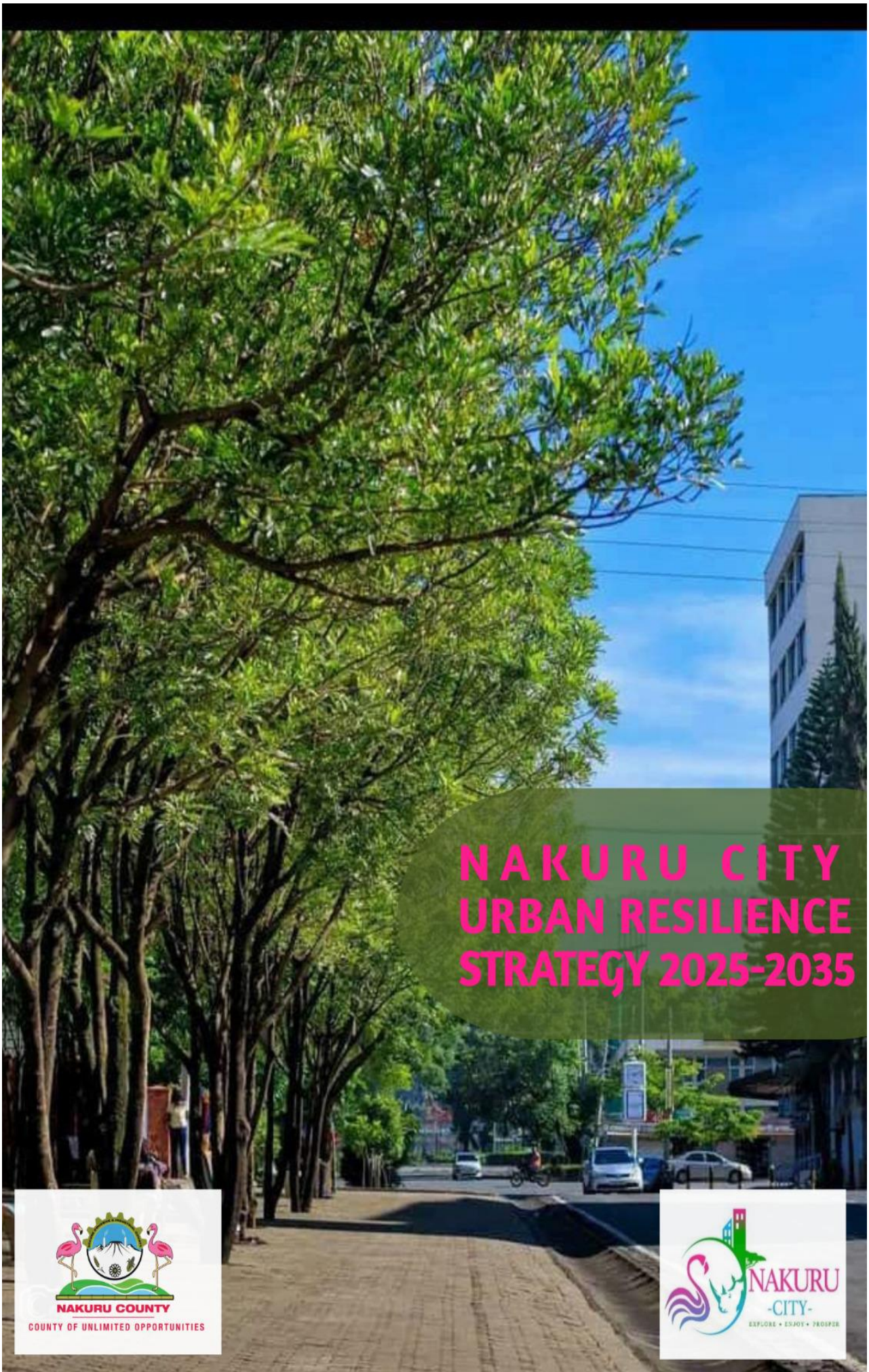

NAKURU CITY URBAN RESILIENCE STRATEGY 2025-2035

NAKURU COUNTY

COUNTY OF UNLIMITED OPPORTUNITIES

NAKURU -CITY-

EXPLORE • ENJOY • PROSPER

FOREWORD

Foreword by H.E. the Governor, Nakuru County

The City of Nakuru stands at a critical point in its urban development journey. As one of Kenya's fastest-growing urban centres, the city continues to experience rapid population growth, economic transformation, and increasing exposure to both natural and human-induced hazards. The Hazard and Risk Report for Nakuru City provide a comprehensive framework for understanding, managing, and mitigating these risks through evidence-based and inclusive planning.

This report complements the City's Urban Resilience Strategy (2023–2033) and aligns with Kenya's Vision 2030 and global frameworks such as the Sendai Framework for Disaster Risk Reduction, the Sustainable Development Goals (SDGs), and the Paris Agreement, 2015. it serves as a blueprint for a safe, livable, and resilient Nakuru where citizens, institutions, and ecosystems thrive together

I wish to extend my appreciation to all partners, stakeholders, and technical teams who have contributed to the development of this report. Let us continue to collaborate in strengthening the resilience of our city and safeguarding the wellbeing of current and future generations.

H.E. THE GOVERNOR SUSAN KIHIKA

COUNTY GOVERNMENT OF NAKURU

Acknowledgement

The preparation of the Naivasha Resilience Strategy Plan was undertaken through a collaborative and consultative process aimed at promoting a sustainable, inclusive, and climate-resilient future for Nakuru City.

The County Government of Nakuru, through the Department of Lands, Physical Planning, Housing and Urban Development, provided overall coordination, technical guidance, and policy direction during the development of this Strategy.

The County Government sincerely acknowledges the Kenya Urban Support Programme Phase II (KUSP 2) for facilitating the preparation of this document. The Programme's support in terms of technical backstopping, institutional coordination, and capacity enhancement was instrumental in ensuring the successful completion of the Strategy.

Appreciation is extended to the officers and stakeholders who provided technical input and insights that informed the formulation of this Strategy. Their professional contributions ensured alignment with the county's development objectives and the broader urban resilience agenda.

The County Government further recognizes the contribution of technical experts and consultants who supported data collection, spatial analysis, and policy formulation, thereby ensuring that the Strategy is evidence-based and implementable.

Finally, the County Government of Nakuru expresses its gratitude to all individuals and institutions whose efforts, cooperation, and dedication contributed to the realization of this document. Their collective commitment has established a strong foundation for building a resilient and sustainable city of Nakuru.

Arch. Kamau Kuria-Chief Officer,
Housing And Urban Development
COUNTY GOVERNMENT OF NAKURU

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LIST OF ACRONYMNS

ASAL – Arid and Semi-Arid Lands

CBO – Community-Based Organization

CEC – County Executive Committee

CGN – County Government of Nakuru

CRO – Chief Resilience Officer

CRI – City Resilience Index

DRR – Disaster Risk Reduction

EMCA – Environmental Management and Coordination Act

GIS – Geographic Information System

IDEP – Integrated Development and Environmental Planning

KFS – Kenya Forest Service

KURA – Kenya Urban Roads Authority

KWS – Kenya Wildlife Service

KUSP – Kenya Urban Support Program

MTP – Medium Term Plan

NDOC – National Disaster Operations Centre

NCCAP – National Climate Change Action Plan

NGO – Non-Governmental Organization

PPP – Public Private Partnership

SDG – Sustainable Development Goal

SDHUD – State Department for Housing and Urban Development

UNDRR – United Nations Office for Disaster Risk Reduction

UN-Habitat – United Nations Human Settlements Programme

EXECUTIVE SUMMARY

Nakuru City, one of Kenya's fastest-growing urban centres and a strategic regional hub in the Great Rift Valley, stands at a critical juncture. The City's rapid growth, economic potential, and transition to city status are increasingly threatened by compounding climate-induced and geological hazards. This urban climate risk and resilience profile Report provides a data-driven blueprint for proactive, evidence-based investment to safeguard the City's infrastructure, economy, and over one million future residents.

Aligned with Kenya's Vision 2030, the global Sustainable Development Goals (SDGs), and the Sendai Framework for Disaster Risk Reduction, this Summary outlines a portfolio of highly bankable, risk-informed projects designed to secure Nakuru's long-term resilience and set a model for sustainable urbanization in Africa. Immediate and strategic capital injection is required to transition the City from a reactive posture toward crisis management to a proactive stance focused on systemic, adaptive capacity building. Nakuru faces a multi-hazard threat profile, where climate variability interacts dangerously with underlying geological fragility and rapid, unplanned urban development such as:

Hydro-Climatic Extremes: Flooding and Lake Level Rise (High Impact, High Visibility) The city is severely impacted by intensified wet seasons leading to two distinct flooding hazards. Storm-Water Flooding occurs in low-lying, densely populated informal settlements, where inadequate sewerage and drainage infrastructure causes routine inundation, disrupting livelihoods and damaging micro-infrastructure. Concurrently, Lake Nakuru Water Level Rise, the persistent, unprecedented swelling of Lake Nakuru, poses an existential threat to riparian communities and critical infrastructure. The rising water has displaced thousands, submerged farmlands, and threatened the Lake Nakuru National Park ecosystem—a vital economic asset. This hazard requires strategic, long-term spatial planning and ecosystem-based adaptation measures to mitigate further economic and social losses.

Geological and Infrastructure Vulnerability Nakuru sits on the geologically active Rift Valley floor, characterized by loose volcanic soils and active fault lines. This exposes the city to Subsidence and Sinkholes, particularly in areas like London, Kiamunyi, and Ngata, where the intersection of heavy rainfall, poor drainage, and underlying tectonics leads to ground-saturation and the formation of sinkholes, directly threatening utility lines, roads, and residential structures. Furthermore, the outdated sewerage network faces significant stress from structural damage

caused by ground instability, leading to Sewerage System Failure, environmental contamination, and public health crises.

Social and Economic Vulnerability The impacts of these hazards are disproportionately borne by the urban poor. Approximately 35% of Nakuru's population resides in informal settlements—precisely the areas most exposed to storm-water flooding, poor sanitation, and insecurity risks. This structural inequality is a major obstacle to inclusive growth and represents a high-priority area for equity-focused funding. The City of Nakuru presents a portfolio of robust, locally-led projects that are structurally aligned with international climate finance criteria, emphasizing adaptation, mitigation, and social co-benefits. We are seeking long-term partnership and catalytic funding to realize the following core investment pillar on Climate-Resilient Infrastructure and Nature-Based Solutions (Medium-Long Term, Core Adaptation) and Social Equity, Adaptive Capacity, and Local Ownership (Immediate Impact, Equity-Focused).

Hon John K. Kihagi
County Executive Committee Member
Department of Lands, Physical Planning & Urban Development

COUNTY GOVERNMENT OF NAKURU

CHAPTER ONE:
BACKGROUND AND INTRODUCTION

1.1 CLIMATE CHANGE HAZARD AND RISK PROFILE IN NAKURU CITY

The 21st century is defined by an unprecedented global shift toward urbanization, transforming cities into the primary engines of economic growth, innovation, and demographic change. In line with this trend, United Nations reports project that over 50% of the world population will be residing in urban areas by the year 2050, making cities the critical focal points of human migration and settlement. This rapid growth, however, introduces systemic complexities and heightens the exposure of urban populations and critical infrastructure to both natural and human-induced hazards. The need for comprehensive risk assessment in this context is paramount to securing sustainable urbanization.

The City of Nakuru, recognized as one of Kenya's fastest-growing urban centres and a strategic regional hub within the Great Rift Valley, stands at a critical juncture in its development journey. While experiencing rapid population growth and economic transformation, the City's progress is increasingly threatened by a complex and compounding multi-hazard threat profile. This is where climate variability interacts dangerously with underlying geological fragility and rapid, often unplanned urban development.

This Urban Climate Risk and Resilience Profile serves as the comprehensive framework for understanding, managing, and mitigating these multifaceted risks through evidence-based and inclusive planning. The profile's primary objective is to undertake a detailed hazard and risk assessment for Nakuru City, specifically aiming to:

- Identify and map key issues related to both climatic and non-climatic attributes that profoundly affect city residents.
- Propose strategic intervention measures that translate diagnostic findings into actionable solutions.
- Provide a data-driven blueprint for proactive, evidence-based investment to safeguard the City's economy, infrastructure, and its growing resident population.

1.2 Urban Context

1.2.1. Location and Size of the City

Nakuru City is located 160 km North West of Nairobi City along Nairobi - Eldoret Highway in Nakuru County. It lies on the floor of the Rift Valley between latitudes 0˚15'0˚31'S and longitudes 36˚00'36˚12'E at an average elevation of 1850 meters above sea level. It is centrally located within Nakuru County.

The city hosts the Nakuru County headquarters and the Rift Valley Regional Headquarters. It borders four Sub-counties; Njoro to South and West, Gilgil to the East, Bahati to the North and Rongai to the North West.

The city is comprised of Nakuru East and Nakuru West Sub- Counties and 11 Wards namely; Nakuru East, Menengai, Flamingo, Kivumbini, Biashara all in Nakuru Town East; Shabaab, London, Rhonda, Kapkures, Kaptembwo, Barut in Nakuru Town West. The city boundaries are depicted in Map 2.1 below;

Politically, the City falls under two (2) Constituencies, namely; Nakuru Town East and Nakuru Town West.

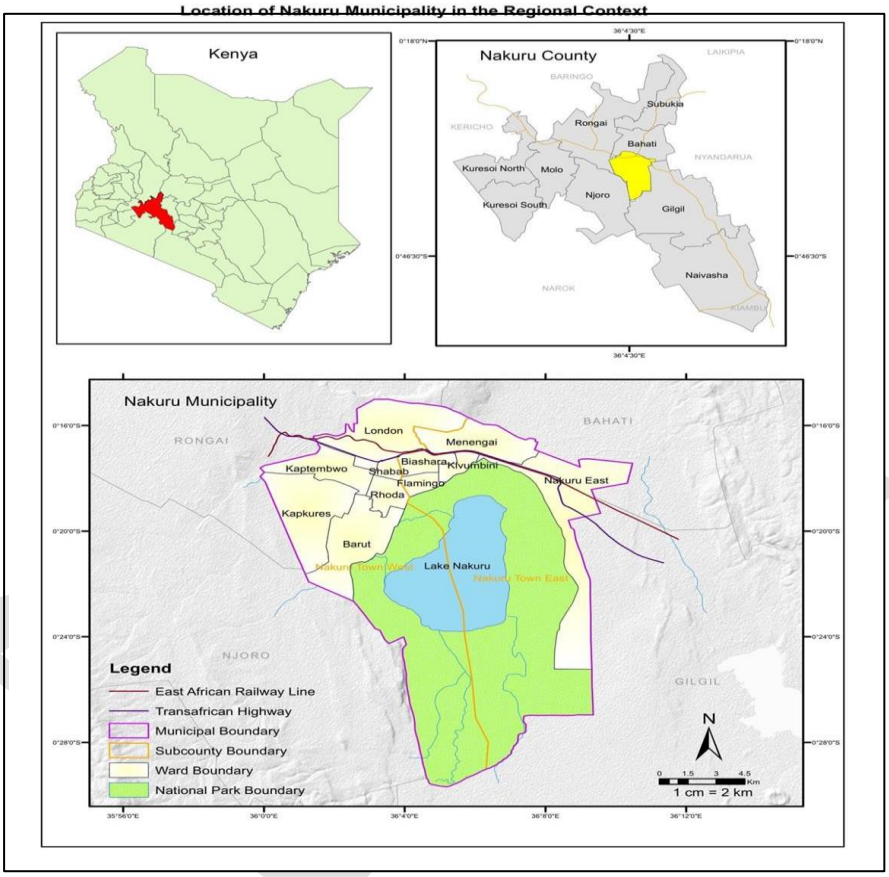

Figure 1.1: Location of Nakuru City

1.2.1.2 Administrative Units by National Government structure

The city falls under two administrative Sub-Counties/Districts namely; Nakuru East and Nakuru West with 6 divisions, 16 locations and 38 sub-locations. Table 3.1: Area by Sub Counties, Divisions, Locations and Sub-Locations

Sub-County	Area in Km²	No. of Divisions	No. of Locations	No. of Sub Locations
Nakuru West	71.9	3	9	22
Nakuru East	230.9	3	7	16
TOTAL	302.8KM²	6	16	38

Source: Kenya National Population and Housing Census 2019

Table 1.1: Administrative Units

1.2.1.3 Physiographic Characteristics, Natural Resources and Environment

Topography

Nakuru City's topography is highly varied, directly influencing its vulnerability to hazards like flooding and landslides. It ranges from the steep, forested slopes of the Menengai Crater, which forms a natural northern boundary, to the gentle, undulating slopes encompassing the Central Business District (CBD) and surrounding residential areas.

- **Highest Point:** The Menengai Forest slopes, with a peak at approximately **2,160 meters above sea level**.
- **Lowest Point:** The floor of **Lake Nakuru**, typically at an elevation of about **1,759 meters above sea level**.

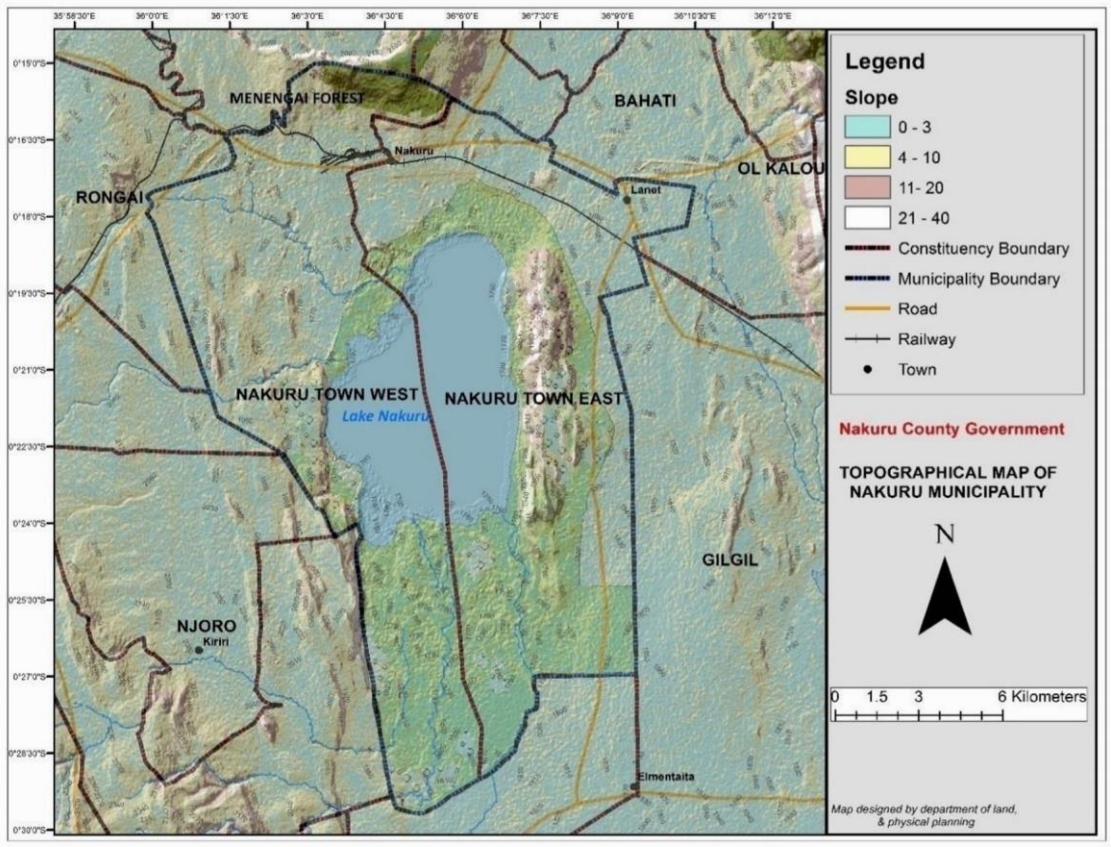

Figure 1.2: Topo- Map

Geological Features

The city's location within the Great Rift Valley formation is characterized by volcanic activities (Menengai Crater being a dormant caldera) and inherent geological instability. This includes active geological fault lines that traverse the urban and peri-urban landscape, posing a significant risk to infrastructure and human settlements, particularly during seismic events or periods of intense hydrostatic pressure (e.g., rising lake levels). Prudent urban planning mandates the preservation of natural areas with scientific and historical values (e.g., Lake Nakuru National Park, Hyrax Hills pre-historic site). Crucially, a minimum 10-meter buffer/green network is recommended along all rivers to serve dual purposes: recreation and conservation of fragile riparian habitats.

The areas that have geological fault lines are marked in Map 1.3 below.

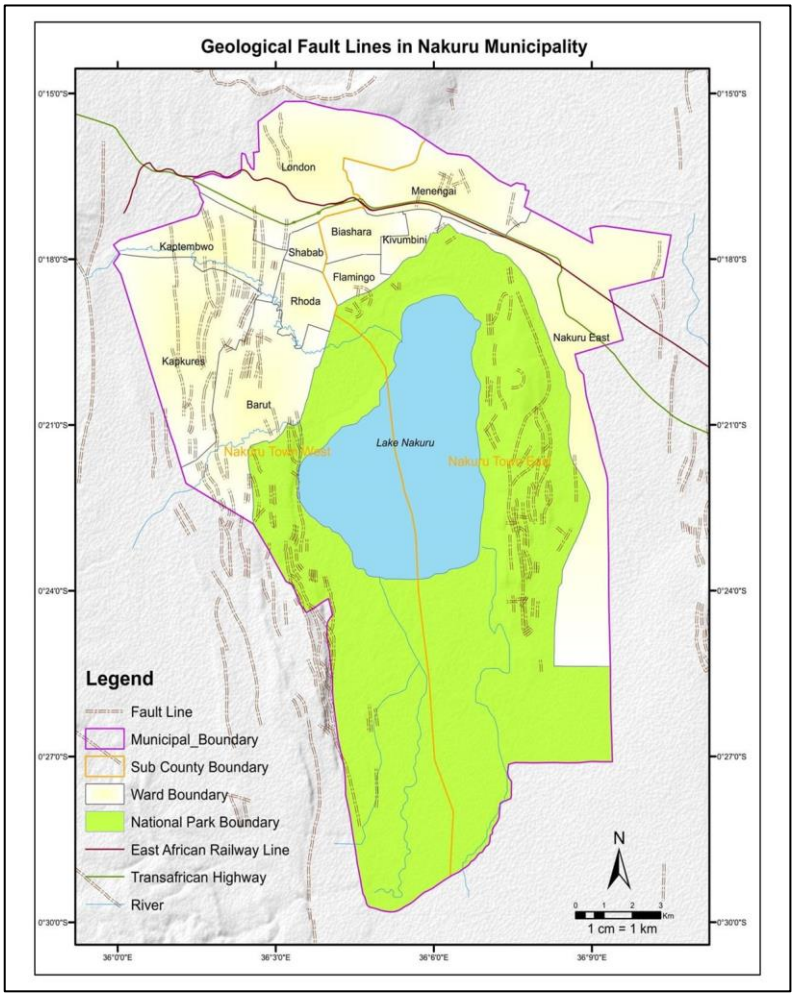

Figure 3: Geological Fault

Climate

Nakuru City experiences a warm temperate climate, locally classified as Cwb (Subtropical Highland Climate) under the Köppen climate classification, primarily due to its high altitude. The city generally receives moderately high rainfall, with the mean annual rainfall typically ranging between 950 mm and 1,500 mm per annum. However, climate change projections indicate increasing variability, leading to more frequent and intense droughts and flash flooding events.

Hydrology

The city's hydrology is dominated by the endorheic Lake Nakuru, a saline, shallow lake famous for its flamingos, located within a protected National Park. The lake's water level is highly dynamic, historically fluctuating between a low water mark and a high.

Major Rivers that drain into Lake Nakuru, serving as crucial surface water sources and flood conduits, include: River Njoro (also known as Ndarugu, River Enderit, and River Lamuriak. A recent and major climate-related hazard is the significant and unprecedented rise in Lake Nakuru's water levels since 2010. This event has led to the inundation of shoreline infrastructure, critical wetlands, and adjacent urban areas, destroying property, disrupting biodiversity, and increasing saline groundwater intrusion.

Map 1.4 below shows the location of water resources and catchment areas within the city.

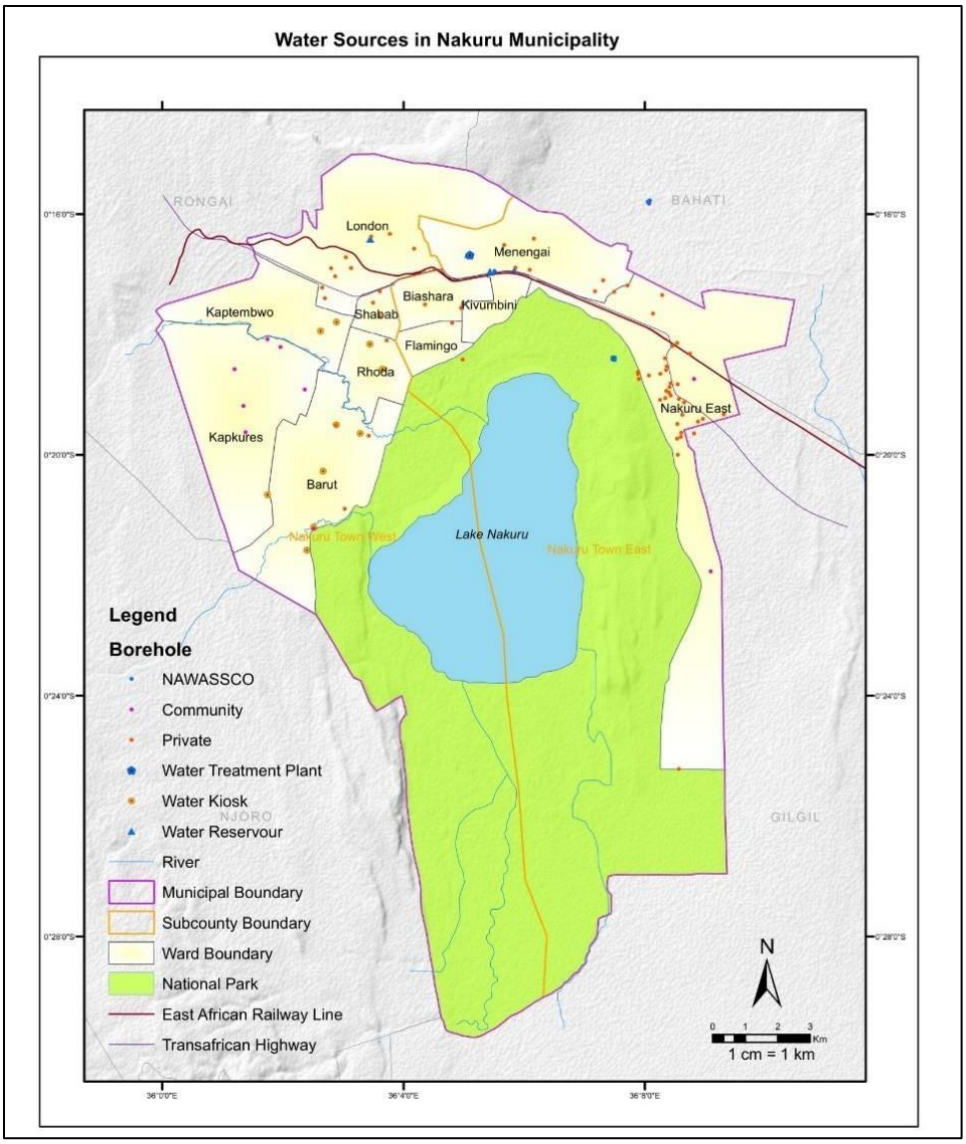

Figure 4: Water Sources

Source: Nakuru ISUDP, 2015-2035

Ground water resources

High salinity levels of the lakes place dependency on boreholes for water production.

Due to the high volcanic ground conditions the quality of infiltrated water is reduced. Therefore, boreholes at a depth of 150m are used to reach fresher aquifers.

Due to volcanic ground conditions water pockets can be found at different depths leading to certain boreholes to have high fluoride concentrations. Water measured at 1,5 mg/l fluoride (Legend: high, medium and low concentrations) are a health risk.

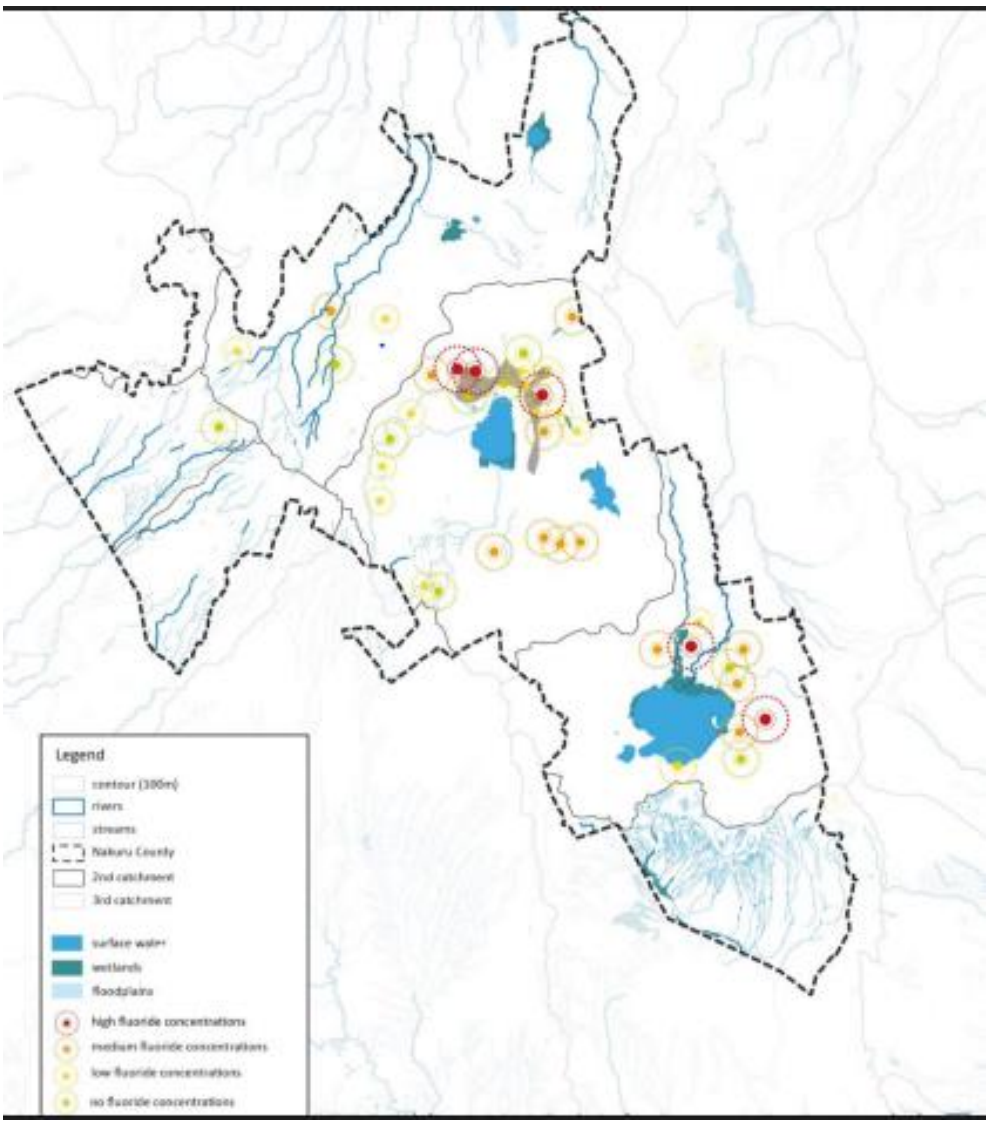

Figure 5: Ground Water Resources

Forest and Vegetation Cover

Key forested areas within or abutting the city include Menengai Forest largely dominated by exotic species and areas within the Lake Nakuru National Park (characterized by natural marsh, grasslands, acacia woodlands, and Euphorbia trees). In built-up areas, common exotic ornamentals include Jacaranda, Grevillea, Acacia species, and

ornamental shrub. Peri-urban zones retain crop vegetation, supporting subsistence agriculture.

Natural Resources

The city has limited known mineral resources. However, it is adjacent to the vast geothermal energy potential located in the Menengai Crater area, a key national renewable energy asset. Sand harvesting, a major contributor to environmental degradation and potential geological instability, is concentrated in areas like Barut (Nakuru West) and Mzee Wanyama (Nakuru East Ward).

Environment

Nakuru County is synonymous with the Rift Valley formation. As a result of its formation, key environmental features were formed including escarpments, Menengai crater (which abuts the city on the northern side), and L. Nakuru, located on the southern side of the city.

Environmental degradation in Nakuru City is mainly as a result of inappropriate farming methods in upstream areas, effects of climate change, poor solid waste and liquid waste disposal, inadequate sanitary facilities, encroachment of forest reserves, and conversion of land from agricultural use. In addition, lack of/limited implementation physical and land use plans, quarrying activities, pollution and toxic from agro-chemicals also contribute to environmental degradation.

Major degraded areas include the Barut sand quarries. Water pollution is present in River Njoro from farming activities upstream. The lake is likely to be also polluted from storm water and effluent discharge from the town dwellings. Increased silting in the Lake is also inevitable, given the upstream activities.

The major environmental threats in the city include; climate change threats, deforestation at Menengai Forest, bush/forest fires, pollution, drought, flooding, and rising lake water levels.

Environmental pollution through littering and indiscriminate waste disposal is a common occurrence in the city. There is a strong need to enforce the EMCA Act, Physical and Land Use Act and the City by-laws, among others to address environmental pollution.

Key Intervention Areas
1. Protection of the natural ecosystems 2. Controlled development on areas with geological instabilities 3. Control of excessive vibration from quarrying activities 4. Mapping out areas for future urban development of the city 5. Establishment of green networks along rivers and their tributaries 6. Mapping out areas experiencing flooding and development of flood management strategy 7. Development of Climate change adaptation mitigation measures

Source: IdeP, 2023

Climate Change

Climate change, in the context of Nakuru City, must be understood not merely as a set of isolated weather events, but as a systemic risk multiplier that amplifies pre-existing urban vulnerabilities. The shift in atmospheric moisture and temperature patterns translates directly into two primary forms of threat: acute shocks (such as flash floods or sudden infrastructure failures) and chronic stresses (like continuous water scarcity, heat stress, and livelihood erosion). This continuous, compounding pressure wears down the City's adaptive capacity, disproportionately affecting the urban poor and threatening to unravel the economic and social gains achieved through rapid urbanization. Successfully building resilience requires the city to move beyond post-disaster response and integrate climate-informed decision-making into every layer of governance, from land-use planning to budgetary allocation.

Nakuru's susceptibility to climate hazards is critically tied to its unique geological position on the floor of the Great Rift Valley. This reality creates a complex risk nexus where external climatic drivers intersect with fundamental earth science and urban morphology. For instance, increased rainfall intensity from climate variability exacerbates the inherent instability caused by active fault lines and loose volcanic soils, leading to phenomena like ground saturation, subsidence, and sinkhole formation—hazards distinct from, yet amplified by, the rainfall itself. Furthermore, the rapid and often unplanned expansion into geologically sensitive or riparian zones institutionalizes the city's exposure, turning natural phenomena into preventable human disasters by placing critical infrastructure and vulnerable populations directly in harm's way.

1.2.2 Governance Structure

1.2.2.1 The Nakuru City Board

The County Governor is the overall head of the County Government administration and the City Board's appointing authority.

The City Board is an institution that was established under the articles of the Urban Areas and Cities Act (2011), and is mandated with administration duties of the City, as prescribed in schedule 11 & 12 of UACA.

The City Board manages the affairs of the County at the City level in a principal–Agent relationship with the Nakuru County Government. It undertakes auditing of the city functions through monitoring and evaluation of projects in the city. It is guided by its' Vision: A model city that enhances quality of life and fosters economic prosperity'.

The City Manager is the Secretary and an ex-officio member of the Board. Also, the manager is responsible for the implementation of the decisions and functions of the board, making reports and recommendations to the Board of the city about the needs of the city as well as the annual city budget and be answerable to the board at all times.

The Chief Administrative Officer is in charge of all the departmental staff of the city and running of day-to-day operations of the city.

Nakuru City is administered under four main departments; Finance and administration, Environment and Public Health, Planning and Infrastructure, together with Trade, Tourism and Investment. The departments shall be headed by their respective competent heads and relevant staff that will help in performance of various functions under each department as depicted in the organogram.

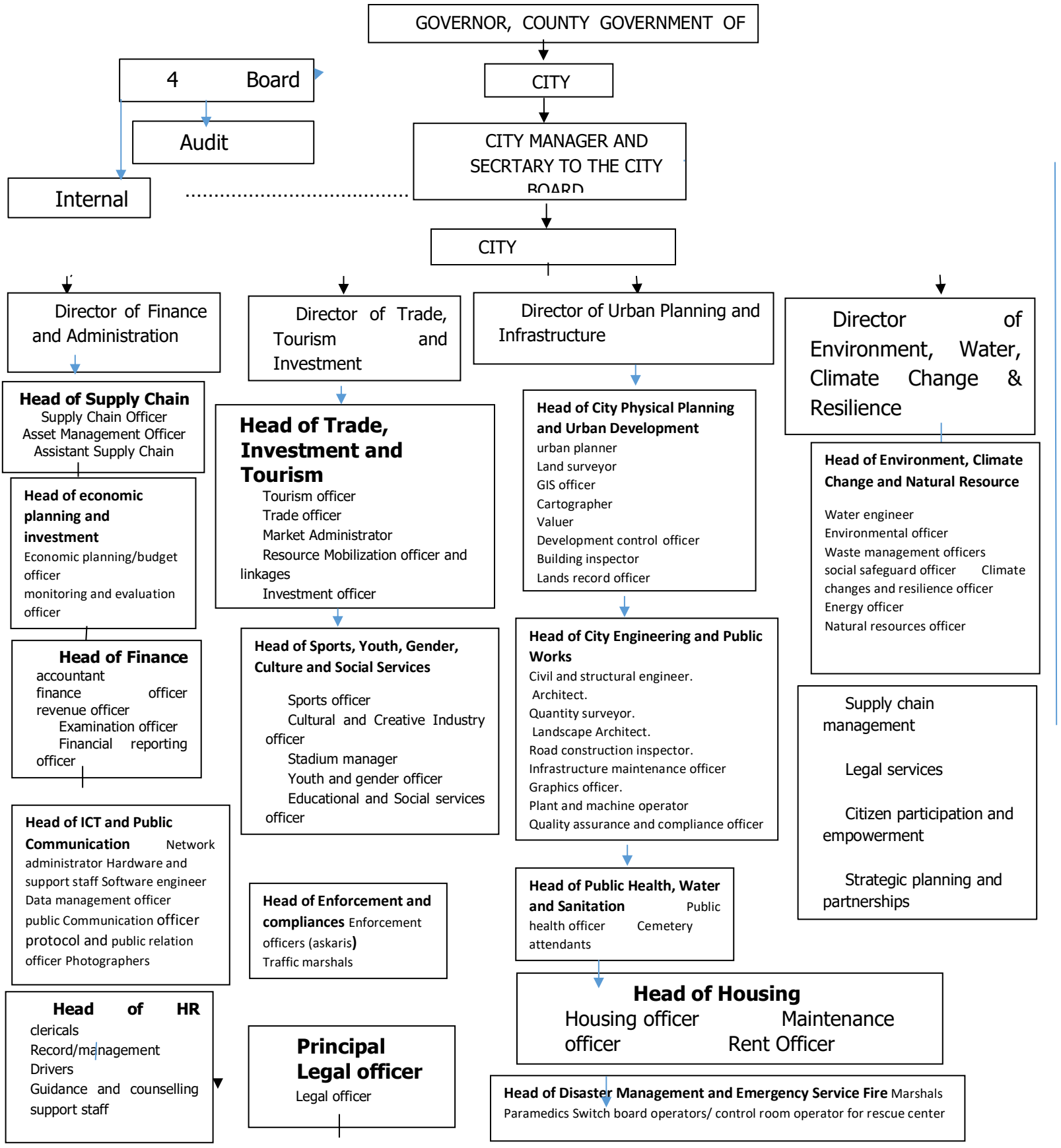
GOVERNOR, COUNTY GOVERNMENT OF
4 Board
CITY
Audit
CITY MANAGER AND SECRTARY TO THE CITY BOARD
Internal
CITY
Director of Finance and Administration
Director of Trade, Tourism and Investment
Director of Urban Planning and Infrastructure
Director of Environment, Water, Climate Change & Resilience
Head of Supply Chain
Supply Chain Officer
Asset Management Officer
Assistant Supply Chain
Head of economic planning and investment
Economic planning/budget officer
monitoring and evaluation officer
Head of Finance
accountant
finance officer
revenue officer
Examination officer
Financial reporting officer
Head of ICT and Public Communication Network administrator Hardware and support staff Software engineer Data management officer public Communication officer protocol and public relation officer Photographers
Head of HR
clericals
Record/management
Drivers
Guidance and counselling support staff
Head of Trade, Investment and Tourism
Tourism officer
Trade officer
Market Administrator
Resource Mobilization officer and linkages
Investment officer
Head of Sports, Youth, Gender, Culture and Social Services
Sports officer
Cultural and Creative Industry officer
Stadium manager
Youth and gender officer
Educational and Social services officer
Head of Enforcement and compliances Enforcement officers (askaris)
Traffic marshals
Principal Legal officer
Legal officer
Head of City Physical Planning and Urban Development
urban planner
Land surveyor
GIS officer
Cartographer
Valuer
Development control officer
Building inspector
Lands record officer
Head of City Engineering and Public Works
Civil and structural engineer.
Architect.
Quantity surveyor.
Landscape Architect.
Road construction inspector.
Infrastructure maintenance officer
Graphics officer.
Plant and machine operator
Quality assurance and compliance officer
Head of Public Health, Water and Sanitation Public health officer Cemetery attendants
Head of Housing
Housing officer Maintenance officer Rent Officer
Head of Disaster Management and Emergency Service Fire Marshals
Paramedics Switch board operators/ control room operator for rescue center
Head of Environment, Climate Change and Natural Resource
Water engineer
Environmental officer
Waste management officers
social safeguard officer Climate changes and resilience officer
Energy officer
Natural resources officer
Supply chain management
Legal services
Citizen participation and empowerment
Strategic planning and partnerships

Figure 6: Governance Structure

The Department that is primarily involved in the preparation of Urban Climate Risk Profile is that of Environment and Public Health while all the City's Departments are involved in the preparation of IdeP*, inter alia*.

1.2.3 Socio-Economic Context

1.2.3.1Population and Demography

The City's population according to the 2019 National Population and Housing Census was 392,587. This comprises 194,753 males and 197,814 females with a sex ratio of 0.98:1, and 20 intersex persons. The distribution of population and densities by Sub counties is shown in Table 3.2 below.

SUBCOUNTY	Population				Households	Land area in Sq. Km	Pop. Density
	Male	Female	Intersex	Total			
Nakuru East	92,956	100,960	10	193,926	61,398	230.9	840
Nakuru West	101,797	96,854	10	198,661	64,481	71.9	2,764
Total	194,753	197,814	20	392,587	125,879	302.8	1,802

Table 2: Population Distribution

Source: KPHC 2019

1.2.3.2 Population density and distribution

The average population density in the city is 1802 people per square kilometer. Nakuru West Sub- County has the highest population density with 2764 persons per square kilometer, while Nakuru East Sub County has a density of 840 persons per square kilometer. Areas classified as informal settlements contribute to the highest densities.

.The population growth rate stands at 2.9 percent yearly. The city has a big youthful population, with over 75 percent being between 0-34 years. There also exists a high dependency rate, with 55 percent of the population lying 0- 24 years.

Labor force:

In 2019, slightly above half of the City's population was in the labor force bracket at 55 percent. 45 percent was economically inactive while 47 percent were working. Similarly, 8 eight percent of the labor force bracket were actively looking for work, depicting the

levels of unemployment. Employment opportunities need to be created in both the formal and informal sectors.

Health Sector

There is a total of 104 health facilities spread across the city. The city also hosts the only level 5 hospital in the County- Nakuru Provincial General Hospital (PGH) that serves Nakuru, Baringo, Nyandarua and Laikipia counties. The Nakuru PGH benefitted from state-of-the-art equipment under the Managed Equipment and Supplies Programme (MES). Table 1.2 shows the various levels/categories of health facilities.

Level of care					Bed Capacity
	Public	FBO/NGO	Private	Total	
Level VI-County referral hospital	1	-	-	1	522
Level V-County referral hospital					
Level IV- Sub-County hospitals	4	1	15	20	163
Level III – Health Centres	5	16	37	58	34 (Public)
Level II – Primary care facilities	10	10	77	97	-
Level I – Community units	33	-	-	33	-

Table 3: Health Facilities

Source: Department of Health June 2020, County Government of Nakuru

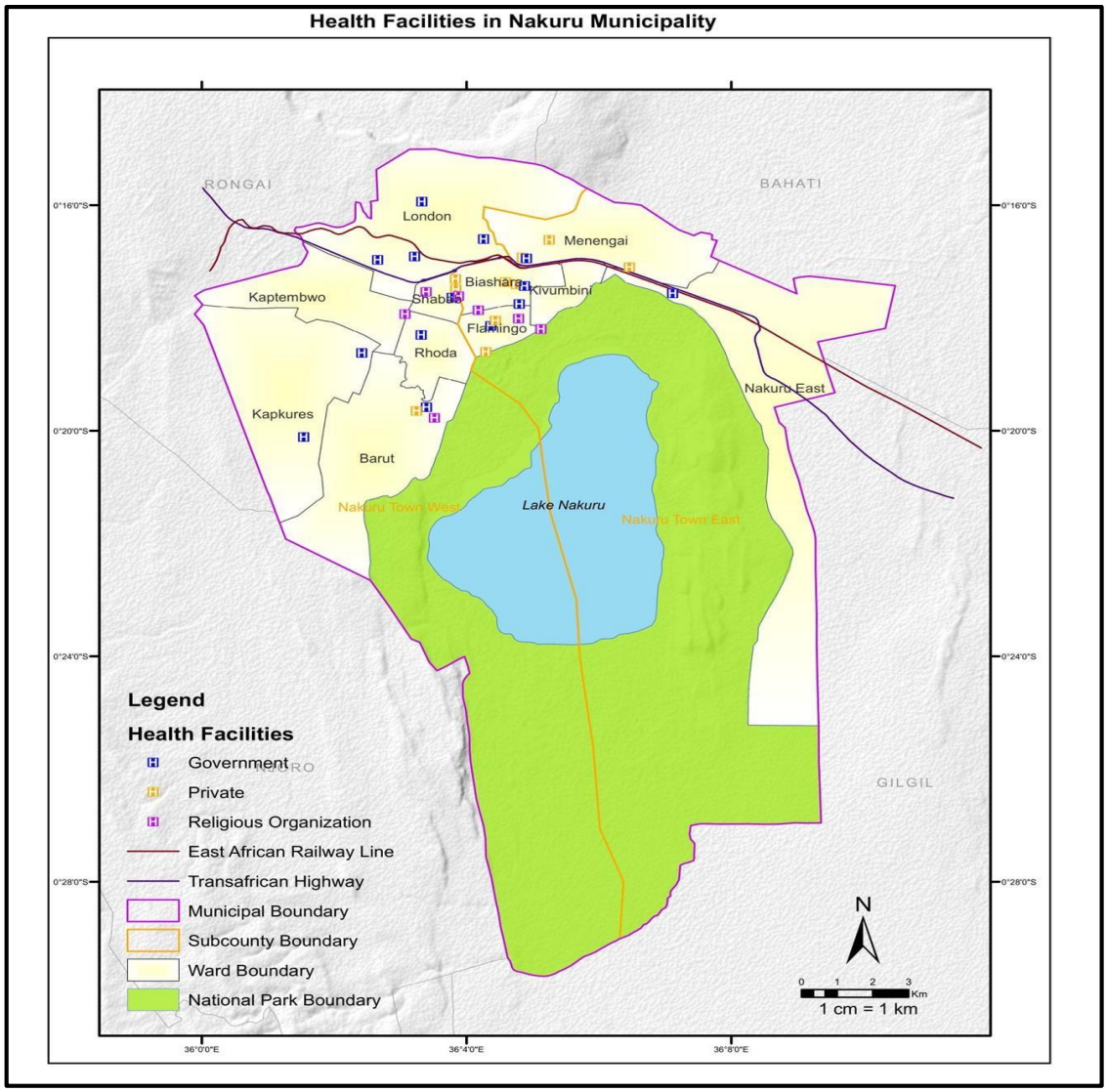

Figure 7: Health facilities Map

Education and Vocational Training

The ECDEs are preparatory schools where children between 4-5 years are taught prior to joining primary schools. They may be attached to existing primary schools. It is desirable that a nursery school is attached to every primary school for ease of transition. The city has 67 public ECDEs and 210 private ECD Centres. Bondeni ECDE is a standalone public ECDE Centre in Nakuru East while Nakuru West Sub-County has Tulwet, Gk prison and Kapnandi as standalone ECDs. Due to dense population in the city, the Teacher: Pupil ratio in ECD stands at 1: 50 in public and 1:30 in private institutions.

The 2020 enrolment in the ECDE centers in City is 5,981 pupils in public and 8,254 in private totaling to 13 (ISUDP 2015-2035)

Within the City there are two vocational Training centres (Nakuru and Barut) fully registered with Technical Vocational Education and Training Authority (TVETA) with approved programs. Most of the trainees come from the eleven wards within the City and beyond.

1. Key Areas of Interventions
2. Construction of 80 new ECDE Classrooms and 67 ECDE Toilets 3. Induction of 900 ECDE Teachers on current trends on ECDE Education e.g. Pre- 4. Primary Education Policy of 2017, Competency Based Curriculum 5. Supply of furniture, instructional materials and equipment to 20 ECDE Centres iv. Recruitment of additional ECDE teachers 6. Fair distribution of educational facilities in the peripheral wards 7. Investment in education sector by offering ECDE training vii. Provision/ Construction of more technical colleges

Source: IDeP Committee Analysis, 2023

Social Protection

Social protection interventions aim at achieving sustainable and equitable socio-cultural and economic empowerment to all Citizens. The relevant sub-components include the number of Orphans and Vulnerable Children (OVCs), cases of street children, street families, child care facilities and Institutions, and Gender Based Violence (GBV) cases

Other sectors include: Culture and Gender. the elderly People Living with Disabilities, youth talent academies and sports and recreation facilities.

	Key Interventions
	Gender issues i. Prevention and response to GBV ii. Advocating for women Participation in Leadership and decision making iii. Women Economic Empowerment iv. Sexual Reproductive Health Education for Adolescents & Youth and support. v. Mainstreaming Gender in County Departments vi. Development of a County Gender policy.

	vii. Establishment of a Gender Based Violence Rescue Centre Culture i. Digital platform for artists to showcase their talents ii. Signing of an MOU with the National Museums of Kenya for the use of Hyrax Hills Museum to empower artists and cultural practitioners. iii. Rehabilitation of Nakuru Players Theatre Social services i. Liaison with the State Department of Children and also National Council for Persons with Disability (NCPWD). ii. Secured budgetary allocation for construction of social halls and expansion of new infrastructure at Alms House. iii. Provision of PWD fund after complying with the controller of budget requirements. Youth affairs i. Training of youth in areas such as entrepreneurship, health, ICT and agribusiness ii. Offering linkages, partnership and mainstreaming opportunities to youth. Sports i. Establishment of a sport fund to support local games teams and nurture talents ii. Establishment of a sports centre at St. Teresa Primary School iii. Refurbishment of Kamukunji playground Recreational i. Greening and beautification in the city (currently on-going) ii. Provision of recreational facilities within residential estates iii. Rehabilitation of existing recreational facilities

Source: IdeP, 2023

1.2.4 Economic Context

1.2.4.1 Industry and Trade

The city has hosted a wide range of industries in the past years having set aside an industrial zone. However, some have been closing down. Industries play a key economic role for local communities in terms of provision of employment opportunities, translating to improved livelihood status. In addition, the city would gain investors' confidence which will equally translate to other related economic advantages such as rates and levies collection.

There are various industries that drive the economy of Nakuru County as well as offer employment opportunities. They include; animal feeds production companies, agricultural inputs

e.g. Syngenta, engineering works, manufacturing industries e.g. Menengai Oil Refineries, canners, dairy products, bakery and hotel industry.

1.2.4.2 Markets

The city has a main market (Wakulima Market) where trading of farm produce takes place. The market functions as a wholesale market for Nakuru County and other neighboring counties i.e. Nyandarua, Laikipia, Baringo and Narok counties.

The County has constructed a hawker's complex which accommodates small scale traders in Nakuru Town. There are other satellite markets within the city such as Free Area, Rhonda, Kiratina and Ziwani.

1.2.4.3 Commerce

Commercial activities are determined by geographical centrality, accessibility to vehicles and pedestrians and availability of ample parking space.

A significant number of people rely on business income to support their livelihoods. Most of the businesses in the city fall under the micro, small, or medium level enterprises. The retail business has the lion share of registered businesses (County Statistical Abstract, 2015).

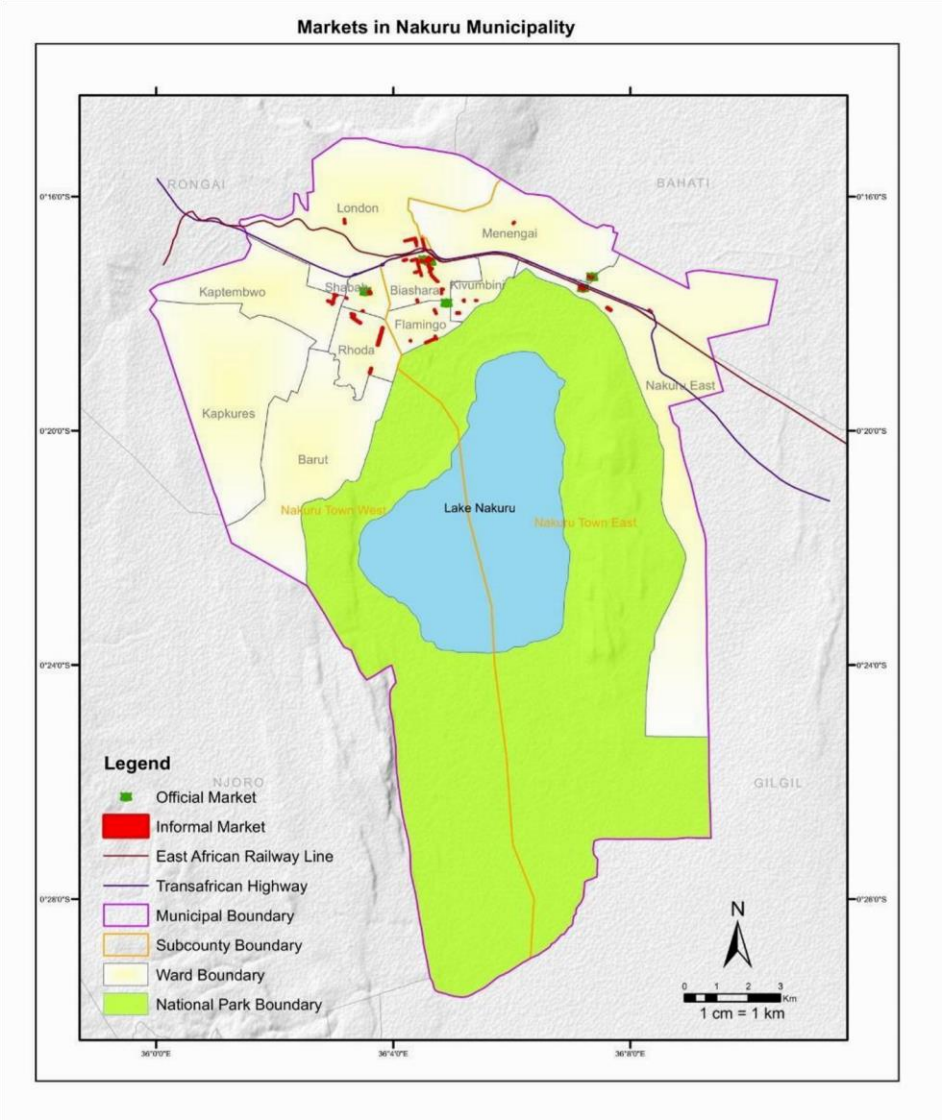

Figure 8: Distribution of Markets

City Source: Nakuru ISUDP, 2015-2035

1.2.4.4 Financial services

Financial services in the County are offered by; banks, Micro finance institutions, mobile money agents and SACCOs that offers back office and Front office service activities.

1.2.4.5 Tourism and Wildlife

Nakuru County is among the counties with a large inflow of tourists from within and outside Kenya. The county boasts of major flora and fauna that attract tourists. Lake Nakuru National Park is the only wildlife conservation area within the city and occupies an estimated 188 KM^2.

1.2.4.5 Urban Agriculture

The city falls within the medium potential area as per the agro-ecological zones. Land sizes have significantly reduced from between 0.8ha and 10 ha in the last 10 years to between 0.045ha to 1 ha on average due to massive sub-divisions thus limiting agricultural production. The main agricultural activities include subsistence farming of various food crops, livestock keeping, bee keeping and aquaculture.

Key Areas of Interventions
i. Changes in urban agricultural technologies (domestic agriculture, fish farming, etc) ii. Establishment of modern markets (equipped with market infrastructure) for farm produce iii. Establishment of food processing and storage factories iv. Development of City by laws to guide agricultural activities within the city v. Investments in research and development on urban agriculture

Analysis of the General Economic and Commercial Affairs

The existing sites for markets within the city is less than 40 acres. Due to high population of more than 392,000 people demand for land for the expansion of the market is high. Planning standards dictate that for a population of 5,000 people, a market with a minimum of 1 acre should be provided. Nakuru City requires about 80 acres of land for the establishment of markets. However, with the constraints on availability of land, densification of the available markets through vertical expansion can be explored.

With some industrial land having changed use currently, there is limited land for industrial expansion within the city. A total of between 500-1200 acres for a major industrial area is required for a population of between 200,000 and 500,000. This would in turn provide between 20,000 and 50,000 jobs, based on an average industrial density of 40 workers per acre.

Industrial vibrancy is heavily dependent on transport, both road and rail for the supply of materials and distribution of finished goods. A number of roads in the industrial area need rehabilitation to ease movement of goods. Currently, the railway line is underutilized/non-functional within the industrial area. With the construction of SGR to the Dry Port in Mai Mahiu, there is a growing need to revitalize the old railway line and connect it to the SGR network.

The city hosts the Lake Nakuru National Park, Menengai Crater and Hyrax hill prehistoric site. The potential for tourism cannot be overemphasized. This contributes to the creation of job opportunities both directly and indirectly.

Statistics show that 8 percent of the labour force are actively looking for employment opportunities. The table below presents a summary of issues in the sector.

Key Intervention Areas
i. Enhancing ease of doing business in the city
ii. Creation of employment opportunities through engagement of the locals for labour services
iii. Decongesting of the CBD market by developing alternative markets in the commercial nodes and estates (Rhonda, Ziwani, Kiratina, Kaptembwa/Githima,
iv. ASK Showground/ KFA, County estates)
v. Implementation of the integrated Transportation system (as proposed in the ISUDP)
vi. Alternative trade and business activities
vii. Densification of developments through vertical expansion in strategic locations vii. Development of modern markets

Source: IDEP, 2023

1.2.5 Land Use Context

This section highlights the current and projected economic context for the urban areas in terms of the existing and proposed physical infrastructure.

Urban development incorporates all types of land uses and spatial developments. They include residential, industrial, educational, recreational, public purpose, commercial, public utility, transportation, undefined/deferred, urban agriculture and conservation.

Most land in Nakuru City falls under both categories of leasehold or freehold. Generally, the city has a relatively small developable foot print, considering that more than 60% of the City's coverage is occupied by natural features including Lake Nakuru National Park and Menengai forest. The map below highlights the various land uses within the city.

Key Areas of Intervention

1. Expansion of the city boundaries.
2. Protection of environmentally fragile areas.
3. Expansion of the sewer reticulation network.
4. Redevelopment of county estates.
5. Enhancement of the staff establishment in the city to improve the workforce.
6. Development of a mobility master plan for the city.
7. Acquisition of alternative land for cemetery use.

8. Mapping of all social and recreational facilities.
9. Identification of suitable land for development and redevelopment.
10. Detailed planning of the city to support effective development control.
11. Establishment of a structured urban planning section with adequate staff for research, strategic planning, development control, and enforcement.

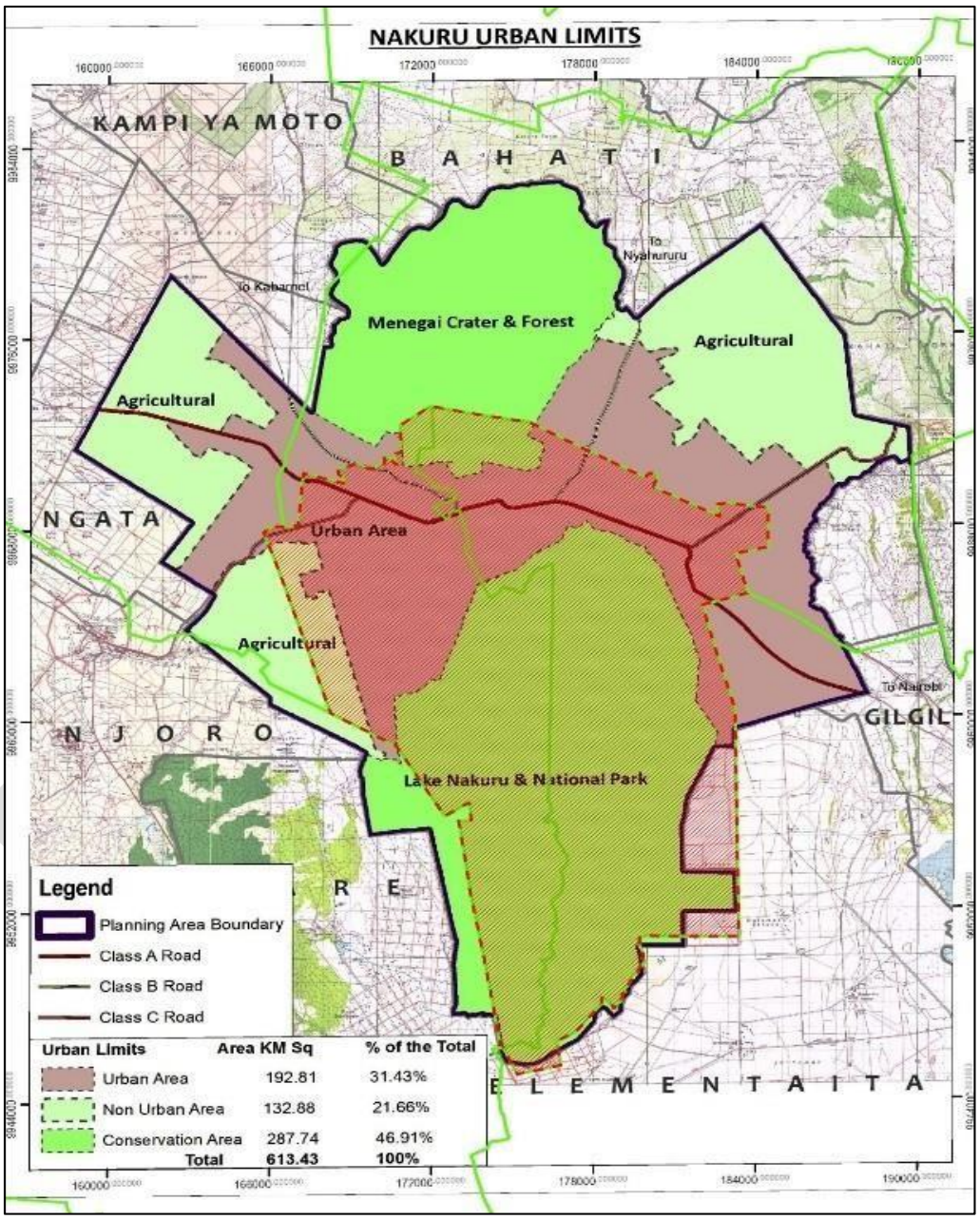

Figure 9: Urban Limits

Source: Nakuru ISUDP, 2015-2035

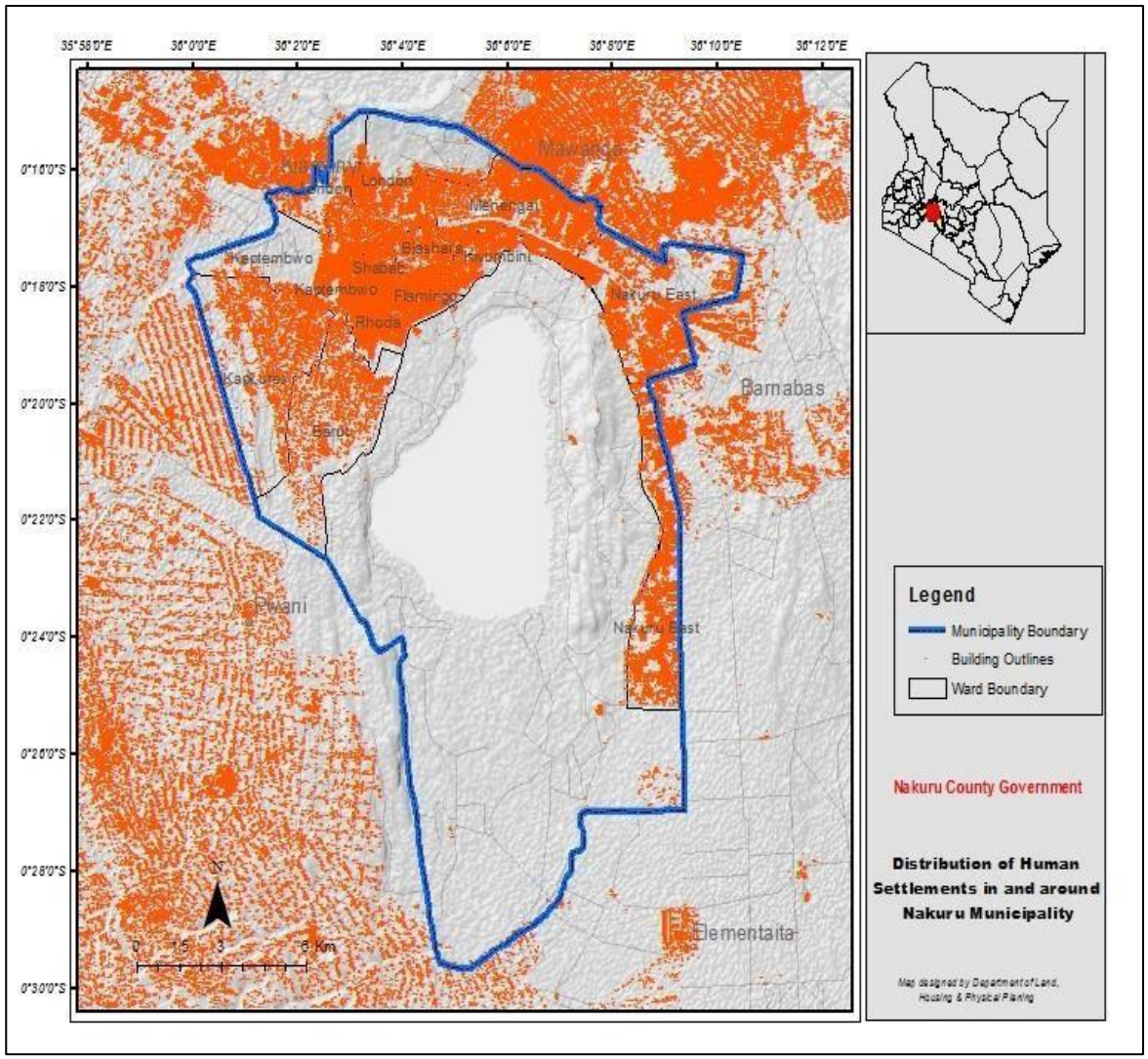

Figure 10: Built Up areas

Source: Nakuru ISUDP, 2014-2034

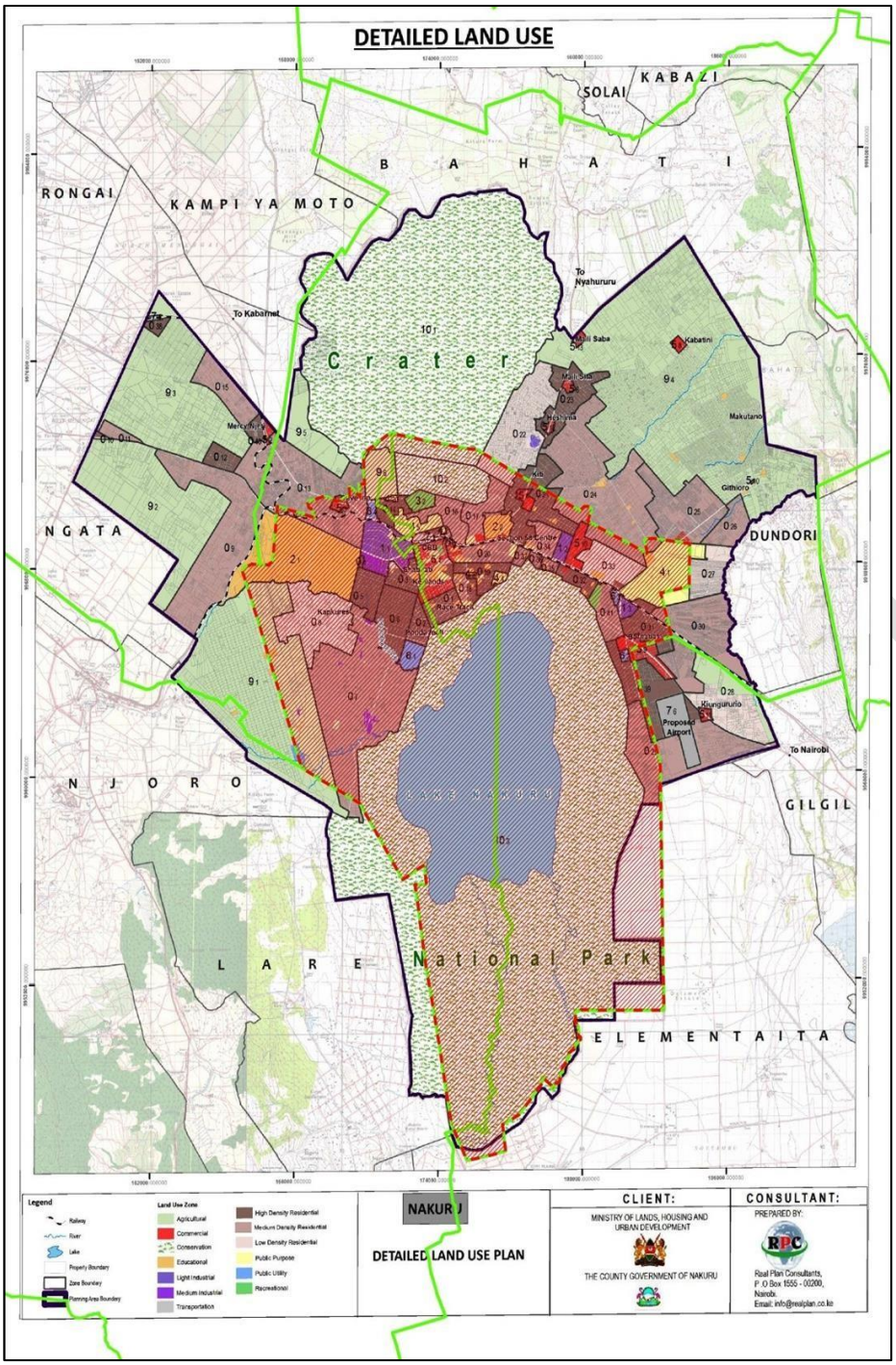

Figure 11: land use

Source: Nakuru ISUDP, 2014-2034

Energy, Infrastructure and ICT

The City's infrastructure facilities include road network, NMT network rail network, an airstrip, ICT, line utilities among others.

Energy

Electricity is the main source of energy for lighting in the city with over 92% of households in both sub-counties using it LPG is the predominant cooking fuel, followed by charcoal. Another renewable includes solar and biogas

The adjacent Menengai Crater area is also a potential source for geothermal energy, with several explorations ongoing at the site. It has the potential to complement the provision of alternative sources of energy.

Road Network

The road network in the city is a mix of tarmacked and earthen roads. The city has a total road network of about 816km out of which 117km is paved and about 698km is unpaved.

NMT: Provision for NMT is an essential part of city infrastructure. A total of about 40 km of NMT has been provided.

Rail Network

The East African Railway line traverses through the County to Uganda, which transports cargo mainly from the port of Mombasa to Malaba border, and has a station at Nakuru Town. The railway line has witnessed declining traffic volumes over time and is now almost none existent.

Airport/Airstrip

Currently, the city does not have an existing airport. However, expansion of the airstrip at Lanet Military Base for commercial services is on course. This will improve economic integration with the rest of the nation and open international market for products within the County including direct export of horticulture and floriculture.

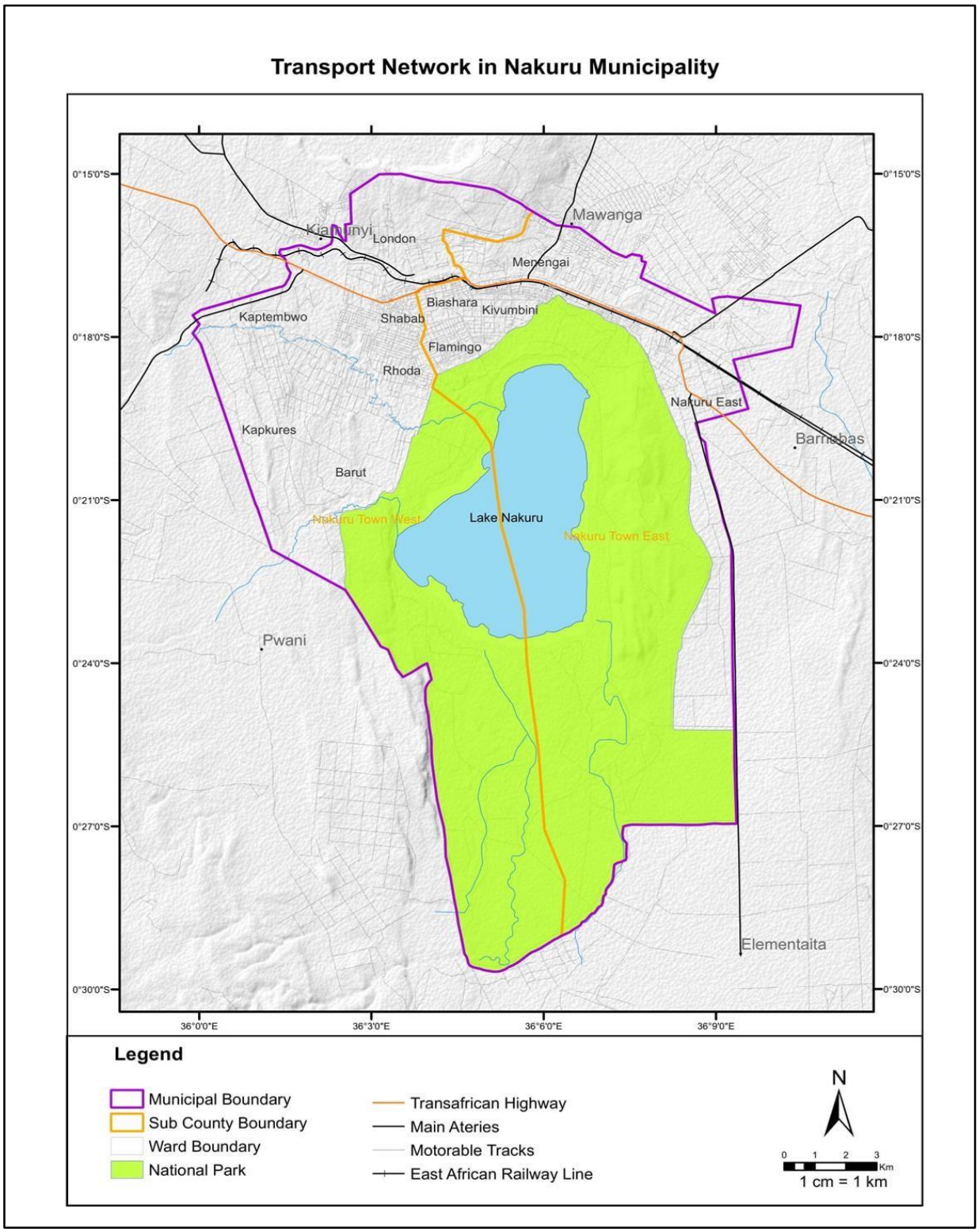

Figure 12: Transport Network

Fire Fighting Station

Currently, the city has one fire station which is crossly inadequate. For a population of between 50,000 to 100,000, there should be at least one fire station. A total of at least 4 fire stations is required.

Storm Water Drainage

The steep slope of the Menengai Crater (1750m - 2100m) gives rise to intense and fast-moving surface run-off during the rainy seasons. During the heavy rains, surface runoff is discharged to the lake through artificial and natural drains. Part of it is also discharged to underground reservoirs through normal seepage and through the geological faults. Man- made storm water drains are found mainly in the CBD.

While physical development has complicated the storm water drainage situation by reducing the amount of ground for normal seepage, artificial drains are inadequate, poorly developed and poorly maintained. In many instances surface run-off runs directly into physical developments. This creates numerous drainage problems. Such problems are common mainly in the low-income settlements in the periphery of the city where artificial drainage system does not exist.

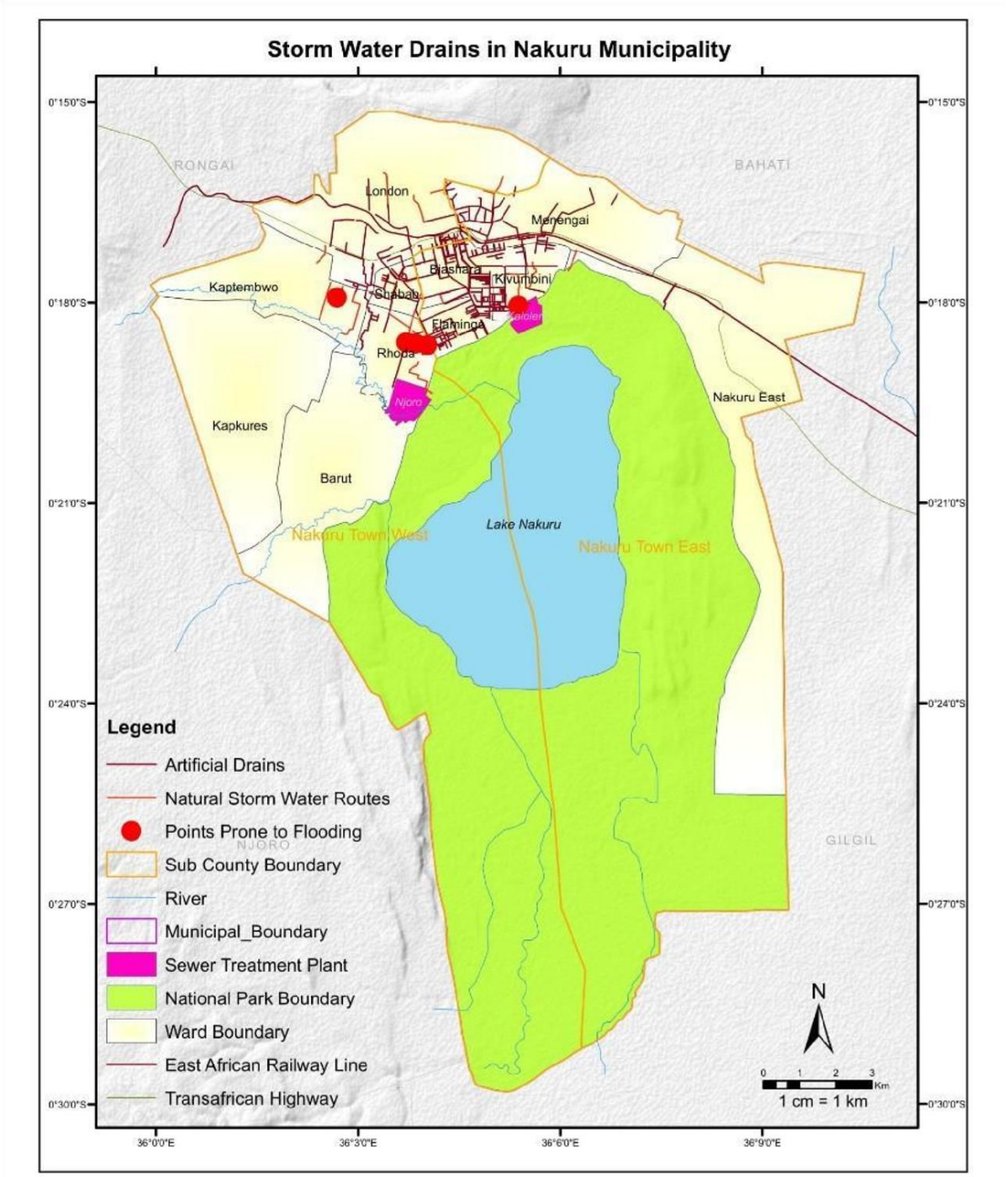

Figure 13: Storm water drains

Source: ISUDP, 2015-2035

Key Areas of Intervention

i. Preparation of a mobility master plan that will guide urban transport.
ii. Upgrading all roads to gravel and bitumen standards within the city.
iii. Integration of NMT (Non-Motorized Transport) infrastructure on all primary, distributor, and local distributor roads.
iv. Establishment of alternative termini outside the CBD at Ziwani.
v. Enhancing traffic flow within the city to reduce congestion.
vi. Construction of bypasses to filter traffic not terminating in the CBD.
vii. Planning and redesigning of the existing Matatu termini.
viii. Transport segregation between vehicular, cycling, and pedestrian lanes.
ix. Acquisition of adequate road reserves.
x. Formulation and implementation of a stormwater drainage master plan.
xi. Unblocking of roadside drainage channels.
xii. Incorporation of rainwater harvesting and storage facilities in building plan approvals.
xiii. Factoring proper space-sharing design in transport corridors.
xiv. Use of ecologically viable surfaces (e.g., soft ground, permeable pedestrian walkways).
xv. Adoption and implementation of the “spongy city” concept.

Solid waste

According to UN report,2022 about 0.56 kg of waste is generated per person per day. Nakuru City alone contributes about 700 tonnes daily due to dense population and rapid growth. There is one designated solid waste disposal site in the city situated at Gioto, Nakuru West. This dumpsite serves a large catchment area, since there is no other site in the city and the surrounding sub-counties. The dumpsite has been in operation for nearly 50 years, now overstretched and poses environmental and health risks.

A 2017 Mott MacDonald study found that organic waste makes up 70% of urban waste, followed by plastics (13.2%), paper/cardboard (9%), and other materials, including hazardous waste.

Most solid waste is collected by prequalified private companies, followed by County government especially for markets and low-income settlements.

Interventions
i. Encourage waste recycling, recovery and re-use strategies ii. Improvement on solid waste management system including finding alternative land for land infill/dumpsite (relocate Gioto dumpsite) iii. Establishment of a waste material recovery iv. Implementation of the Extended producer responsibility regulation

Water and Sanitation

The main sources of water for Nakuru City are surface water and groundwater. Surface water is mainly sourced from River Malewa, Mereroni and Turasha accounting for 10%, while groundwater sourced from 24 boreholes contributing to 90% of the current production. Other private boreholes supplement water supply especially in areas not served by NAWASSCO piped water.

Sanitation

According to the Census 2019, most of the city households dispose human waste through covered pit latrines at 30.8 percent, 29.6 percent are connected to sewer, 20 percent have septic tanks while 14.5 percent have VIP latrines. Incidences of open defecation were minimal at 0.1 percent.

Sewerage coverage in the city is low with only about 29% of the population being covered by 17,000 connections.

Poor wastewater collection and treatment in and around the city has been cited, with a huge amount of polluted wastewater being discharged to the lake prior to proper treatment. There are 2 waste treatment facilities. The Town STW has been under high risk of flooding as a result of rising lake levels.

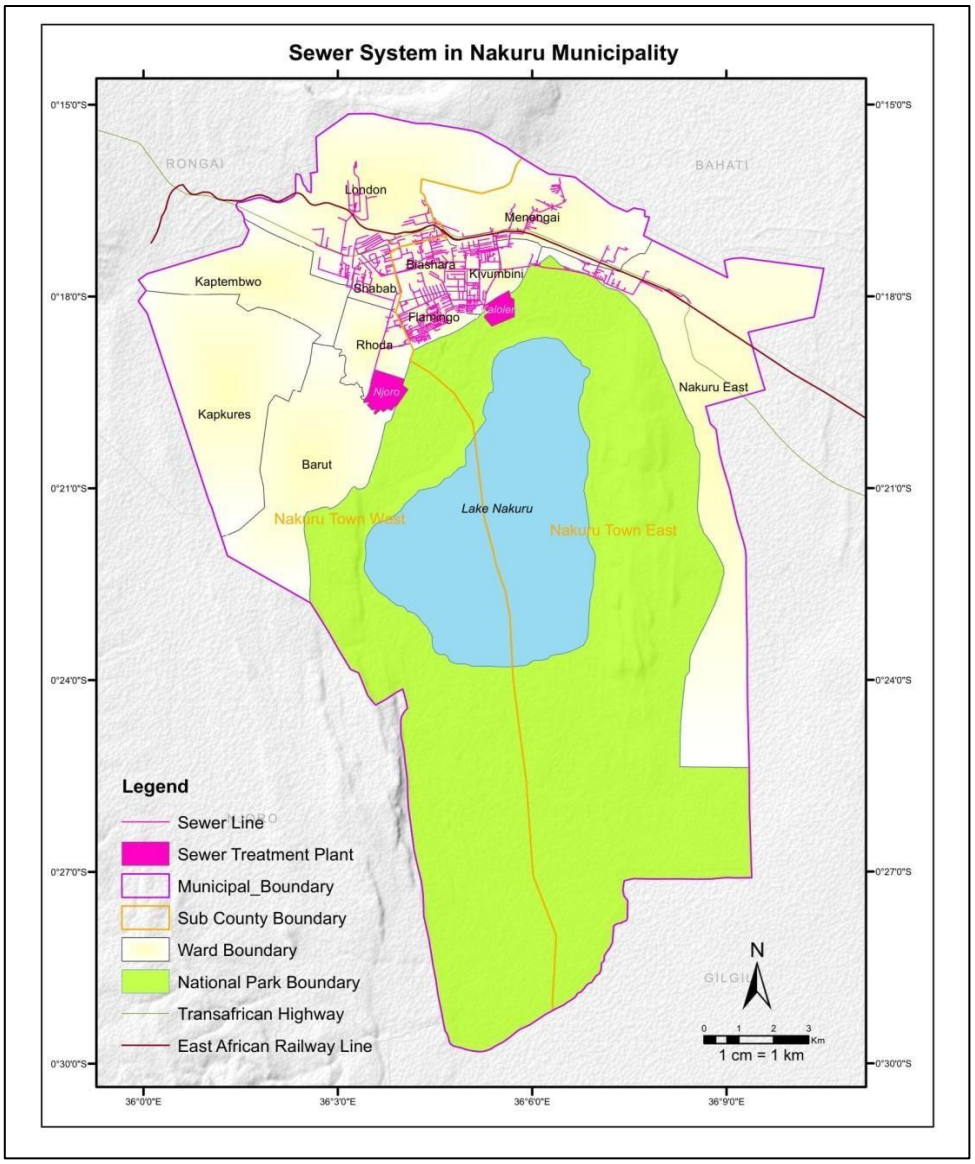

Figure 14: Sewer network

Source: Department of Lands, Physical Planning and Housing

Similarly, public ablution facilities are inadequate yet the requirement is that they should be provided on every major street. In slums/informal settlements, 1 ablution block is required for every 100m of street length.

Sand harvesting in some parts of Barut and Mwariki 'B' has caused environmental degradation and it must be regulated.

Interventions
i. Increasing piped water reticulation and supply
ii. NAWASSCO to explore installation of extra water treatment plants to augment water supply
iii. Overhaul/expansion of the sewerage connectivity within the city
iv. Incorporate water harvesting facilities in buildings
Rehabilitation of the underutilized STW
vi. Mapping out areas for future urban development of the city for proper planning

Source: IDeP Committee Analysis, 2023

Information and Communication Technology (ICT)

The rapid uptake of ICT has seen a significant rise in investment of ICT infrastructure across the County and particularly in Nakuru City. According to the 2019 Census, 40 percent of households in Nakuru East and 25.9 in Nakuru West had access to internet.

The Nakuru post office has also contributed to information and communication flow.

Interventions
i. Designation of ICT hubs in each ward
ii. Installation of CCTV surveillance system at the County headquarters and
iii. County offices at the Regional Co-coordinator's building
iv. Implementation of a revenue management system
v. Installation and configuration of Local Area Networks (LAN) at the County headquarters and all sub counties offices
vi. Installation and configuration of Wide Area Network (WAN) at the County headquarters, Governor's office – Milimani, Department of Environment, Water,
vii. Energy & Natural Resources and ICT offices at Regional Co-ordinator's building
viii. Implementation of an assets management system
ix. Decentralization of ICT functions within the County departments

Source: IDeP Committee Analysis, 2023,

Nature-Based Solutions (NBS) and Green Infrastructure

Beyond core drainage improvements, Nakuru City has strategically invested in Nature-Based Solutions (NBS) as a crucial element of its climate adaptation strategy, directly addressing the urban heat island effect and improving localized water management. The establishment and rehabilitation of public parks and green spaces, such as the restoration of Nyayo Garden and Lions Garden, are essential to increasing the city's vegetative cover. These areas function as vital urban lungs, lowering ambient temperatures, providing shade in a region prone to heat stress (as noted in the climate projections), and enhancing the quality of life for residents. Furthermore, the proactive beautification initiatives along major city streets and highways—

through planting and landscaping—are designed to slow storm-water runoff, promote infiltration, and prevent the rapid movement of water that contributes to flash flooding in downstream settlements, thereby integrating aesthetic improvement with practical hazard mitigation.

Photo: Nyayo Garden in Nakuru

Photo: Green spaces regeneration along Nakuru-Nairobi Highway

Leveraging Cultural Assets for Socio-Economic Resilience

Nakuru's resilience profile is significantly bolstered by its vibrant cultural sector and its commitment to harnessing creative industries for sustainable development. This commitment was formally recognized in November 2021 when the city was designated by UNESCO as a Creative City under the Craft and Folk Art category (Source: UNESCO Creative Cities Network). This prestigious status is not merely an accolade but a strategic driver for socio-economic growth, positioning the city as a regional hub for arts-based commerce. Through initiatives supporting local artists, the visible proliferation of public art, including artistic murals and graffiti created by youth, transforms public infrastructure into canvases for cultural expression. These projects not only enhance the urban environment but also create employment opportunities, foster social cohesion, and provide vulnerable youth with pathways into the formal creative economy, thereby enhancing the city's overall adaptive capacity and sense of shared identity in line with the goals of the Urban Resilience Strategy.

Photo: Graffiti arts on county estate residential houses

1.3 Key Stakeholders and Inclusiveness

The Kenya Constitution of 2010 in Chapter 4 on General Provisions Relating to the Bill of Rights together with Section 22 of Urban Areas and Cities Act on Citizens Fora allow residents to engage in making proposals on certain thematic issues affecting them. Nakuru City has identified and engaged stakeholders in various fora to determine and implement strategies and projects in line with their expectations. The identification and mapping of stakeholders is provided for under various legislation such as UACA. The list includes, but not limited to:

Category	Stakeholders / Organizations
Investors	- Britam- I&M Bank- Residential and Commercial Real Estate Developers- Insurance Firms, Land Agents, Property Management Agencies- Hotels and Lodges- Business Associations (e.g., Chamber of Commerce, Hoteliers' Association, Kenya Investment Authority)
Community	- Nakuru County Youth Forum- Nakuru County Artists Association- Nakuru County Women's Group- Nakuru County Residents Association (NACORA)- Various cultural and community-based associations
Development Partners	- SNV- GIZ- MasterCard Foundation- World Bank- USAID- Rockefeller Foundation- UNDP- African Development Bank (AfDB)
Government	- County Government- Kenya Wildlife Service (KWS)- Kenya Forest Service (KFS)- Water Resources Authority (WRA)- National Environment Management Authority (NEMA)- Kenya Urban Roads Authority (KURA)- Kenya Railways- Kenya Tourism Board
NGOs and CBOs	- World Vision Kenya- Red Cross - Save the Children- - AMREF- Local CBOs involved in youth, women, and environmental initiatives

Table 4: Stakeholders

A minimum of four stakeholder meetings are held in every financial year.

CHAPTER TWO:
METHODOLOGY AND APPROACH

2.1 Introduction and Chapter Overview

This chapter outlines the systematic methodology and analytical framework utilized for the development of Nakuru urban climate risk and resilience profile for Nakuru City. The primary purpose of the methodology is to establish a credible, transparent, and reproducible process for identifying, quantifying, and analyzing the city's exposure to various shocks and stresses, thereby ensuring the findings directly support the objectives of the City's Urban Resilience Strategy.

The overall approach adopted for this report is Mixed-Methods, combining the quantitative analysis of spatial and climate data with qualitative inputs gathered through extensive stakeholder consultation and document review. The chapter proceeds with a detailed description of the research design, the data sources utilized, and the specific risk assessment framework applied.

2.2 Research Design

The study employed a Descriptive, Analytical, and Policy-Oriented Research Design. This design was chosen for its capacity to:

1. **Describe** the physical characteristics, historical trends, and current status of hazards impacting Nakuru City.
2. **Analyze** the complex interactions between physical hazards (e.g., flooding, drought) and socio-economic vulnerabilities (e.g., poverty, informal settlements).
3. **Translate** analytical findings into actionable policy recommendations aligned with national and international disaster risk reduction frameworks.

The methodology is inherently evidence-based, prioritizing the synthesis of pre-existing studies and official data while grounding the analysis in spatial data and expert opinion.

2.3 Study Area and Scope

The geographical scope of this report is strictly confined to the Nakuru City and its designated administrative wards.

The analysis focuses on current (2023) and projected risks up to the year 2035 aligning with the time horizon of the City's Resilience Strategy. The hazards investigated were categorized as follows:

- **Natural Hazards:** Including floods, droughts, extreme heat events, and geological risks (e.g., fault lines, volcanic activity).

- **Human-Induced/Technological Hazards:** Including fires, infrastructure failure, and pollution/waste-related risks.
- **Biological/Health Hazards:** Including disease outbreaks and public health crises.

2.4 Data Collection and Sources

Data was collected from two primary source categories to ensure comprehensive coverage and validity.

2.4.1 Secondary Data Review

A comprehensive desk review was conducted to synthesize existing literature and official records. Key documents reviewed included:

- **Planning Documents:** The Nakuru City Urban Resilience Strategy (2023–2033), County Integrated Development Plan (CIDP), and Physical Land Use Plans.
- **Hazard Data:** Historical climate records from the Kenya Meteorological Department (KMD), hydrological data, and past disaster event reports from the County Disaster Management Unit.
- **Socio-Economic Data:** Census data, vulnerability indices, and demographic statistics from the Kenya National Bureau of Statistics (KNBS).
- **Thematic Maps:** Existing Geographic Information System (GIS) layers related to drainage, infrastructure, land cover, and elevation.

2.4.2 Primary Data Collection

Primary data collection focused on triangulating secondary findings, validating site-specific vulnerabilities, and gathering expert opinion.

Method	Purpose	Respondents/Tools
Key Informant Interviews (KIIs)	To gather qualitative insights on institutional capacity, historical risk management effectiveness, and policy gaps.	County Executive Committee Members, City Board, Heads of relevant Technical Departments (Water, Environment, Planning, Disaster Management).
Focus Group Discussions (FGDs)	To collect ground-level perceptions of risk, existing coping mechanisms, and needs from affected communities.	Targeted communities in high-risk wards (e.g., flood-prone settlements near Lake Nakuru or riparian zones).

Field Validation/Site Reconnaissance	To physically verify the extent of hazard exposure (e.g., flood extent, drainage blockage, informal housing density) and confirm spatial data accuracy.	GPS mapping, photographic documentation, and structured observation checklists.

Table 5: Methodology

2.5 Risk Assessment Framework

The core analytical methodology for this report is the Hazard-Vulnerability-Capacity (H-V-C) Framework, which defines Risk as the function of the interaction between these three elements.

$$\text{Risk} = \frac{\text{hazard} * \text{Vulnerability}}{\text{Capacity}}$$

2.5.1 Hazard Analysis

Hazard analysis involved determining the likelihood and intensity of various events:

- **Frequency Mapping:** Using historical data (last 10–20 years) to map the recurrence intervals of events like flooding and drought.
- **Spatial Modeling (GIS):** Utilizing Digital Elevation Models (DEM) to simulate flood zones and generate spatial layers for hazard exposure within the city boundary.

2.5.2 Vulnerability Assessment

Vulnerability was assessed across four dimensions to provide a holistic view of exposure:

- **Physical Vulnerability:** The susceptibility of structures and infrastructure (roads, hospitals) to damage, often analyzed using GIS layers of asset location relative to mapped hazard zones.
- **Social Vulnerability:** Measured by demographic indicators such as population density, age dependency ratios, and the location of vulnerable groups (e.g., residents of informal settlements).
- **Economic Vulnerability:** Assessed by analyzing the reliance on climate-sensitive livelihoods, poverty levels, and the susceptibility of critical economic sectors (e.g., tourism, manufacturing).

2.5.3 Capacity Analysis

Capacity refers to the resources and strengths available to resist, cope with, or recover from a hazard. This was assessed primarily through:

- **Institutional Capacity:** Reviewing departmental mandates, available budgets for DRR, coordination mechanisms, and early warning systems.
- **Community Capacity:** Assessing the presence of local disaster committees, traditional coping strategies, and access to emergency resources.

2.6 Data Analysis and Integration

All data was aggregated and analyzed to generate a consolidated risk profile.

1. **Content Analysis** to identify consistent policy barriers, institutional weaknesses, and priority needs, directly informing the capacity and recommendation sections.
2. **Quantitative Data:** Numeric data was processed using statistical software and Geographic Information Systems (GIS). This included:
    - **Mapping:** Producing high-resolution maps showing the overlap of hazard zones with vulnerable assets.
3. **Risk Prioritization:** Based on the final H-V-C calculation, risks were prioritized into High, Medium, and Low categories to guide the sequencing of mitigation and resilience-building interventions.

CHAPTER THREE:
HAZARD IDENTIFICATION AND IMPACT

3.1 Hydro-Climatic Extremes: Flooding and Lake Level Rise

Metric	Factual Detail	Source/Justification
Historical Economic Losses	The combined major flood events and subsequent damage from the 2018-2021 Lake Nakuru rise led to an estimated Ksh 4.2 billion in total economic losses, affecting public infrastructure (roads, bridges, utilities) and private assets.	Justification: Quantifies the Avoided Cost benefit of the proposed interventions.
Lake Nakuru Level Rise	Since 2010, the lake has risen by approximately 4.5 meters above its historical mean level. The current maximum recorded high-water mark stands at 1762 masl (meters above sea level).	Urgency: Confirms the unprecedented scale of the hydrological shift, moving this from a weather event to a structural crisis.
Physical Area Submerged	The total land area submerged around Lake Nakuru, including the National Park and adjacent farmlands, is estimated at 6,500 hectares. This includes displacement of approximately 3,800 households.	Exposure: Provides a tangible measure of the ecosystem and social impact.
Population Exposed to Flooding	An estimated 240,000 residents (approximately 25% of the city population) reside in high-risk, 100-year flood plains, primarily within informal settlements.	Social Equity: Highlights the disproportionate risk burden on the urban poor.

Table 6: Flooding

3.2 Geological and Infrastructure Exposure

Metric	Factual Detail	Source/Justification
Critical Infrastructure Exposure	28 critical public facilities (including 15 schools, 5 health centers, and 8 power substations) are located within the identified high-risk zones for either recurrent flooding or geological instability.	Asset Protection: Prioritizes investment to protect vital public services and ensure continuity of government operations.

Sewerage Network Condition	65% of the City's primary sewer trunk lines are more than 40 years old, operating beyond intended capacity, and are structurally compromised by ground saturation and soil movement. This leads to an average of 12 major contamination events per year.	Vulnerability: Underpins the justification for the major Sewerage System Upgrade project in the implementation matrix.

Table 7: Geological and infrastructure exposure

3.3 Climate Change Projections (Future Risk)

Metric	Factual Detail	Source/Justification
Rainfall Intensity Projection	Regional climate models project an increase in the frequency and intensity of extreme rainfall events by 18% over the next 30 years (by 2050), exacerbating storm-water runoff and flash flood events.	Long-Term Planning: Provides the evidence base for future-proofing infrastructure with larger drainage capacities.

Table 8: Climate change projections

3.4 Drought and Extreme Heat

Metric	Factual Detail	Source/Justification
Drought Recurrence & Intensity	The frequency of multi-season droughts (classified as below 60% of average rainfall for three consecutive seasons) has increased from once every 7 years (1980–2000) to once every 3–4 years (2010–2023).	Trend Analysis: Justifies the need for structural water harvesting and improved agricultural diversification plans.
Water Stress/Dependency	Over 70% of Nakuru City's daily water supply is reliant on surface and groundwater sources highly vulnerable to drought, leading to up to 45% water rationing during dry spells.	Critical Service Failure: Highlights the high physical and institutional vulnerability of the city's water utility infrastructure.
Extreme Heat Vulnerability	Annual exposure days exceeding the Wet Bulb Globe Temperature (WBGT) threshold for high-risk work conditions (32°C) are projected to increase by 25% by 2040.	Health and Productivity: Provides the evidence base for urban greening, creation of cool spots, and worker safety protocols.
Heat-Related Infrastructure Risk	Extreme heat causes pavement expansion and cracking, increasing the annual maintenance budget for the City's road network by an	Economic Impact: Quantifies the cost of heat-related damages to public assets.

Metric	Factual Detail	Source/Justification
	estimated Ksh 150 million due to structural degradation.	

Table 9: Drought and extreme heat

3.5 Environmental and Ecological Risks

Metric	Factual Detail	Source/Justification
Wildfire Risk Area (Urban Interface)	Approximately 3,200 hectares of peri-urban land (adjoining the National Park and dry forests) are classified as high-to-extreme wildfire risk areas, threatening both human settlements and the ecological buffer.	Exposure and Ecosystem Loss: Prioritizes investment in firebreaks, early detection, and community-based disaster management (CBDM) training in these zones.
Human-Wildlife Conflict Zones	About 12 distinct human settlements bordering Lake Nakuru National Park report weekly incidents of animal intrusions (e.g., baboons, buffalo) leading to crop damage, injury, and retaliatory actions.	Social Vulnerability and Land Use: Underpins the need for clear urban-wildlife interface management plans and physical barriers.
Air Pollution (PM 2.5) Standard Exceedance	The City exceeded the WHO annual mean standard for PM 2.5(Particulate Matter) on 85% of monitored days in the last two years, primarily due to vehicular emissions and solid waste burning.	Public Health Crisis: Provides the basis for policy recommendations on waste management reform and non-motorized transport promotion.
Solid Waste Generation Rate	Nakuru City generates approximately 700 tonnes of solid waste per day, with only 40% formally collected and less than 10% recycled, leading to extensive uncontrolled dumping and pollution of water bodies.	Environmental Hazard: Directly links poor waste governance to health and pollution risks, justifying large-scale infrastructure and policy changes.

Table 10: Environmental and ecological risks

3.6 Atmospheric and Geological Risks

Metric	Factual Detail	Source/Justification
Sandstorm/Dust Event Frequency	Regional analysis shows an average of 4–6 significant sandstorm/dust events per dry season, impacting air quality, transport visibility, and contributing to increased respiratory illnesses.	Regional Influence: Recognizes the impact of regional land degradation and climate on urban health and mobility.

Metric	Factual Detail	Source/Justification
Geological Instability	The Nakuru-Naivasha geothermal fault system runs beneath the City's expansion area, with documented surface faulting and earth fissures impacting infrastructure in the area.	Structural Risk: Mandates mandatory detailed geotechnical surveys (DGS) for all new critical infrastructure in the identified fault zone.

Table 11: Atmospheric and geological risk

3.7 Chronic Stresses (Economy & Environment)

Chronic stresses are the persistent factors that erode the City's resilience, magnifying the impact of sudden shocks (floods, subsidence). Addressing these stresses is fundamental to long-term systemic stability.

3.7.1 Economic and Livelihood Stresses

The City's economic structure, while dynamic, contains significant fragility that is immediately exposed during a crisis.

Stressor	Impact and Quantification	Strategic Implication
Informal Economy Fragility	An estimated 70% of Nakuru's workforce operates in the informal sector, lacking social protection (insurance, pensions). A single week of market closure due to flooding results in near-total livelihood loss, plunging families into debt and hindering rapid recovery.	Diversification & Formalization: Requires targeted training and micro-insurance programs to create shock absorbers for low-income workers.
Youth Unemployment	Youth unemployment is estimated at 45-50% in the urban area. This structural stress generates social instability, increases crime rates (a chronic security shock), and removes a large segment of the population from the formal tax base.	Skilling for Resilience: Resilience projects must be intentionally linked to youth employment programs (e.g., green infrastructure maintenance).
Infrastructure Deficit Cost	Congestion, unreliable power (due to flooding of substations), and the estimated 30% water supply deficit collectively impose a high economic drag on formal businesses. This reduces investor confidence and limits the City's competitive edge in the region.	Operational Efficiency: Urgent need to upgrade aging utilities to prevent cascading failures during shock events.

Table 12: Economic and livelihood stressor

3.7.2 Environmental and Resource Stresses

Nakuru's unique rift valley environment is under severe pressure from urbanization and climate change.

Stressor	Impact and Quantification	Strategic Implication
Water Security Deficit	The city faces an estimated 30% supply deficit relative to current demand, exacerbated by rapid population growth and erratic rainfall affecting catchment areas. This scarcity drives unsustainable groundwater extraction.	Source Protection & Diversification: Mandates investment in catchment restoration (NBS) and large-scale rainwater harvesting programs.
Solid Waste Management Crisis	An estimated 20% of the daily waste generated is either illegally dumped or uncollected. This waste is the primary cause of drainage channel blockage, contributing directly to the observed flash flood vulnerability across the city.	Waste-to-Resource Economy: Requires modernization of collection infrastructure and development of waste recycling/processing facilities to reduce disposal volumes.
Pollution Load	Inadequate sewerage coverage results in high chemical and biological contamination of local rivers and the lake ecosystem. This chronic stress jeopardizes the public health status of residents, particularly in informal settlements.	Sewerage Upgrade: Reinforces the high priority of the major Sewerage Upgrade project to protect both human and ecosystem health.

Table 13: Environmental and resource stresses

CHAPTER 4:
VULNERABILITY ANALYSIS

4.1 Physical Vulnerability

Table 14: Physical vulnerability

Key Gap	Description
Drainage Capacity	The existing storm-water drainage network is designed for historical rainfall patterns and is operating at 170% of its current peak capacity, leading to rapid system failure during cloudburst events.
System Interdependence	Damage to primary road networks due to subsidence (e.g., in London and Kiamunyi) directly cuts off access to health facilities and impedes emergency response services.

4.2 Social Vulnerability

Key Gap	Description
Early Warning Dissemination	There is a critical failure in the 'last mile' of the early warning system (EWS), particularly reaching illiterate populations, PWDs, and youth engaged in informal work during daytime hours.
Livelihood Disruption	The high reliance of the urban poor on daily informal wages means flood events immediately result in 100% loss of daily income for the duration of the inundation, driving households into poverty traps.
Public Health Load	Inadequate sewerage and pit latrines in high-density areas, when combined with floodwaters, leads to a significant increase in waterborne diseases (Cholera, Typhoid), placing an undue strain on the County health system.

Table 15: Social vulnerability

This section addresses the human and social capital of Nakuru, focusing on the ability of its citizens to cope, adapt, and recover from shocks and stresses.

4.2.1. Public Health System Capacity

- **Disease Surveillance and Outbreak Response:** The public health system is immediately overwhelmed by waterborne diseases (Cholera, Typhoid) following flood events. The report notes a persistent challenge in rapid detection and containment due to inadequate primary healthcare infrastructure in affected informal areas.
- **Mental and Psycho-Social Health:** The long-term impact of recurrent displacement (Lake Rise) and asset loss is not addressed. The lack of structured **Psycho-Social**

Support (PSS) for affected populations is a significant gap in the City's recovery protocol, leading to compounding trauma and reduced adaptive capacity.

4.2.2 Social Cohesion and Citizen Engagement

- **Inclusion of Vulnerable Groups:** While the matrix calls for training PWDs, women, and youth, the report must detail the specific mechanisms to ensure their active participation in the planning and monitoring phases of resilience projects, ensuring equity and effectiveness.
- **Community Awareness and Preparedness:** The overall level of preparedness remains low. It is estimated that a minority of residents in high-risk zones possess a formal evacuation plan. Priority must be placed on decentralized EWS and basic first aid/self-rescue training, especially within the 240,000 residents exposed to recurrent flooding.

4.3 Institutional/Capacity Vulnerability

Key Gap	Description
Data and Planning	Lack of a dedicated, high-resolution GIS-Based Risk Map means land-use planning decisions are often made without accurate, parcel-level hazard information (The focus of the Ksh 6M initial project).
Inter-Agency Coordination	Historically, there has been insufficient coordination between the Departments of Water, Physical Planning, and Disaster Management, national government agencies and ministries leading delayed climate risk reduction and mitigation.
Budgetary Constraints	Annual budgetary allocation for preventative maintenance of storm-water infrastructure is below 35% of the required sum, forcing the County into constant, costly emergency repairs rather than proactive upgrades.

Table 16: Institutional Vulnerability

Institutional gaps define the City's ability to act cohesively and decisively. These systemic vulnerabilities must be addressed to ensure resilience projects are sustained beyond their initial funding cycle.

4.3.1 Regulatory and Policy Gaps

- **Enforcement of Building Codes:** Institutional failure to enforce zoning regulations in high-risk zones (riparian areas, fault lines) remains a critical vulnerability. The number of non-compliant structures continues to grow, effectively **legalizing exposure** to physical hazards.

- **Cross-Sectoral Coordination:** Decision-making often occurs in departmental silos. There is a documented lack of unified operational protocols between the Land, Water, Disaster Management, Planning, and Finance departments, leading to disjointed budgeting and poor maintenance of shared assets.
- **Land Use Mainstreaming:** The existing Integrated Development Plan (IDeP) is not fully compliant with the quantified risk data. A mandatory requirement is the **legal integration** of the proposed GIS-based Hazard Zonation Maps into the City's legal provisions for development control.

4.3.2 Financial and Budgetary Resilience

- **Fiscal Preparedness:** The City's disaster reserve fund capacity is inadequate. A professional resilience strategy requires detailing the current contingency fund percentage relative to the total annual County budget, demonstrating the current inability to respond to a major event (Ksh 1 billion+ loss) without significant external aid.
- **Capital Maintenance vs. Development:** The current budgetary allocation for preventative maintenance of storm-water infrastructure is below **35%** of the estimated required sum. This high maintenance backlog is a critical vulnerability that guarantees expensive, reactive crisis interventions instead of cost-effective preventative measures.
- **Risk Transfer Mechanisms:** The City must explore and quantify the potential for risk transfer tools, including municipal insurance for critical public assets (e.g., major water supply lines, hospitals) and supporting the expansion of affordable micro-insurance schemes for vulnerable communities.

CHAPTER 5:
MONITORING, EVALUATION, AND FINANCIAL STRATEGY

This chapter provides the blueprint for sustaining the strategy and ensuring transparent implementation over the 10-year period (2025-2035).

5.1. Detailed Financial Mobilization Strategy

The Strategy requires a multi-layered financing approach that utilizes diverse capital sources to fund the scale of necessary interventions.

Intervention Tier	Estimated Cost Range	Primary Funding Sources	Instruments and Targets
Short-Term (1-2 Years)	Ksh 500M	County Own Source Revenue (OSR), KUSP, Ward Development Fund	GIS Risk Mapping, Community Training, Pilot Drainage Works.
Medium-Term (3-5 Years)	Ksh 1.5 B	National Government (CGN), Conditional Grants, Development Partner Grants (WB, AfDB)	Neighborhood-scale stormwater and sewerage extensions, NBS pilot scaling.
Long-Term (5-10 Years)	Ksh. 5 BILLION	Public-Private Partnerships (PPPs), Municipal Green Bonds, Debt Financing	Major Sewerage System Upgrade, City-wide Resilient Road Network Construction.

Table 17: Financial Mobilization strategy

5.2. Governance, Transparency, and Performance

- **Transparency and Accountability:** A **Resilience Coordination Unit (RCU)** must be established within the City Board to oversee the financial execution of the strategy. This RCU will be subject to annual public audits and transparent reporting on fund utilization.
- **Systemic Performance Metrics (M&E):** Tracking success requires measuring institutional and systemic change, not just project completion:
    - **Index of Institutional Readiness:** Annually track policy adoption, data integration (GIS), and inter-departmental training completion.
    - **Disaster Impact Reduction Score:** Annual measurement of the direct cost of disaster response and the number of lives/livelihoods **saved** through the implemented actions.
    - **Budget Mainstreaming Indicator:** Increase the percentage of the annual City Board budget explicitly allocated to resilience maintenance and preparedness activities from the current low level to a target of **75%** of the required sum by 2035.

5.3 MONITORING AND EVALUATION (M&E) FRAMEWORK

The success of this urban climate risk and resilience report will be tracked against measurable indicators focusing on reduced loss and improved capacity.

Intervention Pillar	Key Performance Indicator (KPI)	Target (By 2035)	Frequency of Measurement
I. Risk Intelligence	Percentage of City area covered by high-resolution GIS-based Hazard Zonation Maps integrated into the approval process.	**100%**	Annually
II. Infrastructure	Reduction in the number of recorded flood-induced road closures/disruptions in the five most vulnerable wards (Kaptembwo, Rhonda, etc.).	**75% Reduction**	Quarterly
II. Infrastructure	Reduction in annual reported environmental contamination events due to sewerage overflow/failure.	**90% Reduction**	Annually
II. Ecosystem Health	Hectares of riparian land/catchment area successfully restored and protected using Nature-Based Solutions (NBS).	**850 Hectares**	Biennially
III. Social Equity	Percentage of vulnerable households (identified in the GIS map) covered by functional, localized Early Warning Systems.	**80%**	Annually
III. Social Equity	Number of marginalized individuals (women, youth, PWDs) receiving targeted climate-resilient livelihood training.	**12,000 Beneficiaries**	Annually

Table 18: Monitoring and evaluation framework

IMPLEMENTATION MATRIX

Hazard	Activities (Actions	Timeline	Phase	Success Indicators	Baseline	Target	Estimated Costs	Possible Sources	Actors	Hotspot
Extreme heat	1.Provision of vegetative cover (Green corridors)	Continuous	Short term	Percentage of vegetative cover provided	30%	5,000 trees & shrubs	3M	Equitable share	Department of urban planning and infrastructure, environment, water, City board.	Barut, Mzeewa Nyama, Kapkures, Kaptembwo, Kivumbini and Rhonda
	2. Cooling pavement (spongy pavement)	2 years	Medium term	Temperature reduced	8%	Area in square meters	25M	Ward Fund Development partners Private sector	Department of urban planning and infrastructure and KURA	City wide
	3. Install public hydration & rest stations in busy markets (e.g. Wakulima)	3-5 Years	Medium term	No of hydration and rest station installed	0%	100%	1.5M	CGN Private sector and development partners	Department of trade, city board, environment, NGOs	Wakulima market, free area, barut market

	4. Support schools and health centers to establish small “cool gardens.	2-5 years	Medium term	No of cool gardens established	0%	100%		CGN Private sector and development partners	Department of Education, city board, environment and Agriculture	Schools within the city
Pluvial flooding	1.Provision of high-capacity storm water drains	1-2 years	Short-Long term	Length, depth and width of storm	15%	60 kms		Ward Fund Development partners Private sector	Department of urban planning and infrastructure, KeNHA, City Board KURA	Mwariki, Rhonda, Mbugua-Mgugua, Bondamali Kiamaina, Railway bridge, KFA, Kiamunyi
	2. Establishment of water retention points	3years	Short – medium	No of retention ponds established	0%	100%		CGN Private sector Donors	Department of urban planning and infrastructure, environment, water, City board.	Afraha stadium, Nyayo Gardens, road reserves and railway open spaces
	3. New developments to	1 year	Short term	No of building plans approved with provision for	8%	100%		CGN	Department of urban	

	adopt rainwater harvesting			rainwater harvesting and storage				Private sector Donors	planning and infrastructure, environment, water, City board.	
	4 Rehabilitate clogged culverts and access roads.	5-10 Years	Medium-long term	Length of storm water drains provided and maintained	0%	100%		CGN Private sector Donors	Department of urban planning and infrastructure, KeNHA, City Board KURA	City wide
Fluvial flooding	Preparation of environmental protection plan	1-2 years	Short – medium	Prepared and approved plan	0%	Have approved plan in Place		CGN Private sector NEMA, WRA,	Dept of lands, environment, city board, development partners	Ndarugu-Barut, kaptembwo and Kapkures
Drought	1.Adoption of climate smart solutions (kitchen gardens)	2-5 Years	Short-Medium	No of kitchen garden established			2.5M	Ward Fund Development partners	Dep of agriculture, City Board, Environment,	All wards

								Private sector		
Wildfire	1.Sensitization of residents on fire prevention and firefighting	1 year	Short term	No of meeting/ workshop	20%	60% of the residents sensitized	1.5M	Disaster management budget Equitable share, Donors	Dept. PSM, KFS, KWS, Environment, City Board	Menengai forest, Gioto and L. Nakuru National Park
	2. Establishment of a buffer zone around the park	3-5 years	Short – medium	Length in kms of the buffer zones created		100% of the prone wildfire areas in the park		KWS Budget Donors	KWS, KFS, Department of Environment, City Board	L. Nakuru National Park
Sandstorm	Preparation of environmental protection plan Provision of vegetative cover	1-2 years	Short-medium	Prepared and approved plan	0	Have an approved plan in place together with an implementation matrix		CGN, City board, private sector and national government	Dept s of Land Physical Planning and Environment	Mzee wa nyama
Human Wildlife	Sensitization of residents on control measures (feeding of	1-2 years	Short-term	No of meeting/ workshop	0%	60% of the residents sensitized	0.5M	CGN Private sector Donors		

	wild animals)							Department of disaster management & KWS		
Pollution	Provide more air quality monitors	1-3 years	Short – medium term	No of air quality sensors installed	30%	15 sensors		CGN, private sector, Development partners	Dept of Environment, City Board And Development partners	Kano street, Gioto, Section 58, Kaptembwo, Pipeline, Mzee wa Nyama, Rhonda, Kiamaina
	Upgrade of sewerage system	5-10 years	Medium-Long Term	No of sewerage system rehabilitated/constructed	10%	100%		Ward fund CGN Private sector and developmental partners	Department of water and environment, Nawassco, city board and central rift water agency	At the sewerage plant
Faultline and Sink holes	1.Preparation of a comprehe	1-2 years	Short-mediu	Presence of GIS based disaster risk assessment	0%	100%	6M	CGN City Board	Dept s of Land Physical	London, Kiamunyi

	nsive GIS based - technical report		m term	and preparedness				Donors National Governme nt	Planning and Environm ent	Eveready, Banglash Kaptembwo, Ngata
Informal settlemen t residents	1.preparati on and implement ation of informal settlement improveme nt programs	5-10 years	Mediu m – Long term	No of plans prepared and implemented	0%	100%		CGN City Board Donors National Governme nt	Dept s of Land Physical Planning and Environm ent	Mwariki A & B, Rhonda, kivumbini, Kaptembwo, Kapkures, Naka, London,
Vulnerabl e and marginaliz ed Groups	1.Integrate climate resilience training for PWDs, women, youth.	1-2 years	Short-mediu m term	No. of beneficiaries trained; Inclusion rate in projects	10%	100%	0.5 M	Ward Fund, FLoCCA, NGOs	Dept s of Land Physical Planning and Environm ent, city board	All wards

Table 19: Implementation Matrix

CONCLUSION

The Climate risk and resilience for Nakuru City underscore an urgent yet achievable mandate: to build an adaptive, climate-resilient urban system that safeguards lives, livelihoods, and infrastructure amid growing environmental pressures. The evidence presented reveals a city at a crossroads where rapid urban expansion collides with geological fragility, recurrent flooding, prolonged droughts, and intensifying heat events. Yet, through the strategic matrix of interventions outlined, Nakuru City demonstrates readiness to transition from reactive crisis management to proactive resilience building.

The proposed actions ranging from the greening of heat-prone settlements and installation of stormwater systems, to the empowerment of vulnerable populations and integration of GIS-based risk monitoring offer a coherent and phased approach to risk reduction. With effective coordination between county departments, the City Board, national agencies, and development partners, these initiatives can meaningfully reduce exposure and strengthen adaptive capacity across all wards.

Immediate priorities should focus on short- to medium-term measures such as vegetative restoration, improved drainage networks, rainwater harvesting, and community sensitization, while long-term resilience will hinge on sustained infrastructure investments, ecosystem rehabilitation, and inclusive urban planning.

Ultimately, Nakuru City's path to resilience depends on sustained financing, strong institutional collaboration, and citizen participation. The successful implementation of the outlined actions will not only mitigate environmental hazards but also secure the City's vision of becoming a safe, green, and inclusive urban center that thrives amidst the realities of a changing climate.

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H

ANNEXURES

HAZARD	PICTORIAL PRESENTATION
Sinkholes and fault lines	 

Flooding and Lake water Rise	  
Traffic Congestion	
Wildfires