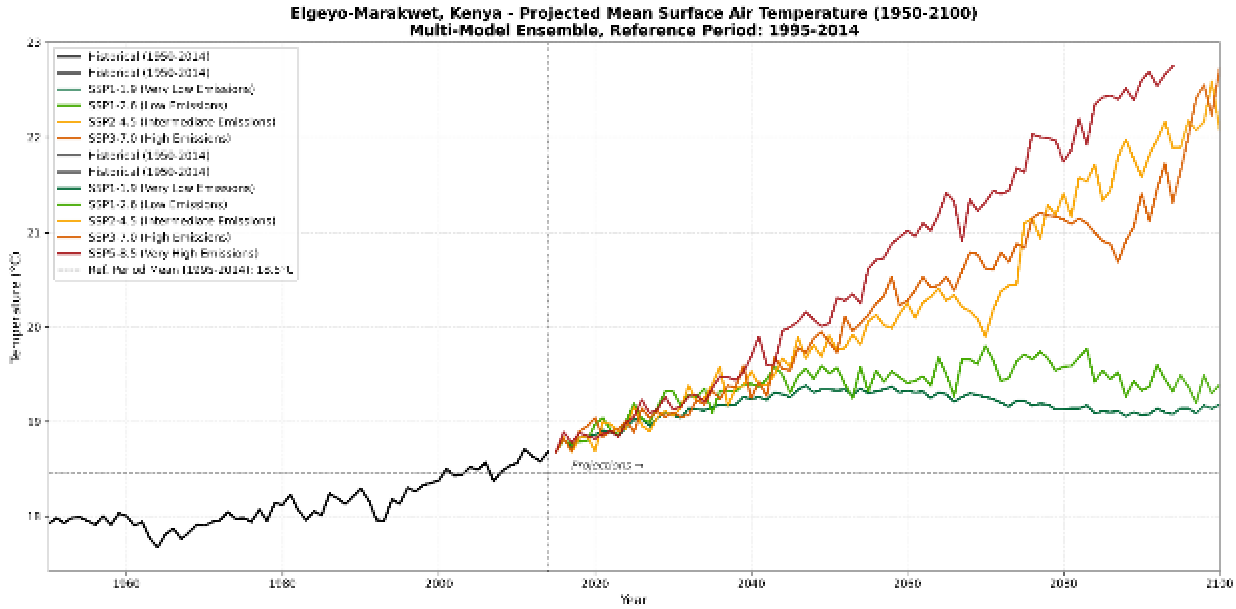


Figure 7-3: Observed Annual Average Surface Air Temperature for Elgeyo-Marakwet County (1901–2024).

Data source: World Bank Climate Change Knowledge Portal (CCKP); analysis and visualization by author.

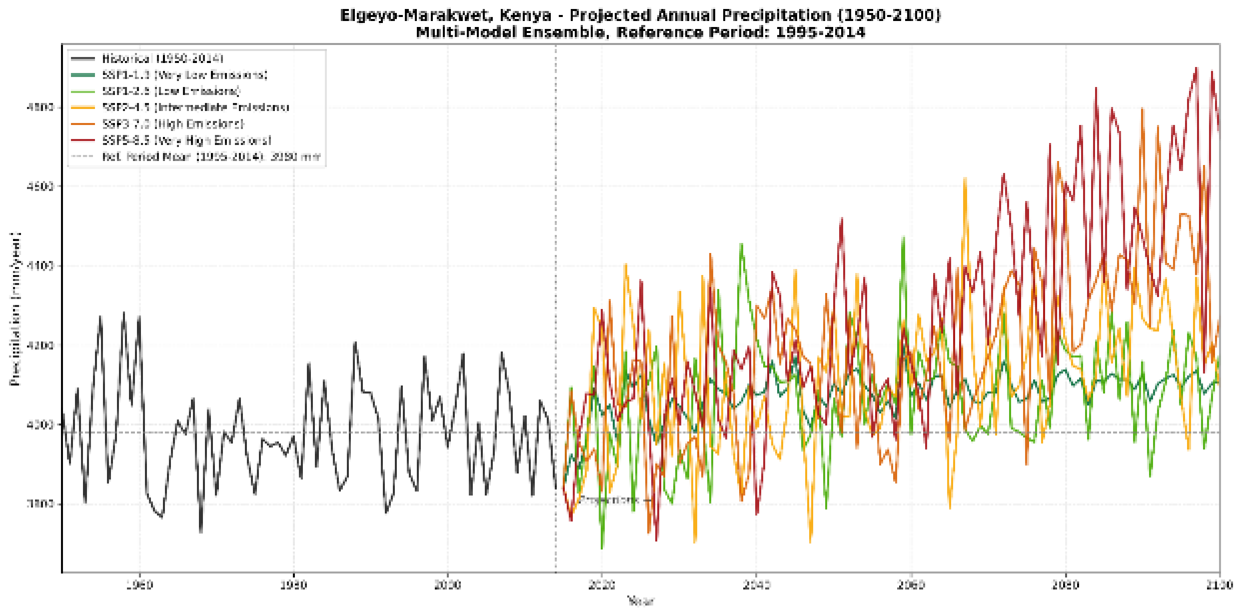


Figure 7-4: Project Annual Precipitation for Elgeyo Marakwet County (1901–2024)

Data source: World Bank Climate Change Knowledge Portal (CCKP); analysis and visualization by author.

7.6 Climate Risk Assessment Methodology

7.6.1 Conceptual Framework

The climate risk evaluation along the proposed road corridors was conducted by modeling risk as the functional interaction of three variables:

Risk = Hazard × Exposure × Vulnerability

This methodology operationalizes the PIARC International Climate Change Adaptation Framework and the ROADAPT methodology [PIARC Framework, Roads for Today-Adapted for Tomorrow]. The structure was further operationalized through GIS-based terrain modelling using FABDEM (30 m resolution) and road segmentation analysis.

Hazard (H)- Climate hazards represent the physical manifestation of atmospheric shifts over the 20-year project design life (2030–2050). Hazards are classified based on their capacity to induce physical or structural stress on civil infrastructure assets:

- **H1:** Low-intensity climatic variation
- **H2:** Moderate rainfall and temperature variability
- **H3:** High-intensity storm events (increased extremes)
- **H4:** Extreme and flood-triggering rainfall events

Exposure (E)- Exposure reflects the physical setting and geomorphic positioning of the infrastructure assets within the landscape. The terrain metrics are grouped into four exposure vectors aligned with the terrain classification standards mandated by the **Road Design Manual (RDM) Volume 1: Geometric Design**:

- **E1:** Flat valley floors
- **E2:** Rolling terrain
- **E3:** Steep mountainous terrain
- **E4:** Escarpments and active drainage corridors

Vulnerability (V)- this represents the internal structural sensitivity of specific infrastructure components and their inherent capacity to suffer structural degradation or full failure when exposed to a climate hazard:

- **V1:** Subgrade and foundational layers
- **V2:** Pavement structures
- **V3:** Drainage infrastructure
- **V4:** Slopes, bridges, and critical structural elements

7.6.2 Risk Integration Approach

The interaction of H–E–V parameters is resolved through a structured matrix to produce qualitative risk classes (LOW, MEDIUM, HIGH, VERY HIGH).

This ensures a translation from climate forcing to engineering consequence across the entire road network.

7.7 Climate Risk Results

7.7.1 Overview of Risk Distribution

The analysis shows that climate risk is strongly controlled by **terrain morphology rather than uniform climatic exposure**.

- Escarpments and river crossings exhibit highest risk concentration
- Mid-slope areas show erosion-driven instability

- Valley floors are dominated by drainage and pavement stress

7.7.2 Corridor-Level Risk Characterization

B126 (Biretwo–Arror–Chesongoch)

The Biretwo–Arror–Chesongoch corridor (B126) extends along the floor and lower escarpment of the Kerio Valley, where the alignment is continuously shaped by a dense network of seasonal and perennial river systems draining from the Cherangani Hills. This positioning places the corridor within an active fluvial system, where both channelized flows and overland runoff processes strongly influence infrastructure performance.

The corridor exhibits a clearly stratified risk distribution driven by topography, hydrology, and exposure conditions. Approximately 5% of the alignment falls within the low-risk category, primarily located on relatively stable valley floor sections where climate stressors remain limited and structural responses are well within design tolerances. A further 70% of the corridor is classified as medium risk, reflecting widespread exposure to moderate hydrological variability, including extended wet-season conditions and periodic waterlogging that gradually affects pavement performance. High-risk conditions account for about 20% of the alignment and are mainly associated with sections influenced by intensified storm runoff and proximity to active drainage channels. The remaining 5% falls within the very high-risk class, concentrated at river crossings and dynamic channel interfaces where extreme flow conditions dominate.

The most critical vulnerabilities are concentrated at river crossing structures and their immediate approaches. In these locations, intense convective cloudbursts (H3) and episodic flash flood events (H4) interact directly with active drainage convergence zones classified as high-exposure buffers (E4). This interaction generates severe hydraulic forces, leading to scour and undermining of bridge foundations, including abutments, piers, and approach embankments, which fall within the highest vulnerability class (V4). These sections therefore represent the principal drivers of very high-risk classification along the corridor, despite their relatively limited spatial extent.

On the valley floor, where medium-risk conditions dominate, extended wet-season rainfall (H2) interacts with low-gradient terrain (E1), resulting in persistent waterlogging and gradual reduction in subgrade strength. Over time, this leads to progressive deterioration of flexible pavement layers (V2), particularly through moisture-induced stripping and loss of structural cohesion. Although these impacts are less abrupt than those observed at river crossings, they represent the dominant maintenance challenge across most of the corridor.

To address these spatially differentiated risks, the engineering response prioritizes hydraulic resilience and structural protection. Bridge abutments are to be relocated inland where feasible to reduce exposure to active channel migration. All cross-drainage structures are designed with an enhanced hydraulic safety factor of 1.22 to accommodate increased peak flows associated with climate intensification. In addition, critical foundation zones are reinforced using heavy wire-crushed rock gabions to dissipate hydraulic energy and reduce scour potential, ensuring long-term stability of river crossing infrastructure.

B124 (Nyaru–Kapkayo)

The Nyaru–Kapkayo corridor (B124) traverses the upper escarpment zone of Elgeyo Marakwet, a geomorphologically complex landscape characterized by steep gradients, deeply incised valleys, and highly weathered volcanic formations. These conditions create a naturally unstable environment where both hydrological acceleration and slope failure processes are highly sensitive to climatic variation.

Across the corridor, risk distribution is strongly controlled by slope steepness and exposure class. Approximately 23.58% of the alignment is classified as low risk, primarily located in relatively stable transitional terrain where baseline climate variability remains within manageable thresholds. A further 29.87% falls within the medium-risk category, reflecting moderate exposure to rainfall variability and localized drainage stress. The largest share**,** 44.03%, is classified as high risk and is predominantly associated with mountainous terrain. A smaller but critical portion, 2.52%, falls within the very high-risk category, concentrated along escarpment cliff faces and structurally fragile cut sections.

The high-risk mountainous segments are primarily influenced by intensified storm rainfall (H3), which interacts with steep mid-slope gradients (E3). This combination accelerates surface runoff, leading to erosion of side slopes and repeated stress on drainage infrastructure such as side drains and miter drains (V3). These processes manifest as progressive channel incision and localized embankment instability, particularly during peak rainfall periods when hydraulic conveyance capacity is exceeded.

In contrast, the very high-risk escarpment sections represent the most critical instability zones along the corridor. Here, extreme convective rainfall events (H4) act directly on highly fractured escarpment terrain (E4), where slopes exceed 31 degrees and geological discontinuities are prevalent. This interaction results in rapid pore-water pressure buildup, significantly reducing shear strength within the volcanic soils and bedrock interfaces. The consequence is a heightened susceptibility to deep-seated landslides and large-scale mass wasting affecting cut slopes and adjacent road formations (V4). Although spatially limited, these zones define the upper bound of risk severity for the corridor.

The engineering response is therefore strongly focused on slope stabilization and subsurface water control. Mechanical benching is applied to reduce effective slope angles and interrupt potential failure planes, while high-tensile steel drapery mesh anchored with rock bolts provides immediate containment against rockfall hazards. Complementing these surface interventions, subsurface horizontal drainage systems are installed to relieve pore-water pressure and enhance long-term geotechnical stability under sustained or extreme rainfall conditions.

B122 (Kimwarer–Emsea)

The Kimwarer–Emsea corridor (B122) represents a transitional geomorphic system extending from high-altitude uplands into the lower Kerio Valley basin. The alignment traverses a heterogeneous landscape composed of rolling hills, mid-slope descents, and low-lying depositional plains characterized by variable drainage efficiency and mixed soil conditions.

The risk profile of the corridor reflects this spatial diversity. Approximately 40.80% of the alignment classified as low risk, mainly concentrated in flat or gently rolling terrain where climatic variability produces limited structural stress. A further 39.80% falls within the medium-risk category, where moderate rainfall variability and terrain gradients introduce localized drainage inefficiencies. High-risk conditions account for 19.40% and are primarily associated with steep descent zones where runoff concentration becomes significant. No very high-risk segments are recorded along this corridor, reflecting the absence of extreme escarpment or active river convergence conditions comparable to those observed in B124 and B126.

In the high-risk descent sections, intensified storm events (H3) interact with steep mid-slope terrain (E3), generating rapid runoff acceleration and elevated flow velocities. This leads to erosion along unlined drainage channels and progressive undermining of roadside embankments, particularly affecting hydraulic structures classified as highly vulnerable drainage assets (V3). These impacts are episodic but can be severe during peak rainfall events, especially where flow concentration exceeds design expectations.

The low and medium-risk portions of the corridor are governed primarily by baseline climatic conditions (H1 and H2) interacting with low-gradient terrain classes (E1 and E2). In these zones, the dominant climate impacts are gradual rather than catastrophic, typically manifesting as moisture accumulation, seasonal softening of subgrade layers, and thermally induced pavement deformation. These processes primarily affect flexible pavement systems (V2), resulting in rutting, minor cracking, and reduced service life if not adequately maintained.

To address these differentiated risks, the design strategy emphasizes improved hydraulic efficiency and enhanced pavement durability. Concrete lining is introduced for side drains on steeper slopes to minimize erosion and maintain flow capacity, while scour control structures are installed at regular intervals to dissipate hydraulic energy. In addition, Polymer Modified Bitumen (PMB) is applied in low-lying areas to improve resistance to moisture ingress and temperature-induced deformation, thereby enhancing long-term pavement performance under variable climatic conditions.

7.7.3 Consolidated Project Risk Profile and Summary

The integration of spatial outputs derived from QGIS-based zonal statistics across the three road corridors provides a unified representation of climate risk exposure across the entire project network. This consolidated profile establishes the baseline reference for climate resilience planning and supports ongoing compliance monitoring under the relevant safeguards and national climate adaptation frameworks.

The aggregated results demonstrate a clear stratification of risk across the network, reflecting the combined influence of terrain morphology, climatic forcing, and infrastructure vulnerability.

Table 7-1: Spatial Distribution of Aggregated Climate Risk Across the Project Network

Risk Significance	**B126 (Biretwo–Chesongoch)** ***(1,082 Segments)***	**B124 (Nyaru–Kapkayo)** ***(318 Segments)***	**B122 (Kimwarer–Emsea)** ***(191 Segments)***	**Net Aggregated Network Share (%)**	**Primary Geomorphic Focus / Structural Vulnerability**
LOW	~5.0% (54 segments)	75 Segments (23.58%)	78 Segments (40.80%)	**~11.6%**	**H1 × E1**: Flat terrain profiles; baseline pavement layer resilience (**V1/V2**) is adequate.
MEDIUM	~70.0% (757 segments)	95 Segments (29.87%)	76 Segments (39.80%)	**~58.5%**	**H2 × E2**: Rolling terrains and gentle mid-slopes; unlined shoulder and ditch erosion (**V3**).

HIGH	~20.0% (217 segments)	140 Segments (44.03%)	37 Segments (19.40%)	**~24.8%**	**H3 × E3**: Mountainous descents; high surface water velocity and drainage line degradation (**V3**).
VERY HIGH	~5.0% (54 segments)	8 Segments (2.52%)	0 Segments (0.00%)	**~3.5%**	**H4 × E4**: Active escarpment cliff faces and river channels; high mass wasting or hydraulic scour risk (**V4**).
Total Counts	**1,082 Segments**	**318 Segments**	**191 Segments**	**100.0%**	**Combined Network Length Evaluated**

At the network scale, approximately 11.6% of the alignment is classified as low risk, primarily located in stable flat terrain where standard infrastructure performance remains sufficient under projected climate conditions. The medium-risk category dominates the network at approximately 58.5%, reflecting widespread exposure to rolling terrain where moderate climatic variability gradually affects drainage and pavement systems. The high-risk category accounts for approximately 24.8%, concentrated in mountainous zones where intensified rainfall events significantly increase erosion and hydraulic stress. Finally, the very high-risk category comprises approximately 3.5% of the network, concentrated in escarpment and river crossing environments where extreme events can trigger structural failure and major service disruption.

This distribution confirms that while most of the network operates under moderate and manageable climatic stress, the minority of high-risk locations governs the resilience requirements of the project. These areas define the priority zones for adaptation investment, ensuring that engineering resources are directed toward locations where hazard intensity, exposure conditions, and structural vulnerability converge most critically.

7.8 Integration of Climate Resilience in Design

To ensure structural integrity, slope stability, and operational continuity over the 20-year asset lifecycle (2030–2050), climate-resilient engineering parameters have been integrated into the geometric, hydrological, and material specifications of the B122, B124, and B126 corridors.

7.8.1 Hydrological and Drainage Adaptation

To address increased runoff intensity and flood risk, drainage systems have been redesigned to safely accommodate projected extreme events:

- A 1.22 hydraulic climate factor is applied to all runoff calculations, increasing design capacity by 22%

- Culvert systems are upgraded to 50-year return period design standards, with major river crossings designed for 100-year events
- Minimum culvert diameters are increased to 900 mm (standard) and 1200 mm (high-risk zones)
- Drainage channels are widened and lined in steep terrain (E3–E4 zones) to reduce erosion and overtopping risk

These measures directly address H3–H4 rainfall intensification interacting with V3 drainage systems.

7.8.2 Geotechnical and Slope Stabilization

Slope stabilization measures are applied in escarpment and mountainous terrain where failure risk is highest:

- Mechanical bench-cut terracing reduces slope angle and controls rockfall paths
- Horizontal subsurface drains reduce pore-water pressure during prolonged rainfall
- Rockfall protection systems, including high-tensile steel mesh and rock bolts, stabilize fractured escarpment faces
- Gabion and riprap protection is applied at river approaches to prevent scour-induced failure

These interventions directly address V4 structural vulnerabilities under H3–H4 rainfall conditions.

7.8.3 Pavement and Material Adaptation

Pavement design is modified to respond to combined thermal and moisture stress:

- Polymer Modified Bitumen (PMB) is used in low-lying high-temperature zones (>38°C) to prevent rutting and bleeding
- Subgrade stabilization (lime/cement treatment) is applied in moisture-sensitive soils
- Drainage-linked pavement design reduces water infiltration and stripping risk

These measures address V2 vulnerability under H1–H2 thermal and moisture variability.

7.9 Construction and Operational Climate Risks (Residual Exposure)

Even with embedded design adaptation, residual risks remain during both construction and operation.

7.9.1 Construction Phase Risks

- Erosion of exposed earthworks during active excavation
- Failure of temporary drainage under extreme rainfall events
- Sediment transport into river systems causing downstream siltation
- Landslides triggered on newly cut slopes before stabilization

These risks are short-term but highly sensitive to storm timing.

7.9.2 Operational Phase Risks

- Progressive slope instability due to long-term moisture cycling
- Bridge scour from intensified peak flows
- Pavement fatigue under combined thermal and moisture stress
- Localized drainage blockage leading to overtopping

These risks are cumulative and evolve over the asset lifecycle.

7.10 Residual Climate Risks and Uncertainty

Residual risk remains due to inherent limitations in climate and geotechnical predictability.
Key sources include:

- Uncertainty in convective storm localization and intensity
- Non-linear hydrological response under saturated soil conditions
- Progressive deep-seated slope instability beyond engineered cut zones
- Dependence of system performance on maintenance continuity

These factors mean that while risk is significantly reduced, it cannot be fully eliminated.

7.10 Climate Change Management Plan

All climate adaptation measures defined in Section 7.7 are implemented through the Environmental and Social Management Plan (ESMP) under a dedicated Climate Change Management Plan (CCMP) sub-component (Chapter 9).

This ensures:

- Contractual enforcement through BoQ specifications
- Construction compliance monitoring
- Operational maintenance integration
- Institutional accountability within KeNHA systems

7.11 Conclusion

The climate risk assessment undertaken for the B122, B124, and B126 corridors indicates that the project area is exposed to moderate to high climate-related hazards, with spatial variability primarily driven by extreme rainfall events, terrain complexity, and associated hydrological and geotechnical sensitivities.

Using the PIARC/ROADAPT methodology supported by FABDEM-based spatial analysis, these risks have been systematically identified, quantified, and translated into practical, location-specific engineering and design responses. This has enabled the integration of climate considerations into the core infrastructure planning and design process, rather than treating them as external constraints.

Accordingly, the proposed design approach enhances climate resilience by:

- Prioritising interventions in high-risk zones, particularly escarpment sections and river crossing areas
- Integrating hydrological, geotechnical, and material-specific adaptation measures within the road design
- Maintaining cost-effectiveness and technical feasibility within the 20-year design life horizon
- Ensuring alignment with the African Development Bank (AfDB) climate risk management requirements and applicable national climate policy frameworks

The project is therefore considered to achieve an acceptable level of climate resilience, with residual risks remaining manageable provided that the Environmental and Social Management Plan (ESMP) is fully implemented and maintained throughout the project lifecycle.

CHAPTER 8: POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

8. POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

8.1 Overview

Development inevitably brings about economic, social, and environmental change. While such change is intended to generate positive outcomes, it may also result in adverse or conflicting impacts if not properly managed. Historically, development initiatives focused primarily on economic growth, often with limited consideration of social and environmental consequences. This approach has since evolved with the recognition that sustainable development requires the avoidance, minimization, and management of adverse impacts while enhancing long-term social, economic, and environmental benefits.

Field inspections were undertaken during the ESIA study to verify and validate baseline environmental and social- economic information obtained from secondary sources, desk reviews and existing datasets. The exercise involved site inspections along the project corridor, stakeholder consultations, household surveys, Key Informant Interviews (KII), Focus Group Discussions (FGDs), and observations of existing environmental and social conditions. This approach enabled the study team to confirm existing land uses, settlement patterns, environmental sensitivities, community infrastructure, livelihood activities within the project area, thereby improving the accuracy of the impact assessment and mitigation planning. Hence, this section was informed by the baseline findings presented in Chapter 4&5.

The proposed project is therefore expected to generate both positive and adverse impacts across biophysical, social, and economic environments. These impacts will occur at different stages of the project lifecycle, namely:

- Pre-construction
- Construction
- Operation and maintenance
- Decommissioning

8.2 Methodology for Assessment of Environmental and Social Impacts

8.2.1 Risk Classification Methodology for Ecological Impacts

8.2.1.1 Overview

Impacts in this chapter are classified using a risk matrix that combines Consequence (severity of ecological damage) and Likelihood (probability of occurrence). The resulting risk level (CRITICAL, HIGH, MEDIUM, LOW) determines the intensity of mitigation required in Chapter 6.

8.2.1.2 Consequence (Severity) Categories

Rating	Descriptor	Ecological Definition	Example
5	Critical	Irreversible loss of a protected species population (IUCN threatened or WCMA protected), permanent loss of critical habitat (wetland, forest, corridor), or violation of national law.	Extirpation of an elephant corridor, destruction of a breeding wetland for endangered amphibian.
4	Major	Long-term (>5 years) but potentially reversible damage to a habitat or species population;	Loss of mature *Ficus sycomorus*, permanent

		loss of keystone species individuals; significant fragmentation of connectivity.	sediment deposition in a stream.
3	Moderate	Medium-term (1–5 years) impact; local reduction in species abundance; temporary habitat degradation from which recovery is possible with active restoration.	Loss of scattered trees, temporary roadkill increase, localized erosion.
2	Minor	Short-term (<1 year) disturbance with full recovery expected without active intervention.	Temporary noise disturbance during construction, dust deposition on roadside vegetation.
1	Negligible	No measurable ecological effect; within natural variability.	Brief presence of construction workers, low-level vibration.

8.2.1.3 Likelihood (Probability) Categories

Rating	Descriptor	Definition	Example
5	Almost Certain	Expected to occur >90% of the time under normal construction conditions.	Vegetation loss within cleared reserve, soil compaction from machinery.
4	Likely	Likely to occur 50–90% of the time.	Erosion on exposed slopes without mitigation.
3	Possible	May occur 10–50% of the time.	Roadkill at a specific crossing point.
2	Unlikely	Could occur but <10% probability.	Collapse of a termite mound from machinery movement.
1	Rare	May occur only in exceptional circumstances (<1%).	Mass mortality event from accidental chemical spill.

8.2.1.4 Risk Level Matrix (Consequence × Likelihood)

Likelihood \ Consequence	1 (Negligible)	2 (Minor)	3 (Moderate)	4 (Major)	5 (Critical)
5 (Almost Certain)	MEDIUM	MEDIUM	HIGH	**CRITICAL**	**CRITICAL**
4 (Likely)	LOW	MEDIUM	HIGH	HIGH	**CRITICAL**
3 (Possible)	LOW	MEDIUM	MEDIUM	HIGH	**CRITICAL**
2 (Unlikely)	LOW	LOW	MEDIUM	MEDIUM	HIGH
1 (Rare)	LOW	LOW	LOW	LOW	MEDIUM

8.2.1.5 Risk Level Definitions and Required Action

Risk Level	Definition	Required Action	Management Priority
CRITICAL	Unacceptable risk. May violate law, cause irreversible damage, or affect protected species or critical habitats.	Must be avoided. No construction in area until risk reduced to ≤HIGH through design change or enhanced mitigation. Requires KWS/NEMA approval if unavoidable.	Immediate. Stop work if detected.
HIGH	Major ecological damage likely. Requires stringent, specific mitigation with performance standards and independent verification.	Must be minimized. Mitigation measures mandatory with third-party verification. Regular monitoring (weekly/monthly).	High. Senior management attention required.

MEDIUM	Moderate impact, reversible with standard mitigation.	Manage with routine mitigation. Standard measures applied. Monthly monitoring.	Routine. Include in regular environmental inspections.
LOW	Minor or negligible impact.	Monitor only. No specific mitigation required beyond good practice. Quarterly monitoring.	Low. Track but no special action.

8.2.2 Assessment Approach

The assessment of potential environmental and social impacts for the proposed road project was undertaken using a structured, risk-based and precautionary methodology appropriate for an Environmental and Social Impact Assessment (ESIA). The purpose of the assessment at this stage is to identify key risks, sensitivities, and impact pathways, rather than to provide final or fully quantified impact predictions.

The assessment considers how project activities, as currently defined, may interact with physical, biological, and human receptors within the project’s Area of Influence (AoI) across the following phases:

- Pre-construction;
- Construction;
- Operation and maintenance; and
- Decommissioning.

8.2.3 Identification of Project Activities and Receptors

Potential impacts were identified through a systematic review of interactions between indicative project activities and environmental and social receptors.

Project activities were identified based on:

- Alignment drawings and detailed engineering design information;
- Bills of Quantities (BoQs) and typical activities associated with Class B Road upgrades;
- Professional experience from similar road projects in comparable environments.

Environmental and social receptors were identified using:

- Baseline information collected during field surveys, site observations and physical visits
- Household Survey along the corridor
- Review of available secondary data and maps;
- Stakeholder consultations with local authorities, technical officers, and wider community through Barazas, Focus Group Discussions (FDGs) and interviews as outlined in Chapter 5
- Professional judgment informed by regional environmental and social context.

For the purpose of this assessment:

- A receptor is defined as any environmental, social, or economic component that may be affected by the project (e.g. communities, land, water resources, habitats, species, livelihoods, cultural assets);

- An impact occurs where there is an interaction between a project activity and a receptor that results in a change from baseline conditions.

8.2.4 Impact Typology and Classification

Identified impacts were classified using standard ESIA terminology to support transparency and consistency.

By Nature:

- Positive impacts - Impacts that enhance baseline conditions or provide socio-economic or environmental benefits.
- Negative impacts - Impacts that degrade baseline conditions or introduce adverse change.

By Pathway:

- Direct impacts- Impacts resulting directly from project activities (e.g. vegetation clearance, land acquisition).
- Indirect impacts- Impacts arising from secondary or induced effects of the project (e.g. settlement expansion following improved access).
- Cumulative impacts- Impacts resulting from the combined effect of the project and other existing or reasonably foreseeable developments affecting the same receptors.

8.2.5 Assessment of Impact Magnitude (Screening Level)

Impact magnitude was assessed qualitatively using a structured screening framework. Magnitude represents the degree of change from baseline conditions, taking into account:

- Extent- the spatial area or population affected;
- Duration- the time over which the impact is expected to occur;
- Frequency- how often the impact is likely to occur;
- Reversibility- the ability of the receptor to recover once the activity ceases.

Magnitude was classified using a four-tier qualitative scale: negligible, low, medium, or high. Magnitude ratings are indicative and reflect the likely order of change based on project design information and typical construction methods, rather than precise quantification.

8.2.6 Assessment of Receptor Sensitivity

Receptor sensitivity reflects the degree to which a receptor is susceptible to change and combines two key elements:

- Value, considering ecological importance, legal protection, cultural significance, or socio-economic importance; and
- Resilience, reflecting the ability of the receptor to withstand or recover from disturbance.

Sensitivity was assessed using a qualitative scale of negligible, low, medium, or high, informed by:

- Baseline conditions;
- Conservation status or social vulnerability;
- Availability of alternatives or substitution;
- Professional judgment.

8.2.7 Determination of Impact Significance (Pre-Mitigation)

Impact significance was determined by combining impact magnitude and receptor sensitivity using an impact significance matrix. The resulting significance categories include:

- Negligible
- Minor
- Moderate
- Major

8.2.8 Mitigation Hierarchy and Enhancement Measures

Mitigation measures were identified in accordance with the internationally recognized mitigation hierarchy:

1. Avoid impacts through design and alignment optimization where feasible;
2. Minimize impacts through engineering controls and construction management;
3. Restore affected environments through rehabilitation and reinstatement;
4. Compensate/Offset residual impacts where avoidance is not feasible.

8.3 Pre-Construction Phase Impacts

The impacts identified under this phase are based on the design road alignment and construction footprint.

8.3.1 Adverse Impacts

8.3.1.1 Land Acquisition and Displacement

The proposed project will require permanent acquisition of land for the road carriageway, shoulders, drainage structures, borrow areas, camps, and associated infrastructure across sections of Elgeyo Marakwet County, Uasin Gishu County, and Baringo County. The baseline socio-ecological analysis indicates that the corridor traverses agro-pastoral landscapes characterized by cultivated land, grazing areas, settlement zones, riparian resources, and ecologically connected community landscapes associated with the Rimoi–Kapnarok ecosystem. As demonstrated in the biodiversity baseline, these areas also support important ecological functions, vegetation resources, and livelihood systems linked to farming, grazing, fuelwood collection, and ecosystem services. Consequently, land acquisition may result in both physical and economic displacement through loss of land parcels, crops, structures, access to communal resources, and disruption of local livelihood networks and resource-use patterns.

Impact significance is considered Major due to the high sensitivity of affected agro-pastoral communities, the dependence of local livelihoods on land and natural resources, and the mandatory application of national land legislation and African Development Bank Operational Safeguard 5 (OS 5).

Mitigation Measures

The proposed mitigation measures have been informed by the project design process, the baseline socio-ecological assessment, and the Resettlement Action Plan (RAP) undertaken for the project. Baseline findings indicate that the project corridor traverses agro-pastoral landscapes containing cultivated land, grazing areas, settlement zones, riparian resources, and ecologically connected community landscapes that support both livelihoods and ecosystem services. During project planning and design, efforts were therefore made to avoid and minimise involuntary resettlement by optimising the road alignment and, where technically feasible, fitting the road within the existing corridor to reduce land acquisition, fragmentation of productive land, and unnecessary impacts on communities and natural resource use systems.

Consistent with the RAP findings, eligible Project Affected Persons (PAPs) will be compensated at Full Replacement Cost for affected land, structures, crops, assets, and livelihood losses in accordance with the approved entitlement framework. Compensation and livelihood restoration measures will be completed prior to commencement of construction works to minimise social disruption and economic vulnerability. Continuous stakeholder engagement has been undertaken throughout the RAP preparation process and will continue during implementation, with particular attention given to vulnerable households and resource-dependent communities to ensure that compensation, livelihood restoration, and transitional support measures are inclusive and effective.

These mitigation measures are directly linked to the baseline analysis and identified impacts by seeking to minimise disruption to settlement patterns, agro-pastoral livelihoods, communal resource access, and ecologically sensitive landscapes associated with the broader Rimoi–Kapnarok ecosystem and surrounding community land-use systems.

8.3.1.2 Impacts on Flora and Fauna

Pre-construction clearing and construction activities will result in localized removal of trees, shrubs, grasses, and ground vegetation within the road corridor. Baseline biodiversity assessments indicate that the project area supports ecologically heterogeneous habitats comprising dryland woody vegetation, riparian systems, rocky escarpments, wetlands, drainage-linked habitats, and structurally diverse woodland patches associated with the broader Rimoi–Kapnarok ecosystem linkage across the Keiyo River. These habitats support diverse plant communities, pollinators, birds, reptiles, amphibians, mammals, and ecologically important microhabitats identified in the baseline analysis.

Vegetation clearing may therefore lead to localized habitat loss, temporary displacement and disturbance of fauna, reduction of nesting and foraging habitats, disruption of ecological connectivity, and degradation of sensitive microhabitats, particularly within riparian zones, wetlands, drainage crossings, woodland patches, and rocky habitats supporting reptiles, amphibians, pollinators, and arboreal species. Habitat fragmentation and edge effects may also facilitate the spread of invasive species such as *Prosopis juliflora* and *Opuntia elatior*, which were identified in the baseline as indicators of ecological disturbance and vegetation transformation.

Impact Significance is rated to be Moderate (Localized), with higher sensitivity anticipated within riparian zones, wetlands, drainage systems, woodland patches, and ecologically connected habitats where biodiversity values and ecosystem functions are concentrated.

Mitigation Measures

The proposed mitigation measures have been informed by the biodiversity baseline assessment, which identified ecologically heterogeneous habitats comprising riparian systems, wetlands, woodland patches, rocky escarpments, drainage-linked habitats, and structurally diverse dryland vegetation associated with the broader Rimoi–Kapnarok ecosystem linkage across the Keiyo River. Baseline findings also identified sensitive biodiversity features including native woody vegetation, pollinator habitats, amphibian and reptile microhabitats, arboreal mammal habitats, bird nesting areas, and the presence of invasive species such as *Prosopis juliflora* and *Opuntia elatior*.

To minimise the identified impacts of vegetation loss, habitat disturbance, fragmentation, and invasive species spread, the evolving design will prioritise avoidance of ecologically sensitive areas through refinement of the road alignment and reduction of unnecessary vegetation clearing wherever technically feasible. Particular attention will be given to riparian zones, wetlands, drainage crossings, woodland patches, and rocky habitats where biodiversity values, ecological functions, and habitat connectivity are concentrated.

A Vegetation Management and Rehabilitation Plan will be developed to guide clearing limits, vegetation protection measures, rehabilitation requirements, and landscape restoration. Disturbed areas will be progressively rehabilitated using indigenous dryland species suited to local ecological conditions to restore habitat structure, ecological connectivity, slope stability, and ecosystem functionality. Where vegetation removal is unavoidable, compensatory planting will be undertaken to restore ecological functions and reduce long-term habitat degradation. Special emphasis will be placed on maintaining riparian buffer integrity, preserving drainage-line vegetation continuity, controlling invasive species spread, and protecting structurally important habitats that support birds, pollinators, reptiles, amphibians, mammals, and other fauna identified in the baseline biodiversity assessment.

8.3.1.3 Soil Removal, Blasting, and Geotechnical Risks

Sections of the proposed road, particularly along the steep escarpment terrain of the B124 Nyaru–Kapkayo corridor within Elgeyo Marakwet County, are expected to require substantial cut-and-fill earthworks and potentially controlled blasting within hard volcanic rock formations. Baseline biophysical assessments identified the escarpment landscape as environmentally sensitive due to its steep slopes, shallow and erosion-prone soils, rocky outcrops, concentrated drainage systems, and ecologically important escarpment habitats associated with woodland vegetation, riparian systems, and wildlife movement corridors linked to the broader Rimoi–Kapnarok ecosystem. These areas also support structurally complex vegetation, reptiles, birds, pollinators, arboreal fauna, and specialized rocky microhabitats identified in the biodiversity baseline analysis.

The interaction of steep slopes, unstable cut faces, shallow soils, and high rainfall intensity creates a significant risk of slope instability, rockfalls, erosion, sediment transport, dust generation, vibration impacts, and localized habitat disturbance. The associated impacts may affect construction workers, nearby communities, adjacent infrastructure, drainage systems, and ecologically sensitive habitats downslope, while increased sedimentation may degrade riparian systems and downstream water quality if not effectively controlled.

Impact Significance is rated to be High due to potentially Significant Geotechnical Risk, reflecting the sensitivity of steep escarpment terrain, ecological vulnerability of drainage-linked habitats, and the likelihood of engineered slope modification and rock excavation works.

Mitigation Measures

Mitigation measures have been informed by the baseline geotechnical, hydrological, and biodiversity assessments that identified the Elgeyo Escarpment as a highly sensitive terrain characterized by steep slopes, shallow erosion-prone soils, concentrated drainage systems, rocky habitats, woodland vegetation, and ecologically important escarpment and riparian ecosystems associated with the broader Rimoi–Kapnarok landscape. To minimise the identified risks of slope instability, erosion, sediment transport, habitat disturbance, and downstream water-quality degradation, the alignment will be adjusted where technically feasible to reduce deep cuts, unstable slope exposure, and blasting requirements.

Where excavation is unavoidable, engineered slope stabilisation measures such as benching, retaining structures, rock bolting, bioengineering approaches, drainage control, and erosion protection systems will be incorporated into the project design to reduce slope failure, sediment mobilisation, and habitat degradation. Particular attention will be given to protecting drainage lines, riparian systems, and ecologically sensitive escarpment habitats identified in the biodiversity baseline.

Any blasting activities will be undertaken using certified procedures, controlled blast designs, exclusion zones, and monitored vibration thresholds to minimise risks to nearby communities, workers, infrastructure, and sensitive habitats. A Slope Stability and Blasting Management Plan will be integrated into the Construction ESMP and will include geotechnical monitoring, erosion and sediment control measures, worker safety protocols, community notification systems, biodiversity protection measures, and emergency response procedures to ensure that impacts remain localized and effectively managed throughout construction.

8.4 Construction Phase Impacts

8.4.1 Impacts on Topography

8.4.1.1 Alteration of Existing Topography and Landforms

The upgrading of the Biretwo–Arror–Chesongoch (B126), Nyaru–Kapkayo (B124), and Kimwarer–Emsea (B122) road sections will inevitably modify the existing topography along the project corridor. The project traverses highly variable terrain ranging from the steep slopes of the Elgeyo Escarpment to the rolling highlands and relatively gentle valley floors of the Kerio Valley. To achieve the required road geometry, widening standards, and safety requirements, substantial earthworks including cut-and-fill operations, excavation of hill slopes, formation of embankments, and grading of existing surfaces will be required. These activities will alter the natural landscape by modifying slope profiles, reducing natural ridges and benches, and creating engineered landforms. The magnitude of these changes will be particularly significant along the escarpment sections where steep gradients and rugged terrain constrain alignment improvements. Impact Significance is rated as Major (Pre-Mitigation) due to the negative, direct nature of the earthworks, a medium magnitude of permanent landform alteration, and the high sensitivity of the fragile escarpment landscape.

Mitigation Measures

i. Minimize cut-and-fill requirements through optimization of the road alignment and geometric design.
ii. Restrict construction activities and earthworks to the approved road corridor and designated work areas.
iii. Utilize balanced cut-and-fill techniques to reduce the need for excessive excavation and disposal of spoil material.
iv. Preserve natural terrain features where feasible, particularly in environmentally sensitive areas.
v. Rehabilitate disturbed areas through grading, landscaping, and revegetation immediately after construction.
vi. Establish designated spoil disposal sites approved by the supervising engineer and relevant authorities.
vii. Reinstate temporary construction areas and borrow sites to blend with the surrounding landscape upon completion of works.

8.4.1.2 Increased Risk of Slope Instability and Landslides

The project alignment traverses several areas characterized by steep to very steep slopes, particularly along the Biretwo–Chesongoch and Nyaru–Kimwarer sections, where slope gradients frequently exceed 30% and in some areas surpass 60% and even 80%. Construction activities involving excavation and slope cutting may reduce the natural stability of these slopes by removing toe support and disturbing existing soil and rock structures. Such disturbances could trigger localized slope failures, landslides, rockfalls, and slumping of cut slopes, especially during periods of heavy rainfall. The risk is further heightened in areas with deeply incised drainage channels and unstable volcanic soils. Without appropriate slope stabilization measures, these failures could affect road integrity, increase maintenance requirements, and pose safety risks to road users and nearby communities. Impact Significance is rated as Major (Pre-Mitigation) reflecting a negative, direct risk of high magnitude due to the extreme slope gradients (exceeding 30–80%) and the high sensitivity/low resilience of the unstable volcanic soil profiles.

Mitigation Measures

i. Undertake detailed geotechnical investigations to inform slope design and stabilization requirements.
ii. Design cut slopes at stable angles appropriate to local soil and rock conditions.
iii. Construct retaining walls, gabions, reinforced earth structures, and rock buttresses in unstable sections.
iv. Install rockfall protection measures such as rock nets, catch fences, and rockfall barriers where necessary.
v. Implement bioengineering techniques including grassing, hydroseeding, and planting of deep-rooted vegetation on exposed slopes.
vi. Avoid undercutting natural slopes and maintain adequate toe support during excavation.
vii. Conduct routine inspections of cut and fill slopes during construction and operation.
viii. Establish emergency response procedures for areas prone to landslides and slope failures.

8.4.1.3 Acceleration of Soil Erosion Processes

The removal of vegetation cover and exposure of soil surfaces during construction will increase the susceptibility of the project area to erosion. This impact is expected to be most pronounced within the escarpment sections where steep slopes naturally promote rapid runoff and sediment transport. Disturbed surfaces, spoil heaps, cut slopes, and embankments may experience sheet erosion, rill erosion, and gully formation, particularly during intense rainfall events. The mobilized sediments may subsequently be transported into nearby drainage channels and downstream watercourses, contributing to sedimentation and degradation of aquatic habitats. The extensive areas of steep terrain along the B126 and B122 corridors are especially vulnerable to accelerated erosion if effective erosion control measures are not implemented during construction. Impact Significance is rated as Moderate to Major (Pre-Mitigation) based on the negative, direct pathway of vegetation removal, a medium magnitude of accelerated sheet/gully erosion, and the high sensitivity of the escarpment's shallow soils.

Mitigation Measures

i. Limit vegetation clearing and ground disturbance to the minimum area required for construction.
ii. Stabilize exposed soils immediately after earthworks through revegetation, mulching, or hydroseeding.
iii. Install erosion control measures such as silt fences, sediment traps, check dams, and erosion control blankets.
iv. Sequence construction activities to minimize the duration that soils remain exposed.
v. Construct contour drains and interceptor drains to reduce runoff velocity.
vi. Protect embankment and cut slopes using riprap, stone pitching, or geotextiles where necessary.
vii. Monitor erosion-prone areas regularly, particularly during the rainy season.
viii. Restore disturbed areas promptly upon completion of construction activities.

8.4.1.4 Alteration of Natural Drainage Patterns

Road upgrading works have the potential to alter existing topographic drainage patterns through the construction of embankments, side drains, culverts, and cross-drainage structures. The project area contains numerous seasonal and perennial drainage channels that have developed in response to the natural terrain. Modifications to the landscape may interrupt natural runoff pathways and redirect water flows into concentrated channels. In steep escarpment areas, such concentration of runoff can increase flow velocities and erosive forces, potentially leading to channel incision, gully development, scour around drainage structures, and destabilization of adjacent slopes. Improperly designed or undersized drainage systems may also contribute to localized flooding and overtopping during heavy storm events. Impact Significance is rated as Major (Pre-Mitigation) due to the negative, direct concentration of runoff, a medium magnitude of hydrological alteration, and the high sensitivity of the receiving natural catchment networks.

Mitigation Measures

i. Design drainage structures based on detailed hydrological and hydraulic assessments.
ii. Maintain natural drainage connectivity across the road corridor through appropriately sized culverts and bridges.
iii. Provide adequate side drains, mitre drains, and energy dissipation structures.
iv. Avoid blockage or diversion of natural drainage channels unless approved and appropriately engineered.
v. Stabilize culvert inlets and outlets using riprap, gabions, or concrete aprons.
vi. Ensure drainage structures are designed to accommodate projected increases in rainfall intensity associated with climate change.
vii. Regularly inspect and maintain drainage systems to prevent blockages and overtopping.
viii. Incorporate stormwater management measures that reduce concentration of runoff on vulnerable slopes.

8.4.2 Impacts on Drainage

8.4.2.1 Disruption of Natural Drainage Patterns

The proposed road upgrading will involve excavation, embankment construction, culvert installation, and improvement of roadside drainage systems at numerous drainage crossings along the Biretwo–Chesongoch, Nyaru–Kapkayo, and Kimwarer–Emsea road sections. Given the high density of drainage channels, particularly within the escarpment zones and transitional landscapes, construction activities may temporarily disrupt natural drainage pathways and alter existing flow patterns. Temporary diversions, channel obstruction, and modification of natural drainage alignments could interfere with the movement of runoff, potentially causing localized ponding, erosion, or changes in downstream drainage connectivity. The impact is expected to be most pronounced during the construction phase when earthworks are being undertaken at channel crossings and drainage structures are under installation. Impact Significance is rated as Moderate (Pre-Mitigation), representing a negative, direct impact of medium magnitude due to localized temporary channel diversions, interacting with a medium receptor sensitivity across the transitional road sections.

Mitigation Measures

i. Undertake detailed hydrological and hydraulic assessments to guide drainage design.

ii. Maintain natural drainage connectivity through appropriately sized culverts, bridges, and cross-drainage structures.
iii. Avoid unnecessary diversion or realignment of natural drainage channels.
iv. Schedule works within active channels during dry weather periods where feasible.
v. Reinstate disturbed drainage channels immediately following construction activities.
vi. Align drainage structures with existing flow directions and natural channel gradients.
vii. Regularly inspect drainage crossings during construction and rectify any disruptions promptly.

8.4.2.2 Increased Surface Runoff and Flow Concentration

The introduction of paved road surfaces, compacted shoulders, and engineered drainage systems will reduce infiltration and increase the volume and velocity of surface runoff. In the steep escarpment sections, runoff that is currently dispersed across natural slopes may become concentrated within side drains and culverts, increasing flow velocities and erosive potential at discharge points. Concentrated runoff may accelerate erosion of adjacent land, drainage channels, and embankment slopes, particularly during intense rainfall events. This impact may persist into the operational phase if drainage systems are not adequately designed and maintained. Impact Significance is rated as Major (Pre-Mitigation) because the introduction of permanent paved surfaces creates a negative, direct impact of medium magnitude on high-sensitivity downslope receptors and vulnerable catchment slopes.

Mitigation Measures

i. Design drainage systems to safely accommodate anticipated peak runoff flows.
ii. Install energy dissipation structures such as riprap, gabions, and stilling basins at culvert outlets.
iii. Construct interceptor drains, contour drains, and mitre drains to reduce runoff concentration.
iv. Stabilize drainage outlets and adjacent slopes using stone pitching, vegetation, or bioengineering measures.
v. Incorporate vegetated drainage channels where practical to slow runoff velocities.
vi. Undertake routine inspection and maintenance of drainage infrastructure.
vii. Integrate climate-resilient drainage designs capable of handling extreme rainfall events.

8.4.2.3 Increased Risk of Localized Flooding

The project crosses numerous drainage channels draining both small headwater catchments and larger integrated catchment systems. During operation, undersized, blocked, or poorly maintained culverts and drainage structures may impede natural water flows, causing ponding upstream of the road and increasing the risk of localized flooding. This risk is particularly significant at major drainage crossings along the Biretwo–Chesongoch corridor and within the lower-gradient sections of the Nyaru–Kapkayo and Kimwarer–Emsea roads, where larger catchments generate substantial runoff volumes during prolonged rainfall events. Impact Significance is rated as Major (Pre-Mitigation) reflecting a negative, indirect impact of medium magnitude (high seasonal frequency) on communities and floodplains of high socio-economic sensitivity.

Mitigation Measures

i. Size culverts and bridge openings based on detailed hydrological and flood frequency analyses.
ii. Provide sufficient cross-drainage structures at all major channel crossings.
iii. Preserve natural flood pathways and avoid restricting floodplain flows.
iv. Incorporate adequate freeboard into drainage structure designs.
v. Establish routine maintenance programmes to remove debris and sediment accumulation.
vi. Inspect drainage structures regularly, particularly before and during rainy seasons.
vii. Incorporate emergency overflow provisions where appropriate.

8.4.2.4 Channel Erosion and Scour

The concentration of runoff within engineered drainage systems and culvert outlets may increase flow velocities, resulting in erosion of channel beds and banks. The risk is particularly high within the steep escarpment drainage systems where runoff naturally possesses high erosive energy. Scour around culvert inlets and outlets may undermine drainage structures and road embankments, while channel incision may alter natural drainage morphology and contribute to downstream sedimentation. Impact Significance is rated as Major (Pre-Mitigation) based on a negative, direct pathway of medium magnitude involving structural undermining, paired with the high sensitivity and low physical resilience of the steep escarpment torrents.

Mitigation Measures

i. Protect culvert inlets and outlets using riprap, gabions, concrete aprons, or stone pitching.
ii. Install energy dissipation structures at all high-velocity discharge points.
iii. Stabilize channel banks through revegetation and bioengineering techniques.
iv. Minimize disturbance to natural streambeds and banks during construction.
v. Monitor drainage crossings for signs of erosion and scour throughout construction and operation.
vi. Repair erosion damage immediately upon detection.
vii. Design drainage structures to minimize excessive discharge velocities.

8.4.2.5 Sedimentation of Drainage Channels

Construction activities including excavation, earthworks, slope cutting, and spoil handling will expose soils to rainfall and surface runoff. Sediments generated from disturbed areas may be transported into adjacent drainage channels, causing siltation, reduced channel capacity, increased turbidity, and potential impacts on downstream aquatic habitats. The impact is likely to be particularly significant within the escarpment sections where steep slopes promote rapid sediment transport during rainfall events. Impact Significance is rated as Moderate to Major (Pre-Mitigation), given the negative, direct influx of construction sediments of medium magnitude into downstream aquatic habitats categorized as high sensitivity.

Mitigation Measures

i. Develop and implement an Erosion and Sediment Control Plan.
ii. Install silt fences, sediment traps, check dams, and sediment retention structures near drainage crossings.
iii. Stabilize exposed soils immediately after earthworks through revegetation, mulching, or hydroseeding.

iv. Manage stockpiles and spoil heaps to prevent sediment wash-off.
v. Restrict major earthworks during periods of intense rainfall where practicable.
vi. Conduct routine inspection and maintenance of sediment control measures.
vii. Rehabilitate disturbed areas promptly following construction.

8.4.2.6 Blockage of Natural Drainage Channels

Improper placement of excavated materials, construction waste, stockpiles, and equipment may obstruct natural drainage channels during construction. Such blockages can impede water flow, resulting in localized flooding, diversion of runoff, and increased erosion of adjacent land. The risk is particularly pronounced along the Nyaru–Kapkayo and Kimwarer–Emsea sections where numerous small headwater channels intersect the road alignment. Impact Significance is rated as Moderate (Pre-Mitigation) due to the negative, direct risk of waste obstruction, which represents a medium magnitude event affecting headwater streams of medium sensitivity.

Mitigation Measures

i. Prohibit disposal of spoil, excavated material, or waste within drainage channels.
ii. Establish approved spoil disposal and storage sites away from watercourses.
iii. Maintain unobstructed drainage pathways throughout the construction period.
iv. Conduct regular inspections and immediately remove any blockages.
v. Train construction personnel on proper spoil and waste management practices.
vi. Develop site-specific drainage management procedures for sensitive crossing locations.
vii. Maintain emergency equipment for rapid clearance of blocked channels.

8.4.2.7 Increased Sediment and Pollutant Loading in Watercourses

Runoff from construction areas may transport sediments, fuels, oils, lubricants, cement residues, and other contaminants into nearby drainage channels. During operation, stormwater runoff from the road surface may continue to carry pollutants into receiving watercourses. Given the dense and interconnected drainage network along the project corridor, contaminants may be rapidly transported downstream, affecting water quality and aquatic ecosystems. Impact Significance is rated as Major (Pre-Mitigation) reflecting a negative, direct and indirect contamination risk of medium magnitude affecting a highly sensitive, interconnected downstream aquatic ecosystem.

Mitigation Measures

i. Implement strict procedures for fuel, oil, and chemical storage and handling.
ii. Designate refuelling and equipment maintenance areas away from drainage channels.
iii. Provide spill kits and train workers in spill prevention and emergency response.
iv. Install sediment control measures around active construction areas.
v. Properly manage concrete washout areas and construction wastewater.
vi. Implement good housekeeping practices throughout the project.
vii. Monitor water quality at sensitive downstream locations.
viii. Develop and implement a Pollution Prevention and Emergency Response Plan.

8.4.2.8 Improved Drainage Efficiency and Flood Management (Positive Impact)

The project will incorporate upgraded drainage infrastructure including culverts, side drains, mitre drains, scour protection works, and other stormwater management measures. These improvements will enhance the conveyance of runoff, reduce road flooding, minimize erosion associated with uncontrolled runoff, and improve the resilience of the road corridor to extreme weather events.

Consequently, the project is expected to provide long-term benefits through improved drainage efficiency and reduced flood-related damage to road infrastructure and adjacent land. Impact Significance is rated as a Major Beneficial Impact (Pre-Mitigation), representing a positive, direct long-term effect of medium-to-high magnitude that directly enhances the climate resilience of a high-value regional asset.

Enhancement Measures

i. Construct drainage infrastructure in accordance with approved hydraulic design standards.
ii. Implement routine inspection and maintenance programmes for drainage structures.
iii. Incorporate erosion and scour protection measures into all major drainage crossings.
iv. Ensure drainage systems are designed to accommodate future climate variability and extreme rainfall events.
v. Promote catchment conservation and revegetation initiatives to reduce sediment loads.
vi. Monitor drainage performance during operation and implement corrective actions where necessary.
vii. Raise community awareness on the protection and maintenance of drainage infrastructure.

8.4.3 Visual and Landscape Impacts

The Elgeyo Escarpment and surrounding highland landscapes are prominent visual features within the project area, contributing significantly to the scenic character of the region. Construction activities involving extensive excavation, slope cutting, and the creation of large embankments may alter the natural appearance of these landscapes. Exposed rock faces, cleared vegetation, spoil disposal sites, and engineered slopes may create visual scars that contrast with the surrounding environment. Although these impacts will be localized along the road corridor, they may be particularly noticeable in elevated escarpment sections where the road is visible from considerable distances across the Kerio Valley. Impact Significance is rated as Major (Pre-Mitigation) due to the negative, direct creation of visible scars of medium magnitude across a landscape receptor (the Elgeyo Escarpment) characterized by high visual sensitivity and regional scenic value.

Mitigation Measures

i. Minimize the extent of vegetation clearing and retain mature trees where possible.
ii. Shape and contour cut slopes and embankments to blend with surrounding natural landforms.
iii. Rehabilitate disturbed areas through landscaping and indigenous vegetation planting.
iv. Restrict spoil disposal to designated locations away from visually sensitive viewpoints.
v. Use bioengineering and natural slope stabilization methods where feasible.
vi. Restore temporary construction sites and access roads after completion of works.
vii. Maintain a clean construction site through proper waste and material management.
viii. Implement progressive rehabilitation throughout the construction period.

8.4.4 Generation of Excavated Materials and Spoil

The substantial earthworks required for road upgrading, particularly in steep and rocky terrain, will generate significant quantities of excavated materials. If not properly managed, spoil disposal activities may create artificial landforms that alter local topography, obstruct natural drainage pathways, and increase susceptibility to erosion and slope instability. Poorly located spoil disposal areas may also contribute to sedimentation of nearby watercourses and degradation of surrounding landscapes. Careful selection, design, and rehabilitation of spoil disposal sites will therefore be essential to minimize long-term topographic impacts. Impact Significance is rated as Major (Pre-Mitigation) based on the negative, direct generation of high-volume spoil of medium magnitude, interacting with highly sensitive escarpment slope profiles and natural aquatic systems

Mitigation Measures

i. Develop and implement a Spoil Management Plan prior to commencement of earthworks.
ii. Maximize reuse of excavated materials within the project for embankments, backfilling, and slope stabilization.
iii. Dispose of surplus spoil only at approved disposal sites.
iv. Avoid dumping spoil in drainage channels, wetlands, riverbanks, or steep slopes.
v. Stabilize spoil disposal areas through compaction, grading, and revegetation.
vi. Install erosion and sediment control measures around spoil storage and disposal sites.
vii. Monitor spoil disposal areas regularly for signs of erosion or instability.
viii. Restore spoil disposal sites upon completion of construction activities.

8.4.5 Noise Pollution and Vibration

Construction activities will generate elevated levels of noise and ground vibration from heavy machinery, haulage trucks, generators, batching plants, and controlled rock blasting along escarpment and cut sections. These activities may cause disturbance to nearby communities, schools, health facilities, and wildlife within the project area. Workers exposed to prolonged high noise levels may also face occupational health risks such as hearing impairment. The impact is considered Moderate to Major due to the localized but potentially intense nature of construction noise and vibration.

Mitigation Measures

- Mitigation measures should focus on minimizing noise generation and reducing exposure.
- High-noise activities such as blasting and rock breaking should be restricted to daytime hours and avoided during sensitive periods such as school examinations or clinic operating hours.
- Construction equipment should be properly maintained and fitted with silencers or vibration-dampening devices.
- Stationary noise sources such as generators and batching plants should be located away from sensitive receptors where feasible.
- Buffer zones should be established around high-intensity work areas, and advance notice should be provided to nearby communities before blasting activities.
- Workers operating in high-noise zones should be provided with hearing protection PPE and trained on safe exposure limits.
- Periodic noise and vibration monitoring should be undertaken to ensure compliance with applicable EMCA and OSHA standards.

8.4.6 Air Quality and Dust Impacts

Construction activities including excavation, grading, material crushing, haul traffic, and diesel-powered machinery will generate fugitive dust and exhaust emissions. Dust emissions may reduce local air quality, create nuisance conditions, and increase respiratory health risks for workers and nearby communities. Vegetation and agricultural crops near the road corridor may also be affected by dust deposition. The impact is expected to be particularly significant within the semi-arid Kerio Valley sections due to fine soils and wind erosion potential. The significance of this impact is considered Moderate to High.

Mitigation Measures

i. Mitigation measures should prioritize dust suppression and emission reduction.
ii. Exposed surfaces, haul roads, and stockpiles should be regularly watered, especially within dry and windy sections of the project area.
iii. Trucks transporting loose materials should be covered with tarpaulins, and vehicle speeds on unpaved roads should be controlled.
iv. Machinery and vehicles should be maintained in good operating condition to minimize exhaust emissions.
v. Disturbed areas should be progressively rehabilitated and revegetated to stabilize soils and reduce dust generation.
vi. A Dust Management and Air Quality Control Plan should be developed and implemented, supported by periodic ambient air quality monitoring at sensitive receptor locations.
vii. Workers in high-exposure areas should be provided with appropriate respiratory PPE.

8.4.7 Solid Waste Generation

Construction activities will generate both hazardous and non-hazardous waste, including spoil material, vegetation debris, food waste, plastics, packaging materials, used oils, lubricants, batteries, and contaminated materials. Improper storage or disposal of these wastes may lead to soil and water contamination, public health risks, visual degradation, and harm to wildlife through ingestion or entanglement. The impact significance is considered Moderate because waste generation is unavoidable throughout the construction phase and may become significant if poorly managed.

Mitigation Measures

i. Mitigation measures should focus on waste minimization, segregation, recycling, and safe disposal.
ii. Waste should be segregated at source into recyclable, inert, municipal, and hazardous streams using clearly labeled containers.
iii. Suitable spoil and construction debris should be reused within the project where technically feasible.
iv. Hazardous wastes should be stored in secure, bunded areas and handled only by licensed waste management contractors.
v. Open burning and uncontrolled dumping of waste should be prohibited. Workers should receive regular training on waste handling procedures and environmental protection.
vi. A Construction and Demolition Waste Management Plan should be prepared and implemented prior to commencement of works.

8.4.8 Soil Erosion and Sedimentation

Large-scale earthworks, excavation, borrow pit development, and slope cutting will expose soils to erosion, particularly within steep escarpment areas and erodible valley soils. Sediment-laden runoff may pollute downstream watercourses, damage drainage systems, reduce agricultural productivity, and degrade aquatic habitats. Due to the project scale and physiographic conditions, soil erosion is considered one of the dominant biophysical risks during construction. The impact significance is assessed as Major.

Mitigation Measures

i. Mitigation measures include phased earthworks to minimize the duration and extent of exposed soils.
ii. Temporary erosion control measures such as mulching, erosion control blankets, silt fences, sediment traps, and check dams should be installed before major excavation activities commence.

iii. Final slopes should be stabilized using engineering and bioengineering approaches such as terracing, gabions, rip-rap, and planting of deep-rooted native vegetation.
iv. Disturbed areas should be revegetated promptly after construction activities.
v. A comprehensive Erosion, Sediment, and Stormwater Control Plan (ESSCP) should be developed and implemented, supported by regular inspection and maintenance of erosion control measures.

8.4.9 Geotechnical Instability and Landslide Risk at Nyaru Steep Section

Slope cutting, excavation, vibration from heavy machinery, and drainage alterations at the Nyaru steep section may increase the likelihood of slope instability and landslides. Potential consequences include injuries to workers and road users, obstruction of the roadway, construction delays, and downstream sedimentation of watercourses. The significance of this impact is considered Major to Critical due to the severe consequences associated with slope failure.

Mitigation Measures

i. Mitigation should adopt a precautionary and risk-based approach. Detailed geotechnical investigations should be undertaken to assess slope stability and guide engineering interventions.
ii. Stabilization measures may include retaining walls, reinforced earth structures, gabions, soil nailing, and modified cut-and-fill geometries.
iii. Construction should proceed in controlled phases with immediate stabilization of exposed slopes.
iv. Surface drainage should be carefully managed to prevent infiltration into unstable areas, and spoil material should not be placed near slope crests or toes.
v. A Slope Stability and Management Plan should be developed and implemented, including slope monitoring and emergency response procedures.
vi. Implement the CCMP.

8.4.10 Hydrocarbon Spills and Liquid Waste Contamination

Construction activities involving fuel storage, machinery maintenance, refueling, and camp operations may result in accidental spills or leakage of hydrocarbons and liquid wastes. Contamination of soil, surface water, and groundwater may occur, particularly near streams, drainage channels, and floodplains. Such contamination could affect aquatic ecosystems, irrigation water, livestock watering points, and public health. The impact significance is considered Major due to the potential for downstream pollutant dispersion.

Mitigation Measures

i. Mitigation measures should focus on pollution prevention and rapid response.
ii. Fuel storage, refueling, and maintenance activities should be restricted to designated areas equipped with impermeable surfaces and bunded containment systems.
iii. Workshops and washdown areas should be located away from drainage lines and riparian zones.
iv. Spill kits should be provided at all fuel handling locations, and workers should be trained in spill response procedures.
v. Wastewater from camps and workshops should be treated prior to discharge or reuse using approved systems such as oil-water separators and septic systems.
vi. A Spill Prevention and Emergency Response Plan should be prepared and implemented prior to construction.

8.4.11 Material Borrow Site Impacts

Borrow pits and quarries developed for sourcing construction materials may cause vegetation loss, landscape degradation, dust emissions, erosion, increased traffic, and conflicts over land use. Poorly managed borrow areas may also become sources of safety hazards and long-term environmental degradation. The impact significance is considered Major due to the concentrated and potentially permanent nature of borrow site impacts.

Mitigation Measures

i. Mitigation measures should include careful site selection to avoid ecologically sensitive areas, agricultural land, water sources, and residential areas.
ii. A limited number of well-planned borrow sites should be used to reduce landscape fragmentation.
iii. Site-specific erosion, sediment, and dust control measures should be implemented, and approved haul routes should be established to minimize community disturbance.
iv. All borrow sites should be fenced and access controlled for safety purposes.
v. Rehabilitation plans should be developed prior to excavation and implemented progressively during operations to restore sites to stable and productive conditions.
vi. A Quarry and Borrow Pit Siting, Operations, and Rehabilitation Plan should guide all material extraction activities.

8.4.12 Potential Impacts on Flora and Fauna

Construction activities may lead to vegetation clearance, habitat fragmentation, hydrological alteration, and increased disturbance to plant and animal species including mammals, birds, reptiles, amphibians, and invertebrates. Riparian systems, woodland habitats, escarpment ecosystems, wetlands, and savanna landscapes may experience loss of ecological integrity and reduced habitat quality. Wildlife movement patterns may also be disrupted, increasing risks of mortality and human–wildlife conflict. The significance of these impacts ranges from Moderate to Critical depending on habitat sensitivity and species vulnerability.

Mitigation Measures

i. Mitigation should prioritize habitat conservation, ecological restoration, and maintenance of wildlife connectivity.
ii. Vegetation clearance should be limited strictly to approved construction footprints, and sensitive habitats should be protected through establishment of buffer zones and “No-Cut” areas.
iii. Riparian vegetation should be retained wherever possible, and disturbed habitats should be rehabilitated using native plant species.
iv. Wildlife crossings, culverts, and underpasses should be incorporated within key movement corridors to facilitate safe fauna movement.
v. Construction activities near breeding habitats and riparian systems should be scheduled outside critical breeding seasons where feasible. Invasive species monitoring and control programs should also be implemented throughout construction.

8.4.13 Elephant Dispersal and Human–Wildlife Conflict Impacts

Road upgrading may alter elephant movement behaviour by creating avoidance barriers associated with traffic, noise, night-time disturbance, and road widening. Movement disruption may redirect elephants into agricultural lands, increasing human–wildlife conflict within hotspot areas such as Songeto–Rimo, Anin–Komoigon, Chegilet–Koitilial, and Aror. The impact significance is considered Critical due to risks to wildlife conservation, community safety, and livelihoods.

Mitigation Measures

i. Mitigation should focus on maintaining established elephant dispersal routes and reducing behavioural barriers.
ii. Oversized culverts and wildlife underpasses should be installed at identified crossing points and aligned with natural movement pathways.
iii. Install wildlife warning signage at 500 m intervals; rumble strips at 1,000 m intervals; speed limits (60 km/h day, 40 km/h night).
iv. Traffic calming measures such as rumble strips, speed limits, and warning signage should be introduced within high-risk sections.
v. Construction activities in sensitive movement corridors should be minimized during peak dispersal seasons.
vi. Community awareness programs and human–wildlife conflict mitigation initiatives should be implemented in collaboration with local communities and the Kenya Wildlife Service.

8.4.14 Positive Socio-Economic Impacts

The construction phase is expected to generate positive socio-economic impacts through local employment, procurement opportunities for local suppliers, and skills transfer to local workers and technical personnel. Increased demand for goods and services may stimulate local economic growth and strengthen regional human capital development.

Enhancement Measures

i. To maximize positive impacts, contractors should prioritize local recruitment and procurement wherever feasible.
ii. Transparent procurement processes should be established to support local businesses and suppliers.
iii. Structured on-the-job training, mentorship programs, and partnerships with local technical institutions should be implemented to strengthen local technical capacity and improve long-term employability.
iv. Monitoring systems should also be established to track local employment, supplier participation, and skills development outcomes throughout the construction phase.

8.4.15 Potential Impacts on Plant Distribution

Road upgrading activities such as vegetation clearing, cut-and-fill operations, drainage realignment, excavation, and earthworks will directly affect plant communities along the project corridor. In escarpment areas, bushland, riparian vegetation, savanna ecosystems, and grasslands, the project may result in loss of shrubs, grasses, trees, and stabilizing root systems. Habitat fragmentation and disturbance may also create favourable conditions for invasive plant species, while alteration of moisture regimes may disrupt natural vegetation regeneration processes. Riparian vegetation is particularly vulnerable where drainage structures and culvert installations modify natural water flow patterns. The impact significance ranges from Medium to Critical depending on vegetation sensitivity and extent of disturbance.

Mitigation Measures

i. Mitigation measures should prioritize minimizing vegetation loss and restoring disturbed habitats.
ii. Vegetation clearing should be restricted strictly to approved road reserve limits, supported by pre-construction demarcation of sensitive areas.
iii. Riparian vegetation should be retained wherever feasible, with buffer zones established along drainage lines and wetlands.

iv. Disturbed areas should be progressively rehabilitated using native grasses, shrubs, and tree species adapted to local ecological conditions.
v. Bioengineering measures such as mulching, contour planting, and use of deep-rooted vegetation should be applied to stabilize soils and support vegetation recovery.
vi. Invasive species monitoring and control programs should also be implemented throughout construction and rehabilitation phases.

8.4.16 Potential Impacts on Herpetofauna

Construction activities may negatively affect reptiles and amphibians through habitat destruction, drainage modification, increased sedimentation, and road mortality. Cut-and-fill operations and rock excavation may destroy crevices, burrows, and rocky refugia used by reptiles, while removal of surface rocks may reduce thermal shelter availability. Amphibian breeding habitats associated with seasonal streams, drainage crossings, wetlands, and temporary pools may be altered by culvert installation and changes in hydrological connectivity. Increased vehicle movement may also elevate roadkill risks for reptiles and amphibians, particularly during rainy periods when amphibians migrate to breeding sites. The impact significance ranges from Medium to High depending on habitat sensitivity and species vulnerability.

Mitigation Measures

i. Mitigation should focus on maintaining habitat connectivity and minimizing habitat disturbance.
ii. Construction footprints should be minimized within rocky habitats, wetlands, and drainage crossings.
iii. Culverts and drainage structures should be designed to maintain natural substrate continuity and facilitate safe movement of amphibians and reptiles.
iv. Construction activities within amphibian breeding areas should be scheduled outside peak breeding seasons where feasible.
v. Excavated rock materials may be strategically reused to recreate reptile refugia and microhabitats.
vi. Speed control measures, warning signage, and fauna crossings should be implemented to reduce roadkill risks.
vii. Disturbed habitats should be rehabilitated promptly using native vegetation to restore shelter and breeding conditions.

8.4.17 Potential Impacts on Birds

Road construction activities including vegetation clearance, slope cutting, drainage works, noise generation, and increased traffic may disturb bird habitats and reduce availability of nesting, feeding, and perching sites. Woodland insectivores, raptors, kingfishers, wagtails, aerial insectivores, and riparian bird species may experience habitat fragmentation, temporary displacement, reduced prey availability, and increased collision risk. Riparian vegetation removal may degrade breeding and feeding habitats for water-associated birds, while fragmentation of tree cover may increase exposure of birds to predators. The impact significance ranges from Low to High depending on habitat type and species sensitivity.

Mitigation Measures

i. Mitigation measures should prioritize conservation of nesting and feeding habitats.
ii. Vegetation clearance should be minimized, particularly within riparian zones, woodland patches, and areas supporting nesting trees.
iii. Riparian vegetation should be restored immediately after construction using native species to maintain habitat continuity.

iv. Noise-generating activities should be controlled near sensitive bird habitats during breeding periods where feasible.
v. Diverse native vegetation should be incorporated into rehabilitation programs to support insect prey populations and restore ecological functions.
vi. Wildlife signage and traffic calming measures should also be implemented within areas of high bird activity to reduce collision risks.

8.4.18 Potential Impacts on Invertebrates

Construction activities may affect terrestrial and aquatic invertebrate communities through vegetation clearance, habitat fragmentation, sedimentation, soil compaction, and alteration of drainage systems. Removal of flowering plants, shrubs, and native vegetation may reduce nesting substrates and food sources for pollinators such as butterflies and bees. Aquatic and semi-aquatic invertebrates may be affected by sedimentation and reduced water quality associated with culvert installation and drainage modification. Disturbed open habitats may also favour invasive and opportunistic pest species. The significance of these impacts ranges from Low to High depending on habitat sensitivity and ecological function.

Mitigation Measures

i. Mitigation should emphasize habitat restoration and maintenance of ecological processes. Revegetation programs should prioritize diverse native flowering species that support pollinators and beneficial insects.
ii. Drainage works should incorporate sediment control measures such as silt traps and check dams to protect aquatic invertebrate habitats.
iii. Chemical pesticide use during construction should be avoided to minimize impacts on pollinators and predatory insects.
iv. Disturbed areas should be rehabilitated progressively to reduce the duration of habitat exposure and fragmentation.
v. Riparian and wetland habitats should also be protected to maintain moisture conditions required by sensitive invertebrate communities.

8.4.19 Potential Impacts on Mammals

Road upgrading may affect mammals through habitat fragmentation, vegetation loss, disturbance from blasting and machinery, disruption of movement corridors, and increased wildlife-vehicle collisions. Escarpment slopes, bushland, riparian corridors, wetlands, and savanna habitats support a range of mammals including antelopes, primates, carnivores, rodents, hyraxes, and medium-sized mammals. Vegetation clearance and blasting activities may reduce cover and disrupt movement patterns, while road widening may increase mortality risks for small and medium mammals attempting to cross the roadway. Riparian corridor modification may further reduce habitat connectivity and increase exposure to predators and human disturbance. The impact significance ranges from Low to High depending on habitat sensitivity and species distribution.

Mitigation Measures

i. Mitigation measures should prioritize maintaining wildlife connectivity and minimizing disturbance.
ii. Wildlife crossings such as underpasses and oversized culverts should be installed within key movement corridors and riparian zones.
iii. Vegetation clearing should be limited to the minimum required footprint, and construction should proceed progressively to allow wildlife dispersal from active work areas.
iv. Blasting and high-disturbance activities should be carefully controlled and scheduled to minimize disruption to sensitive wildlife habitats.

v. Speed control measures, warning signage, and traffic calming interventions should be implemented within wildlife crossing areas to reduce collision risks.
vi. Disturbed habitats should be rehabilitated promptly using native vegetation species to restore ecological cover and movement pathways.

8.4.20 Potential Impacts on Elephant Dispersal Areas

The Biretwo–Chesongoch corridor forms part of an important seasonal elephant dispersal area associated with Rimoi National Reserve. Road upgrading activities may alter elephant movement behaviour through increased traffic, construction noise, road widening, night-time disturbance, and modification of drainage systems. These disturbances may create behavioural avoidance barriers that discourage elephants from crossing the road and redirect movement into agricultural areas, thereby increasing the risk of human–elephant conflict. High-risk chainages include Songeto–Rimo, Anin–Komoigon, Chegilet–Koitilial, and Aror, where terrain and hydrological conditions naturally concentrate elephant movement. The significance of this impact is considered Critical due to implications for wildlife conservation and community safety.

Mitigation Measures

i. Mitigation measures should focus on maintaining natural elephant dispersal routes and minimizing behavioural disturbance.
ii. Wildlife underpasses and oversized culverts should be installed at identified crossing points, particularly where drainage lines intersect movement corridors.
iii. These crossings should be aligned with natural elephant pathways and designed with sufficient openness to encourage use.
iv. Traffic calming measures including speed limits, rumble strips, and wildlife warning signage should be implemented in high-risk sections.
v. Construction activities within elephant movement corridors should be minimized during peak dispersal periods, particularly during the long rainy season.
vi. Community awareness programs and collaboration with the Kenya Wildlife Service should support conflict mitigation and monitoring of elephant movement patterns.

8.4.21 Potential Impacts on Human–Wildlife Conflict Areas

Road upgrading may indirectly intensify human–wildlife conflict by increasing accessibility, encouraging agricultural expansion, and altering wildlife movement behaviour. Roads may function as barriers that redirect elephants and other wildlife into croplands and settlements, increasing crop damage and risks to community safety. Human–wildlife conflict hotspots have been identified within Songeto–Rimo, Anin–Komoigon, and Chegilet–Koitilial, where elephant dispersal routes intersect agricultural land and settlement areas. The impact significance is considered High due to risks to livelihoods, property, and community safety.

Mitigation Measures

i. Mitigation measures should integrate engineering controls with community-based conflict management approaches.
ii. Wildlife crossings and ecological connectivity structures should be incorporated within identified movement corridors to reduce wildlife displacement into farmland.
iii. Traffic calming measures should be implemented in conflict-prone sections to reduce disturbance and facilitate safer wildlife movement.
iv. Community awareness initiatives should educate residents on wildlife behaviour and conflict prevention strategies.
v. Early-warning systems and collaboration with local authorities and the Kenya Wildlife Service should also be established to improve monitoring and rapid response to wildlife incursions.

8.4.21.1 Summary of ecological impacts on specific sections of the road project

Further detailed analysis of ecological impacts by road section, including specific sensitivity areas and mitigation requirements, is provided in the Biodiversity Management Plan (BMP) Summary of Ecological Impacts on Specific Sections of the Road Project. Table 8-1 summarizes the section specific impacts.

Table 8-1: Summary of impacts on specific sections of the road project

Topic / Focus Area	Sensitive Areas / Chainages
Potential Impacts of Road Upgrading on Biophysical Interactions with Biodiversity	Entire road corridor
Biretwo – Arror – Chesongoch: Biophysical Interactions with Biodiversity	Escarpment slopes, drainage crossings, bushland–savanna mosaics
Nyaru – Kimwarer – Kapkayo: Biophysical Interactions with Biodiversity	Woodland habitats, riparian strips, valley soils
Kimwarer – Emsea: Biophysical Interactions with Biodiversity	Floodplains, valley bottoms, wetlands, riparian corridors
Potential Road-Upgrading Impacts on Plant Distribution	Entire road corridor
Biretwo – Arror – Chesongoch: Plant Distribution Impacts	0+000–70+879
Nyaru – Kimwarer – Kapkayo: Plant Distribution Impacts	0+000–30+800
Kimwarer – Emsea: Plant Distribution Impacts	0+000–19+000
Potential Road-Upgrading Impacts on Herpetofauna	Entire road corridor
Biretwo – Arror – Chesongoch: Herpetofauna Impacts	5+000–22+000, 40+000–63+000, drainage crossings
Nyaru – Kimwarer – Kapkayo: Herpetofauna Impacts	7+200–14+600, 21+400–27+400
Kimwarer – Emsea: Herpetofauna Impacts	11+200–18+600
Potential Road-Upgrading Impacts on Birds	Entire road corridor
Biretwo – Arror – Chesongoch: Bird Impacts	0+000–70+879
Nyaru – Kimwarer – Kapkayo: Bird Impacts	0+000–30+800
Kimwarer – Emsea: Bird Impacts	0+000–19+000
Potential Road-Upgrading Impacts on Invertebrates	Entire road corridor
Biretwo – Chesongoch: Invertebrate Impacts	0+000–70+879
Nyaru – Kimwarer – Kapkayo: Invertebrate Impacts	0+000–30+800
Kimwarer – Emsea: Invertebrate Impacts	0+000–19+000
Potential Road-Upgrading Impacts on Mammals	Entire road corridor
Biretwo – Chesongoch: Mammal Impacts	0+000–70+879
Nyaru – Kimwarer – Kapkayo: Mammal Impacts	0+000–30+800
Kimwarer – Emsea: Mammal Impacts	0+000–19+000
Impacts on Elephant Dispersal Areas	13+000–17+000, 21+000–24+000, 37+000–40+000, 49+000–51+000
Impacts on Human–Wildlife Conflict Areas	13+000–17+000, 21+000–24+000, 37+000–40+000, 49+000–51+000
Impacts on Termite Habitats	13+000–17+000, 21+000–24+000, 37+000–40+000, 49+000–51+000

Impacts on *Ficus sycomorus* Distribution	13+000–17+000, 21+000–24+000, 37+000–40+000, 49+000–51+000, Chesongoch drainage zones

8.4.22 Increased Water Demand

Construction activities will significantly increase water demand for concrete works, compaction, dust suppression, and domestic use within worker camps. Although the Kerio Valley corridor is intersected by both permanent and seasonal streams, uncontrolled abstraction—particularly during dry periods—may place localized stress on available water resources. The key concern is not absolute scarcity, but competition for water and deterioration of water quality. Unsustainable withdrawal or contamination risks could affect downstream users, livestock watering points, and aquatic ecosystems, thereby creating both environmental and socio-economic pressures. The impact is considered of Moderate significance, as it is largely manageable through planned abstraction and is unlikely to result in long-term depletion if properly controlled. With appropriate permitting, efficient use, and alternative sourcing, the residual impact can be effectively reduced.

Mitigation Measures

i. To address these risks, the project will prioritize the development of independent and sustainable water sources such as licensed boreholes and off-stream storage systems to reduce reliance on natural streams.
ii. All water abstraction will be undertaken in compliance with the Water Act, 2016, including obtaining the necessary permits from the Water Resources Authority (WRA).
iii. Abstraction from small or ecologically sensitive streams will be avoided, while water-efficient construction practices, including reuse and recycling where feasible, will be implemented.
iv. Local communities will be actively engaged in water-use planning, particularly where shared resources are involved, to minimize conflict and ensure equitable access. With these measures in place, the residual impact is expected to reduce to low significance.

8.4.23 Construction Works-Induced Traffic and Inconveniences

Construction activities will introduce a substantial increase in heavy vehicle traffic along narrow, unpaved rural roads, resulting in disruptions to mobility and daily life. Temporary road closures, diversions, and shared use of road space with construction machinery will restrict access to homes, farms, schools, health facilities, and businesses. Communities will also experience increased dust, noise, and vibration, reducing livability. Poorly maintained diversions may cause vehicle damage, while disrupted access to markets could negatively affect livelihoods. Critically, the interaction between heavy vehicles and vulnerable road users—including pedestrians, cyclists, and livestock—will significantly elevate the risk of accidents. This impact is assessed as of High significance, given the direct interaction with public mobility systems and the elevated safety risks to pedestrians, cyclists, and livestock. The magnitude is particularly high due to the vulnerability of rural road users and the limited availability of alternative routes.

Mitigation Measures

i. Mitigation will focus on proactive planning and traffic control. Construction schedules will be designed to avoid peak traffic periods and sensitive times such as school commute hours and market days.
ii. The contractor will prepare and implement a comprehensive Traffic Management Plan (TMP), incorporating clearly marked diversions, speed limits, and deployment of trained flag personnel at critical points.
iii. Temporary access routes will be maintained in good condition, with regular dust suppression.
iv. Continuous communication with communities and local authorities will ensure awareness of planned disruptions, while emergency access will be guaranteed at all times.
v. Monitoring systems and rapid response mechanisms will be established to address complaints and incidents promptly.

8.4.24 Disruption of Public Utilities and Infrastructure

Road upgrading works involving excavation, widening, and realignment pose a high risk of damaging existing utilities such as water pipelines, electricity lines, and telecommunication cables. Such disruptions could lead to temporary or prolonged service outages, affecting households, businesses, healthcare, and education services. Additionally, heavy construction traffic may damage adjacent feeder roads, footpaths, and informal drainage systems, further compounding infrastructure degradation. Given the likelihood of encountering unmapped or informal utilities, the potential for service disruption is considerable. At this stage, the impact is considered of High significance, mainly due to the uncertainty in utility locations and the potential for unplanned service interruptions. The risk is particularly relevant in densely settled sections where infrastructure mapping may be incomplete or outdated.

Mitigation Measures

i. A proactive "locate, plan, and protect" approach will be adopted.
ii. Detailed utility mapping will be undertaken in collaboration with all relevant service providers prior to construction.
iii. Where feasible, the design will avoid major utility lines, while necessary relocations will be completed before commencement of earthworks.
iv. Physical protection measures, such as trench supports and exclusion zones, will be implemented for utilities that remain in place.
v. Advance notice will be provided to communities regarding planned service interruptions, and a 24-hour emergency response system will be established to address accidental damage.
vi. This coordinated planning will significantly reduce the likelihood and severity of disruptions.

8.4.25 Spread of Communicable Diseases and Respiratory Health Impacts

The influx of a large workforce and establishment of temporary camps introduces significant public health risks. Poor sanitation or waste management could contaminate water sources, leading to diseases such as cholera and typhoid. Excavations may create stagnant water, increasing the risk of vector-borne diseases like malaria. Crowded living conditions can facilitate the spread of airborne diseases such as tuberculosis and influenza. Simultaneously, dust emissions from construction activities will degrade air quality, exacerbating respiratory conditions among workers and nearby communities, particularly vulnerable groups such as children and the elderly. This impact is assessed as of High significance, due to the combination of population influx, exposure of vulnerable groups, and potential for rapid disease transmission if sanitation and health controls are inadequate.

Mitigation Measures

i. A comprehensive health management approach will be implemented.
ii. Worker camps will be located away from sensitive receptors such as schools and water sources.
iii. Pre-employment medical screening and vaccination requirements will be enforced, alongside strict sanitation and waste management systems.
iv. Vector control measures, including elimination of stagnant water and provision of mosquito nets, will be implemented.
v. Dust suppression measures will be rigorously applied to reduce air pollution.
vi. Health education campaigns will be conducted for both workers and communities, supported by onsite medical facilities and regular outreach programs in collaboration with local health authorities.

8.4.26 Increased Risk of HIV/AIDS and Other STIs

The presence of a transient, predominantly male workforce is likely to increase the risk of HIV/AIDS and other sexually transmitted infections. Economic disparities and increased disposable income may drive transactional sex, exposing women and adolescent girls to exploitation and gender-based violence. Additionally, migrant workers may introduce new infection pathways, increasing disease transmission within local communities. This is considered a High significance impact, particularly due to the vulnerability of young women and the potential for long-term public health consequences if preventive measures are not effectively implemented.

Mitigation Measures

i. Mitigation will focus on prevention, awareness, and access to services.
ii. Local employment will be prioritized to reduce workforce influx, while contractors will be required to enforce strict codes of conduct and provide mandatory training on sexual and reproductive health (SRH) and gender-based violence prevention.
iii. Condom distribution and voluntary counseling and testing (VCT) services will be made accessible in both camps and communities.
iv. Partnerships with local health organizations will support outreach programs, while a dedicated SRH and GBV prevention plan will guide implementation.
v. These measures aim to reduce transmission risks and protect vulnerable groups.

8.4.27 Worker Welfare and Occupational Health and Safety

Construction workers face high risks of injury from machinery, falls, and hazardous working conditions, as well as chronic health issues from dust, noise, and poor ergonomics. Inadequate camp conditions could further expose workers to disease, while poor labor practices may lead to exploitation and reduced morale. The impact is assessed as of High significance, reflecting the inherent hazards of large-scale construction activities and the high exposure of workers in active construction zones.

Mitigation Measures

i. A comprehensive Occupational Health, Safety, and Welfare (OHS&W) system will be implemented.
ii. Contractors will be required to prepare detailed OHS and camp management plans, ensuring compliance with national and international standards.
iii. Workers will receive regular safety training and be provided with appropriate personal protective equipment (PPE).
iv. Camps will maintain adequate sanitation, clean water, and safe living conditions.
v. Medical facilities, fair labor practices, grievance mechanisms, and independent audits will ensure worker welfare is safeguarded.

8.4.28 Community Health and Safety

Construction activities will expose nearby communities—especially children—to significant safety risks from traffic, open excavations, and falling materials. Additional health risks may arise from dust and poor sanitation, particularly in areas close to schools and residential settlements. This impact is considered of High significance, due to the direct interaction between construction activities and vulnerable community groups.

Mitigation Measures

i. The project will establish controlled safety zones around schools, enforce speed limits, and provide safe pedestrian crossings.
ii. Construction sites will be secured with fencing and clear signage.

iii. Dust suppression measures will be intensified near sensitive receptors, and sanitation controls will prevent contamination.
iv. Community awareness programs and grievance mechanisms will enhance safety and responsiveness.

8.4.29 Conflicts Between Construction Workers and Local Communities

The interaction between local communities and an external workforce may lead to social tensions arising from unmet expectations, perceived inequality, and cultural differences. Such conflicts could disrupt project implementation and undermine community relations. The impact is rated as Moderate significance, as it is largely socio-behavioural, context-dependent, and can be effectively managed through structured engagement and grievance mechanisms.

Mitigation Measures

i. A transparent Local Employment and Procurement Plan (LEPP) will be implemented to manage expectations and ensure equitable access to opportunities.
ii. Continuous stakeholder engagement, conflict sensitivity training, and community-building activities will foster positive relationships.
iii. A culturally appropriate grievance redress mechanism (GRM) will be established to resolve disputes promptly.

8.4.30 Labour Influx and Induced Social Change

Labour influx may alter local social dynamics, leading to informal settlements, cultural conflicts, and increased exposure to risky behaviors such as substance abuse and commercial sex work. Economic disparities may also distort local livelihoods and create dependency. This is considered a High significance impact, reflecting both the scale of workforce influx and the sensitivity of rural social systems to rapid demographic and behavioural change. This impact is considered of High significance, due to the high vulnerability of children and the serious, irreversible nature of potential harm.

Mitigation Measures

i. Mitigation will include maximizing local employment, careful siting and management of worker camps, and strict enforcement of worker codes of conduct.
ii. Camp decommissioning plans will prevent permanent settlement formation.
iii. Community engagement programs, especially targeting youth, will promote positive social outcomes and long-term skills development.

8.4.31 Child Protection and Sexual Exploitation and Abuse (SEA)

Children in host communities face heightened risks of exploitation, abuse, and involvement in hazardous labor due to increased economic activity and workforce presence. Consequences include school dropout, health risks, and long-term psychological harm. This impact is considered of High significance, due to the high vulnerability of children and the serious, irreversible nature of potential harm.

Mitigation Measures

i. A zero-tolerance policy on child exploitation will be enforced through contractual obligations, worker training, and strict supervision.
ii. Child-friendly reporting mechanisms will be established, and partnerships with local authorities and NGOs will support monitoring and response.
iii. Awareness programs in schools will empower children and communities to recognize and report abuse.

8.4.32 Cross-Cutting Safety and Social Risks

Additional risks include occupational hazards, heat stress, road safety issues, potential loss of life or property, and disproportionate impacts on vulnerable groups. These risks are interconnected and can escalate if not systematically managed.

Mitigation Measures

i. Integrated management plans—including Health and Safety Plans, Traffic Management Plans, and Emergency Response Plans—will be implemented to address these risks holistically.
ii. Specific measures such as heat stress management, road safety campaigns, and targeted support for vulnerable groups will ensure inclusive and effective risk mitigation.
iii. Continuous monitoring, stakeholder engagement, and adaptive management will be essential to maintaining safety and social sustainability throughout the project lifecycle.

8.5 Operation Phase Impacts

The operational phase introduces long-term, transformative changes driven by the presence and use of the upgraded road. These impacts reflect both significant development opportunities and emerging environmental and social risks. Their ultimate outcomes will depend on how effectively they are managed through integrated planning, policy alignment, and sustained institutional oversight.

Positive Impacts

8.5.1 Spurred Economic and Spatial Development

The upgraded all-weather road will act as a major catalyst for economic growth and spatial transformation along the corridor. Improved accessibility will lower transport costs and travel time, enhancing agricultural productivity, reducing post-harvest losses, and strengthening market linkages. This will stimulate growth in trade, roadside businesses, and service provision, particularly in nodal centres such as Biretwo and Chesongoch. Additionally, improved connectivity is likely to attract both public and private investment in sectors such as agri-processing, healthcare, and financial services. However, these benefits may be accompanied by risks of unplanned land-use change, including conversion of agricultural and rangeland into settlements or commercial uses, leading to habitat fragmentation, pressure on water resources, and potential increases in human-wildlife conflict.

Enhancement and Mitigation Measures

i. To maximize economic benefits while managing associated risks, the project will be integrated with county spatial planning frameworks to guide orderly development and protect sensitive areas such as wildlife corridors and riparian zones.
ii. Targeted economic development programs—including support for farmer cooperatives, business training, and market linkages—will be implemented to ensure inclusive growth.
iii. Environmental safeguards will be strengthened through collaboration with relevant authorities to protect ecologically sensitive areas.
iv. Social risks such as land speculation and displacement will be monitored through the project's grievance redress mechanisms, ensuring early identification and resolution of emerging issues.

8.5.2 Reduced Vehicle Operating Costs (VOCs)

The transition from an unpaved to a paved road will significantly reduce vehicle operating costs by improving fuel efficiency, reducing wear and tear, and lowering maintenance requirements. These savings will benefit all road users, including public transport operators, freight carriers, and private vehicle owners. Lower transport costs will enhance the efficiency of the corridor, encouraging increased trade and economic activity.

Enhancement and Mitigation Measures

i. To sustain these benefits, the project will ensure high construction quality and durable pavement design suited to local environmental conditions.
ii. A structured maintenance plan, supported by adequate funding and institutional commitment, will be established to preserve road conditions and prevent deterioration that could erode cost savings over time.

8.5.3 Improved Access to Services and Emergency Response

The upgraded road will significantly improve access to essential services, including healthcare, education, and security. Reliable, all-weather access will enable faster emergency response times for ambulances, police, and fire services, directly improving public safety and health outcomes. Improved road conditions will also encourage the use of safer and more efficient public transport systems, enhancing mobility and connectivity for local communities.

Enhancement and Mitigation Measures

i. To fully realize these benefits, coordination with county health and emergency services will be undertaken to update response protocols and optimize service delivery along the corridor.
ii. Engagement with transport operators will support the transition to safer and more reliable vehicle fleets.
iii. Road safety awareness campaigns will also be implemented to help communities adapt to changing traffic conditions.

8.5.4 Reduced Travel Time and Improved Reliability

The upgraded road will eliminate seasonal disruptions and significantly reduce travel times, improving reliability for both passenger and freight movement. This will reduce indirect costs associated with delays, such as spoilage of perishable goods and missed economic opportunities, thereby enhancing household welfare and business efficiency.

Enhancement and Mitigation Measures

i. Sustaining these benefits will require robust engineering design, particularly for drainage and slope stabilization, to prevent road damage and service interruptions.
ii. Continuous maintenance will also be essential to preserve road performance and ensure long-term reliability.

8.5.5 Reduced Dust Pollution

The paving of the road will eliminate a major source of dust emissions, significantly improving air quality for communities living along the corridor. This will reduce respiratory health risks, particularly for vulnerable groups such as children and the elderly, and improve environmental conditions for vegetation and households.

Enhancement and Mitigation Measures

i. Maintaining a durable road surface will be critical to sustaining this benefit.
ii. Regular maintenance will prevent surface degradation that could reintroduce dust generation.
iii. Monitoring of air quality improvements will also support evaluation of health benefits over time.

8.5.6 Improved Drainage and Hydrological Function

The installation of formal drainage infrastructure will improve water flow management, reducing flooding, erosion, and sedimentation. This will enhance the resilience of the road while protecting adjacent land and aquatic ecosystems.

Enhancement and Mitigation Measures

i. The project will incorporate environmentally sensitive drainage designs, including nature-based solutions where feasible, to maintain ecological connectivity.
ii. Long-term functionality will be ensured through a dedicated drainage maintenance plan and regular inspections.

8.5.7 Potential wildlife collision

8.5.7.1 Potential wildlife collision in Biretwo – Chesongoch corridor

The Biretwo–Chesongoch corridor presents the highest potential wildlife–vehicle collision risk among the three road sections. The proposed road overlaps with a mapped elephant dispersal corridor extending from Biretwo through Songeto, Anin, Chegilet, Aror, and Resim towards Chesongoch. Documented human–elephant conflict (HWC) hotspots, combined with numerous riparian corridors, seasonal drainage channels, and gentle valley-bottom terrain, create ideal conditions for frequent elephant crossings. The highest-risk sections occur at chainages 3+900–8+000, 9+800–13+900, 17+200–24+700, 34+000–43+600, and 47+800–53+600.

Chainage	Likely Collision Risk	Reason
3+900–8+000	**Very High**	Road intersects the southern elephant dispersal corridor near Biretwo–Kapito. Multiple drainage channels and gentle valley-bottom terrain provide natural elephant crossing routes. Existing HWC records confirm elephant activity.
9+800–13+900	**Very High**	Elephant dispersal corridor overlaps the road near Songeto. Dense drainage network and riparian habitats create preferred movement pathways between feeding and watering areas.
17+200–24+700	**Very High**	Major HWC hotspot around Rimoi–Anin–Komogon. The dispersal corridor directly coincides with the road alignment, with numerous drainage crossings and valley-bottom habitats supporting frequent elephant movement.
28+600–30+400	**High**	Road follows the elephant dispersal route through Kobulwo where several drainage channels converge. Suitable terrain increases crossing likelihood.
34+000–43+600	**Very High**	Chegilet–Koitilial section forms a continuous elephant movement corridor linking western and eastern habitats. Gentle slopes, multiple tributaries and recorded HWC make this one of the highest collision-risk sections.
47+800–53+600	**Very High**	Aror area contains documented elephant conflict locations where the dispersal corridor closely follows the road. Riparian vegetation and drainage lines encourage repeated crossings.
56+700–62+700	**High**	Resim section lies within the northern dispersal corridor. Wildlife movement is concentrated along seasonal drainage systems approaching the escarpment.
65+600–70+800	**Moderate–High**	Approaching Chesongoch, elephant movement continues along drainage corridors although settlement influence becomes greater. Crossings remain possible, particularly near seasonal streams.

8.5.7.2 Potential wildlife collision in Kimwarer–Emsea corridor

Potential wildlife–vehicle collisions along the Kimwarer–Emsea corridor are primarily associated with seasonal drainage crossings, riparian habitats, and valley-bottom systems rather than large-mammal migration routes. Wildlife movement is expected to concentrate where tributaries intersect the road, particularly between chainages 5+000–10+000, 11+000–16+800, and 17+000–19+000. These sections contain multiple drainage channels that provide natural movement corridors for terrestrial mammals and other fauna.

Chainage	Likely Collision Risk	Reason
0+000 – 1+000	Moderate	Valley-bottom habitat with drainage crossing near Kimwarer.
3+000 – 4+400	High	Multiple drainage channels intersect gentle terrain, facilitating wildlife movement.
6+600 – 7+800	High	Concentration of drainage crossings and low-gradient corridor.
8+400 – 10+000	High	Broad valley-bottom section adjacent to several tributaries.
10+800 – 11+800	High	Wildlife likely follows drainage line crossing the road.
12+800 – 13+600	High	Gentle terrain with continuous drainage connectivity.
14+000 – 16+800	Very High	Largest concentration of tributaries and valley-bottom habitat; likely preferred wildlife movement corridor.
17+000 – 18+200	High	Transition from valley floor toward Emsea with several stream crossings.
18+400 – 19+000	Moderate–High	Wildlife movement towards Emsea drainage system.

8.5.7.3 Potential wildlife collision in Nyaru – Kapkayo corridor

Potential wildlife–vehicle collision risk along the Nyaru–Kapkayo corridor is generally associated with valley-bottom drainage systems, seasonal streams, and gentle terrain that facilitate wildlife movement between adjacent habitats. The highest likelihood of collisions occurs between chainages 2+200–4+800, 5+200–8+200, 10+800–13+800, 14+000–16+800, and 17+000–21+800, where the road intersects multiple drainage channels and low-gradient movement corridors. Although no major elephant dispersal corridor has been identified along this alignment, medium and small mammals are likely to use these drainage systems as movement pathways, particularly during the wet season. Installation of wildlife warning signs, speed-calming measures, and appropriately sized culverts at major drainage crossings is recommended.

Chainage	Likely Collision Risk	Reason
2+200–4+800	**Very High**	Major transition from steep escarpment to gentle valley-bottom with multiple drainage crossings, creating a natural wildlife crossing corridor.
5+200–8+200	**High**	Several drainage channels intersect the road within low-gradient terrain, concentrating wildlife movement.
10+800–13+800	**Very High**	Highest concentration of drainage crossings and connected valley-bottom habitats, providing continuous wildlife movement routes.
14+000–16+800	**Very High**	Multiple tributary crossings and gentle slopes create one of the strongest landscape connectivity zones along the corridor.

Mitigation measures

- Install wildlife crossing warning signs at identified collision hotspots and known wildlife crossing points.
- Install speed-calming measures (rumble strips, speed humps where appropriate, and reduced speed zones of 30–50 km/h) within wildlife crossing sections and near riparian corridors.
- Design all major culverts and bridge crossings to be wildlife-friendly by providing sufficient width, height, natural substrates, and unobstructed visibility through the structures.
- Install permanent wildlife warning signs and reflective signage at all identified crossing hotspots and maintain road markings for improved driver visibility.
- Enforce speed limits through road signage and periodic traffic enforcement in high-risk wildlife crossing sections.
- Regularly manage roadside vegetation to improve driver sight distance while retaining riparian vegetation and avoiding unnecessary habitat clearing.
- Establish a wildlife roadkill monitoring programme to record collision incidents, identify emerging hotspots, and guide adaptive management measures.
- Collaborate with Kenya Wildlife Service (KWS), local communities, and conservancies to monitor elephant movements and disseminate early warning information during peak dispersal periods.

8.5.8 Social and Cultural Change from Increased Connectivity

Improved connectivity will facilitate increased interaction between local communities and external populations, leading to gradual social and cultural change. While this may promote integration and access to new opportunities, it also carries risks of cultural erosion and social tension, particularly in traditionally structured communities.

Enhancement and Mitigation Measures

i. Managing this transition will require ongoing community engagement and monitoring of social cohesion indicators.
ii. Cultural preservation initiatives and awareness programs may be supported to promote mutual respect and minimize conflict.
iii. Effective management of construction-phase social risks will also be essential in shaping positive long-term outcomes.

Adverse Environmental Impacts

8.5.9 Increased Solid Waste and Littering

Increased traffic and commercial activity will likely result in higher volumes of roadside litter, particularly in trading centres and bus stops. This may degrade environmental quality, block drainage systems, and create public health concerns.

Mitigation Measures

i. Waste management infrastructure, including designated collection points, will be integrated into road design.
ii. Partnerships with county authorities will ensure regular waste collection and disposal, while public awareness campaigns and community engagement initiatives will promote responsible waste management.
iii. Maintenance contractors will be responsible for routine cleaning and monitoring.

8.5.10 Road Maintenance Impacts

Routine maintenance activities will generate waste materials, including hazardous substances and vegetation debris, which may impact soil, water, and air quality if not properly managed.

Mitigation Measures

i. Environmental management requirements will be incorporated into maintenance contracts, including proper waste handling, recycling, and disposal practices.
ii. Contractors will be trained on environmental protocols, and regular inspections will ensure compliance.
iii. Maintenance activities will also be scheduled to minimize disruption to communities.

Increased Runoff and Altered Hydrology

The paved road surface will increase runoff, leading to higher peak flows, potential erosion, reduced groundwater recharge, and transport of pollutants into watercourses. These changes may negatively affect aquatic ecosystems and water resources.

Mitigation Measures

i. Stormwater management systems, including retention structures, vegetated buffers, and sediment control measures, will be implemented to regulate runoff and improve water quality.
ii. Regular monitoring and maintenance of drainage systems will ensure their effectiveness, with adaptive measures applied as needed.

8.5.11 Increased Communicable Diseases (Operational Phase)

Increased transport of agricultural goods and traffic activity may introduce localized health risks, including exposure to vehicle emissions and increased pest activity near trading centres.

Mitigation Measures

Designated loading zones, improved sanitation in markets, and awareness campaigns on hygiene and air quality will be implemented. Collaboration with local authorities will strengthen waste management and public health systems in high-activity areas.

8.5.12 Increased Vehicle Accidents

Improved road conditions may lead to higher vehicle speeds, increasing the risk and severity of accidents involving pedestrians, cyclists, and wildlife.

Mitigation Measures

i. Road safety will be enhanced through engineering measures such as traffic calming, signage, and designated crossing points.
ii. Public awareness campaigns and enforcement of traffic regulations will further reduce risks.
iii. Wildlife crossings and warning systems will be implemented where necessary.

8.5.13 Human Encroachment along the Road Corridor

Improved accessibility may lead to informal settlement and commercial encroachment within the road reserve, creating safety hazards, obstructing maintenance, and degrading environmental conditions.

Mitigation Measures

i. Clear demarcation of the road reserve and enforcement of land-use regulations will prevent encroachment.
ii. Collaboration with county authorities will guide planned development outside the reserve, supported by public awareness and monitoring programs.

8.5.14 Cumulative Impact Assessment

8.5.14.1 Approach

The cumulative impact assessment evaluates whether the incremental environmental and social impacts of the proposed Biretwo–Arror–Chesongoch (B126) Road and Associated Spur Roads Project, when combined with existing, approved and reasonably foreseeable developments within the project area of influence, could result in significant cumulative effects on shared environmental and social receptors.

The assessment considers both adverse and beneficial cumulative impacts during the construction and operation phases and applies the same significance rating methodology used throughout this ESIA. The significance of cumulative impacts is presented as pre-mitigation significance and residual significance, reflecting the anticipated effectiveness of the proposed mitigation, monitoring and management measures.

8.5.14.2 Reasonably Foreseeable Developments

The assessment considered the following existing and reasonably foreseeable developments within Elgeyo Marakwet County:

- Upgrading and maintenance of the national and county road network under the Kenya National Highways Authority (KeNHA) and County Governments.
- Ongoing and planned agricultural expansion, including commercial crop farming, irrigation schemes and horticultural development within the Kerio Valley.
- Expansion of trading centres and urban growth in Biretwo, Arror, Kimwarer, Emsea, Kapkayo and Chesongoch.
- Rural electrification and transmission infrastructure projects by the Kenya Power and Lighting Company (KPLC) and the Kenya Electricity Transmission Company (KETRACO).
- Water supply, borehole development and small-scale irrigation projects implemented by County Governments and Water Works Development Agencies.
- Tourism development associated with the nearby Rimoi National Reserve and Kerio Valley tourism circuit.
- Sand harvesting, quarrying and extraction of construction materials to meet regional infrastructure demand.
- Ongoing and future settlement expansion driven by improved accessibility following road upgrading.
- Climate adaptation and natural resource management programmes implemented by national and county governments and development partners.

8.5.14.3 Common Environmental and Social Receptors

The principal receptors potentially affected by cumulative impacts include:

- surface water resources, wetlands and river crossings;
- groundwater resources;
- riparian habitats and riverine vegetation;

- indigenous woodland remnants;
- ecologically sensitive escarpment habitats;
- wildlife habitats and wildlife movement areas within the wider Kerio Valley landscape;
- elephant dispersal areas outside protected areas;
- aquatic ecosystems;
- agricultural land and grazing areas;
- local communities dependent on ecosystem services;
- roadside settlements and trading centres;
- road users, pedestrians and livestock;
- public infrastructure; and
- cultural heritage resources.

Although the proposed project roads do not traverse Rimoi National Reserve or Kapnarok Game Reserve, elephants have historically been reported crossing sections of the B126 after straying beyond the reserve boundary. In addition, seasonal elephant movement occurs between Rimoi National Reserve and Kapnarok Game Reserve across the wider Kerio Valley landscape. Consequently, increased traffic associated with the upgraded road has the potential to increase wildlife-vehicle collision risk unless appropriate mitigation measures are implemented. The Kenya Wildlife Service (KWS) has indicated plans to fence the section of Rimoi National Reserve adjacent to the B126, which is expected to reduce uncontrolled elephant access to the road and minimise collision risks

8.5.14.4 Assessment of Combined Effects

Table 8-2: Assessment of Combined Effects

Receptor	Potential Combined Effect	Pre-Mitigation Significance	Key Mitigation / Enhancement Measures	Residual Significance
Surface water resources	Increased sedimentation, runoff and pollution from road construction, agriculture, irrigation development and settlement expansion.	Major	Integrated erosion and sediment control, riparian protection, coordinated water abstraction, rehabilitation of disturbed areas.	Moderate
Groundwater resources	Increased abstraction associated with construction, irrigation and settlement growth.	Moderate	Water abstraction permits, efficient water use and monitoring.	Minor
Biodiversity and wildlife	Increased human activity, traffic volumes and land-use change may increase disturbance to wildlife habitats, create a barrier effect for wildlife movement, and increase wildlife-vehicle collision risk, particularly where elephants occasionally	Major	Implement the Biodiversity Management Plan; maintain wildlife warning signage and rumble strips in high-risk sections; enforce speed limits; coordinate with KWS regarding fencing adjacent to Rimoi National Reserve; undertake weekly	Moderate

	cross the B126 outside protected areas.		roadkill surveys during the first 12 months of operation; implement adaptive management where collision hotspots are identified.	
Riparian habitats	Increased pressure on riparian vegetation and aquatic habitats arising from road development, agriculture and settlement expansion.	Major	Protect riparian buffers, rehabilitate disturbed areas and implement integrated watershed management.	Moderate
Air quality	Combined dust and vehicle emissions from road works, quarrying and agricultural activities.	Moderate	Dust suppression, vehicle maintenance and roadside vegetation.	Minor
Noise environment	Increased traffic, construction activities and commercial development.	Moderate	Traffic management, speed control and monitoring.	Minor
Land use	Growth-induced conversion of agricultural and natural land to settlements and commercial development.	Major	County land-use planning, protection of the road reserve and enforcement of development controls.	Moderate
Road safety	Increased traffic volumes may increase accidents involving pedestrians, livestock and wildlife.	Major	Speed management, pedestrian crossings, livestock crossings, road signage and road safety awareness programmes.	Moderate
Tourism and socio-economic development	Improved accessibility combined with tourism promotion initiatives is expected to increase visitor numbers to Rimoi National Reserve and Kapnarok Game Reserve, stimulate local businesses, create employment opportunities and strengthen regional economic growth.	High Positive	Promote community-based tourism, improve directional signage and collaborate with KWS and County Governments on sustainable tourism development.	High Positive
Climate resilience	Improved connectivity combined with county development initiatives enhances emergency	High Positive	Climate-resilient Road maintenance and coordinated regional planning.	High Positive

	response, market access and regional resilience.			

Receptor	Potential Combined Effect	Significance
Surface water	Increased sedimentation, runoff and pollution from road construction, agriculture and settlement expansion.	Moderate
Groundwater	Increased abstraction from construction, irrigation and urban growth leading to localized pressure on groundwater resources.	Moderate
Biodiversity	Habitat fragmentation, increased human access, wildlife disturbance and potential increase in wildlife-vehicle collisions near Rimoi National Reserve.	Moderate
Air quality	Combined dust emissions from road works, quarry operations and agricultural activities during the dry season.	Moderate
Noise	Construction activities combined with increased traffic and commercial growth within trading centres.	Moderate
Land use	Progressive conversion of agricultural and natural land to commercial and residential development following improved accessibility.	Moderate
Socio-economic conditions	Positive cumulative impacts through improved accessibility, market access, employment opportunities and regional economic growth.	High Positive
Road safety	Increased traffic volumes may elevate accident risks involving pedestrians, livestock and motorcycles unless safety measures are implemented.	Moderate
Climate resilience	Improved transport connectivity combined with complementary county investments enhances resilience, emergency response and access to markets.	High Positive

8.5.14.5 Key Cumulative Impacts

The principal adverse cumulative impacts are expected to arise from:

- increased pressure on surface water resources resulting from road development, irrigation expansion and settlement growth;
- cumulative degradation of riparian habitats due to expanding human activities;
- increased traffic volumes leading to higher risks of wildlife-vehicle collisions, particularly where elephants and other wildlife occasionally cross the B126 outside protected areas;
- increased air emissions and noise associated with regional transport growth; and
- growth-induced land-use change along the upgraded corridor.

Although the proposed project roads do not pass through Rimoi National Reserve or Kapnarok Game Reserve, increased accessibility may contribute to increased human activity within the surrounding landscape. Appropriate mitigation and collaboration with KWS will therefore be important to minimise indirect effects on wildlife and maintain road safety.

The project is also expected to generate significant positive cumulative impacts through improved regional connectivity, reduced transport costs, enhanced access to education, healthcare and markets, and stimulation of local economic development. Improved accessibility is expected to increase visitor numbers to Rimoi National Reserve and Kapnarok Game Reserve, thereby supporting tourism growth, strengthening conservation awareness and creating opportunities for community-based enterprises and local employment.

8.5.14.6 Mitigation Measures

To minimise adverse cumulative impacts and maximise long-term project benefits, KeNHA shall:

- coordinate project implementation with County Government of Elgeyo Maeakwet and other infrastructure developers to minimise cumulative environmental disturbance;
- implement integrated erosion, sediment and stormwater management measures throughout the project corridor;
- protect riparian habitats and minimise unnecessary vegetation clearance;
- implement the Biodiversity Management Plan (BMP) and Environmental and Social Management Plan (ESMP) throughout construction and operation;
- maintain wildlife warning signage and rumble strips in identified high-risk wildlife crossing sections and enforce the prescribed speed limits;
- undertake weekly roadkill surveys during the first 12 months of operation to identify wildlife collision hotspots and implement adaptive management measures where increasing wildlife mortality is observed;
- collaborate with the Kenya Wildlife Service to monitor elephant sightings, reported elephant crossings and wildlife-vehicle collisions along the B126 and to review the effectiveness of mitigation measures, including the planned fencing of Rimoi National Reserve adjacent to the road;
- monitor cumulative changes in land use, traffic volumes, air quality, noise levels, surface water quality and biodiversity indicators throughout the operational phase;
- coordinate construction water abstraction with the Water Resources Authority (WRA) and Water Resource Users Associations (WRUAs);
- maintain stakeholder engagement with County Governments, KWS, local communities and other infrastructure proponents to facilitate coordinated cumulative impact management;
- collaborate with KWS and County Governments to promote sustainable tourism associated with Rimoi National Reserve and Kapnarok Game Reserve, including visitor information, directional signage and support for community-based tourism initiatives; and
- review cumulative monitoring results annually and update mitigation measures where monitoring indicates emerging cumulative impacts or ineffective controls.

8.5.14.7 Residual Cumulative Impacts

Following implementation of the proposed mitigation, enhancement and monitoring measures, the residual cumulative impacts on biodiversity, riparian habitats, surface water resources, land use and road safety are expected to reduce from **Major** to **Moderate**. Residual cumulative impacts on groundwater resources, air quality and the noise environment are expected to be **Minor**. Positive cumulative impacts associated with tourism, regional socio-economic development and climate resilience are expected to remain **High Positive** throughout the operational life of the project.

Implementation of the mitigation and monitoring measures specified in the ESMP, together with the biodiversity-specific commitments contained in the standalone Biodiversity Management Plan (BMP), adaptive monitoring and periodic review of cumulative impact indicators, will ensure that cumulative impacts remain within acceptable levels throughout the project life cycle

8.6 Decommissioning Phase Impacts

8.6.1 Positive Impact (Reuse of Facilities)

Decommissioning presents an opportunity to repurpose project facilities for community use, creating a positive long-term legacy. Conversely, poor management could result in environmental degradation and abandoned infrastructure.

Mitigation Measures

i. A formal decommissioning plan will guide facility closure, site rehabilitation, and potential asset transfer.
ii. Early planning and stakeholder engagement will ensure beneficial reuse while preventing negative outcomes.

8.6.2 Adverse Impacts (Environmental and Social)

Decommissioning activities may generate noise, dust, and waste, while poorly rehabilitated sites could pose long-term safety hazards. Workforce demobilization may also lead to economic disruption for affected workers and local businesses.

Mitigation Measures

i. Strict environmental management during decommissioning will control pollution and ensure proper waste disposal.
ii. Rehabilitation of all disturbed areas will eliminate safety risks, while worker transition plans will support affected individuals through fair compensation and skills development opportunities.

The operational and decommissioning phases present a mix of transformative benefits and manageable risks. With proactive planning, strong institutional coordination, and sustained monitoring, the project can deliver long-term socio-economic gains while minimizing environmental and social impacts.

CHAPTER 9: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

9.1 Introduction and Objective

This chapter presents the Environmental and Social Management Plan for the Biretwo–Chesongoch Road Upgrading Project. Developed from the impacts described in Chapter 8, the plan establishes a structured, strategic approach to managing environmental and social risks while enhancing project benefits across the project lifecycle. Objectives include to:

1. Provide a structured framework to avoid, minimize, mitigate, and compensate for adverse impacts.
2. Define institutional roles, responsibilities, and accountability for safeguard implementation.
3. Outline management instruments required for detailed planning.
4. Establish monitoring, reporting, and adaptive management mechanisms.
5. Identify opportunities for enhancement of positive impacts for communities and stakeholders.

9.2 Management Principles and Strategy

The project will adopt a risk-based, proactive, and lifecycle-oriented management approach, guided by the following principles:

1. Mitigation Hierarchy: Impacts will be managed according to the following order:
    - Avoidance (through design and planning)
    - Minimization (through controls and operational practices)
    - Restoration/Rehabilitation
    - Compensation/Offset as a last resort
2. Proactive Enhancement: Positive impacts will be actively maximized through corridor design, community programs, and partnerships.
3. Adaptive Implementation: Management measures will be regularly reviewed and updated based on monitoring data, stakeholder feedback, and emerging risks.

Strategic Focus: The ESMP prioritizes impacts rated as Moderate or Major significance, especially those triggering mandatory safeguards such as land acquisition and resettlement, geotechnical hazards, and high-risk ecological areas (riparian zones, escarpments).

9.3 Institutional Roles and Responsibilities

Successful ESMP implementation requires clearly defined institutional mandates and accountability. Table 9-1 summarizes key roles.

Table 9-1:Institutional Implementation Framework

Entity	*Primary Role*	*Key ESMP Responsibilities*
Project Proponent (KeNHA)	Accountability and fiduciary management	✓ Secure and allocate budget for ESMP and RAP implementation ✓ Integrate safeguard requirements into bidding and contracts. ✓ Oversee contractor compliance and performance. ✓ Lead high-level stakeholder engagement and regulatory reporting.

ESIA Consultant / Environmental & Social Supervisor	Technical advisory and compliance assurance	✓ Review and approve contractor method statements and plans. ✓ Conduct independent monitoring and audits, prepare compliance reports
Supervising Engineer	Construction supervision & quality assurance	✓ Daily supervision of works, including environmental and social safeguards ✓ Ensure construction aligns with ESMP and design specifications ✓ Certify payments linked to ESMP performance
Contractor(s)	On-ground implementation	✓ Develop and implement site-specific management plans (CESMP) ✓ Execute all mitigation/enhancement measures ✓ Train workforce on ESMP requirements and codes of conduct ✓ Monitor and report compliance monthly
County Governments (Elgeyo Marakwet, Uasin Gishu, Baringo)	Regulatory coordination & long-term benefit integration	✓ Participate in planning, monitoring, and review committees ✓ Enforce local by-laws and provide permits ✓ Co-develop long-term sustainability measures (spatial planning, waste management)
NEMA	Regulatory oversight & enforcement	✓ Review and approve ESIA and ESMP ✓ Conduct compliance inspections and monitoring ✓ Enforce environmental regulations
AfDB	Safeguard compliance and supervision	✓ Ensure project alignment with AfDB ISS ✓ Review and approve safeguard instruments (ESMP, RAP) ✓ Monitor implementation via supervision missions and report reviews

Coordination Mechanism: A Project Environmental and Social Steering Committee (PESSC) will be established, chaired by the Project Proponent, including representatives from the Contractor, Supervising Engineer, relevant County Departments, and NEMA. The PESSC will meet quarterly to review implementation progress, resolve systemic issues, and approve updates to management plans.

9.4 Management of Adverse Impacts

Adverse impacts identified in the ESIA will be managed through a structured approach following the mitigation hierarchy. A implemetion of a section of the identified impacts have been considered and in built in the civil works cost. The table presents a summary of the ESMP implementation costing for Phase 1 and Phase 2 of the project

Total Estimated Budget for ESMP Implementation

Category	Estimated Cost (KES)
ESMP Mitigation Measures-Pre Construction, Construction, Decommissionimg nd Operation Phases	356,445,000
Contingency (15%)	53,466,750
TOTAL ESMP BUDGET	**409,911,750**

Table 9-2,3,4 and 5 presents the adverse impacts management matrix.

9.4.1 Adverse Impacts Management Matrix- Pre – construction phase

Table 9-2: Adverse Impacts Management Matrix- Pre – construction phase

Project Activity	Impact	Significance(pre-mitigation)	Mitigation measures	Residual Significance	Monitoring Indicators	Monitoring Frequency	Responsibility	Budget (KES)
Right-of-Way clearing, structural alignment mapping, and land take	Land Acquisition and Displacement	Major	• Optimize alignment to minimize land take; • Prioritize use of existing corridor; • Implement RAP; • Compensate at full replacement cost; • Ensure compensation before construction; • Maintain stakeholder engagement; • Operationalize GRM; • Provide livelihood restoration and transitional support to vulnerable groups through the LRP	Minor	• % PAPs compensated before works start • No. of grievances received/resolved • Livelihood restoration participation rate • Land acquired vs avoided	Monthly (pre-construction & RAP phase)	KeNHA / RAP Consultant / County Government / Supervision Consultant	97,330,000
Site clearing, tree felling, and vegetation stripping	Impacts on Flora and Fauna	Moderate	• Avoid sensitive habitats; • Minimize clearing footprint; • Implement Biodiversity Management Plan;	Minor	• Area cleared vs planned (ha) • Tree survival rate (%) • Riparian buffer integrity maintained • Invasive species occurrence	• Monthly during construction; • Quarterly post-construction	Contractor / Environmental Officer / County Forestry / KWS	Inbuilt in Civil Works Cost
Mass excavation, deep cutting, rock	Soil Removal, Blasting & Geotechnical Risks	High	• Adjust alignment to reduce deep cuts; • Engineered slope stabilization (benching,	Minor	• Number of slope failures • Turbidity in receiving waters	• Weekly during earthworks;	Contractor / Geotechnical Engineer /	Inbuilt in Civil Works Cost

Project Activity	Impact	Significance(pre-mitigation)	Mitigation measures	Residual Significance	Monitoring Indicators	Monitoring Frequency	Responsibility	Budget (KES)
blasting, and slope reshaping			retaining structures, rock bolts); • Drainage and erosion control systems; • Controlled blasting with exclusion zones; • Vibration monitoring		• Vibration levels (mm/s) • Area stabilized vs exposed slopes	• continuous during blasting	Supervision Consultant	

9.4.2 Adverse Impacts Management Matrix- Construction phase

Table 9-3 Adverse Impacts Management Matrix- Construction phase

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
Earthworks, cutting, & filling	Alteration of Topography & Landforms	Major	• Optimize road alignment & geometric design to minimize cut-and-fill. • Restrict earthworks to approved road corridor. • Use balanced cut-and-fill techniques. • Preserve natural terrain features where feasible. • Rehabilitate disturbed areas via grading/revegetation immediately post-construction. • Establish approved spoil disposal sites. • Reinstate temporary areas/borrow sites to blend with landscape.	Moderate	% of cut-and-fill balance achieved. Area (m^2) of landscape progressively rehabilitated. Number of unauthorized corridor encroachments (Target: 0). *Frequency:* Monthly & post-construction.	Contractor /Supervising Engineer (SE), NEMA	Inbuilt in Civil Works Cost
Excavation on steep slopes (>30%–80%)	Increased Risk of Slope Instability & Landslides	Major	• Undertake detailed geotechnical investigations. • Design cut slopes at stable angles based on soil/rock conditions. • Construct retaining walls, gabions, reinforced earth, and rock buttresses. • Install rockfall protection (nets, catch fences, barriers). • Apply bioengineering (grassing, hydroseeding, deep-rooted vegetation).	Moderate	Number of localized slope failures/landslides reported (Target: 0). Linear meters of retaining structures successfully installed. Inspection log frequency compliance. *Frequency:* Weekly during wet season; Monthly during dry season.	Contractor /SE, KeNHA Geotechnical Dept.	KSh 19,425,000 (Specialist Geotechnical budget)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Avoid undercutting natural slopes; maintain toe support.Conduct routine slope inspections. • Establish landslide emergency response procedures.				
Vegetation clearance & soil exposure	Acceleration of Soil Erosion Processes	Major	• Limit vegetation clearing to the absolute minimum footprint. • Stabilize exposed soils immediately via revegetation, mulching, or hydroseeding. • Install silt fences, sediment traps, check dams, and erosion blankets. • Sequence construction to minimize soil exposure duration. • Construct contour and interceptor drains. • Protect slopes using riprap, stone pitching, or geotextiles. • Monitor erosion-prone areas regularly. • Restore disturbed areas promptly.	Moderate	Area (m^2) of bare soil exposed at any given time. Number of functional silt fences and check dams installed. Presence of visible rill/gully erosion (Target: None). *Frequency:* Weekly and immediately after heavy rainfall.	Contractor /SE, NEMA	KSh 5,827,500
Drainage modifications	Alteration of Natural Drainage Patterns	Major	• Design structures based on detailed hydrological/hydraulic assessments. • Maintain natural connectivity via properly sized culverts/bridges. • Provide adequate side, mitre, and energy dissipation drains.	Moderate	Number of drainage structures constructed to hydraulic design specs. Incidences of localized flooding or overtopping (Target: 0).	Contractor /Design Engineer, SE	Inbuilt in Engineering Design Cost

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Prohibit unauthorized diversion of natural channels. • Stabilize culvert inlets/outlets with riprap, gabions, or concrete aprons. • Integrate climate change resilience factors into design rainfall intensity. • Perform regular maintenance to prevent blockages. • Incorporate stormwater management to reduce runoff concentration. • Implement the CCMP		*Frequency:* Monthly and during peak storm events.		
Culvert installation & channel crossings	Disruption of Natural Drainage Patterns	Major	• Use hydrological assessments to guide drainage design. • Maintain connectivity using appropriately sized cross-drainage structures. • Avoid unnecessary channel realignments. • Schedule instream works during dry weather windows. • Reinstate disturbed channels immediately post-construction. • Align structures with existing flow directions and gradients. • Regularly inspect crossings and rectify disruptions.	Moderate	Duration of temporary stream diversions (Target: <14 days per site). % of channels returned to original alignment post-construction. *Frequency:* Daily during instream works.	Contractor /SE, Water Resources Authority (WRA)	KSh 3,237,500

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
Pavement surfacing & compaction	Increased Surface Runoff & Flow Concentration	Major	• Design drainage to safely accommodate peak runoff flows. • Install energy dissipators (riprap, gabions, stilling basins) at outlets. • Construct interceptor, contour, and mitre drains. • Stabilize outlets and adjacent slopes with stone pitching or bioengineering. • Incorporate vegetated drainage channels where practical. • Undertake routine infrastructure inspection and maintenance. • Integrate climate-resilient drainage designs.	Moderate	Number of Major-velocity discharge outlets fitted with functional energy dissipators. Evidence of downstream scour at outlets (Target: None). *Frequency:* Monthly.	Contractor /SE, KeNHA	Inbuilt in Civil Works Cost
Catchment runoff management	Increased Risk of Localized Flooding	Major	• Size culverts/bridges based on flood frequency analysis. • Provide sufficient cross-drainage at major channel crossings. • Preserve natural flood pathways/floodplains. • Incorporate adequate freeboard into structure designs. • Establish routine debris and sediment clearance programs. • Inspect structures before and during rainy seasons. • Incorporate emergency overflow provisions.	Moderate	Adequacy of structural freeboard verified against design standards. Logbook of debris clearance operations. Incidences of upstream ponding (Target: 0). *Frequency:* Bi-monthly (Dry season), Weekly (Rainy season).	Contractor /SE, WRA	KSh 1,942,500 (Maintenance log management)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
Concentrated outlet flows	Channel Erosion and Scour	Major	• Protect inlets/outlets using riprap, gabions, aprons, or stone pitching. • Install energy dissipation structures at high-velocity discharge points. • Stabilize banks through revegetation and bioengineering. • Minimize disturbance to natural streambeds/banks during construction. • Monitor crossings for signs of erosion and scour. • Repair erosion damage immediately upon detection. • Design structures to minimize excessive discharge velocities.	Moderate	% of culverts with intact structural protection at inlets/outlets. Response time to repair detected scour (Target: <48 hours). *Frequency:* Bi-weekly during the rainy season.	Contractor /SE	KSh 3,885,000
Excavation & earthmoving near rivers	Sedimentation of Drainage Channels	Major	• Develop and implement an Erosion and Sediment Control Plan. • Install silt fences, sediment traps, and check dams near crossings. • Stabilize exposed soils via revegetation, mulching, or hydroseeding. • Manage stockpiles and spoil heaps to prevent sediment wash-off. • Restrict major earthworks during periods of intense rainfall. • Conduct routine inspection of sediment control structures.	Moderate	Total Suspended Solids (TSS) levels downstream vs. upstream. Frequency of sediment removal from traps and check dams. *Frequency:* Weekly during construction near watercourses.	Contractor /SE, WRA	KSh 2,590,000

Activity	**Potential Impact**	**Significance (pre-mitigation/ enhancement)**	**Mitigation / Enhancement Measures**	**Significance(post-mitigation)**	**Monitoring Indicators & Frequency**	**Responsibility (Impl. / Monitor)**	**Estimated Budget (KSh)**
			• Rehabilitate disturbed areas promptly.				
Material stockpiling & waste handling	Blockage of Natural Drainage Channels	Major	• Prohibit disposal of spoil, excavation material, or waste within channels. • Establish approved spoil disposal sites away from watercourses. • Maintain unobstructed drainage pathways throughout construction. • Conduct regular inspections and remove blockages immediately. • Train personnel on proper spoil and waste management. • Develop site-specific drainage management for sensitive crossings. • Maintain emergency equipment for rapid clearance.	Moderate	Number of structural blockages caused by construction waste (Target: 0). Training attendance logs for spoil management. *Frequency:* Daily site inspections by Environmental Officer.	Contractor /SE	KSh 1,295,000 (Training & clearance tools)
Machinery operations & chemical use	Increased Sediment & Pollutant Loading	Major	• Implement strict procedures for fuel, oil, and chemical storage/handling. • Designate refueling/maintenance areas away from drainage channels. • Provide spill kits and train workers in emergency response. • Install sediment control measures around active zones. • Properly manage concrete washout areas and wastewater.	Moderate	Presence of oil sheens or chemical residues in water (Target: Zero). Number of fully stocked spill kits available on-site. Water quality parameters (pH, Turbidity, Oil & Grease) within NEMA limits. *Frequency:* Monthly sampling.	Contractor /SE, WRA, NEMA	KSh 4,532,500 (Water sampling & spill kits)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Implement good housekeeping practices. • Monitor water quality at sensitive downstream locations. • Develop a Pollution Prevention and Emergency Response Plan.				
Infrastructure upgrades	Improved Drainage Efficiency (Positive Impact)	Major	• Construct infrastructure per approved hydraulic design standards. • Implement routine inspection and maintenance programs. • Incorporate erosion and scour protection at major crossings. • Design systems for future climate variability and extreme rainfall. • Promote catchment conservation and revegetation initiatives. • Monitor drainage performance during operation. • Raise community awareness on drainage protection.	Major	% completion of upgraded climate-resilient drainage structures. Number of community members reached through awareness campaigns. *Frequency:* Quarterly during construction/operation.	KeNHA /Local Administration, Community	KSh 1,942,500 (Community engagement)
Landscape scarring & vegetation clearance	Visual and Landscape Impacts	Major	• Implement the BMP • Shape/contour cut slopes and embankments to blend with natural landforms. • Rehabilitate disturbed areas via landscaping and indigenous planting. • Restrict spoil disposal to designated, non-sensitive viewpoints.	Moderate	% of visual scars/exposed faces treated with progressive bioengineering. Number of designated spoil sites violating scenic view criteria (Target: 0). *Frequency:* Monthly.	Contractor /Landscape Architect, SE	KSh 6,475,000 (Landscaping & native seeds)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Use bioengineering and natural slope stabilization methods. • Restore temporary construction sites and access roads post-works. • Maintain a clean site through waste management. • Implement progressive rehabilitation.				
Mass earthworks	Generation of Excavated Materials and Spoil	Major	• Develop and implement a Spoil Management Plan prior to earthworks. • Maximize reuse of excavated materials for embankments/backfilling. • Dispose of surplus spoil only at approved disposal sites. • Prohibit dumping in drainage channels, wetlands, riverbanks, or steep slopes. • Stabilize disposal areas through compaction, grading, and revegetation.Install erosion control around spoil storage/disposal sites. • Monitor spoil areas for signs of erosion or instability. • Restore spoil disposal sites upon completion.	Moderate	Approved Spoil Management Plan signed off before breakout. % of excavated material reused within the project (Target: >40%). Number of complaints regarding illegal spoil dumping (Target: 0). *Frequency:* Weekly haulage log reviews.	Contractor /SE, NEMA	KSh 5,180,000 (Plan development & site audit)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
Machinery, blasting, & heavy hauling	Noise Pollution and Vibration	Moderate	• Restrict high-noise activities (blasting, rock breaking) to daytime hours. • Avoid blasting during sensitive local periods (e.g., school exams). • Maintain equipment properly; fit silencers/vibration dampeners. • Locate generators and batching plants away from sensitive receptors. • Establish buffer zones; provide advance community notice before blasting. • Provide workers with hearing protection PPE (earmuffs/plugs). • Conduct periodic noise and vibration monitoring (EMCA/OSHA compliance).	Minor	Ambient noise levels $dB(A)$ at sensitive receptors within legal limits. 100% PPE compliance observed in high-noise zones. Number of community noise/vibration grievances logged. *Frequency:* Weekly spot checks; monthly formal logging.	Contractor /OSHS Officer, SE, NEMA	KSh 3,237,500 (Noise meters & PPE)
Haulage, grading, & material crushing	Air Quality and Dust Impacts	Moderate	• Regularly water exposed surfaces, haul roads, and stockpiles (especially in semi-arid zones). • Cover trucks transporting loose material with tarpaulins. • Enforce vehicle speed controls on unpaved roads. • Maintain machinery and vehicles in good operating condition. • Progressively rehabilitate and revegetate disturbed areas.	Minor	Frequency and volume of water bowser deployments. Particulate Matter (PM_{10} and $PM_{2.5}$) levels at receptor sites.% worker adherence to respiratory PPE requirements. *Frequency:* Daily visual checks; Monthly ambient air testing.	Contractor /Environmental Officer, NEMA	KSh 3,885,000 (Water bowser operations & testing)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Provide appropriate respiratory PPE (dust masks/respirators) to workers.				
Camp operations & workshop waste	Solid Waste Generation	Moderate	• Enforce waste minimization, segregation, recycling, and safe disposal. • Segregate waste at source (recyclable, inert, municipal, hazardous) in labeled bins. • Reuse suitable construction debris within civil structures where feasible. • Store hazardous waste in secure, bunded areas; use licensed NEMA waste contractors. • Prohibit open burning and uncontrolled dumping. • Train workers regularly on waste handling procedures.	Minor	Presence of a NEMA-approved waste vendor consignment log. Number of open burning incidents recorded (Target: 0). % of waste stream segregated at site audits. *Frequency:* Weekly camp and workshop audits.	Contractor /Waste Management Subcontractor, SE	KSh 2,590,000 (Bins, bunding, & disposal fees)
Stripping & grading	Soil Erosion and Sedimentation	Moderate	• Phase earthworks to minimize duration/extent of exposed soil surfaces. • Install temporary controls (mulching, blankets, silt fences, traps) prior to excavation. • Stabilize final slopes using engineering/bioengineering (terracing, native vegetation).	Minor	ESSCP approval status prior to structural mobilization. Hectares of land cleared vs. hectares under active/completed stabilization. *Frequency:* Bi-weekly auditing.	Contractor /SE, NEMA	KSh 7,122,500

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Revegetate disturbed zones promptly after structural completion				
Deep cutting at Nyaru steep section	Geotechnical Instability & Landslide Risk	Major	• Adopt a precautionary, risk-based approach using geotechnical data. • Install stabilization infrastructure (retaining walls, reinforced earth, soil nailing, modified geometries). • Proceed in controlled phases with immediate stabilization of exposed cut faces. • Manage surface drainage to prevent infiltration into unstable zones. • Prohibit placement of spoil material near slope crests or toes. • Implement a Slope Stability and Management Plan with active monitoring.	Moderate	Real-time extensometer/inclinometer displacement metrics (Target: Stable). Zero injuries or structural collapses during excavation works. Compliance with the staged excavation protocol. *Frequency:* Continuous electronic monitoring / Daily visual checks.	Contractor /Specialist Geotechnical Engineer, SE	KSh 25,900,000 (Monitoring instruments & soil nails)
Storage & equipment refueling	Hydrocarbon Spills & Liquid Waste Contamination	Moderate	• Restrict fuel storage, refueling, and maintenance to designated areas with impermeable surfaces and bunds (110% capacity) • Locate workshops and washdown bays away from drainage lines/riparian zones.	Minor	Volume of uncontained hydrocarbon spills logged (Target: 0 liters). Inspection logs of fuel bund integrity and oil-water separator functionality. *Frequency:* Daily workshop walk-throughs; Monthly system audits.	Contractor /Environmental Officer, SE	KSh 3,237,500 (Bund engineering & separators)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Provide complete spill kits at all handling points; train workers on response. • Install sediment control systems around active mechanical areas. • Treat wastewater from camps/workshops using oil-water separators/septic systems.				
Quarrying and pitting	Material Borrow Site Impacts	Moderate	• Select sites carefully to avoid ecologically sensitive, agricultural, or residential zones. • Minimize landscape fragmentation by consolidating material extraction to fewer pits. • Implement site-specific erosion, sediment, and dust suppression frameworks. • Establish approved haul routes to minimize community disturbance. • Fence all borrow sites and control access for public safety. • Implement progressive rehabilitation plans to return sites to stable/productive usage.	Minor	NEMA licensing status for all operating quarries/pits. % of closed borrow pit area restored to baseline conditions. Presence of functional safety perimeter fencing. *Frequency:* Monthly compliance reviews.	Contractor /Material Engineer, NEMA	KSh 11,007,500 (Site fencing & restoration deposits)
Right-of-Way clearing	Potential Impacts on Flora and Fauna	Moderate	• Limit clearance strictly to approved construction footprints. • Implement the Biodiversity Management Plan	Minor	Number of mature trees preserved within the alignment corridor.Linear meters of physical "No-Cut" buffer fencing installed.	Contractor /Project Ecologist, KWS, Kenya Forest Service (KFS)	KSh 7,770,000 (Ecological monitoring & crossings)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
					Presence/absence of target invasive species on disturbed soil.*Frequency:* Bi-weekly ecological surveys.		
Works near Songeto, Anin, Chegilet, and Aror corridors	Elephant Dispersal and Human–Wildlife Conflict	Moderate	• Implement the BMP	Minor	Number of human-elephant conflict incidents linked to project activity (Target: 0). % of haul drivers trained on wildlife safety protocols. Functionality of communication link between Contractor and KWS scouts. *Frequency:* Continuous tracking; Weekly reporting.	Contractor /KWS, Community Wildlife Scouts, SE	KSh 9,712,500 (EWS integration, scouts, & signage)
Right-of-Way clearing, chainage excavation, and paving works.	Spatial Impacts on Sensitive Corridors	Moderate	• Biretwo–Arror–Chesongoch (0+000–70+879): Restrict cutting in escarpment slopes, bushland-savanna mosaics, and herpetofauna hot spots (Ch. 5+000–22+000, Ch. 40+000–63+000). Salvage Ficus sycomorus seedlings in Chesongoch drainage zones. • Nyaru–Kimwarer–Kapkayo (0+000–30+800): Establish physical buffers around woodland habitats, riparian strips, and herpetofauna zones (Ch. 7+200–14+600, Ch. 21+400–27+400).	Minor	Number of unauthorized clearing incidents outside designated chainages (Target: 0). Number of linear meters of protective buffer fencing installed around riparian strips. Telemetry or physical track confirmations of wildlife utilizing installed culverts/crossings. *Frequency:* Weekly ecological sweeps; daily monitoring during clearing phases.	Contractor /Project Ecologist, KWS, Kenya Forest Service (KFS), Supervising Engineer (SE)	KSh 18,777,500 (Includes crossing structural retrofits & KWS/scout stipends)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Kimwarer–Emsea (0+000–19+000): Prohibit heavy machinery operations inside wetlands, valley bottoms, floodplains, and bird/herpetofauna nodes (Ch. 11+200–18+600). • Termite & Mega-fauna Zones (Ch. 13+000–17+000, 21+000–24+000, 37+000–40+000, 49+000–51+000): Protect mature mounds from grading; integrate at least 4 specialized underpasses/oversized culverts for terrestrial fauna connectivity. • Implement traffic calming (speed humps, rumbler strips) and warning signage at elephant crossing chainages. • Deploy an Early Warning System (EWS) linked to community scouts and the Kenya Wildlife Service (KWS) at Songeto–Rimo, Anin–Komoigon, and Chegilet–Koitilial corridors.				
Water extraction for camp use, concrete batching, and dust suppression.	Increased Water Demand & Localized Strain	Moderate	• Prioritize independent water sourcing by drilling 3 solar-powered, licensed boreholes and establishing off-stream storage ponds. • Prohibit water abstraction from small, unmapped, or ecologically vulnerable seasonal streams.	Minor	Valid WRA abstraction permits on-site. Daily extraction volumes logged per source	Contractor /WRA, SE	KSh 8,417,500 (Borehole exploration & monitoring gear)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Obtain formal abstraction permits from the Water Resources Authority (WRA) outlining daily caps. • Deploy water-efficient civil practices, including recycling concrete-wash water via sedimentation basins. • Establish a joint Water-Use Committee with village elders to monitor community spring discharge levels and resolve usage disputes.		Downstream flow rates measured weekly to ensure ecological base-flows are maintained. *Frequency:* Daily logging; Monthly reporting.		
Heavy vehicle operation and temporary corridor diversions.	Construction-Induced Traffic & Public Inconveniences	Moderate	• Develop and enforce a comprehensive, section-specific Traffic Management Plan (TMP). • Schedule heavy haulage fleets to completely avoid local market days and school commute windows (07:00–08:30 and 15:30–17:00). • Deploy trained, high-visibility flag personnel at all blind escarpment bends and intersection points. • Apply daily dust suppression watering cycles along all active community bypasses and unpaved diversions. • Maintain alternative bypass lanes to a minimum structural standard to prevent axle damage to local public transport vehicles.	Minor	Number of traffic-related incidents involving local residents or livestock (Target: 0). Daily haulage log adherence to non-peak hours. Grievance closure rate for transport disruptions within 48 hours. *Frequency:* Continuous tracking; Weekly reviews.	Contractor /Traffic Safety Officer, Local Traffic Police, SE	KSh 5,180,000 (Signage, flag gear, and bowser fuel)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Ensure dedicated, 24/7 unimpeded access corridors for emergency response vehicles.				
Trenching, structural alignment clearing, and grading.	Disruption of Public Utilities & Infrastructure	Moderate	• Adopt a rigorous "locate, plan, and protect" mandate across all sections. • Execute joint, physical utility mapping walk-throughs with Kenya Power (KP), local water service providers, and telecom representatives before grading. • Complete required structural relocations of major lines before breaking ground on localized earthworks. • Install structural trench supports, marker tape, and protective exclusion barriers around existing critical utilities left in-situ. • Provide a mandatory 7-day advance notice to local neighborhoods prior to any planned service cutovers. • Maintain an active, 24-hour utility repair standby crew to mitigate accidental line strikes.	Minor	Length (km) of utilities mapped and physically marked ahead of subgrade works Number of unplanned utility service disruptions (Target: 0). Average resolution time for accidental strikes (Target: <4 hours). *Frequency:* Daily pre-work mapping checks.	Contractor /Utility Liaison Officer, Service Providers (KP, Water Cos), SE	KSh 4,532,500 (Mapping surveys & emergency repair retainers)
Workforce housing, sanitation, and unpaved excavation.	Communicable Diseases & Respiratory Health Risks	Moderate	• Site all base camps at a minimum distance of 500 meters away from schools, medical clinics, and community water supply catchments.	Minor	Residual dust concentration (PM_{10}) parameters at adjacent school perimeters.	Contractor /Camp Manager, OHS Officer, County Public Health Dept.	KSh 7,122,500 (Sanitation infrastructure & clinical screenings)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Equip all camps with deep pit latrines, flush toilets connected to septic tanks, and enclosed waste storage configurations. • Enforce mandatory pre-employment medical examinations, baseline respiratory health checks, and routine vaccinations for all workers. • Implement active vector control, including draining accidental standing water pools and distributing insecticide-treated bed nets within worker dorms. • Apply continuous hydro-suppression on high-dust work faces near settlements. • Deliver joint community-worker health clinics and disease awareness programs in collaboration with County Health Authorities.		Bi-weekly vector and sanitation compliance scores across all camp blocks.Incidences of waterborne or camp-linked illnesses reported to local clinics (Target: 0). *Frequency:* Weekly sanitation audits; Monthly ambient air monitoring.		
Presence of non-local transient labor forces.	Increased Risk of HIV/AIDS and Other STIs	Moderate	• Prioritize local community hiring via a transparent registration system to cap non-local labor influx at under 30%. • Enforce a legally binding, signed Worker Code of Conduct with explicit dismissable penalties for fraternization with minors or sexual exploitation.	Minor	% of the total labor force hired from local sub-counties (Target: >70%). 100% of workers with signed Codes of Conduct on file. Volume of barrier contraceptives distributed monthly.	Contractor /HR Officer, Designated SRH/GBV Expert NGO, SE	KSh 3,885,000 (NGO partnerships & awareness materials)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Conduct mandatory, bi-weekly Sexual and Reproductive Health (SRH) and Gender-Based Violence (GBV) prevention training modules. • Install discreet, free-access condom distribution boxes inside all camp blocks and project offices. • Partner with local accredited NGOs to provide confidential Voluntary Counseling and Testing (VCT) services inside camps twice a month. • Prepare and implement a Labor Management Plan		*Frequency:* Monthly labor register and training log audits.		
Heavy machine handling, cutting, paving, and working at heights.	Worker Welfare & Occupational Health & Safety	Moderate	• Implement a comprehensive, site-specific Occupational Health, Safety, and Welfare (OHS&W) system. • Establish mandatory morning safety "toolbox talks" covering daily hazards, task assignments, and physical controls. • Issue and enforce the 100% usage of task-appropriate PPE (steel-toed boots, high-visibility vests, hard hats, ear protection, safety harnesses). • Maintain fully stocked, functional first aid stations and a dedicated 4WD emergency evacuation vehicle at active work fronts.	Minor	Lost Time Injury Frequency Rate (LTIFR) (Target: 0).PPE compliance audit score across all sub-contracted crews.Number of labor or safety disputes logged and cleared. *Frequency:* Daily safety patrols; Monthly formal OHS performance reviews.	Contractor /OHS Manager, Directorate of Occupational Safety and Health Services (DOSHS)	KSh 6,475,000 (Safety assets, signage, and medical standbys)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Enforce clear labor parameters, including maximum 8-hour shifts, paid overtime, structured rest breaks, and clean drinking water points every 500 meters. • Implement the GRM				
Open utility cuts, structural clearing, and active equipment staging areas.	Community Health and Safety Risks	Moderate	• Install continuous, high-visibility perimeter safety fencing, barrier mesh, and warning signs around all deep open cuts and excavations near walkways. • Establish designated, structurally secured pedestrian pathways and crossings around active paving machinery zones, particularly adjacent to school access points. • Enforce a strict 30 km/h speed limit for all project vehicles operating inside village centers and school zones. • Backfill or securely plate over open roadside trenches left inside public access zones before shifting crews off-site daily. • Implement an active Community Grievance Redress Mechanism (GRM) with clear dropboxes and localized contact channels.	Minor	Number of public injuries or close-call safety incidents recorded (Target: 0).Linear meters of physical exclusion fencing maintained around deep excavations.Average turnaround time for community safety complaints (Target: <24 hours). *Frequency:* Daily morning corridor safety reviews.	Contractor /Community Liaison Officer (CLO), Local Administration, SE	KSh 3,237,500 (Exclusion fencing, safety barriers, and GRM management)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
Day-to-day engagement between communities and crews.	Social Conflicts & Community Relations	Moderate	• Deploy a transparent Local Employment and Procurement Plan (LEPP) prioritizing community asset sourcing and logistics. • Provide mandatory cultural sensitivity and conflict resolution orientation training to all incoming technical and management personnel. • Establish a multi-stakeholder Grievance Redress Committee (GRC) comprising local chiefs, youth leaders, women's representatives, and project management. • Hold structured, bi-weekly status updates with community leaders to share upcoming work schedules and discuss local concerns proactively.	Minor	Number of formal community grievances filed regarding social disruptions. % of logged social conflicts resolved via the GRC path (Target: 100%) .*Frequency:* Bi-weekly GRC tracking meetings.	Contractor (CLO) /Local Grievance Committee, County Administration	KSh 1,942,500 (GRC operations & community town halls)
Demographic changes around base camps and construction nodes.	Labor Influx & Induced Social Fragmentation	Moderate	• Prohibit the development of informal commercial kiosks or settlements within a 200-meter perimeter of worker camps using physical fencing and security patrols. • Enforce a strict "no-on-site-overnight-guests" policy within camp housing blocks, backed by professional security teams. • Implement a structured Camp Decommissioning and	Minor	Number of informal commercial structures built along camp perimeters (Target: 0). Security log metrics on camp access compliance.Progress of progressive camp block restoration tracking. *Frequency:* Weekly perimeter and security log checks.	Contractor /Camp Security Head, Local Physical Planning Dept., SE	KSh 2,590,000 (Camp amenities & security controls)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			Restoration Plan before project completion to guarantee all temporary assets are cleared or repurposed productively. • Provide recreational facilities inside the camp compound to encourage workers to remain on-site during off-hours and minimize friction in local villages.				
Interactions between workforce and vulnerable local youths.	Child Protection, Exploitation, and Abuse (SEA)	Moderate	• Enforce a strict, zero-tolerance policy against child labor, statutory abuse, and Sexual Exploitation and Abuse (SEA), backed by immediate employment termination and criminal prosecution. • Verify national identification cards and age records for all site workers, suppliers, and sub-contractor personnel to guarantee no one under 18 is employed. • Establish independent, child-friendly reporting hotlines managed by a third-party child protection specialist or NGO. • Roll out child safety and rights protection awareness programs across all schools along the active B126, B124, and B122 sections.	Minor	Number of underage workers detected on active sites (Target: 0).100% execution rate for school safety training modules along the right-of-way.Number of verified SEA or child protection incidents reported (Target: 0). *Frequency:* Daily random ID spot checks; Monthly NGO performance review.	Contractor /Child Protection Specialist, Partner Child Welfare NGO, SE	KSh 4,532,500 (School outreach programs & hotline infrastructure)

Activity	Potential Impact	Significance (pre-mitigation/ enhancement)	Mitigation / Enhancement Measures	Significance(post-mitigation)	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSh)
			• Mandate that all delivery truck operators sign an explicit child safety transit rider sheet.				
Cross-cutting site exposures and hazardous environments.	Cross-Cutting Safety, Environmental, and Social Risks	Minor	• Consolidate the site's OHS, Traffic, and Emergency plans into a single, cohesive Environmental and Social Management System (ESMS). • Implement a dedicated heat-stress management protocol, including providing shaded rest stations and hydration breaks when temperatures exceed 32°C in the Kerio Valley. • Conduct regular, cross-functional emergency response simulation drills covering hazmat spills, landslide extractions, and mass-casualty traffic incidents. • Perform targeted quarterly equity reviews to verify that project benefits (employment, access upgrades) are reaching marginalized households fairly.	Negligible	ESMS operational status verified by independent external auditors.Log of heat-stress relief distributions and training completion metrics.Emergency drill execution timelines and performance scores. *Frequency:* Quarterly comprehensive system health checks.	KeNHA PIU /Lead External Auditor, Contractor ESG Team, NEMA	KSh 3,237,500 (External safety audits & simulation logistics)

9.4.3 Adverse Impacts Management Matrix- Operation phase

Table 9-4 Adverse Impacts Management Matrix- Operation phase

Project Activity / Aspect	**Potential Impact**	**Significance-pre-mitigation (major, moderate or minor)**	**Enhancement / Mitigation Measures**	**Residual Significance**	**Monitoring Indicators & Frequency**	**Responsibility (Impl. / Monitor)**	**Estimated Annual Budget (KSh)**
Increased commercial transit, roadside business growth, and changing settlement patterns.	Spurred Economic and Spatial Development	Major Positive	• Integrate the road corridor layout into Elgeyo Marakwet and Baringo County Spatial Plans to establish clear, enforced zoning around nodal centers (Biretwo, Chesongoch). • Identify and legally gazette localized buffers around critical wildlife corridors and riparian strips to prevent settlement conversion. • Partner with the Department of Agriculture to roll out training programs and market-linkage networks for local smallholder farmer cooperatives. • Utilize the project's established Grievance Redress Mechanism (GRM) to log, monitor,	Major Positive	County spatial zoning bylaws formally enacted and updated along the corridor.Number of farmer cooperatives receiving training and market-access support.Number of land-tenure or speculation grievances logged and closed (Target: 100%). *Frequency:* Semi-annual planning audits; Monthly GRM reviews.	County Governments (Elgeyo Marakwet & Baringo), KeNHA / National Land Commission (NLC), National Environment Management Authority (NEMA)	KSh 5,827,500

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			and mitigate land speculation and informal displacement disputes.				
Regular vehicle movement, public transit, and freight transport.	Reduced Vehicle Operating Costs (VOCs)	Moderate Positive	• Conduct rigorous post-construction quality audits to verify pavement smoothness ($IRI \le 2.0\text{ m/km}$) and durable design life parameters. • Establish a multi-year, ring-fenced road maintenance funding structure within the Kenya Roads Board (KRB) framework. • Deploy progressive, routine maintenance teams to instantly patch minor cracks, pothole openings, and edge-breaks before structural deterioration occurs.	Major Positive	International Roughness Inde x (IRI) ratings across paved sections.Annual budget allocation (USD/km) dedicated explicitly to the corridor's routine maintenance. *Frequency:* Annual structural road conditions surveys.	KeNHA, Kenya Roads Board (KRB) / Independent Road Auditor	KSh 15,540,000 (Sourced from Road Maintenance Levy Fund)
Ambulance, police, fire, and public transport vehicle movements.	Improved Access to Services and Emergency Response	Major Positive	• Formulate an emergency dispatch protocol with County Health Services to leverage the	Major Positive	Average ambulance and police response times to roadside emergencies along the corridor.Number of community road	County Department of Health, National Police Service (NPS), KeNHA /	KSh 3,237,500

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			upgraded road for optimized ambulance route planning. • Establish roadside police patrol check-points at designated junctions to secure transit routes and manage responses.Engage the Matatu Owners Association (MOA) to encourage operators to upgrade to modern, high-capacity, and safety-compliant vehicle fleets. • Deliver community road safety campaigns focusing on high-speed traffic adaptation near schools and markets.		safety workshops executed in roadside villages. *Frequency:* Quarterly health and emergency data reviews.	National Transport and Safety Authority (NTSA)	
All-weather passenger and commercial haulage.	Reduced Travel Time and Improved Reliability	Major Positive	• Incorporate engineered slope-stabilization structures, gabions, and reinforced retaining walls along high-risk escarpment slopes.	Major Positive	Average travel time between Biretwo and Chesongoch compared to baseline records.Number of hours the road experiences full or partial seasonal closures (Target: 0). *Frequency:* Continuous traffic log data; Monthly maintenance checks.	KeNHA, Maintenance Contractors / Supervising Engineer	KSh 7,770,000 (Emergency clearing standby retainer)

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			• Construct oversized drainage culverts to prevent seasonal washouts and blockages during heavy rainfall events. • Deploy rapid-response maintenance clearing units equipped with earth-moving gear during monsoon windows to clear unexpected rockfalls within 2 hours.				
General vehicle operations along the fully asphalted alignment.	Reduced Dust Pollution	Moderate Positive	• Maintain a completely intact, clean bitumen running surface to entirely eliminate historical particulate matter suspension. • Schedule mechanical or manual clearing of edge-accumulated silt and gravel along paved shoulders within trading centers. • Establish community-based ambient air quality monitoring stations at sensitive	Major Positive	Ambient particulate matter parameters ($PM_{2.5}$ and PM_{10}) at school boundaries along the right-of-way.Incidences of dust-related respiratory admissions at local health facilities. *Frequency:* Quarterly ambient air quality testing.	KeNHA, Maintenance Contractors / County Public Health Department, NEMA	KSh 1,942,500

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			institutional perimeters (schools, clinics).				
Operational side-drains, mitre drains, culverts, and discharge points.	Improved Drainage and Hydrological Function	Major Positive	• Incorporate nature-based engineering solutions, including grass-lined swales and rock-check dams, to slow down peak discharge velocities. • Conduct mandatory pre-rainy season clearings of all side ditches, catchpits, and culvert barrels to eliminate siltation or debris blockages. • Perform regular hydrological checks at all outfall discharge points to verify that adjacent agricultural fields are protected from scouring.	Major Positive	% of drainage infrastructure cleared and fully functional ahead of seasonal rains.Number of downstream erosion or scouring incidents recorded on farmlands (Target: 0). *Frequency:* Bi-annual comprehensive drainage audits.	KeNHA, Maintenance Contractors / Water Resources Authority (WRA)	KSh 5,180,000
Sustained demographic mixing, tourism, and external trading.	Social and Cultural Change from Increased Connectivity	Moderate	• Maintain an active, post-construction Community Grievance Redress Committee (GRC) to track and mediate emerging localized social tensions.	Minor	Number of social cohesion or cultural friction complaints filed via the community GRM.% of social grievances successfully mediated by local elders and the GRC pathway. *Frequency:* Semi-annual social monitoring reviews.	County Department of Social Services, Local Administration / Community GRC	KSh 1,295,000

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			• Partner with local cultural centers, women's groups, and youth councils to host community-led heritage preservation events. • Incorporate community-monitored social cohesion indicators into routine county social development assessments.				
Public transport boarding areas, bus stops, and market nodes.	Increased Solid Waste and Littering	Moderate	• Install standardized, animal-proof solid waste collection bins at all designed bus bays, trading centers, and market nodes. • Establish a binding Memorandum of Understanding (MoU) with County Waste Management Departments for thrice-weekly waste collection and disposal. • Incorporate routine litter collection and roadside debris	Minor	Number of waste bins installed and structurally intact across designated nodes.Frequency of documented waste collection and disposal transfers to certified landfills.Siltation rate of side drains due to plastic waste blockages. *Frequency:* Weekly sanitation sweeps; Monthly contract reviews.	County Government Waste Departments, KeNHA Maintenance Teams / NEMA, Local Traders Associations	KSh 2,849,000

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			sweeping into the performance terms of long-term maintenance contracts. • Execute community-led clean-up campaigns and distribute waste management awareness materials across trading centers.				
Resurfacing, shoulder repairs, drainage clearing, and structural maintenance.	Road Maintenance Impacts	Moderate	• Mandate that all future maintenance contracts contain strict clauses for proper handling, recycling, and certified disposal of bitumen waste and hazardous chemicals. • Conduct mandatory environmental protocol briefings and OHS training for all maintenance crew members. • Schedule highly disruptive maintenance activities (heavy	Minor	100% of maintenance contracts containing active, enforceable environmental safeguard clauses.Volume of maintenance-generated asphalt waste recycled or safely disposed of.Number of worker injury incidents during routine maintenance cycles (Target: 0). *Frequency:* Per maintenance cycle audit.	Maintenance Contractors / KeNHA Environmental Unit, DOSHS	KSh 2,331,000

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			paving/cutting) to completely avoid peak community commute windows and nighttime periods. • Set up temporary, safe storage bunds for fuel and asphalt materials during minor localized structural repairs.				
Stormwater concentration over impervious paved road surfaces.	Increased Runoff and Altered Hydrology	Moderate	• Construct engineered stormwater retention basins, sediment traps, and vegetated buffer strips at critical outfall sections to regulate runoff velocities. • Incorporate energy-dissipating structures (cascade drop structures, rip-rap basins) at outfalls draining into sensitive wetlands or valley bottoms. • Execute adaptive engineering structural adjustments at locations exhibiting	Minor	Turbidity and suspended solid levels measured downstream of major outfalls during rain events.Linear meters of functional vegetated buffer strips maintained along sensitive alignments. *Frequency:* Quarterly water quality sampling; Post-rain erosion tracking.	KeNHA, Maintenance Contractors / WRA, NEMA	KSh 4,532,500

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			high downstream bank erosion.				
Agricultural loading zones and commercial trading centers.	Increased Communicable Diseases	Major	• Design and construct segregated agricultural loading/unloading zones completely separate from primary traffic lanes to eliminate gridlock. • Upgrade market sanitation facilities by building public, water-compliant ablution blocks and managed drainage connections. • Partner with County Health Officers to execute regular hygiene, food handling safety, and vector control awareness campaigns in trading hubs.	Moderate	Number of functional, clean public ablution blocks maintained in designated market centers.Incidences of foodborne or vector-borne disease outbreaks linked to trading centers (Target: 0). *Frequency:* Monthly public health and market sanitation inspections.	County Public Health Department, KeNHA / Traders Committee	KSh 2,590,000
Unchecked vehicle acceleration along straight and downhill road sections.	Increased Vehicle Accidents	Major	• Install engineered traffic calming measures (speed humps, rumbler strips, raised pedestrian crossings) near all schools, markets, and villages.	Moderate	Number of traffic-related accidents involving vehicles, pedestrians, or livestock (Target: 0).Number of documented wildlife collision fatalities along the corridor.	KeNHA, NTSA, National Police Service (NPS) / Kenya Wildlife Service (KWS)	KSh 3,885,000

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			• Erect highly visible, reflective road signage indicating speed limits, school zones, and known animal crossing hot spots. • Partner with NTSA and traffic police to enforce speed limits utilizing automated speed cameras and random highway checks. • Maintain clear sightlines by routinely trimming roadside vegetation, especially around sharp escarpment bends.		*Frequency:* Monthly traffic accident log reviews (compiled with local police data).		
Monitoring of the gazetted right-of-way boundaries.	Human Encroachment along the Road Corridor	Moderate	• Install permanent, physical right-of-way demarcation markers (concrete beacons) along the entire road reserve boundary. • Execute bi-weekly road reserve surveillance patrols to detect and halt informal commercial or structural	Minor	Number of informal structures or kiosks established within the road reserve (Target: 0).% of road reserve kilometers physically beaconed and fully unobstructed. *Frequency:* Bi-weekly boundary surveillance patrols.	KeNHA Corridor Management Unit, County Physical Planning Dept. / Local Administration	KSh 1,942,500

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			encroachment instantly. • Collaborate with County Planning Departments to guide new private developments to set back safely outside the statutory road reserve limits. • Issue immediate, formal legal notices to illegal encroachers backed by enforcement mechanisms.				
Interaction of road traffic with regional agricultural, mining, and urban developments.	Cumulative Impacts	Major	• Establish a Multi-Stakeholder Regional Development Committee to align road corridor operations with wider catchment management initiatives. • Participate in integrated basin-wide water resource assessments to ensure road drainage patterns do not	Moderate	Active participation logs and resolutions of the Regional Development Committee.Hectares of regional woodlots or reforested segments maintained outside the immediate right-of-way. Frequency: Annual multi-stakeholder strategic performance reviews.	KeNHA PIU, County Governments, NEMA / KFS, KWS, Regional Development Authorities	KSh 3,237,500

Project Activity / Aspect	Potential Impact	Significance- pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			exacerbate regional water stress. • Coordinate with county forestry units to execute landscape-level tree planting campaigns to offset regional habitat fragmentation.				
Operation of road (vehicular traffic)	Direct mortality of wildlife due to vehicle collisions; barrier effect on wildlife movement; increased human–wildlife conflict risk along road corridors.	Major	• Maintain wildlife warning signs at **500 m intervals** and rumble strips at **1,000 m intervals** within identified high-risk wildlife crossing sections. • Enforce speed limits of **60 km/h during daytime** and **40 km/h at night** within designated wildlife crossing zones. • Undertake **weekly roadkill surveys for the first 12 months** of operation to identify wildlife collision hotspots. • Remove wildlife carcasses promptly to avoid attracting	**Moderate** (Direct mortality of wildlife due to vehicle collisions; barrier effect on wildlife movement; increased human–wildlife conflict risk along road corridors.)	**Indicators:** • Number of wildlife–vehicle collisions recorded. • Roadkill index (animals/km/month). • Number and location of reported elephant crossing incidents. • Percentage of wildlife warning signs and rumble strips maintained in good condition. • Percentage compliance with posted speed limits. **Target:** Progressive reduction in wildlife collisions, no increasing trend in roadkill at identified hotspots, and timely implementation of corrective measures where hotspots persist. **Monitoring Frequency:** • Weekly roadkill surveys during the first 12 months of operation.	*Implementation*: KeNHA (Road Maintenance/Operations Department) in collaboration with the National Police Service and Kenya Wildlife Service (KWS) *Monitoring*: KeNHA Environmental and Social Safeguards Unit, KWS and the Independent Environmental Consultant (where applicable).	Ksh. 4,000,000

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			scavengers. • In collaboration with KWS, monitor reported elephant sightings and occasional elephant crossing incidents along the B126 and review wildlife movement information within the wider Rimoi–Kapnarok landscape to determine whether additional mitigation measures are required. • Review monitoring results and implement adaptive measures such as additional warning signage, enhanced traffic calming measures, wildlife reflectors, vegetation management to improve driver visibility, or other KWS-approved mitigation measures where persistent		• Monthly inspection of wildlife warning signs and rumble strips. • Quarterly review of elephant sightings/crossing records with KWS. • Quarterly monitoring reports and annual review of mitigation effectiveness		

Project Activity / Aspect	Potential Impact	Significance-pre-mitigation (major, moderate or minor)	Enhancement / Mitigation Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Annual Budget (KSh)
			collision hotspots are identified.				

9.4.4 Adverse Impacts Management Matrix- Decommissioning phase

Table 9-5 Adverse Impacts Management Matrix- Construction phase

Project Phase / Activity	Potential Impact & AfDB OS Mapping	Significance-pre-mitigation (major, moderate or minor)	Mitigation / Enhancement Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSH)
Handover of office blocks, workshops, storage yards, and borehole infrastructure.	Progressive Handover and Beneficial Reuse of Facilities	Moderate Positive	• Draft a formal, comprehensive Decommissioning Plan 12 months prior to civil completion. • Conduct structured, multi-stakeholder consultations with local sub-county administrators, elders, and women's representatives to map community priority needs (e.g., converting camp dorms into a health clinic or a vocational center). • Formally transfer solar-powered boreholes, water kiosks, and piping networks to community-run Water Services Associations. • Conduct independent environmental site assessments (Phase I ESA) to certify that all structures designated for handover are completely free of structural hazards or chemical contamination.	Moderate Positive	Legal asset handover agreements signed and executed by KeNHA and the County Government. Number of camp facilities successfully repurposed for community medical, educational, or civil use. *Frequency:* Monthly progress audits during the final year of construction.	Contractor, KeNHA PIU / County Administration, Community Water Committees, SE	KSh 3,235,250 *(Legal, structural audits, and survey mapping)*
Dismantling heavy structural elements, paving removal, and camp yard clearing.	Environmental Degradation & Abandoned Ruin Vectors	Major	• Incorporate strict, legally binding environmental restoration clauses into all master construction contracts. • Demolish all concrete foundations, equipment slabs, and structural footings not targeted for community reuse, down to a depth of 1 meter below ground level. • Segregate and break up civil debris; haul crushed concrete and asphalt waste chunks	Moderate	Volume of civil rubble diverted from open-air landfilling to certified structural reuse. Number of concrete foundations completely	Contractor / NEMA Field Inspectors, County Public Health Unit, SE	KSh 5,823,450 *(Heavy earthmoving equipment and disposal costs)*

Project Phase / Activity	Potential Impact & AfDB OS Mapping	Significance-pre-mitigation (major, moderate or minor)	Mitigation / Enhancement Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSH)
			to licensed quarries for deep structural backfilling or recycling. • Evacuate and pump out all camp pit latrines and septic tanks using vacuum trucks, followed by lime treatment and secure backfilling with clean, compacted subsoil.		excavated, broken up, and backfilled. *Frequency:* Weekly field verification sweeps during the camp dismantling window.		
Scraping compacted surfaces, leveling terrain, and replacing soil layers.	Secondary Site Pollution, Dust, and Long-Term Safety Hazards	Moderate	• Rip and scarify all heavily compacted camp parking lots, laydown yards, and heavy machinery paths to a minimum depth of 300mm to restore natural soil permeability. • Spread a layer of reserved topsoil (minimum thickness of 150mm) evenly across all graded, unpaved project footprints. • Implement immediate slope stabilization using biodegradable jute netting, rock-check dams, and terracing on steep inclines to prevent soil erosion. • Revegetate all exposed earthworks using a curated mix of indigenous grasses and native leguminous nitrogen-fixing groundcovers.	Minor	Total area (m^2) of scarified and structurally loosened ground footprint. Survival rate (%) of newly seeded native vegetation over a 6-month monitoring window *Frequency:* Bi-weekly erosion and vegetation checks during rehabilitation.	Contractor / Project Ecologist, Kenya Forest Service (KFS), SE	KSh 4,529,350 *(Scarification operations, topsoil handling, and seed stock)*
Termination of contracts, retrenchment of labor forces, and camp closure.	Socio-Economic Shock and Workforce Demobilization Disruptions	Major	• Develop a formal Labor Demobilization and Transition Plan 6 months before winding down operations. • Provide a mandatory 30-day advance written notice of terminal contract dates to all workers, matching the Kenyan Employment Act requirements.	Moderate	100% of workers with fully signed, documented clearance forms and paid severance packages on file.	Contractor (HR Dept.) / County Labor Officer, Worker Union	KSh 5,176,400 *(Financial workshops and outplacement services)*

Project Phase / Activity	Potential Impact & AfDB OS Mapping	Significance-pre-mitigation (major, moderate or minor)	Mitigation / Enhancement Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSH)
			• Pay out all statutory end-of-service benefits, accrued leave days, and termination packages in full, accompanied by clear, audited payslips.Issue official Certificates of Service detailing acquired skills (such as machine handling, concrete work, or safety auditing) to boost future employment prospects. • Deliver local business-readiness, financial planning, and micro-credit management workshops for demobilized personnel. • Implement the Labor Management Plan		Number of local workers participating in financial planning and business startup workshops. Number of labor-related disputes logged via the internal worker GRM (Target: 0). *Frequency:* Monthly HR ledger audits during the demobilization window.	Representatives, SE	
Closure, decommissioning, and rehabilitation of Material Sites (Quarries and Borrow Pits).	Severe Ecosystem Degradation, Landslides, Drowning Hazards in Pit Ponds, and Deforestation (AfDB OS 1 & OS 4)	Critical / Major	• Mechanically grade and batter back vertical quarry walls and borrow pit faces to safe stable angles (maximum 1:3 slope) to eliminate landslide hazards. • Establish permanent drainage channels to prevent uncontrolled stormwater pooling; backfill and grade low pits to prevent stagnant water ponding. Where deep pits cannot be backfilled, install chain-link perimeter fencing and warning signs to eliminate drowning risks. • Rip the floor of material sites to break compaction, re-spread stockpiled	Minor	Percentage (%) of quarry/borrow pit area successfully reshaped and stabilized. Linear meters of safety perimeter fencing installed around open pit voids. Soil erosion indicators (rills, gullies) recorded per site.	Contractor / NEMA Field Inspectors, County Geologist, SE, Community Representatives	KSh 8,411,650 (Excavators/bulldozers for heavy earth-shaping, safety fencing, topsoil hauling, hydroseeding, and NEMA auditing fees)

Project Phase / Activity	Potential Impact & AfDB OS Mapping	Significance-pre-mitigation (major, moderate or minor)	Mitigation / Enhancement Measures	Residual Significance	Monitoring Indicators & Frequency	Responsibility (Impl. / Monitor)	Estimated Budget (KSH)
			overburden and topsoil (min 300mm depth), and apply organic manure. • Apply hydroseeding or manual broadcasting of fast-growing native trees/grasses to control erosion. • Conduct a dedicated Post-Closure Environmental Audit and secure formal decommissioning clearance from NEMA.		Vegetation canopy cover (%) achieved on rehabilitated pit floors. *Frequency:* Weekly inspections during active earthworks; monthly ecology/safety audits for 12 months post-closure.		

9.5 Enhancement of Positive Impacts

The project will proactively secure and maximize positive impacts. Table 9-6 presents an enhancement strategy.

Table 9-6:Positive Impacts Enhancement Matrix

Positive Impact	Primary Phase	Significance	Key Enhancement Measures	Required Planning Instrument	Primary Responsibility	Cost (Average – KES)
Spurred Economic Development	Operation	Major Positive	Integrate corridor with CIDPs; develop Corridor Economic Development Program; protect agricultural land via zoning	Land-Use & Economic Development Framework	KeNHA + County Govts.	KES 40,000,000
Improved Accessibility & Service Delivery	Operation	Major Positive	Agreements with emergency services; partnerships with SACCOs; improve access to schools/markets	Service Delivery Optimization Plan	County Govt. + KeNHA	KES 25,000,000
Reduced Vehicle Operating Costs & Travel Time	Operation	Major Positive	Durable pavement; implement maintenance plan; monitor travel efficiencies	Pavement Management & Maintenance Plan	KeNHA / Contractor	KES 20,000,000
Reduced Dust Pollution	Operation	Major Positive	Paving near sensitive receptors; indigenous tree planting; rapid maintenance	Roadside Landscape & Revegetation Plan	KeNHA / Contractor	KES 15,000,000
Improved Drainage & Flood Reduction	Operation	Major Positive	Nature-based drainage; culverts; water harvesting systems	Sustainable Drainage Design Manual	KeNHA / Contractor	KES 50,000,000
Skills Development & Local Employment	Construction	Moderate Positive	Local training; certification; job linkage for workers	Local Employment & Skills Development Plan	KeNHA / Contractor	KES 18,000,000
Reuse of Contractor Facilities	Decommissioning	Major Opportunity	Convert facilities for community use; formalize transfers; rehabilitate sites	Asset Transfer & Legacy Plan	KeNHA + County Govts.	KES 22,000,000

9.6 Stakeholder Engagement and Grievance Redress Mechanism (GRM)

Stakeholder engagement and grievance management form a central pillar of the project's environmental and social risk management approach. The project will adopt a structured and transparent system that ensures affected communities and other stakeholders are able to participate meaningfully in project implementation and raise concerns in a timely and fair manner.

A multi-tier Grievance Redress Mechanism (GRM) as presented in Chapter 11 will be established and operational throughout the project lifecycle. The GRM will provide multiple and easily accessible channels for submitting complaints, including community-level entry points and formal project structures. All grievances will be handled in a confidential and impartial manner, with clear procedures for registration, assessment, and resolution. Acknowledgement of grievances will be provided within 48 hours of receipt, and efforts will be made to resolve complaints within 30 days. Where grievances cannot be resolved at the initial level, the mechanism will allow for escalation to higher project or institutional levels, without prejudice to the complainant's right to access judicial remedies.

In parallel, the project will implement a Stakeholder Engagement Plan (SEP) that promotes continuous and inclusive engagement with Project Affected Persons (PAPs), local communities, and county governments. Engagement activities will be carried out through regular consultations, disclosure of relevant project information, and participatory monitoring processes. This approach is intended to foster transparency, manage expectations, build trust, and ensure that stakeholder feedback is systematically integrated into project decision-making and adaptive management throughout construction and operation.

9.7 Capacity Building Requirements

Targeted training will be provided as follows:

Target Group	Training Focus
Contractor Staff	ESMP implementation, specific management plans
All Workers	Environmental awareness, health & safety, code of conduct
Community Representatives	GRM procedures, basic monitoring
County Officials	ESMP oversight, long-term benefit sustainability planning

CHAPTER 10: GRIEVANCE REDRESS MECHANISM

9.8 Grievance Redress Mechanism

9.8.1 Introduction and rationale of GRM

Grievances Redress Mechanism (GRM) is a tool developed as a response for complaints arising from the communities and stakeholders regarding one or more aspects of the project implementation. The GRM will describe the mechanisms available to the immediate community/workers and stakeholders in reporting complaints related to the project and illustrate how they will be addressed and what recourse/appeal may be available. It will ensure that the grievance redress mechanism include access to an unbiased third party.

The main objective of GRM is to encourage the affected communities to own project within their localities through participation at all levels of formulation and implementation and therefore it is imperative to involve them in dispute resolution where possible. GRM, therefore, will be constituted during project implementation process to address emerging issues associated with construction, operation and ESMP implementation. The mechanism will lead to creation of Grievance Redress Committees (GRCs), categorize grievance issues, develop grievance registration and other tools as well as conceptual levels of grievance resolutions.

Grievance mechanisms should receive and facilitate resolution of the affected institutional or communities' concerns and complaints. AfDB Environmental and Social Safeguard policies states that concerns should be addressed promptly using an understandable and transparent process that is culturally appropriate and readily acceptable to all segments of affected communities, at no cost and without retribution. Proposed mechanisms should be appropriate to the scale of impacts and risks presented by a project.

Grievances can be an indication of growing stakeholder concerns and can escalate if not identified and resolved. The management of grievances is therefore a vital component of stakeholder management and an important aspect of risk management for proposed road improvement project. The proposed project may have a range of potential adverse impacts to people and the environment in general, and identifying grievances and ensuring timely resolution is therefore very necessary.

The following sections describe the proposed procedures that will be followed to address complaints or concerns submitted by people who may benefit from or impacted by the proposed project. It intends to provide clarity and predictability on how complaints will be received, assessed, sorted, resolved and monitored.

9.8.2 Possible Types and Causes of Grievances

Some of the issues that may elicit complaints during project implementation process include;

(i) Inadequate stakeholders' consultation and participation at any stage of project implementation, (including public services providers and other government agencies or departments);
(ii) Negative social and environmental impacts emanating from the implementation of the project (including project sites, materials sites, health and safety, security, traffic management related issues, dust and vibrations management, etc.)
(iii) Lack of sufficient information in regard to the project impact by the local communities – lack of detailed impacts resultant from the project implementation and options available. (This could lead to wrong perceptions and creation of discontent and suspicion)

(iv) Concerns on socioeconomic, cultural and environmental safeguards matters and impacts (including employment opportunities, working hours, wages and benefits, local inputs) emanating from or related to project interventions;
(v) Gender abuse, harassment, discrimination, mainstreaming and/or inclusivity related concerns,
(vi) Political interests and pressure, (personal benefits, favors, chauvinism, and negative publicity, among others).
(vii) Grievance Redress Mechanism infectiveness and inclusivity issues
(viii) Institutional impacts and mitigation procedures including replacement of public facilities and utilities.
(ix) General complaints emerging from conflicts of the project implementation and the public/communities.

Concerns that might be raised outside the above will be redirected to other relevant authorities or actors, e.g., issues related to violence, gender abuse, assault, theft, moneylending, harassment, impropriety, destruction of property. They will not be within the mandate of the project GRM and therefore they will be expected to be referred to the Police or other relevant regulatory Authorities for necessary action.

9.8.3 Grievance redress mechanism structure

The Project Implementation Team from KeNHA will form a Grievance Redress Committee (GRC) within the proposed project area. This committee will oversee the process of grievance handling. This ESIA has enhanced framework of GRM through the following three-tier Grievance Redress Mechanism stages;

9.8.4 Locational Grievance Redress Committees (LGRCs)

It is desirable to resolve all the grievances at the community level to the greatest extent possible. The community or locational level grievance mechanism must be credible and generally acceptable. The grievance redress mechanism will aim to solve disputes at the earliest possible time in the interest of all parties concerned.

In April 2026, community engagement meetings held along the proposed road corridor led to the establishment of No.18 Locational Grievance Redress Committees (LGRCs), across the affected locations. The consultant explained the selection criteria, representation requirements, and nomination process for committee members. Attendees were also sensitized on the purpose and significance of the LGRCs and informed that members would undergo formal training and be assigned specific roles during the construction phase.

The LGRC will be managed at the administrative location and chaired by the Assistant County Commissioner (ACC), assisted by the locational chief or assistant chief. Membership will include 7 to 15 members i.e. a representative from the local administration, KeNHA, community representatives of equal representation in terms of gender. The committee comprised of the following;

(i) Complainant /Complainant Representative
(ii) 2 No. Community Elders,
(iii) 1 No. Women's Representative,
(iv) 1 No. Youth Representative,
(v) 1 No. Representative of Vulnerable Groups or PLWD
(vi) Locational Administrative Representation
(vii) Project representatives (both contractor, Resident engineer representative, KeNHA)

The Committee in addressing construction related grievances will give opportunity to the local communities and the public to express any grievances related to Project.

It is worth to note that the Locational Grievance Redress Mechanism (LGRM) will be formally constituted and trained during the implementation phase to ensure alignment with actual project impacts, affected communities, and operational structures.

9.8.5 Sub County Grievance Redress Committees

The Sub County Grievance Redress committee (SCGRC) will be constituting seven members and must have a quorum of at least three persons during the mediation. Decisions will be reached by simple majority. The Grievance Committee should be constituted for as long as grievances are being lodged. This committee is made up of the below listed persons.

(i) One representative of the Administration; - National Government (Assistant County Commissioner or Deputy County Commissioner).
(ii) One representative of area local Chief.
(iii) One representative of KeNHA
(iv) Representative from the project (both Contractor and Resident Engineer)
(v) Three representatives of the affected people, amongst them at least one woman. These representatives will be chosen from locational grievance redress committees or other key community leaders where necessary.
(vi) Relevant County Government or National Government representative such County Labour officer, County Surveyor, NEMA among others depending on the grievance under resolution.

In case the grievance is not resolved at first tier, the SCGRC handling resettlement-related grievances will be enjoined by the Resettlement Implementation Committee (RIC) from KeNHA. The SCGRC will hold the necessary meeting with the affected party and attempt to find a solution acceptable at all levels. The GRC would record the minutes of the meeting and filed by the Resident Engineer. If the complainant does not accept the solution offered by the GRC, then the complainant is passed to the next level/ or the complainant can reach out to the next level for redress. This process should be handled within 21 days before referral to the next level.

9.8.6 Third Tier (Legal & Judicial Redress Mechanisms in Kenya)

In the event that that the complainants are dissatisfied with the outcome of the second level of grievance resolution, they shall be advised to seek recourse through the following dispute resolution bodies at their own cost and as a last resort. For land related matters, this is mainly directed to the Land and Environment Court particularly, the Land Value (Amendment) Act 2019 and constitution establish the Land Acquisition Tribunal (The Tribunal) and Environment and Land Court (high court) and empowers this court to determine disputes relating to the amount of compensation to be paid for land acquired compulsorily in the public interest. For other matters, and depending on the nature of the issue, this can also include:

i. The Commission on Administrative Justice for matters on Administrative Justice
ii. The Alternative Dispute Resolution (ADR) Mechanisms

9.8.7 Grievance handling procedure

(i) Grievance Reception/ Acceptance.

A grievance can be submitted either in writing or verbally through various mechanisms such as the grievance redress committees, suggestion box or area chief. The project social safeguard team and the contractor sociologist will be the focal point in the collection of grievances in the community and from workers. The project will also adopt the use of emails, suggestion box and phone conversations (Dedicated phone number to record grievances) in collecting grievances that are considered confidential.

There is no formal minimum requirement for submitting a grievance to enable review and management. However, the following need to be met:

a) The name (s) of the complainant (s).
b) Information on whether the identity of the complainant should be kept confidential (cases reported by interested and third-party stakeholders).
c) Contact details (Administrative locations, telephone number, email)

Details of grievance should answer the question of how and when with detailed information of the location, time, date and the circumstances under which it happened. While the GRM is operated in English, the person picking or handling grievances will make all efforts to translate or write down grievances presented in local languages.

(ii) Acknowledgement, Assessment and Record.

The grievance officer who will receive all grievances and feedback for the project will acknowledge grievances about the project from all stakeholders and the different channels mentioned. The complainant should receive an acknowledgement of receipt of the grievance within 3 days from the receipt of the complaints, in writing. The participant will be engaged in the resolution process. This process is participatory as the aggrieved can spell out his/her wishes and be part of the problem-solving process.

The grievance will be logged in the grievance register before the assessment of the grievance is done. Assessment is done to ascertain the type of grievance before relevant GRC is notified. Assessment of the grievance helps in the determination of the magnitude and intervention paths to be adopted and assigning responsibilities. This is expected to be done in five days within which the grievance has been received.

(iii) Investigation

Complaints may be straightforward and can often be resolved on receipt of the grievance. If not, the case requires investigation. The investigation includes gathering relevant documents, data and maybe statements and facts as well as clarifying the background information to verify the circumstances surrounding the grievance. It also may include risk assessment, follow-up meetings between stakeholders where an impartial party is present, and minutes of the meeting recorded. The aggrieved will be continuously updated on the progress of the investigation. The investigation will be carried out within 14 days. The outcome of the investigation will include an investigation report highlighting steps and procedures, and recommendations towards grievance resolution.

(iv) Resolution

Depending on the findings and severity of a complaint, resolution and response timelines will be set with a condition and where the set timelines cannot be met due to complexity of the grievance, notification will be sent to the aggrieved. The GRM will employ the following resolution options when handling Grievances:

- Unilateral- Where a solution to a presented complaint is sorted internally
- Bilateral- Where the complainant is involved in decision making and find solution to the Grievance.
- Third party- Where an Impartial party is involved to assist in solving grievances.
- Traditional and Customary Practices (Where the Traditional or customary ways of solving grievances and conflicts is us

(v) Consider Recourse or Appeal

Before a consideration for recourse, the Resident Engineer will review to ascertain whether additional reasonable actions are appropriate. The grievance mechanism will incorporate any appeals provision for complaints that cannot be solved by the Project level grievance committees. The process of appeal is expected to take a period of five days towards closure of the grievance; the aggrieved will be notified if the appeal process may take longer than the outlined timing.

Recourse will be considered where there is need of involving an impartial mediator or legal action to completely resolve a case. This will in turn be communicated to the aggrieved.

(vi) Follow Up and Close Out.

Once a resolution would have been reached or a decision made to close out, the final stage will be to monitor outcomes and close out the grievance. All grievances redress activities will be recorded. See grievance redress process as shown in figure 11-1 below. It is best to have the complaint countersign to show their satisfaction with the response. The grievance is then indicated as closed.

9.8.8 Grievance redress mechanism key factors to consider

1. GRM Budget

Grievance redress mechanisms (GRMs) is an effective tool for early identification, assessment, and resolution of complaints on the proposed project road Project. Like any other activity, allocation of adequate resources is needed to enhance the effectiveness of the process. The budget (derived as a percentage cost of the ESMP) should ensure efficiency in setting up suggestion/anonymous boxes, a dedicated hotline for receiving grievances, running of the GRMC's amongst other issues deemed necessary for effective implementation of GRM.

2. Remuneration Of Committee Members

All the members of the various committees established at the different levels will perform their duties on a voluntary basis. There will be no renumeration other than costs associated with transport, communication, meals and sitting allowance. The amount can be reviewed from time depending on logistics involved in bringing the members together for admission of justice to aggrieved parties.

3. Appointment Of Committee Members

The members of the GRC will be appointed through a nomination process within the project area and general community in the project area participating through a public community meeting.

4. Sensitization and Capacity Building

To create demand for the GRM mechanism, thus avoiding escalation of issues to court, KeNHA will undertake the following;

(i) Sensitization of the PAPs on the grievance redress mechanism and its procedures.

The effectiveness of the GRMC depend on the awareness of its existence. Therefore, community, workers and stakeholders need to understand and support the purpose of the project GRM. Although the consultant undertook some level of sensitization, comprehensive exercise is required to publicize the existence of the GRM, its procedures, the levels, and other relevant information during implementation of the project. The GRM mandate should also reach out to disadvantaged and marginalized groups, which often cannot access GRMCs. Communication methods and materials should include meetings, project website, bulletin boards in strategic sites (for instance at the chief's office) brochures summarizing the GRM process, and where possible be translated into the local languages as resources permit. Further, KeNHA, consultant, contractor (where applicable) staff working on the project will be sensitized on the Code of Conduct (COC), SEP and GRM.

(ii) Capacity Building for the Grievance Redress Mechanism (GRM)

This involves strengthening the skills, knowledge, systems, and resources necessary to ensure that grievances are addressed effectively, efficiently, and fairly. This notwithstanding, it will be important that steps are taken to orient and build the capacity of the committees and grievance officers as part of the project implementation team in conflict resolution procedures, such as mediation and reconciliation, and other management areas such as record keeping and report writing. The committees will also need to be oriented to the grievance management system suggested in the ESIA/RAP. It will be necessary to strengthen the capacity of the committees in conflict identification, analysis, and resolution, as stipulated in the relevant GOK legislation and AfDB Environmental and Social Standards.

5. Documentation

At all levels, keeping of documentation should be ensured, including the grievance registers and grievance forms. Every meeting should have written minutes and approved by the relevant parties.

6. Monitoring, Evaluation, and Providing Feedback

At all levels, regular progress monitoring of grievances filed, their status and actions taken and recommendations/resolution will be constantly undertaken. The GRC is individually responsible for monitoring and tracking grievances, assessing the extent to which progress is being made to resolve them, and generating quarterly reports. These reports and data/lessons generated should be used to make policy and/or process changes to minimize similar grievances in the future or to adapt the GRM to correct or remove inefficiencies.

Grievance Redress Mechanism Committees monitoring and evaluation reports will comprise of the following key issues;

a) Number of grievances received, logged, acknowledged, processed, resolved and closed within set time frame.

b) Number of stakeholders satisfied with level and timing of information they received during a grievance process
c) Number of cases requesting external review or alternative third-party arbitration
d) Number of stakeholders satisfied with solution
e) Number and percentage of grievances received by categories
f) Number and percentage of grievances received by severity level
g) Number and percentage of grievances resolved versus rejected
h) Number and percentage of grievances per operation site/location
i) Type of grievances received according to the categories,

Qualitative indicators shall be reported monthly and include root cause analysis, specific case examples and lessons learned.

9.8.9 Grievances Related to Gender Based Violence, Sexual Exploitation and sexual Harassment

Grievances related to Gender based violence, sexual exploitation, and sexual harassment will be referred to the Consultant's Sociologist. Upon Completion of the investigation, a resolution to the grievance is decided. Written feedback and response are communicated within five days upon completion of the investigation and report done. Once the aggrieved party is satisfied with resolution a Grievance settlement form is signed to log in satisfaction, and the case is considered closed. There may be a likelihood of aggrieved party to be dissatisfied, and they will be given an option to appeal or consider recourse.

Managing any sexual abuse related cases in the project will require a multifaceted approach that prioritizes prevention, education, and immediate, appropriate responses when incidents occur.

In addition, the ESIA recommends the project to develop supplementary Environmental and social safeguard tools such as the Code of Conduct, Child Protection Strategy, Labour Management Plan, Grievance Redress Mechanism Plan among others that includes how issues of GBV and Sexual Abuse and Harassment will be addressed. KeNHA should incorporate the preparation of these safeguard tools and plans as contractual obligations within the bidding and contract documents. The Contractor should be required to prepare and submit the plans for review and approval before commencement of construction activities to the supervising consultant. In addition, KeNHA through its Environment and Social Safeguards department and Supervising Consultant should provide oversight to ensure that the safeguard instruments are prepared in accordance with the ESIA, ESMP, RAP,applicable GOK regulations, AfDB requirements and are effectively implemented throughout the project lifecycle.

NOTE: *Further reporting of these grievances will follow the process detailed in Section 1 above. It is worth noting that sexual offences in Kenya are considered criminal hence the victim will be guided to report the incident to the gender desk at the nearest police station for further investigation and resolution. The project team will similarly follow up with the case for closure.*

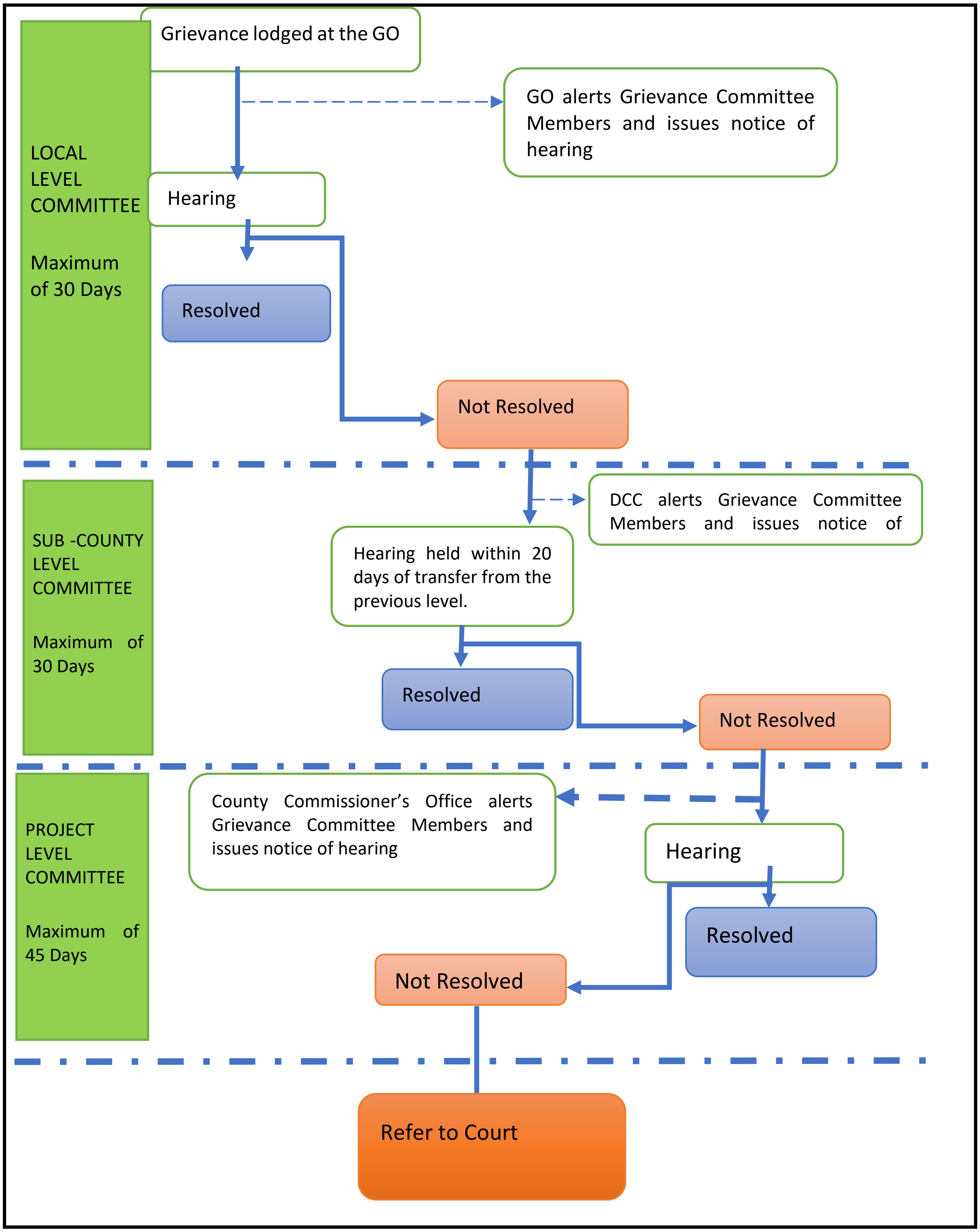


Figure 9-1: Grievance Redress Mechanism Flow Chart

CHAPTER 10: CONCLUSION AND RECOMMENDATIONS

10.CONCLUSION AND RECOMMENDATIONS

The Environmental and Social Impact Assessment (ESIA) for the Phase I Roads Upgrading Project, encompassing the Biretwo–Arror–Chesongoch (B126) Road and its associated spur roads (B124 and B122), has examined the project against established environmental and social standards. The assessment demonstrates that the project is technically and socially feasible, provided that identified risks are adequately addressed through the ESIA and incorporated into the engineering design.

The project is expected to deliver significant socio-economic benefits. Improved road connectivity will enhance access to markets and social services, reduce travel time and transport costs, and strengthen regional integration. The improved infrastructure will also stimulate local economic activity, facilitate safer and more efficient movement of people and goods, and contribute to improved service delivery and livelihood diversification for communities within the project corridor.

Despite these benefits, the assessment has identified potential negative impacts, particularly during construction and operation. Environmental concerns include dust and air emissions, noise and vibration, vegetation clearance, soil erosion, alteration of surface drainage and hydrological patterns, and the risk of soil and water pollution from accidental spills, sediment loading, or improper waste management. The sourcing of construction materials, including borrow pits, quarries, and spoil disposal areas, may also generate impacts that require careful management. Occupational health and safety risks are significant, including potential accidents during construction, exposure to health hazards for workers, and safety risks to nearby communities, road users, and vulnerable groups.

Social impacts are anticipated to include disruption of local businesses and public utilities, increased risk of communicable diseases such as HIV/AIDS, and gender-based violence (GBV), sexual exploitation, and abuse (SEA) associated with labour influx. The project may also affect social and cultural dynamics, increase road safety risks for pedestrians and livestock, and create potential conflicts over employment opportunities. While some physical and economic displacement is expected, the project design emphasizes upgrading within the existing road alignment to minimize resettlement. Cumulative impacts from other developments in the area are also recognized.

The assessment indicates that these impacts are predictable and can be effectively mitigated through the implementation of a structured Environmental and Social Management Plan (ESMP). The ESMP outlines mitigation measures, institutional responsibilities, monitoring requirements, and budget provisions. These measures will be integrated into contractual obligations, including the Bills of Quantities, technical specifications, and design features, and cover aspects such as drainage works, erosion control, protection of water resources, dust suppression, traffic and road safety management, occupational health and safety, HIV/AIDS awareness, rehabilitation of material sites, and restoration of disturbed areas.

10.1 Recommendations

To ensure effective environmental and social risk management throughout project implementation, a number of measures are recommended based on the project design and findings of the ESIA study.

The ESIA has provided an assessment of the project's environmental and social impacts based on the alignment and engineering design and has proposed mitigation measures through a detailed Environmental and Social Management and Monitoring Plan (ESMMP). The project proponent should ensure full implementation of the ESMMP throughout the construction and operational phases. In addition, the Resettlement Action Plan (RAP) should be fully implemented prior to commencement of civil works in affected sections in compliance with national legislation and the African Development Bank safeguard requirements.

The SEP and GRM should remain operational throughout the project lifecycle to facilitate continuous stakeholder engagement, timely resolution of complaints, and transparent communication with affected communities and institutions. Stakeholder consultations should continue during construction and operation to address emerging concerns, monitor community perceptions, and strengthen project accountability.

Environmental and social considerations should continue to be integrated into construction planning and operational management. Contractors should prepare and implement site-specific Construction Environmental and Social Management Plans (CESMPs) aligned with the project ESMMP. These plans should cover construction camps, borrow pits, quarries, spoil disposal areas, traffic management, occupational health and safety, waste management, erosion control, rehabilitation of disturbed areas, and emergency response procedures. Progressive rehabilitation of disturbed sites should be undertaken throughout the construction phase.

Climate resilience and road safety measures incorporated within the design should be fully implemented and maintained during operation. Routine inspection and maintenance of drainage systems, slope stabilization structures, culverts, and erosion control measures will be essential to minimize climate-related risks and maintain road functionality. Road safety audits should continue during construction and operation phases to identify and address emerging safety risks.

Effective management of social safeguards will remain critical during project implementation. Measures to prevent and respond to Gender-Based Violence (GBV), Sexual Exploitation and Abuse (SEA), Sexual Harassment (SH), child protection risks, labor-related grievances, and occupational health and safety risks should be fully implemented. Employment opportunities should be provided in an inclusive and equitable manner, with deliberate consideration for women, youth, and vulnerable groups within the project area. All mitigation and monitoring measures should be incorporated into contractor obligations, supervision frameworks, and operational procedures.

10.2 Conclusion

The ESIA confirms that the Phase I Roads Upgrading Project is timely, necessary, and aligned with Kenya's national and regional development priorities, including Kenya Vision 2030 and broader transport connectivity objectives for the North Rift and north-western Kenya regions.

The assessment has established that the project design incorporates key environmental, social, climate resilience, and road safety considerations intended to minimize adverse impacts and enhance long-term project sustainability. Although the project is expected to generate a range of environmental and social impacts during construction and operation, these impacts are generally predictable, manageable, and capable of being mitigated through effective implementation of the ESMMP, RAP, stakeholder engagement processes, and compliance with applicable legal and safeguard requirements.

Key instruments supporting the ESMP include the Resettlement Action Plan/Livelihood Restoration Plan (RAP/LRP), Stakeholder Engagement Plan (SEP), Grievance Redress Mechanism (GRM), Gender Action Plan (GAP), Biodiversity Management Plan (BMP), and Climate Change Management Plan (CCMP), all of which will be implemented throughout the project lifecycle. Contractors will be required to prepare and implement site-specific Contractor Environmental and Social Management Plans (CESMPs) consistent with the ESMP, Traffic Management Plan, Labor Management Plan and other associated management plans. Continuous environmental and social monitoring, stakeholder engagement, grievance management, and compliance with national legislation and African Development Bank (AfDB) safeguard requirements will be essential to ensure the project's environmental and social sustainability.

With proper implementation of the recommended mitigation measures, continuous environmental and social monitoring, effective stakeholder engagement, and adherence to national and international safeguard standards, the project is expected to achieve environmental compliance, strengthen regional connectivity, improve accessibility and socio-economic opportunities, and deliver substantial long-term benefits to communities within the project corridor and the wider region.

CHAPTER 12: REFERENCES

11.REFERENCES

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12.ANNEXTURE

Annex 1	Minutes of public consultation
Annex 2	List of attendance
Annex 3	FGD Questionnaires
Annex 4	Proposed roads cross-sections
Annex 5	Climate Change Management Plan
Annex 6	NEMA Licenses for Firms of Expert

12.1 Annex 1: Minutes of public consultation

meeting minutes_All.pdf

12.2 Annex 2: Lists of attendance

Attendance Sheets.pdf

12.3 Annex 3: FGD Questionnaires

1. Youth.pdf 2. Youth.pdf 3. Youth.pdf 6. Youth.pdf 7. Youth.pdf

4. Youth.pdf 5. Youth.pdf

1. Male.pdf 3. Male.pdf 4. Male.pdf 5. Male.pdf 6. Male.pdf

7. Male.pdf 8. Male.pdf

1. Female.pdf 2. Female.pdf FGD_Female_Biretwo-Chesongoch_Road_P

12.4 Annex 4: Proposed roads cross-sections

1- Biretwo- Arror- Chesongoch road

From the traffic projections, the estimated AADT in year 10 on the identified homogenous sections along the project road is as shown in Table 1 below.

Table 1 – Year 10 AADT

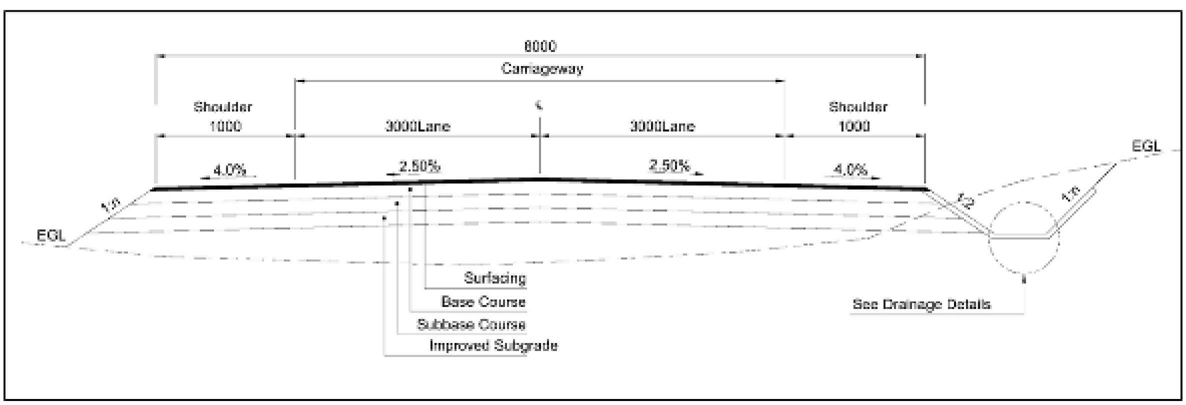
Section	Description	Range	Functional Class	Year 10 AADT	Design Standard	Cross Section Type
1	Biretwo - Chegilet	0+000 – 35+300	B	4144	DR2	R3, R4
2	Chegilet - Arror	35+300 – 49+500	B	2511	DR3	R4, R5
3	Arror - Chesongoch	49+500 – 72+000	B	4597	DR2	R3, R4

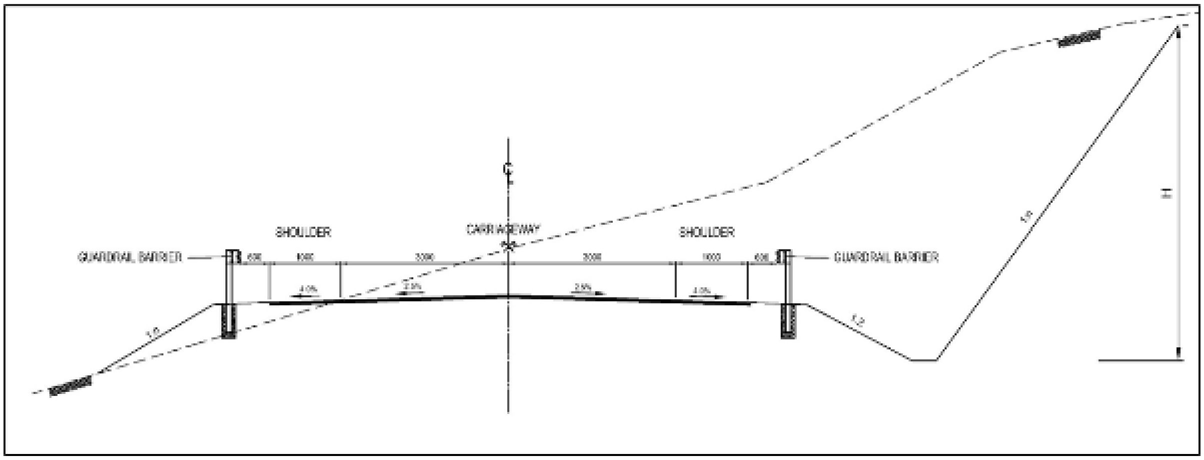
While the projected traffic suggests Cross section Type **R4** i.e., 3.65m wide lane and 2.5m wide shoulders. In a bid to reduce the land take and minimize RAP related costs, a uniform but modified cross-section type **R5** has been adopted i.e. carriageway width of 7.0 m wide lane and 1.5 m shoulders on either side in accordance with the guidelines given in the Road Design Manual 1.3, Vol. 1, Part 3 Table 4.23.

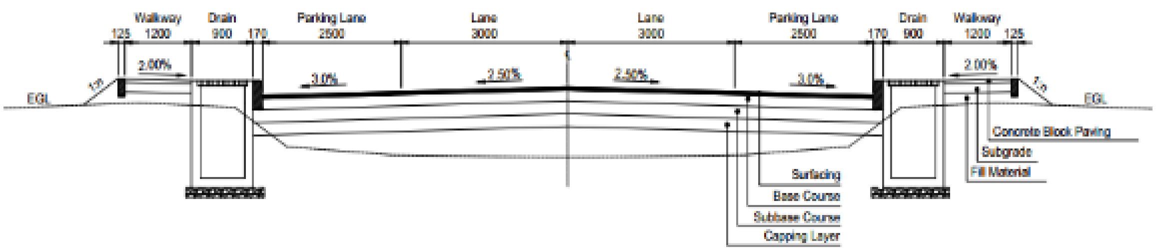
This cross-section is applicable for a class B –Interurban and Rural Roads with two-lanes having traffic level of AADT between 2,000 and 4,000 in year 10.

The proposed road cross-sections are depicted in the figure below.

Fig 1 – Typical Cross Sections







TYPICAL ROAD CROSS SECTION WITHIN TRADING CENTRES

2- Emsea- Flourspar road

From the traffic projections, the estimated AADT in year 10 on the identified homogenous sections along the project road is as shown in Table 2 below.

Table 2 – Year 10 AADT

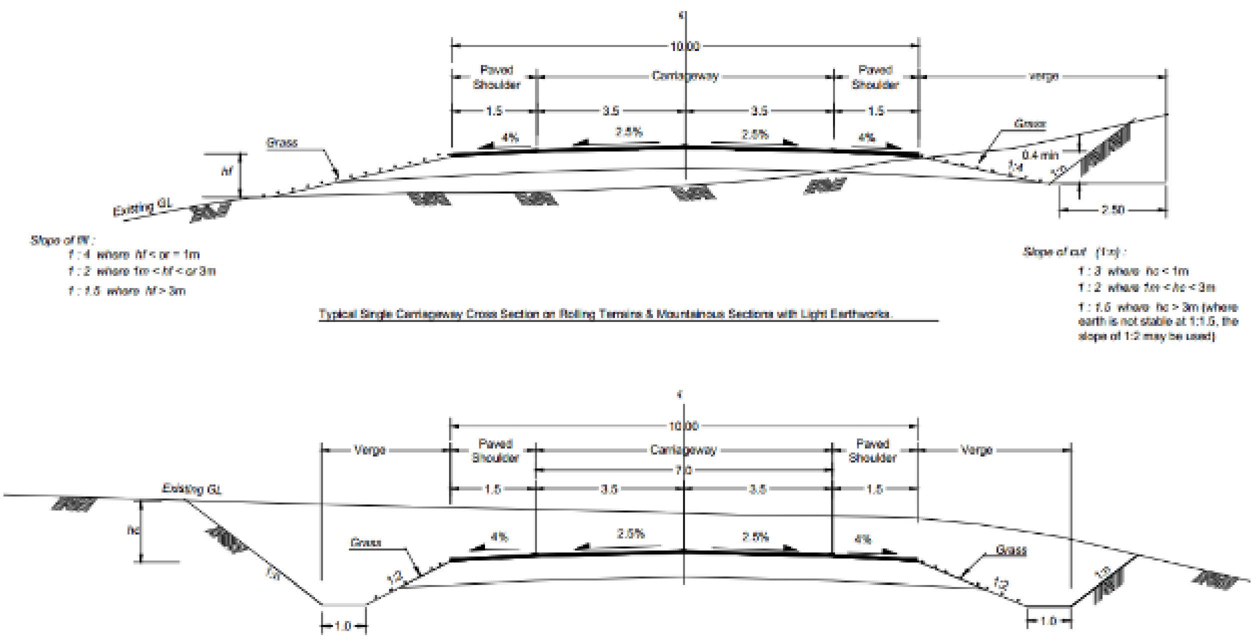
Section	Link	Functional Class	Year 10 PCUS	Design Standard	Cross Section Type
1	Flourspar- Emsea	Class B	2,055	DR3	R4, R5

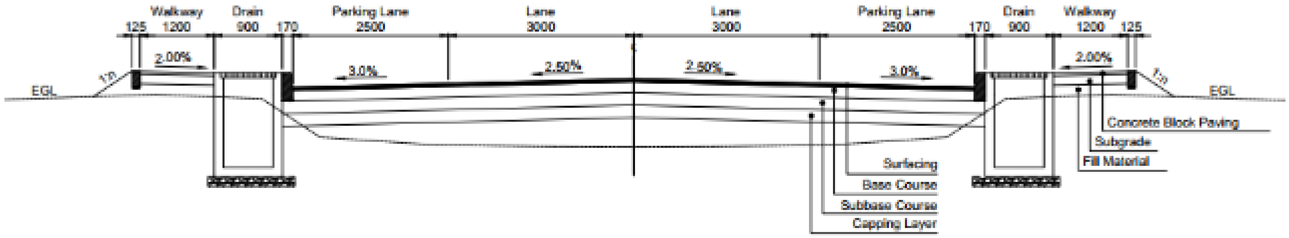
While the projected traffic suggests the above cross-section types, we have adopted cross-section type R5 from Kimwarer-Emsea with reduced shoulder widths i.e. carriageway width of 7.0 m wide with 1.5 m shoulders on either side in accordance with the guidelines given in the Road Design Manual 1.3, Vol. 1, Part 3 Table 4.23

This cross-section is applicable for a class B –Interurban and Rural Roads with two-lanes having traffic level of AADT between 2,000 and 4,000 in year 10.

The proposed road cross-sections are depicted in the figure *Fig 2* below.

Fig 2– Typical Cross Sections





TYPICAL ROAD CROSS SECTION WITHIN TRADING CENTRES

3- Nyaru- Kapkayo road

The AADT PCUS are the cross-section design traffic inputs. The Consultant evaluated the geometric capacity along the road segments based on year 10 projected traffic and the results are in traffic report.

From the traffic projections, the estimated AADT in year 10 on the identified homogenous sections along the project road is as shown in Table 3 below.

Table 3 – Year 10 AADT

Section	Link	Terrain	Section Classification	Year 10 AADT	Year 10 PCUS
1	B53 Junction (Nyaru)-Fluorspar Km 22.6	Escarpment/ Mountainous	Rural	705	1,990
2	Fluorspar Km 9.1	Rolling	Rural	1,122	1,535

The adopted standard cross-section is Type R6, comprising a 6.50 m carriageway with 1.5 m shoulders on either side, in accordance with the provisions of the New Road Design Manual (RDM-1.3), Table 4.23. This cross-section is applicable to a Class B–C single carriageway road, providing two-way traffic with 3.25 m motorized traffic lanes and 1.5 m shoulders in each direction, for roads carrying an AADT of between 500 and 2,000 vehicles, with partial to unrestricted access control.

However, following the Client’s instructions and based on economic considerations, a reduced cross-section has been adopted, consisting of a 3.0 m carriageway with 1.0 m shoulders on either side.

The proposed road cross-sections are depicted in fig. 3 below

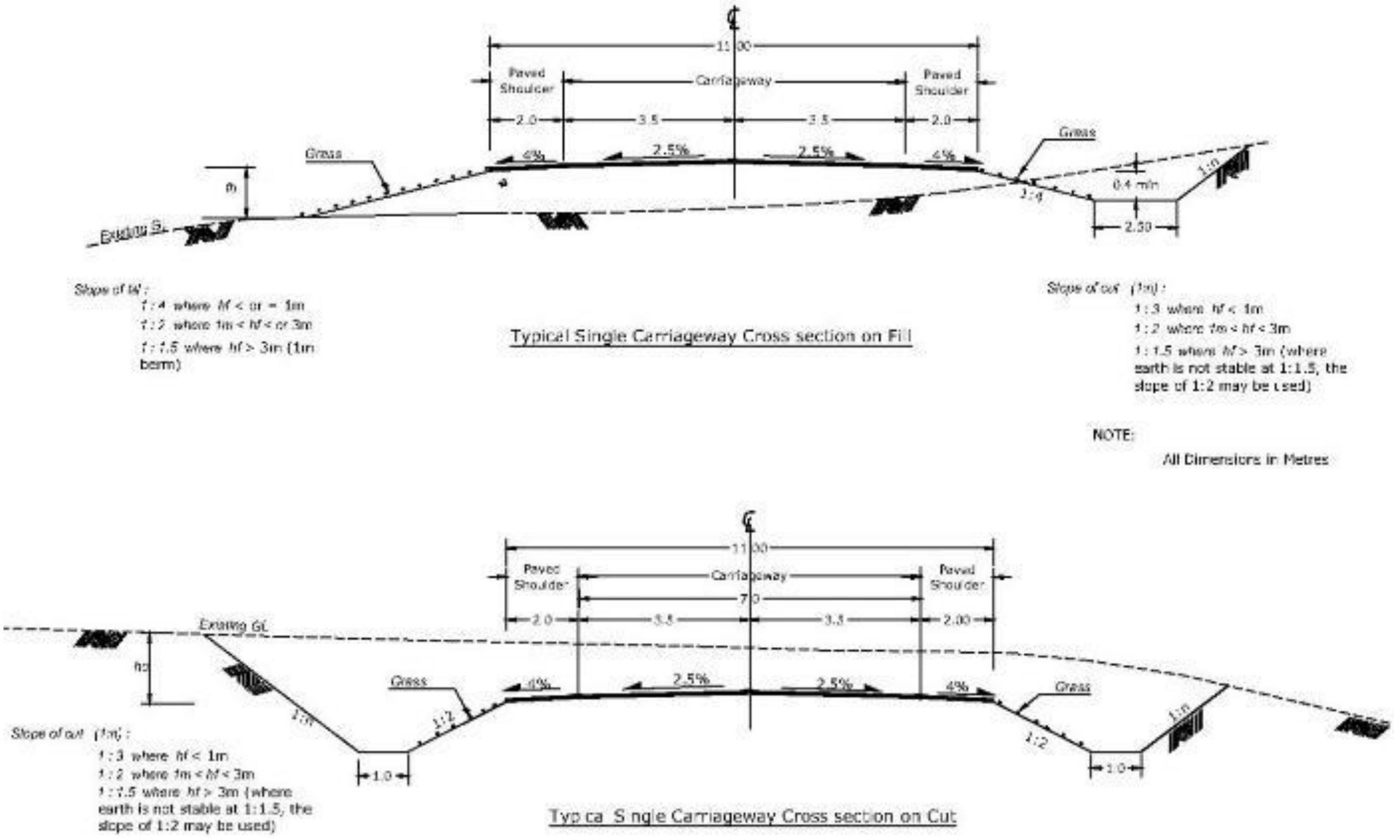


Fig 4– Typical Cross Sections

12.5 Annex 5: Climate Change Management Plan (CCMP)

1.0 Objective and Legal Framework

The Climate Change Management Plan (CCMP) is a sub-plan of the Environmental and Social Management Plan (ESMP) established to integrate climate risk adaptation into the design, construction, and operational phases of the Biretwo–Arror–Chesongoch (B126), Nyaru–Kapkayo (B124), and Kimwarer–Emsea (B122) road corridors.

The CCMP translates the climate risk assessment findings (Chapter 7) into structured adaptation measures that enhance the resilience of road infrastructure to extreme rainfall, flooding, slope instability, erosion, and temperature variability over the project lifecycle (2030–2050).

The CCMP complies with:

- African Development Bank (AfDB) Integrated Safeguards System (ISS), particularly Operational Safeguard 1 on climate risk management
- Kenya Climate Change Act (2016)
- Environmental Management and Coordination Act (EMCA), Cap 387 and associated regulations
- Applicable national road design, drainage, and geotechnical standards incorporating climate resilience principles

2.0 Institutional Roles and Responsibilities

Implementation of the CCMP is undertaken through existing project governance structures. The table below assigns execution, oversight, and reporting responsibilities to specific entities.

Entity	Responsibility	Oversight Authority	Reporting Frequency
Civil Contractor	Execute adaptation items (1.22 culverts, slope benching, PMB)	KeNHA Resident Engineer (RE)	Daily checklists; monthly progress reports
Geotechnical Sub-Contractor	Install rockfall mesh, horizontal drains, and rock bolts	KeNHA Materials Testing Team	Per-work-block handover sign-off
Contractor HSE Officer	Monitor erosion controls, silt traps, and temporary drainage	NEMA County Inspector / KeNHA Environment	Bi-weekly; event-triggered within 24 hours
KeNHA North Rift Regional Office	Manage 20-year asset preservation, drone surveys, and early warning systems	KeNHA HQ Operations Director	Quarterly asset reviews; annual budget audits
Regional Maintenance Contractor	Execute pre-season culvert flushing and rapid rockfall clearance	KeNHA North Rift Regional Director	Bi-annually (pre-rains); event-triggered

The Civil Contractor bears primary responsibility during construction and must assign a dedicated Environmental Officer to perform daily site inspections. The KeNHA Resident Engineer holds contractual authority to reject any works that do not meet the specified hydraulic or geotechnical resilience thresholds. Post-handover, the KeNHA North Rift Regional Office assumes full statutory responsibility for the operational phase.

3.0 Climate Risk Context

The CCMP addresses spatially variable climate risks affecting the project corridors, including:

- Intensification of extreme rainfall events leading to flash flooding and drainage exceedance
- High landslide susceptibility in escarpment terrain, particularly along B124
- River flooding, scour, and hydraulic instability at crossings along B126
- Progressive erosion and sediment transport in disturbed catchments
- Climate-induced deterioration of pavement layers in low-lying and moisture-prone zones

These risks are expected to intensify over the design life of the infrastructure and require integrated structural, ecological, and institutional responses.

4.0 Construction-Phase Climate Adaptation Framework

Construction-phase climate adaptation is aimed at minimizing exposure of works to climate hazards and reducing environmental sensitivity during earthworks and slope modification activities.

4.1 Catchment Protection and Erosion Control

The project shall adopt progressive vegetation clearing to minimize exposure of bare soils during high rainfall periods. Disturbed surfaces shall be stabilized through rapid revegetation and bioengineering techniques using indigenous species.

Sediment management systems shall be applied within sensitive catchments to prevent downstream siltation and protect riverine ecosystems, particularly within the B126 drainage network.

4.2 Climate-Resilient Hydrological Management

Temporary drainage systems and river diversion structures shall be designed to accommodate elevated flow conditions associated with extreme rainfall events under climate change scenarios.

Construction scheduling shall incorporate seasonal rainfall variability to reduce exposure during peak precipitation periods and ensure hydraulic continuity of temporary water conveyance systems.

4.3 Slope Stability and Geotechnical Risk Management

High-risk escarpment and cut slope areas shall be subject to enhanced geotechnical oversight to detect early signs of instability associated with rainfall infiltration and pore-water pressure increases.

Where instability risk thresholds are exceeded, construction activities shall be adjusted to allow installation or reinforcement of slope stabilization systems, including anchored support structures and drainage relief interventions.

5.0 Operational-Phase Climate Adaptation Framework

Following project completion, climate resilience management shall transition to KeNHA's asset management system.

5.1 Drainage System Climate Resilience Management

Drainage infrastructure shall be maintained to ensure continued hydraulic performance under increasing rainfall variability. Maintenance planning shall be informed by seasonal hydrological forecasts and post-event condition assessments.

5.2 Slope and Terrain Stability Monitoring

High-risk terrain sections shall be monitored using remote sensing, geospatial analysis, and periodic terrain surveys to identify early indicators of instability. Outputs shall be integrated into maintenance decision-making systems to support preventive interventions.

5.3 Pavement Climate Resilience Management

Pavement performance in climate-sensitive zones shall be monitored to detect deterioration linked to moisture ingress, thermal variation, and increased loading under extreme weather conditions. Maintenance interventions shall be prioritised based on performance degradation trends.

5.4 Early Warning and Climate Response System

KeNHA shall implement an integrated Early Warning System (EWS) in collaboration with the Kenya Meteorological Department (KMD). The system will support operational decision-making during extreme rainfall and slope instability events.

The system will operate on a tiered alert structure (watch, alert, emergency) to support proactive maintenance deployment, traffic management, and emergency response coordination.

Because local communities live directly adjacent to the right-of-way, they represent a vital first line of defense against rapid-onset geo-hazards. KeNHA, in coordination with the Elgeyo Marakwet County Government, will establish Community Road Resilience Committees (CRRCs).

Local residents along the escarpment paths will be trained to identify early environmental indicators of slope distress. These indicators include sudden structural cracking in hillside soils, tilting trees, or fresh rock-debris accumulation on road margins.

A dedicated mobile communication channel will link the CRRCs directly to KeNHA's regional maintenance dispatch desk. This bypasses standard bureaucratic layers and ensures landslide warnings are acted upon within minutes.

6.0 Institutional Capacity and Climate Risk Governance

The CCMP includes institutional strengthening measures to support long-term climate resilience, including:

- Enhancement of geospatial asset management capacity within KeNHA using GIS-based systems
- Deployment of drone-based terrain monitoring for slope stability assessment
- Strengthening of ecosystem-based adaptation (EbA) maintenance capacity
- Development of inter-agency coordination frameworks for climate data sharing and response

Community participation is integrated through localized reporting systems to enhance early detection of climate-induced hazards.

7.0 CCMP Monitoring and Performance Framework

The CCMP monitoring framework tracks climate resilience performance across construction and operational phases. Monitoring focuses on:

- Hydraulic performance of drainage systems under extreme rainfall conditions
- Stability of slopes and geotechnical systems in high-risk terrain
- Effectiveness of ecosystem-based adaptation measures
- Structural performance of pavement under climate stress conditions
- Responsiveness of institutional early warning and emergency systems

Monitoring outputs inform adaptive management and continuous improvement of climate resilience measures.

The table below establishes the performance indicators, target thresholds, and verification frequencies. Each indicator is tied to a specific project phase, responsible entity, and oversight authority.

Phase	Monitoring Indicator	Target Threshold	Frequency	Verification Method	Responsible Entity	Oversight Entity
Construction	Drainage alignment with 1.22 climate factor	100% of culverts and side drains built to upgraded hydraulic specs	Monthly during drainage installation	Physical tape measurement, concrete batch charts, as-built drawings	Civil Contractor	KeNHA Resident Engineer
Construction	Escarpment cut-slope stabilization	100% of Category 4 high-risk links secured with benching or anchored mesh	Prior to paving on adjacent links	Pull-out test records for rock bolts; visual geotechnical logs	Geotechnical Sub-Contractor	KeNHA Materials Team
Construction	EbA vegetative survival rate	Minimum 85% coverage of hydro-seeded local grass on embankments	Quarterly throughout construction	Quadrat sampling, site photography, survival data sheets	Contractor HSE Officer	KeNHA Environment / NEMA
Construction	Erosion and sediment trap integrity	Zero structural breaches or sediment bypass during precipitation events	Bi-weekly; within 24h of storm >25mm	HSE walkthrough reports, downstream turbidity sampling	Contractor HSE Officer	NEMA County Inspector / KeNHA RE
Operational	Cross-drainage operational capacity	Zero overtopping or bypass failures during	Bi-annually (two weeks pre-rains)	Debris clearance logs, siltation tracking, telemetry data	KeNHA North Rift Office	KeNHA Operations Director

		rainfall up to design limits				
Operational	Escarpment slope stability	Zero major landslides blocking right-of-way; rockfall clearance within 4 hours	Continuous via patrols; quarterly drone surveys	Drone photogrammetry overlays, comparative DTM analysis	Regional Maintenance Contractor	KeNHA North Rift Regional Director
Operational	Pavement structural integrity	Zero thermal bleeding, moisture stripping, or rutting exceeding 10mm	Annually	FWD load test records, laser profilometer profiles	KeNHA Quality Assurance Team	KeNHA Materials Department
Operational	Early warning response integration	100% of KMD Level 2/3 alerts acknowledged with proactive field deployments	Event-triggered	Digital dispatch logs, equipment position sheets, diversion records	KeNHA Regional Dispatch Desk	KMD Liaison Officer

8.0 Enforcement and Compliance Mechanism

CCMP compliance is mandatory under the ESMP and contractual framework.

Non-compliance shall trigger:

- Suspension of works where critical climate adaptation measures are not implemented
- Withholding of payments for non-compliant or unverified climate-resilient works
- Mandatory corrective action plans for repeated deviations
- Enforcement of statutory action under EMCA (Cap 387) in cases of environmental harm or downstream impacts

KeNHA retains authority for enforcement in coordination with regulatory agencies.

12.6 Annex 6: NEMA License (for Firm of Experts/EIA/EA Lead experts)

Norken NEMA License 2026.pdf

Isaiah-NEMA Licence_2026.pdf