# Environmental and Social Impact Assessment Study Report for the Proposed Revitalization of Kisumu Port Infrastructure

| Proponent | Firm of Experts | In Joint Venture |
|---|---|---|
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| Version: Final Report | |
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# CERTIFICATION

## Certification by Lead Experts

We hereby certify that this Environmental Impact Assessment (EIA) Study Report has been prepared under our supervision and that the assessment criteria, methodology and content reporting conform to the requirements of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya.

Signed: _____ _____

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## Certification by Proponent

We, **Kenya Ports Authority** confirm that this Environmental Impact Assessment (EIA) Study Report for the revitalization of Kisumu Port Infrastructure has been prepared and submitted to NEMA with our authority as the proponent.

Signed for and on behalf of: **Kenya Ports Authority**

Name: _____Signature: _____

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We appreciate the proponent for providing logistical support and the project documentation required by the consultants. To this end we thank the Principal Port Environment Officer, Mr. Daniel Githinji, the personnel at Kisumu Port who included the Port Manager Mr. Charles Kitur, Assistant Port Manager Mr. Lucas Odiango, the Procurement Manager Mr. Yobesh Oyaro and the Principal Officer Strategy Kisumu Port Mr. Cosmas Makori. The Kenya Marine and Fisheries Institute-Kisumu Centre collaborated with the consultants in collecting baseline fisheries and macroinvertebrates data at Kisumu Bay as well as mapping of water hyacinth and other macrophytes. In this regard we appreciate the support of the Centre Director, Dr. Christopher A. Mulanda, the field team led by Dr. Chrisphine Nyamweya and comprising of Ms. Hilda Mogaka (Fisheries), Mr. Ouko Oginga (GIS /Spatial mapping), Josphat Mwangi (macro-invertebrate), Mr. Zablon Awuondo and Mr. Joseph Onyango (fisheries technologists), Mr. Caleb Ochiewo, Mr. Odira and Mr. Boaz (maritime technologists). Other government agencies who were instrumental in the ESIA process included Kenya Fisheries Service, Kisumu Water and Sewerage Company Limited and the Kenya Coast Guard Services. Kenya Fisheries Service provided fisheries frame survey data, Kisumu Water and Sewerage Company Limited allowed the consultants access and provided guided tours of the Kisat Sewage Treatment Plants and Dunga treatment ponds. The Kenya Coast Guard Services is acknowledged for assisting the consultants with their boats and coxwains during the reconnaissance survey of the port area and Kisumu Bay.

We are indebted to all participants of both the two consultative meetings who included other government agencies, the private sector, Non-Governmental Organizations and Beach Management Units. We further thank the staff of Envasses Environmental Consultants Limited and Eco Plan Management Limited for their support in data collection and analysis, facilitation of stakeholder meetings as well as preparation of the ESIA report. To this end we acknowledge the input of Dr. Bernerd Fulanda, Ms. Jane Gitau, Mr. Sunday Obuje, Mr. Romanus Opiyo, Mr. Richard Mong'are, Ms. Jackline Odhiambo and Ms. Caroline Njeri. Polucon Services (K) Limited are acknowledged for the sampling and analysis of environmental media including water and air quality, noise level measurements and preparing reports on the same.

## EXECUTIVE SUMMARY

In October 2019, Kenya Ports Authority contracted Envasses Environmental Consultants Limited in Joint Venture with Eco Plan Management Limited to prepare an Environmental and Social Impact Assessment (ESIA) Study Report for the Revitalization of the Kisumu Port Infrastructure. The ESIA is prepared pursuant to Section 58 of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya. Under the Second Schedule of the Act, transportation and related infrastructure projects including harbors and ports are listed as high-risk projects which should undergo ESIA study process.

Kisumu Port is located within the City's Metropolitan area straddling latitude 0.10116$^0$ S and longitude 34.74497$^0$ E at an elevation of 1,135m. It occupies 17.5 hectares of land out of which 6ha have old and dilapidated infrastructure that includes ≈262m quay, a rail-wagon ferry pier, including ≈90 meters of berthing space alongside the pier almost perpendicular to the main quay, a warehouse measuring 50m by 16m on the main quay, a 3,000m$^2$ paved storage area and offices for the harbor master, customs, and police department. The proponent proposes to revitalize the Port by dredging of the access channel and sections of the pier to improve navigation and allow docking of larger vessels at the port, paving the open yard area to facilitate container storage and handling by suitable equipment such as cranes and reach stackers, rehabilitation of the warehouse, improvement of the access road, parking bay, offices and other auxiliary facilities.

The ESIA study focused on the existing status of the port and the proposed revitalization activities. The methodology for preparing the report was guided by the Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. They included data collection through site visits and observations, consultations with the stakeholders through meetings, literature review and baseline monitoring of aquatic macrophytes, environmental media including water, sediments, air, noise and biological communities. Water sampling was carried out in six stations which are the Port area, two areas where storm water and raw effluent discharges into Kisumu Bay, River Kisat Estuary, off the Kenya Pipeline Jetty and Dunga water intake. Fish sampling was conducted in 12 stations within the Port area and sections of Kisumu Bay using a combination of trawled seines, monofilament gillnets and larval trawls. Estimates of abundance of smaller fish larval samples were made from counts of sub-samples under a Leica dissection microscope, at a magnification of x25. The number of individuals per litre of lake water was determined by taking into account the number of organisms in the sub-sample, volume of the lake water filtered by the vertical haul and the depth of the haul. Other biodiversity surveys focused on larger fauna within Kisumu Bay, terrestrial ecosystem of the port area, River Kisat Estuary, Impala Park and Dunga Wetland. The spatial extent of aquatic macrophytes such as water hyacinth and land use land cover were mapped using remotely sensed data and Arc GIS.

Analysis of spatio-temporal satellite data (2013-2019) during the baseline monitoring shows that Kisumu Bay is a water hyacinth hotspot which poses a threat to navigation, fishing, water supply and tourism. In the last five years, the acreage of water hyacinth in Winam Gulf where the port is located exhibited a fluctuating trend. The lowest acreage (< 3000 ha) was observed in 2015 while the highest (> 6000 ha) was recorded in 2018. Fish diversity and abundance is low within the innermost part of Kisumu bay (98-171 individuals per haul) and higher off Luang'ni and Dunga beaches (389-462). Fish diversity and distribution revealed that *Lates niloticus* (Nile perch) is the most dominant fish and is distributed in all the sampled areas. This is followed by *Rastrineobola argentea* (Omena) that was also recorded in all the stations. *Oreochromis niloticus* (Nile tilapia) was the third most abundant fish species. Macroinvertebrates composition and distribution yielded

a total of 251 orders representing 10 families and 10 genera. Among the aquatic macro fauna recorded within the Bay include three distinct herds of hippos at Nyanza Golf Club, Hippo Point and Dunga Beach. A total of 15 bird species were recorded on the terrestrial habitats of the port. Of the biodiversity hotspots, only Dunga Wetland hosts globally threatened bird species i.e. Papyrus Gonolek (*Laniarius mufumbiri*); Papyrus Yellow Warbler (*Chloropela gracilirostris*) and regionally threatened species i.e. Great Egret (*Ardea alba*) and Bailon's Crate (*Porzana pusilla).* Baseline water quality results indicate that raw effluent is being discharged into Kisumu Bay as evidenced by relatively high levels of Biological and Chemical Oxygen Demand and the presence of E. coli among other parameters as per the Water Quality Regulations, 2006. Analysis of sediments from two stations i.e. River Kisat Estuary and the Port area indicated traces of hydrocarbons and heavy metals including zinc, copper, chromium and nickel.

The baseline conditions inform the environmental and social background upon which revitalization of the Port will occur and against which the ESIA predicts both the positive and negative impacts. The anticipated socio-economic benefits are the key drivers for the revitalization. These benefits will include increased exports and imports which will rise from 28,000tons recorded in 2014 to 230,000 by 2035, reduced costs of doing business, enhanced efficiency in transportation of people and goods across the riparian region and land locked hinterland, supporting industrial and agricultural growth and creating thousands of direct and indirect jobs. A variety of other businesses will find opportunities to trade with the port either as suppliers or users of the revitalized infrastructure. The revitalization of the port will contribute to the socio-economic growth of Kisumu City and one of the Presidential Big Four Agenda i.e. manufacturing through exports of finished products and imports of raw materials and inputs. The growth of the port and the supporting industries will enhance the socio-economic pillar for attainment of Kenya's development blue print, Vision 2030. Against the background of positive impacts, the proposed revitalization of port will have several negative environmental and social impacts at the various stages of its implementation.

During the revitalization phase, dredging and dumping activities will impact negatively on the Lake ecosystem through water quality degradation, potential bioavailability of heavy metals, impact on phytoplankton and zooplankton populations, bioaccumulation of polycyclic aromatic hydrocarbons by aquatic organisms from oil spills, impact on fisheries and local livelihoods and occupational safety and health risks. To mitigate these impacts, we recommend scaling down the area to be dredged from 837ha to 150ha which would still serve the navigational needs of the port, address dumping challenges and protect the lake ecosystem, procuring and deploying silt curtains, developing and implementing water and biological monitoring plans and dumping the dredged material onshore at KPA land to the north of Kisumu Port.

Revitalization activities will involve clearing of vegetation cover and felling of trees. Approximately 5ha of the port terrestrial environment are covered by grass, shrubs and scattered trees. Vegetation cover provides significant environmental goods and services such as preventing soil erosion, carbon sequestration and climate regulation and is a habitat for birds and other fauna in the port area. Hence, clearance of the vegetation would lead to the loss of these benefits and creation of loose soils that are susceptible to erosion and will potentially contribute to sedimentation of Kisumu Bay. To mitigate these impacts, the proponent should green the port by planting trees on 2ha, landscaping and compaction of loose soils to prevent erosion.

The Port sources its water from Kisumu Water and Sewerage Company (KIWASCO). During revitalization, water will be required for concrete mixing, casting and curing works, drinking and

sanitation purposes which will lead to increased demand for water. Seventy percent of the water used for domestic purpose will generate effluent whereas the rest soaks into ground areas within the project site or will drain to the lake. Poor disposal of the wastewater will have the potential to pollute underground aquifers and eutrophicate the lake. The ESIA recommends procuring mobile toilets and sensitization of workers and contractors on water conservation.

Solid waste such as biomass, overburden, cuttings and rejected materials among others will be generated during the revitalization activities. Workers at the site will also generate domestic waste. These will need to be disposed off appropriately as poor disposal of solid wastes will negatively impact the environment and provide habitat for disease causing pathogens and reduce the aesthetic value of the port environment. Recommended mitigation measures include procuring adequate solid waste collection bins with a capacity for segregation, sensitization of workers on proper management and disposal of solid wastes and compliance with the Waste Management Regulations, 2006.

During the revitalization phase, the workers and visitors to the Port will be exposed to potential occupational health and safety hazards such as accidental falls, drowning and high noise levels from machinery and equipment. Additionally, the operation of the dredger may pose navigational safety risks to other maritime traffic including local fishing boats. We recommend recruiting qualified and experienced Occupational Safety Officers to train and enforce compliance with safety measures, compliance with the Merchant Shipping Act, 2009 (Part VII Section 117-168 on Safety, Health and Welfare of Seafarers) and the Occupational Safety and Health Act, 2007.

Other impacts at this phase will include air and noise pollution from excavation activities and delivery of raw materials for the site. Recommended mitigation measures include sprinkling of water to manage dust, use of Personnel Protective Equipment and complying with both Noise and Air Quality Regulations gazetted in 2009 and 2014 respectively.

At operational phase, the main impacts will be risks posed by aquatic macrophytes, wastewater generation and management, oil, grease and runoff from the port, solid waste generation and management, air and noise pollution, water and energy demand, safety and health risks, fire risks and emergencies and potential conflicts with the local community. Aquatic macrophytes hinders navigation on the lake and curtail penetration of light into the aquatic ecosystem thus inhabiting the growth of phytoplankton and productivity. Additionally, the decay and decomposition of the macrophytes contributes to air pollution which may affect the touristic appeal of the Bay and neighboring facilities which could potentially host ship crews and other tourists. Key recommendations include developing and implementing an early warning system based on satellite data to inform timely interventions such as mechanical removal and supporting community initiatives that utilize water hyacinth to make handicrafts and biogas.

Wastewater will be generated from the Port's - sanitation facilities, cleaning operations and ships docking at the port which will need to be desludged. Poor effluent management will have the potential to pollute underground aquifers and the lake as well as impact on community health and fisheries. To mitigate these, we recommend construction of a bio-digester in the short term and connecting the port to the Kisat Sewage Treatment Plant in the long term and compliance with the Water Quality Regulations, 2006.

Oil may be introduced within the port environment during maintenance and servicing of water vessels, illegal discharge of tank washings and oil-contaminated ballast water, tanker accidents,

dumping of industrial wastes etc. Leaked oils, oily wastes and mixtures will potentially be transported downstream into the lake through runoff, cleaning activities or direct introduction by ships and maritime crafts leading to water quality degradation. Degraded water quality will in turn impact on fishery resources, aquatic biota, freshwater habitats, tourism and may have adverse health effects. The ESIA recommends establishing a well-equipped pollution control center and implementation of an oil spill contingency plan for the port.

Solid waste will be in form of plastics, paper, organic wastes, oil and grease containers used for machinery maintenance, cargo residues among others. This will be managed through sensitization of employees, visitors, ship crew and the community neighboring the port on the importance of proper solid waste management, provision of solid waste collection infrastructure and compliance with the Marpol Convention 73/78, the Waste Management Regulations, 2006 and the Kenya Maritime Act, 2012.

Sources of air pollution at the port will include smoke, vehicular emissions and fumes such as $NO_2$ and $NO_3$ which are generated by ships and which may affect air pollution in the hinterland. Air pollution and emissions above the limits set under Air Quality Regulations, 2014 can potentially cause health problems which include respiratory diseases, eye irritation and visual intrusion to receptors like KPA employees and visitors especially in areas neighboring the Port. The recommended mitigation measures include the implementation of the air quality monitoring plan proposed by the EISA and compliance with Air Quality Regulations, 2014.

Noise pollution during the operation of the Port will emanate from ships, cargo handling equipment and movement of vehicles within the project area. The noise levels produced may be above the stipulated limits under the Noise Regulations, 2009 and may lead to hearing impairments to workers. The ESIA recommends provision of Personnel Protective Equipment and compliance with the Noise Regulations, 2009.

During the operation of the Port, water will be required for drinking, general cleaning and sanitation purposes among other day to day uses. Ships docking at the facility will also require portable water. Energy will be required for lighting and operation of equipment and machinery. The demand for both water and energy are predicted to increase when the port is fully operational and therefore adequate and reliable supply will be required. To mitigate the increase in water and energy demand we recommend restoring and increasing the volume of the reticulated water supply, enhancing water and energy conservation strategies and installation of solar panels for lighting purposes.

The increased maritime traffic within Kisumu Bay and the Winam Gulf as a result of the revitalized port may lead to accidents especially with the local fishermen boats fishing or conducting tours of the lake. Such accidents could lead to death, are a threat to livelihoods and could lead to conflicts between the proponent and the local community. Within the port, the safety and health of workers and visitors to the facility is of utmost importance. To address these concerns, the study recommends installation or improvement of maritime navigational aids, sensitization of local fishermen and tour operators on the increased traffic at Kisumu Bay, developing and implementing a safety action plan, provision of adequate Personnel Protective Equipment and compliance with the Occupational Safety and Health Act, 2007.

Fire risks and emergencies at the Port can occur due to operational negligence, electrical faults and spillage/leakage of flammable and ignitable chemicals. If precautions are not taken to prevent their

ignition, fire and subsequent safety risks may arise resulting in injuries, loss of lives and property. Key recommendations include developing and implementing a fire and emergency response action plan, providing a fully equipped fire station, ambulances and firefighting equipment, conducting fire drills and annual fire safety audit and implementing the recommendations of the audit.

The socio-economic importance and stature of Kisumu Port to both the County, National and Regional Governments makes decommissioning a remote possibility. Based on the projected growth of the local, national and regional economies as well as the corresponding increase in cargo being handled by the revitalized Kisumu Port, the most likely scenario will be the expansion rather than decommissioning of the port which is consistent with the Port Master Plan of 2019. The expansion activities will have an incremental effect on the environmental and social impacts discussed under the operational phase of the revitalized port which will be subject to a substantive ESIA process.

The findings of the ESIA study indicate that dredging and dumping pose the highest risk to the Lake Victoria Ecosystem. However, their impacts are temporal but irreversible in terms of bathymetric changes and water circulation which ironically is beneficial to the ecological integrity of Kisumu Bay. The mitigation measures proposed by the ESIA study are considered adequate to address the impact of dredging and dumping both in the short term and eventual recovery of potentially affected biological communities. The monitoring plans on water and sediment quality, fisheries and biodiversity should inform the performance of the mitigation measures and changes introduced as appropriate to address any emerging concerns or risks. Going forward there will be need for sustained stakeholder engagement to avoid conflicts with local fishermen and riparian businesses in case of lack of compliance with the mitigation measures by the contractor/KPA and also on account of safety risks posed by increased traffic to and from the port. We have recommended that the proponent develops and implements a grievance redress mechanism during the preparation of the detailed Environmental Management and Monitoring Plan by the contractor.

Based on the foregoing, the ESIA study recommends the issuance of an EIA Licence subject to committed implementation of the EMPs and other conditions prescribed by the Authority.

# TABLE OF CONTENTS

## LIST OF FIGURES

## LIST OF TABLES

## LIST OF ACRONYMNS

| | |
|---|---|
| **AOI** | Area of Interest |
| **BMU** | Beach Management Unit |
| **BOD** | Biochemical Oxygen Demand |
| **CFA** | Cooperative Framework Agreement |
| **CIDP** | County Integrated Development Plan |
| **CITES** | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| **COD** | Chemical Oxygen Demand |
| **CSR** | Corporate Social Responsibility |
| **DOSHS** | Directorate of Occupational Safety and Health Services |
| **DRC** | Democratic Republic of Congo |
| **EA** | Environmental Audit |
| **EAC** | East African Communities |
| **EARHC** | East African Railways and Harbours Corporation |
| **EEZ** | Exclusive Economic Zone |
| **EHS** | Environmental Health and Safety |
| **EIA** | Environmental Impact Assessment |
| **EMCA** | Environmental Management and Coordination Act |
| **EMMP** | Environmental Management and Monitoring Plan |
| **EMP** | Environmental Management Plan |
| **EMPs** | Environmental Management Plans |
| **ESIA** | Environmental and Social Impact Assessment |
| **FAO** | Food and Agricultural Organization |
| **FGD** | Focused Group Discussions |
| **GIS** | Geographic Information System |
| **GoK** | Government of Kenya |
| **GRM** | Grievances Redress Mechanism |
| **HCVs** | Heavy Commercial Vehicles |
| **IFC** | International Finance Corporation |
| **IMO** | International Maritime Organization |
| **IUCN** | International Union for Conservation of Nature |
| **KFS** | Kenya Forest Service |
| **KIWASCO** | Kisumu Water and Sewerage Company |
| **KMA** | Kenya Maritime Authority |
| **KMFRI** | Kenya Marine and Fisheries Research Institute |
| **KPA** | Kenya Ports Authority |
| **KPCL** | Kenya Pipeline Company Limited |
| **KRA** | Kenya Revenue Authority |
| **KRC** | Kenya Railways Corporation |
| **KWS** | Kenya Wildlife Service |
| **LVEMP** | Lake Victoria Environmental Management Program |
| **LVFO** | Lake Victoria Fisheries Organization |
| **NBI** | Nile Basin Initiative |
| **NCCAP** | National Climate Change Action Plan |
| **NEMA** | National Environment Management Authority |
| **NGOs** | Non-Governmental Organizations |
| **NIR** | Near Infrared |
| **ODS** | Ozone Depleting Substances |
| **OLI** | Operational Land Imager |

| | |
|---|---|
| **OSHA** | Occupational Safety and Health Act |
| **PAHs** | Polycyclic Aromatic Hydrocarbons |
| **PPE** | Personal Protective Equipment |
| **RAP** | Resettlement Action Plan |
| **RPM** | Respirable Particulate Matter |
| **SEZ** | Special Economic Zone |
| **SOPs** | Standard Operating Procedures |
| **TEUs** | Twenty-foot Equivalent Units |
| **TIRS** | Thermal Infrared Sensor |
| **TN** | Total Number |
| **TORs** | Terms of Reference |
| **TPH** | Total Petroleum Hydrocarbons |
| **TW** | Total Weight |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **USGS** | United States Geological Survey |
| **VOC** | Volatile Organic Compounds |
| **WHO** | World Health Organization |
| **WRA** | Water Resources Authority |
| **WRUAs** | Water Resources Users Associations |
| **WSPs** | Water Services Providers |
| **WSTF** | Water Sector Trust Fund |

# 1 INTRODUCTION, PROJECT DESCRIPTION AND EIA METHODOLY

## 1.1 Introduction

Kisumu Port was established in 1901 and forms a critical link in an integrated East African rail/water transportation system with particular focus on freight transport to other Ports within the Lake. Overtime the port infrastructure has become dilapidated and the Kenya Ports Authority (KPA) is planning its revitalization. In preparation for the revitalization, Kenya Ports Authority contracted Envasses Environmental Consultants Limited in Joint Venture with Eco Plan Management Limited to prepare an Environmental and Social Impact Assessment (ESIA) Study Report for the Revitalization of the Port. The requirement for ESIA is informed by Section 58 and the Second Schedule (4e) of the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya. Under the Schedule, transportation and related infrastructure projects including harbors and ports are listed as high-risk projects which should undergo ESIA study process. In addition, the report will provide a baseline of the environmental and social conditions of the port area for future monitoring its environmental performance.

## 1.2 Location of Kisumu Port

Kisumu is the largest city in Western Kenya and is the capital city of the Lake Region Economic Block which encompasses 15 out of the 47 counties in Kenya. It is Kenya's designated inland port city on Lake Victoria and the capital city of Kisumu County. The Port is located within the Kisumu Metropolitan area straddling latitude $0.10116^0$ S and longitude $34.74497^0$ E at an elevation of 1,135m (Figure 1). The Kisumu port is accessible via the Marine Drive neighboring the Impala Wildlife Sanctuary to the South, Oil Libya Depot to the North East and Railway Training Institute Marine School to the South East. There are also residential, tourism and commercial developments neighboring the project site.

## 1.3 Project design and description

### 1.3.1 Historical perspective of Kisumu Port

Kisumu Port played a key role in the popular triangle trade in Lake Victoria between Kenya, Uganda (Port Bell) and Tanzania (Mwanza Port) (Figure 2). Historically, marine transport on the lake, together with the rail network, played a key part on the movement of cargo and passengers to and from the land-locked countries. Inland shipping on Lake Victoria formed an important component of an intermodal supply chain along the Central and Northern Corridor linking to Mombasa and Dar es Salaam ports. By the mid-$20^{th}$ Century, the East African Railways and Harbours Corporation (EARHC) operated regular sailings from Kisumu to Port Bell in Uganda and Mwanza in Tanzania, using rail ferries that carried rail wagons loaded directly from rail tracks in the three ports. The train ferries connect the Uganda Railway at Port Bell in Uganda with the Central Line at Mwanza in Tanzania. The central line is linked to the Indian Ocean port of Dar es Salaam in Tanzania to transport freight to and from world markets. The rail jetties at Kisumu and at Musoma connect to railyards in the port area - but these have been rarely in use as there were no operational railways in the hinterland. Typical journey times were 13 hours between Port Bell in Uganda and Kisumu in Kenya, and 19 hours between Port Bell and Mwanza in Tanzania. However, since the collapse of the East African Railways and Harbors (EARH), operations and throughput in the ports went down and as of the 2018, only two of the railroad wharfs at the ports of Port Bell and Mwanza were in use.

Since its inception the Port has been owned and operated by Kenya Railways Corporation (KRC) but was handed over to Kenya Ports Authority from 2018 who are the designated custodian of Kenya's Ports and Harbors as per the Kenya Ports Authority Act, 2014.


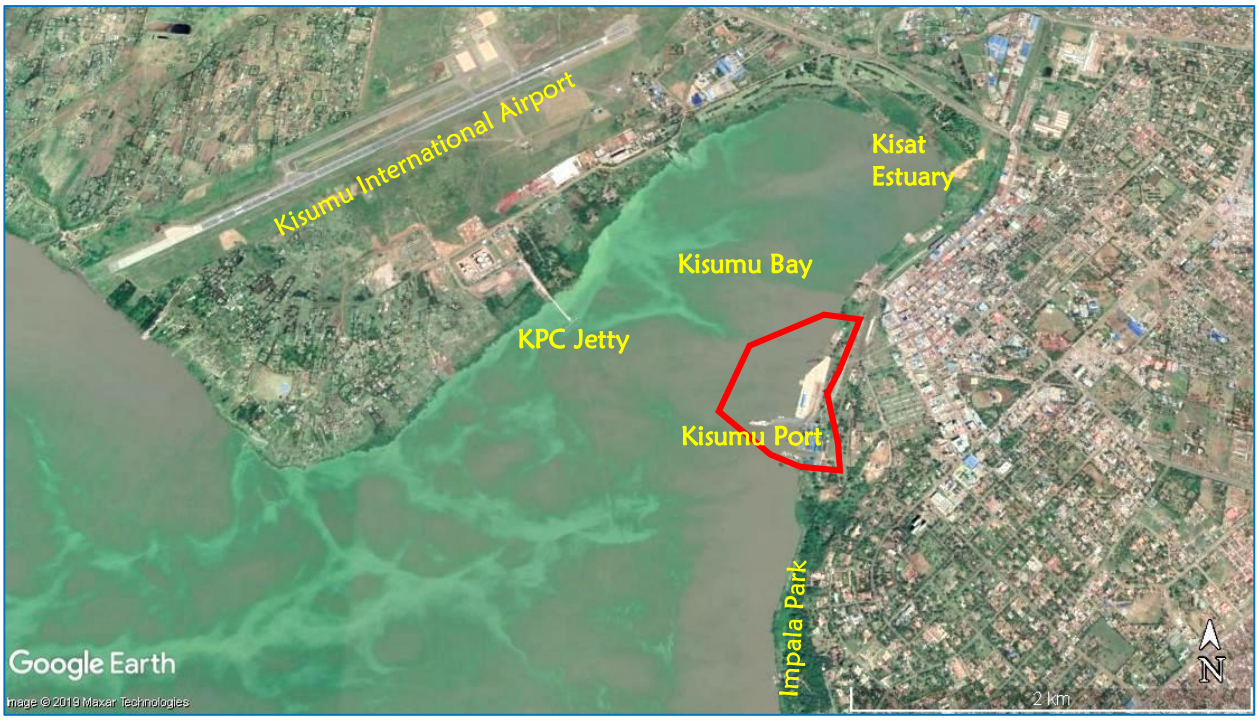


Figure 1. Location of Kisumu Port within the Winam Gulf of Lake Victoria (Source: Google Earth accessed 15th November 2019).

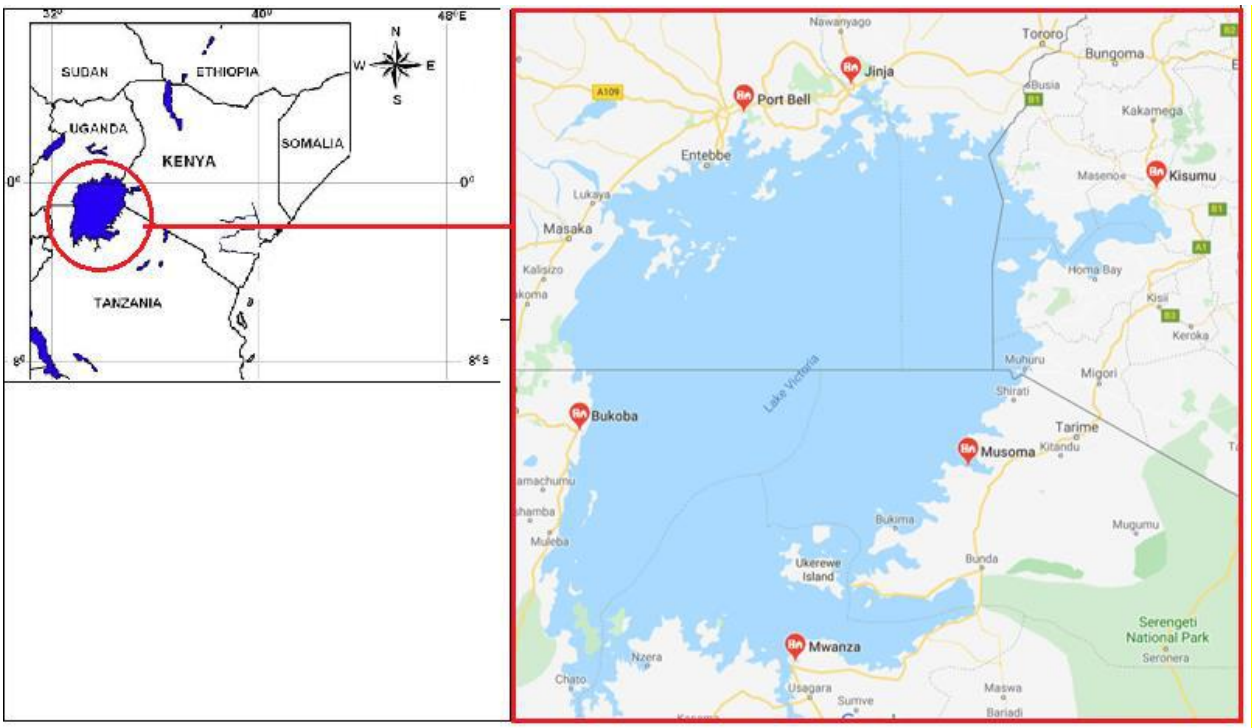


**Figure 2. A map of East Africa (inset) showing Lake Victoria and regional ports of Kisumu in Kenya, Port Bell & Jinja in Uganda; and Mwanza, Bukoba & Musoma in Tanzania (Source: Google Earth accessed November 2019).**

Due to dilapidation of the infrastructure at the Kisumu Port, the port of Mwanza in Tanzania became the most important lake port in the region because of the port infrastructure, rail and road access to the Indian Ocean in addition to major pieces of facilities for ferry operation, service and construction. Although dedicated dry docks for ferry repairs exist in or near Kisumu, Mwanza and Port Bell, only the dry docks in Mwanza are thoroughly used causing the industry for Lake Victoria to move to Mwanza, which has led to the loss of potential business and revenue on the part of Kenya. With the shift business making Mwanza port the busiest, new Ro-Pax (roll-on & passenger ferries) and Ro-Ro (roll-on roll-off) multipurpose ferries are constantly going into operation, built and assembled in Mwanza in Tanzania. Evidently, for the Kisumu Port and Kenya as a country to gain back its glory and create a formidable economic and commercial hub within Lake Victoria region and the wider East African region, there is a need for extensive revitalization of the berth areas, infrastructure, railway lines and the shipping vessels on the Kenyan side. The revitalized Kisumu Port will lead to increased demand and growth of business around the port which will in turn require the expansion of the port infrastructure and the associated auxiliary facilities to cater for the increased growth of the regional hub for economic development. The revitalization and re-operationalization of the Kisumu Port will also present a huge backup to new industries in the marine sector of the Winam Gulf and the wider Lake Victoria and as well as open markets in East African region for Kenyan products.

### 1.3.2 Current status of Kisumu Port

Kisumu port occupies 17.5 hectares of land out of which 6ha are currently occupied by old and dilapidated infrastructure that includes ≈262m quay, a rail-wagon ferry pier, including ≈90 meters of berthing space alongside the pier almost perpendicular to the main quay, a warehouse measuring 50m by 16m on the main quay, a 3,000m$^2$ paved storage area directly behind the warehouse

designed to accommodate a throughput of 15,000 Twenty-foot Equivalent Units (TEUs) per annum and offices for the harbor master, customs, and police department (Figure 14). The port serves as a transit port, focusing on transit cargo from Mombasa to the EAC region; a local cargo port, focusing on export of regional products and import of local products from Uganda and Tanzania, as a passenger ferry port, focusing on passenger transport between EAC destinations around Lake Victoria, port related services, focusing on the Kisumu port shipyard and a special Economic Zone (SEZ) / logistics hub.

Currently, the port exports include bar soaps, blankets, edible oil, exercise books, fertilizer, netting material, shoe shine, sleeper shoes, sweets and other confectionaries. The Port's imports mainly comprise of sugar, cotton seed cake, bottled water and sodas. However, these imports and exports represent only a fraction of the Port's capacity and former throughput. Due to the deterioration of the rail connection from Mombasa to Kisumu, transit cargo volumes have decreased steeply over the last decades. The port still handles some of the local cargo and specific transit cargo. However, all cargo volumes have dwindled, due to a lack of critical mass and the reliability of the transport system.

### 1.3.3 Potential of Kisumu Port after revitalization

With the revitalization of the port and taking into account Kisumu's 2014 export figure of 28,034 tons as a starting point. Kisumu's local cargo exports are estimated to increase to approximately 160,000 tons by 2025, and further to 230,000 tons by 2035. Similarly, taking Kisumu's 2014 import figure of 21,943 tons as a starting point, and taking into account all developments and economic growth, Kisumu's local cargo imports are estimated to increase to approximately 130,000 tons by 2025, and further to 180,000 tons by 2035. Consequently, under this scenario, total estimated local cargo demand at Kisumu Port increases to approximately 290,000 tons by 2025, and further to approximately 410,000 tons by 2035.

The ports local cargo demand is estimated to see strong growth during initial years following the Port rehabilitation works and the improvement of safety and reliability of the lake transport system. After this strong growth, demand growth is expected to be in line with economic growth. Therefore, it can be concluded that, from a demand and revenue potential perspective, the port should focus on the cargo handling. It could become an important hub for East African Community (EAC) trade, as it is conveniently situated for cargo destined for certain regions of Uganda, the Democratic Republic of Congo (DRC), Tanzania, Rwanda, and Burundi.

### 1.3.4 Revitalization activities

The proposed major revitalization activities for Kisumu Port include dredging of the access channel and sections of the docking area to improve navigation and allow docking of larger vessels at the port, paving the open yard area to facilitate container storage and handling by suitable equipment such as cranes and reach stackers, rehabilitation of the warehouse, improvement of the access road, parking bay, offices and other auxiliary facilities (Figure 3).


**Figure 3. The existing facilities at Kisumu Port (Source: Kenya Ports Authority Master plan, 2019).**

### 1.3.4.1 Dredging of the port

The need for dredging of port area and the access channel within Kisumu Bay is informed by a hydrographical survey by Kenya Navy carried out in July 2019. The Survey established that the bathymetry of the Port area and the Bay varies between -2.5m to -3.5m. According to the survey and the proponent the access channel and the port area needs to be dredged to between -4m to -6m (Figure 4). The area to be dredged measures approximately 4km from the entry into Kisumu Bay to the port ships turning basin (Figure 5). The dredged access channel will be 80m wide and restricted to the existing navigational route to the port. The area proposed for dredging by Kenya Navy is a total of 850ha which will yield over 10Million Cubic Meters of dredged material which will need to be dumped sustainably to minimize or eliminate its potential impact on the Lake Ecosystem and livelihoods of the riparian communities.

In the long term, the proponent intends to dredge the area between the Port and the Mbita Causeway to a depth of between-6m to -12m. The area that will be dredged will be 80m wide, 63km long covering 632ha which will yield app 35,000,000m$^3$ of dredged material. This will be done to improve navigation and water circulation in the Winam Gulf as well as potentially reduce water hyacinth infestation in the area. These benefits will be enhanced further with the implementation of the planned removal of Mbita Causeway and replacing it with a bridge by the National and County Government.

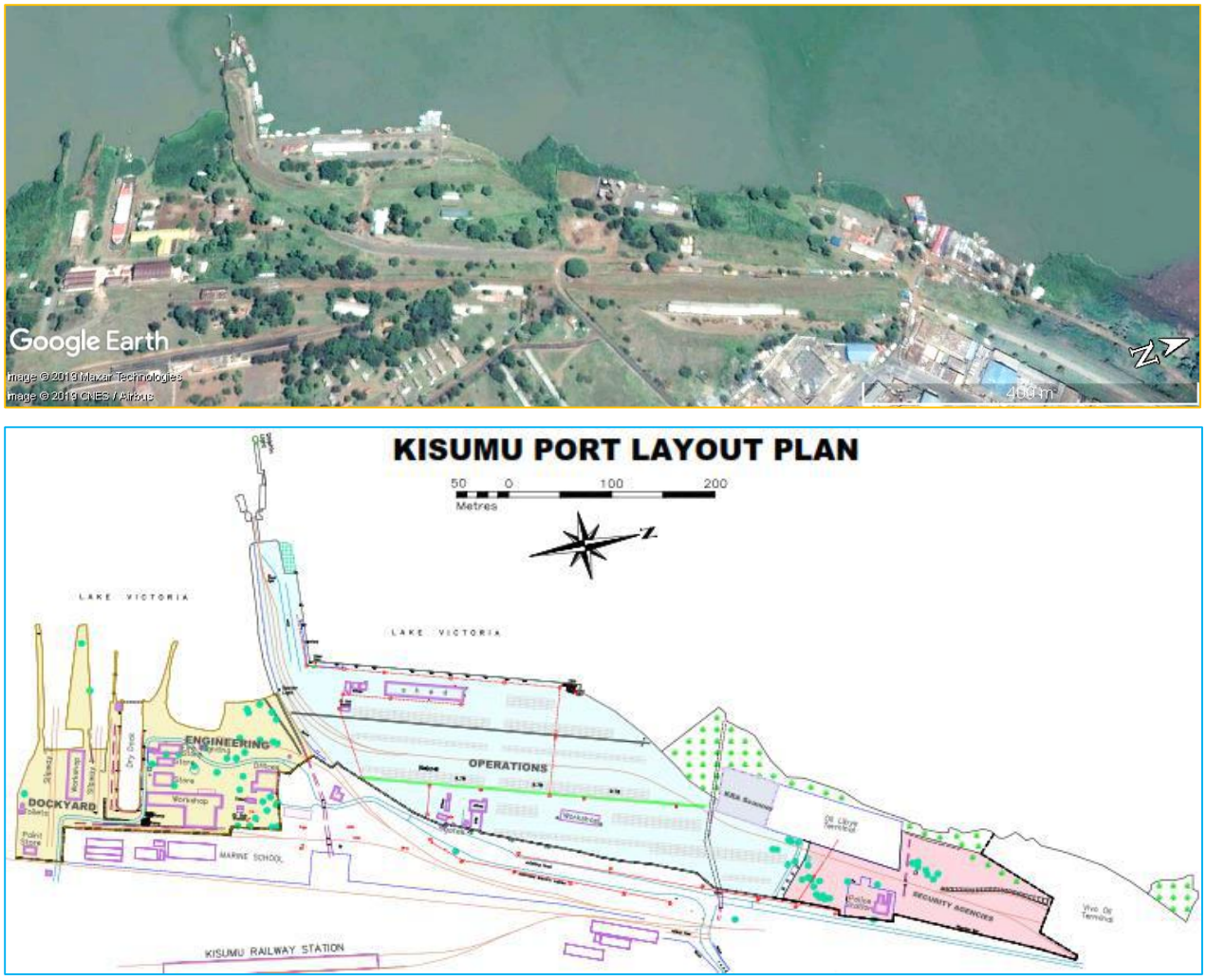


**Figure 4. Top, the status of Kisumu Port in December 2017 and; bottom the layout of the proposed Kisumu Port revitalization works and components (Source: Kenya Ports Authority, 2019).**

### 1.3.4.2 Type of dredger and design of the dredger head

A modular approach in cutter suction dredge design is recommended for the dredging of the Kisumu Port, Kisumu Bay and the Navigation route from the port to the offshore waters past Rusinga island due to the wide variations in depths between the shorelines and the open waters. The dredger can measure upto 100m long, and has the ability to remove sediments in water depths ranging from 1.2 to 90 metres and dump it on land (Figure 5). The modular approach comprises a suction dredge, with an auger suction head that draws sediments in to the intake of the large suction pump (Figure 6). A protective shroud ensures that loss of disturbed material into the water column is minimal. The dredge is controlled by precision Differential GPS units and can control the position of the dredging head to within a few centimetres vertically and laterally, making precision dredging quite straightforward. Up to 3500 $m^3$ of water and sediments may be pumped every hour and the dredged material is pumped through a floating high-density polyethylene (HDPE) pipeline which can be extruded in situ, or brought in as units which are welded together in the field with booster pumps included as necessary. The material is pumped ashore, out of the catchment, dewatered and amended with wood wastes. Therefore, at 3500m3 of dredge per hour, the dredging of the Kisumu port (≈794,580m3) would require about 1.5 years working on 12-hr and 6 days/week schedule.

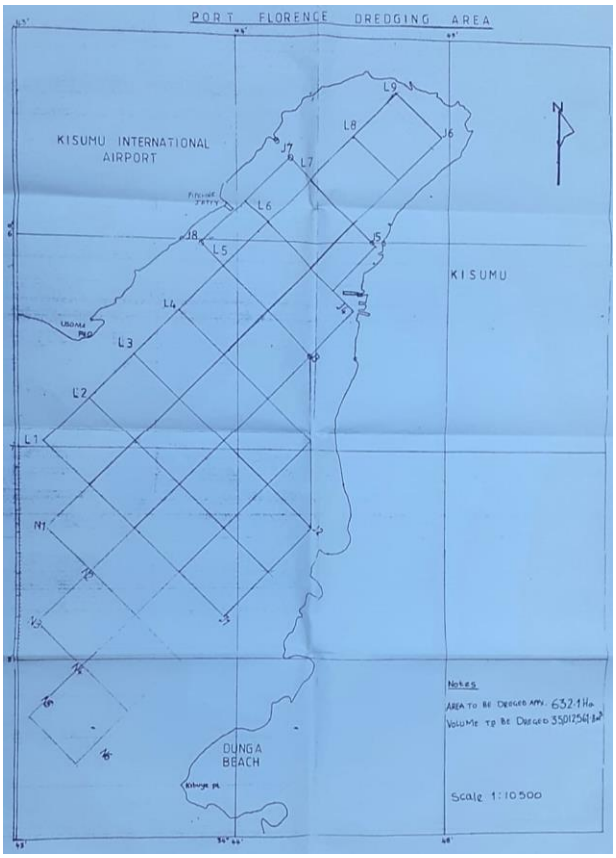


**Figure 5. The proposed dredging area as per the survey done by Kenya Navy in July 2019.**

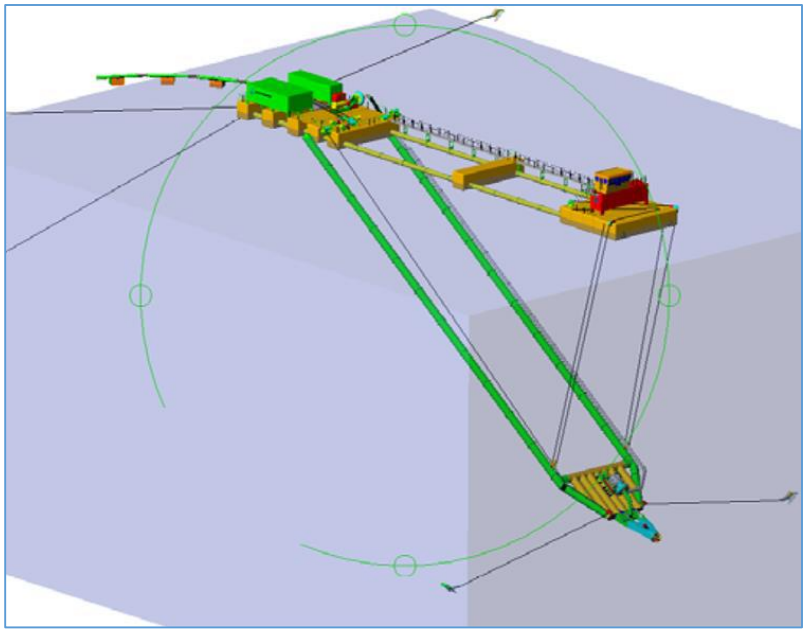

**Figure 6. A sample modular dredger for lake dredging with 1.2m to 90m depth capacities and shore dumping of dredge material (Source: Analytical and Environmental Consultants, 2007)**

The design of the dredge head is critical to the success of dredging operations. The following requirements must be satisfied:

- Capable of removing all the solid and semisolid material along the swathe being dredged, to the required cutting depth and dumping onshore
- Capable of removing dredged material with minimal loss to the water column.
- Able to withstand encounters with rocks, submerged logs, lost outboard motors and other debris.
- Able to pump the sediment slurry with a minimum need to entrain water from the water column (in the interests of increasing dredging efficiency and speeding up the dewatering process).
- Able to be accurately positioned in the horizontal and vertical dimensions, cope with gas trapped in the sediments and safe to operate.

#### 1.3.4.3 Other revitalization activities

Other revitalization works will include removal of water hyacinth and other macrophytes, maintenance of slipways and the winch system to allow proper operation of both slipways, maintenance of the dry dock door and hydraulic systems to allow proper operation of the dry dock, removal of wreck and paving works in the area to sustain ship building and ship repair and support the maritime industry on Lake Victoria. The existing warehouse will be rehabilitated and improved by replacing worn out areas and re-painting. It will offer cash and carry warehousing for small traders arriving by lake transport, cold storage facilities and offices. The warehouse will serve the traders for the next 10 years after which a second warehouse would be built behind the existing one, doubling their capacity.

In order to support the growth of the revitalized Kisumu Port, the proponent plans to rehabilitate the existing landing sites which include Sio Pier, Port Victoria, Usenge Pier, Asembo Bay, Kendu Bay Pier, Kowuor Pier, Homa Bay, Mbita, Luanda K'Oteino, Mfangano, Korungu Pier and Muhuru Pier. The rehabilitated landing sites will serve the local communities by enabling transport between the port by lake to these areas using small roro vessels or barges. Currently the communities on the shores of Lake Victoria are primarily served by road sometimes travelling over long distances which could easily be covered through Lake Victoria. The rehabilitation of the landing sites will be subjected to an independent EIA process in compliance with Section 58 of the Environmental Management and Coordination Act Cap 387 of the Laws of Kenya.

## 1.4 Study approach and methodology

### 1.4.1 Introduction

The ESIA study report methods were guided by the Third Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. The consultants prepared a scoping report and Terms of Reference (TORs) as required under Regulation 11 of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003 and submitted them to NEMA for consideration for approval. The scoping report and TORs were approved on 8th August, 2019 and the consultants began preparation of the ESIA study report.

### 1.4.2 Data collection

The methods for carrying out the study included site visits and observations, consultations with the stakeholders through public meetings, literature review of relevant documents and baseline monitoring of environmental media (water, sediments, air and noise,) and biological monitoring (Fisheries). Site visits were carried out in November 2019 for purposes of area reconnaissance, assessing the baseline environmental conditions of the proposed project site and screening of environmental risks associated with the proposed development as well as the applicable

environmental safeguards and standards. Environmental screening criteria was informed by the Second Schedule of the Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003. As per this schedule, the issues considered by the experts included ecological impacts, socio-economic issues, landscape changes, land use character and water (Table 1).

**Table 1. Summary of results of the screening criteria as per Schedule II of EIA/EA Regulations, 2003.**

| Criteria | Results |
|---|---|
| Ecological impacts | – Proposed project likely to affect the diversity, breeding habitats and population of fisheries and wildlife in Lake Victoria<br>– There are endangered species in the lake<br>– Degradation of Lake Victoria |
| Social-economic considerations | – Income to proponent and employment opportunities<br>– Revenue to the government through taxes & licenses<br>– The project compliments governments effort to attain economic pillar associated with development i.e. Vision 2030<br>– Demographic changes<br>– Disruption on the un-gazetted fishing grounds<br>– Workers during construction and operational phase will be exposed to safety and health risks |
| Landscape impacts | – The landscape of the area will be altered by new views created when trees are felled |
| Water | – The operations of the proposed project will have a potential to pollute the lake |

### 1.4.3 Baseline monitoring of environmental media

Baseline environmental data was collected on biodiversity, land use and land cover, water quality, soil and sediments, ambient air and noise levels. Collection of baseline biodiversity data was conducted by the consultants in collaboration Kenya Marine and Fisheries Research Institute (KMFRI) and the local fishermen. Water quality, soil, air and noise levels sampling and analysis were implemented in collaboration with Polucon Services (K) Limited who are a NEMA designated laboratory pursuant to the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya. The approaches and methods used for sampling and analysis of baseline environmental media are discussed in the following sections.

#### 1.4.3.1 Biodiversity sampling and analysis

Identification of the aquatic macrophytes was conducted following identification keys for aquatic plants and percentage coverage estimated in-situ for each category. Mature plants were extracted from the field for further analysis and preservation (Herbarium).

##### 1.4.3.1.1 Satellite imagery mapping for water hyacinth

KMFRI has conducted routine monitoring and mapping of water hyacinth coverage in Winam Gulf since 2013 to date. This exercise uses the United States Geological Survey (USGS) satellites i.e. Sentinel2A and Landsat8 which relay satellite images on a monthly basis. Sentinel2A relays imageries after every ten (10) days while Landsat8 after every fifteen days (15) in a month. The Imageries/scenes which appear in paths and rows are downloaded and processed using GIS softwares like QGis, Arc Map and ERDAS Imagine. Usually, the image pictures are in TIFF and jpeg formats which have different spectral bands that allow the GIS soft wares to get different image composites. Sentinel-2A has four bands of same resolution (10m) which are made a composite by

use of the method layerstack in ERDAS imaging (Table 2). The bands are 2Blue, 3Green, 4Red and band8 Near Infrared (NIR).

**Table 2. Sentinel-2A-Sensor: MSI.**

| No. | Band name | Central wavelength (nm) | Bandwidth (nm) | Resolution (m) |
|---|---|---|---|---|
| 1 | Coastal aerosol | 443.9 | 27 | 60 |
| 2 | Blue | 496.6 | 98 | 10 |
| 3 | Green | 560 | 45 | 10 |
| 4 | Red | 664.5 | 38 | 10 |
| 5 | Vegetation Red Edge | 703.9 | 19 | 20 |
| 6 | Vegetation Red Edge | 740.2 | 18 | 20 |
| 7 | Vegetation Red Edge | 782.5 | 28 | 20 |
| 8 | NIR | 835.1 | 145 | 10 |
| 8a | Narrow NIR | 864.8 | 33 | 20 |
| 9 | Water vapour | 945 | 26 | 60 |
| 10 | SWIR – Cirrus | 1373.5 | 75 | 60 |
| 11 | SWIR | 1613.7 | 143 | 20 |
| 12 | SWIR | 2202.4 | 242 | 20 |

Landsat8 has six bands of same resolution (30m) which are made a composite by use of the method layers stack in ERDAS imaging ((Table 3). The bands are 2Blue, 3Green, 4Red, Band 5 - Near Infrared (NIR), Band 6 - SWIR 1and band, 7 - SWIR 2.

**Table 3. Landsat 8-9 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS).**

| Landsat 8-9 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) | | |
|---|---|---|
| **Bands** | **Wavelength (micrometers)** | **Resolution (meters)** |
| Band 1 - Coastal aerosol | 0.43-0.45 | 30 |
| Band 2 – Blue | 0.45-0.51 | 30 |
| Band 3 – Green | 0.53-0.59 | 30 |
| Band 4 – Red | 0.64-0.67 | 30 |
| Band 5 - Near Infrared (NIR) | 0.85-0.88 | 30 |
| Band 6 - SWIR 1 | 1.57-1.65 | 30 |
| Band 7 - SWIR 2 | 2.11-2.29 | 30 |
| Band 8 – Panchromatic | 0.50-0.68 | 15 |
| Band 9 – Cirrus | 1.36-1.38 | 30 |
| Band 10 - Thermal Infrared (TIRS) 1 | 10.6-11.19 | 100 |
| Band 11 - Thermal Infrared (TIRS) 2 | 11.50-12.51 | 100 |

After every 10 days or 15 days in a month, an image is downloaded and processed. An area of interest (AOI) is created first and sub-setting after which the images are projected (WGS1984) and clipped using shapes files created from the areas of interests (AOI). Supervised classification of the pixels are given different signatures by the user and unsupervised classifications which allows the computer algorithm to calculate the different signatures. In sentinel2A, the pixel counts are multiplied by 100 while Landsat8 multiplied by 900. One pixel in sentinel2A has an area of 100m while Landsat8 has 900m. The area in square meters is then converted to Hectares. From this, a monthly trend is generated based on different color reflectance of different macrophytes, the broad leaves, thin leaves as well as the chlorophyll intensity.

#### 1.4.3.1.2 Fisheries and macro-invertebrate assessment

The ecological diversity of tropical lakes presents several constraints that often render the design of a single suitable statistical system for lake fisheries rather difficult. The lakes are mostly characterised by having multiple stocks of fish and fisheries, human settlements all along the meandering shorelines, full and part-time fishermen, multiple types and sizes of fishing gears and canoes including outboard engines, multiple roles of the canoes, variation in setting of gears and landing of catches in space and time and the diversity in fishing skills. What is however of main concern in fisheries surveys is catch statistics. It is therefore important to know the quantities and species compositions of fish landed by gear, by canoes, by time, and by place. Total enumeration is not possible because fish is landed by large numbers of small canoes at isolated places and at different time of day and night.

Consequently, scientific surveys, often in combination with catch assessment surveys present the best approach to estimation of fish catch, catch rates and biodiversity. Therefore, in order to deliver on the comprehensive data and information requirements for an ESIA study report as guided by the EMCA Regulations, 2003, the consultants conducted an assessment of the fisheries within the Lake Victoria Winam Gulf and Kisumu Bay using survey methods adopted from the Lake Victoria Fisheries Organization (LVFO) Standard Operating Procedures (SoPs). Twelve (12) sampling stations were established within the Kisumu Bay using a stratified survey design approach as shown in Table 4 and Figure 7, ensuring that the entire Kisumu Bay was sampled for fisheries, macro-invertebrates and general biodiversity especially with focus to hippos, crocodiles and birds among other riparian wildlife.

Fish sampling was conducted using a combination of trawled seines, monofilament gillnets and larval trawls (Figures 8 - 11). During each survey trip, the date and time of the haul, GPS position from of the start and end position of the haul, depth of the fishing area from the start to the end, warp length, haul duration (≈30 min.) and the speed and direction were recorded. Where the catch was too large for all the individual fish to be measured for length, sub-sampling was done. The following procedure was used for sub-sampling; larger individuals were first removed from each taxa, and their lengths and weights recorded, then the remaining catches were thoroughly mixed and a representative sub-sample of about 200 specimens taken. For all the samples, the following parameters were taken; (a) weight of this sub-sample recorded and (b) weight of the remaining sample from which the sub-sample was obtained recorded. The raising factor for the subsample was then calculated from the samples as (a+b)/a. The samples then chilled in ice and transferred to the laboratory for analysis. In the laboratory, the biometrics of the sub-sample were then measured and recorded in detail. In the laboratories, trophic relations were deduced by microscopically examining the preserved gut content from the field in order to identify feeding habits.

**Table 4. Fisheries, Macro-invertebrates and Biodiversity Sampling Stations within the lake.**

| Sampling site | Location | Coordinates |
|---|---|---|
| F1. Fish Survey Stn 1 | Storm runoff discharge north of port pier | -0.102690° S / 34.744121° E |
| F2. Fish Survey Stn 2 | Storm runoff discharge before Kichinjio | -0.094477° S / 34.749474° E |
| F3. Fish Survey Stn 3 | Kichinjio BMU area shore | -0.091756° S / 34.752365° E |
| F4. Fish Survey Stn 4 | River Kisat estuary | -0.088035° S / 34.750793° E |
| F5. Fish Survey Stn 5 | Kisumu golf club shores | -0.090125° S / 34.741298° E |
| F6. Fish Survey Stn 6 | Central bay off north of jetty | -0.096085° S / 34.735812° E |
| F7. Fish Survey Stn 7 | North of KPC pipeline jetty | -0.102768° S / 34.728600° E |
| F8. Fish Survey Stn 8 | South of KPC pipeline jetty | -0.105619° S / 34.736448° E |
| F9. Fish Survey Stn 9 | Central bay off dock yard | -0.105619° S / 34.736448° E |
| F10 Fish Survey Stn 10 | Kisumu port dock yard | -0.105499° S / 34.743317° E |
| F11 Fish Survey Stn 11 | Impala Point | -0.117776° S / 34.743392° E |
| F12 Fish Survey Stn 12 | Dunga Municipal water intake | -0.125558° S / 34.741030° E |


**Figure 7. A map of Kisumu Bay showing the sampling stations for fisheries, macro-invertebrates and biodiversity surveys and monitoring (Source: Google Earth accessed November 2019).**

Larval fish samples were collected using a 1 m long Nansen type plankton net of 60 µm mesh size and mouth opening measuring 30 cm diameter. The net was hauled vertically through the water column and the depth of sampling recorded with three replicates. The samples were chilled in ice and transferred to the laboratory for analysis. In the laboratory each sample was sorted to the species level and the total number (TN) and total weight (TW, g) taken to assess the biomass of the fish larval samples and biodiversity. Estimates of abundance of smaller fish larval samples were made from counts of sub-samples under a Leica dissection microscope, at a magnification of x25. The number of individuals per Litre of lake water was determined by taking into account the number of organisms in the sub-sample, volume of the lake water filtered by the vertical haul and the depth of the haul.

**Figure 8. Fisheries sampling using a monofilament seine**

**Figure 9. Grab sampling of macro-invertebrate along the lake shores**

**Figure 10. Larval fish samples caught using the plankton nets**

**Figure 11. Omena, *Rastreneobola argentea* fish samples caught within the Kisumu Bay**

Macro-invertebrate samples were collected on the shores at depths of <1.0m, as follows. At each sampling station, a Ponar grab was used to collect triplicate samples which were then composited, sorted live in a white tray and preserved in absolute (95%) ethanol. The samples were then transported to the laboratory, sorted, observed and counted under light microscope and identified to genus level with the aid of different keys (Cummins and Merritt, 1996, Gerber and Gabriel, 2002). The organisms were further examined for stomach contents to assign feeding habits and where this failed, the feeding guild was assigned according to Gerber and Gabriel (2002) and Chesire et al. (2005).

The raw data for site replicates for each sampling station were combined. All branchiopods and copepods were subsequently removed since they are not benthic organisms. The counts for each site were weighted to 100 to provide a total count of 100 organisms per replicate as well as for the sampling stations and the bay. Macro- invertebrate community structure and functional composition was described using descriptive metrics and comparison metrics before conclusion and recommendations for future consideration options. The results are represented in tables and graphs. Data analysis was done using excel.

#### 1.4.3.1.3 Biodiversity of Kisumu Bay and other hotspots

The methodology for establishment the baseline biodiversity profile of the terrestrial environment of Kisumu Port area and neighboring biodiversity hotspots included desktop review, reconnaissance of the project area and determination of the different unique zones/habitats and flora and fauna survey. Figure 12 shows the port area (dotted red line) and the survey stations while Figure 13 shows the survey stations outside the port area but which are regarded as biodiversity hotspots. The survey methods used were transect walks, traps and pit falls, fixed radius method, visual encounter method and interviews with the local community and Kenya Wildlife Service. These are discussed briefly below.

##### 1.4.3.1.3.1 Transect walk surveys

Transects were used in the flora and habitat survey, bird survey and the reptile/amphibian study. This involved preliminary survey of the study area (predetermined transect locations) and making adjustments on transect orientation based on topography and physical characteristics in order to capture comprehensive data. Methodologies described in the Monitoring Manual for Grassland, Shrubland and Savannah Ecosystems (Herrick, Van Zee, Havstad, Burkett, & Whitford, 2005) were used as a guide in developing this protocol. Vegetation sampling transects were setup at each of the habitat types. In addition, vegetation sampling was conducted at other randomly located locations within the project footprint. The line-intercept method was utilized to gather vegetation attributes for the proposed Project site. The line intercept method consists of horizontal, linear measurement of plant intercepts along the course of a line. A minimum of 30-meter transects were established within the survey areas shown in Figures 12 and 13.

For the birds, strip transects were established along the access roads, in order to identify bird species via observation and/or bird vocalization. This field evaluation was from 7:30 am to 10:00 am according to the method recommended by Ralph et.al. (1996). It was applied in both terrestrial and aquatic locations. The terrestrial was conducted through walking while aquatic was conducted through the use of a boat along the shoreline.

##### 1.4.3.1.3.2 Traps and pit falls surveys

Traps and trapping station were used to collect data on insects and reptiles/amphibians. Pit-fall traps were established, baited with fruits. Each trap consisted of a small jar set into the ground, with the finish level with the ground, so insect could pit-fall into it. A stone is lay on the trap to avoid depredation by small carnivores.


**Figure 12. Biodiversity survey sites within Kisumu Port area (Source: Source: Google Earth accessed November 2019).**

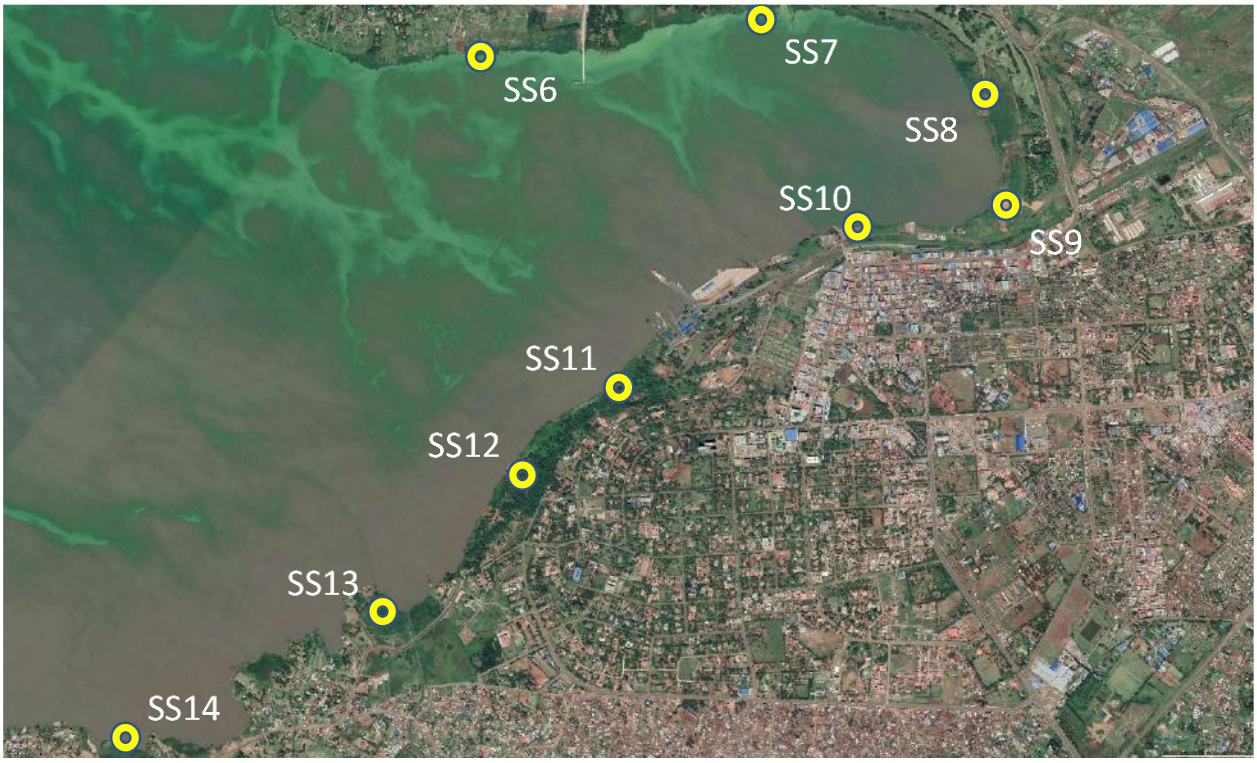


**Figure 13.Biodiversity survey sites outside Kisumu Port (Source: Google Earth accessed November 2019).**

#### 1.4.3.1.3.3 Fixed radius method

This was used to collect data in birds in addition to the transect method. Six bird count points were established within the project area. Bird counts were conducted in the morning from 7:00 am to 10:00 am and during the afternoon from 3:00 pm to 5:00 pm. This followed the methodology described in Bird Monitoring Methods: A Manual of Techniques for Key UK Species (Gilbert, Gibbons, & Evans, 1998). In each bird count point, all bird species either observed or heard for a period of 10 minutes were identified and recorded. Additionally, the weather characteristics such as wind, cloudiness and rain occurrence as well as the type surrounding vegetation were noted following standard methodology described in the Handbook of Field Methods for Monitoring Landbirds (Ralph, Geupel, Pyle, Martin, & DeSante, 1993).

#### 1.4.3.1.3.4 Visual encounter method

To evaluate the status of reptiles and amphibian populations within the Project area, visual encounter surveys were conducted in accordance with procedures described in Field Techniques for Herpetofaunal Community Analysis (Campbell & Christman, 1982) and Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians (Heyer, Donnelly, Foster, & Mcdiarmid, 2014). Surveys were conducted utilizing a randomized-walk design. The observer chose at random a sequential series of compass directions and a random number of meters to be walked in each selected direction. All reptile and amphibian observed within 1 meter on either side of the path were recorded. Leaf litter, logs, rocks, and other likely microhabitats were randomly turned over and investigated.

#### 1.4.3.1.3.5 Interviews and Focused Group Discussions

Local community members, project site users and specialized informants were identified for the purpose of interviews and Focused Group Discussions (FDG). Targeted information on the interviews and FGD were the historical and current perspective of biodiversity composition (habitats typologies and fauna).

### 1.4.3.2 Baseline water quality monitoring

Baseline water quality sampling was carried out at six stations within the lake on 2nd November, 2019 (Table 5 and Figure 14) by Polucon Services (K) Limited and the consultants using. The six Water samples were then analyzed for physical and chemical parameters including pH, Total Dissolved Solids, Total Suspended Solids, Chemical Oxygen Demand, Biological Oxygen Demand, Ammonia, Total Coliforms, E. coli, Turbidity, Dissolved Oxygen, Perspective Degree and Temperature. In addition, water sample from the municipal water supply intake and sewage discharge points were analyzed for compliance with the First and Third Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006 respectively.

**Table 5. Water Quality Monitoring Stations selected within the lake.**

| Sampling site code | Location description | Coordinates |
|---|---|---|
| Station 1 | Sewage discharge point 1 from town | -0.098648° S / 34.747207° E |
| Station 2 | Sewage discharge point 2 from town | -0.096842° S / 34.748091° E |
| Station 3 | River Kisat Estuary | -0.087168° S / 34.749992° E |
| Station 4 | Port Pier Central Area | -0.103129° S / 34.744403° E |
| Station 5 | Kisumu Bay Central areas (offshore) | -0.105619° S / 34.736448° E |
| Station 6 | Municipal water supply intake Dunga | -0.125558° S / 34.741030° E |


**Figure 14. A map of Kisumu Bay showing the baseline water quality monitoring stations (Source: Google Earth).**

### 1.4.3.3 Baseline sediment quality

Baseline sediment quality monitoring was carried out at Rive Kisat estuary (Station 3) and at the Port area (Station 4) on 2nd November, 2019 by Polucon Services (K) Limited and the consultants. The sampling strategy involved use of Auger Sampler to scoop sediments from the river bed and the Bay Sediment samples were then analyzed for heavy metals and hydro carbon (Figure 15).

**Figure 15. The Auger Sampler used in collection of sediments at River Kisat Estuary and the Kisumu Port Pier area (Source: Site visit, November 2019).**

#### 1.4.3.4 Ambient air quality measurements

A Fixed-Point monitoring strategy was used to obtain baseline ambient air quality for the proposed project at Kisumu Port which was conducted on 1st November, 2019. Air monitoring was conducted over a 1-hour duration weighted average period and a calculated 24-hour time weighted average period for the measurements of Nitrogen dioxide, Sulfur dioxide, particulate matter (dust particles), Hydrogen Sulphide and Carbon Monoxide (CO).

Sampling of gases was done by use of Aeroqual portable air monitors (Figure 16) which uses a mix of sensor technologies. Sampling for nitrogen dioxide, sulfur dioxide, hydrogen sulphide and carbon monoxide (CO) was done using the gas sensitive electrochemical methods of active and continuous sampling. Dust was sampled using the laser particle sensors. The results interpretation and analysis as well as sampling duration information was used to calculate the gases concentrations.

#### 1.4.3.5 Ambient noise level measurements

Ambient noise measurements were conducted on 1st November, 2019 within the port. Prior to recording the noise measurements, an inspection of the monitoring points and implicated activities of the area was undertaken, perimeter walls were identified and noise level meter calibrated. Noise levels were determined by the noise level meter (Figure 17), with an inbuilt, ϖoctave/octave band filter which does real time and octave analysis. The noise level meter was raised 2 meters above the ground and fitted with a ½" electrets condenser microphone with a measurement range of between 30 - 130dB and a frequency range and weighting of 25Hz – 10KHz and A, C & Z respectively. For all measurements taken to establish the ambient noise levels, the equivalent noise

level (LAeq), the sound pressure level at 5%, 50% & 95% (L5), (L50), (L95) respectively during that measurement period was at 1-hour interval. The noise level was measured in terms of the A-weighted equivalent continuous sound pressure level Leq. Each individual measurement was taken simultaneously with the nature of the noise climate of the area. This involved an auditory observation and identification of noise incidents influencing the noise level meter readings by the surveyor.


**Figure 16. A portable (Aeroqual 500 - Series) used in obtaining baseline air quality measurements at Kisumu Port.**

**Figure 17. Noise level meter (Model TES 1358 C) used in obtaining baseline noise levels at Kisumu Port.**

### 1.4.4 Stakeholder engagement strategy

Prior to commencement of the ESIA process, the consultants conducted a stakeholder analysis in consultation with the proponent, the County Government and the Ministry of Interior and Coordination of National Government. Following the analysis, three public meetings were held with the key stakeholders. These are a kick-off meeting, a meeting to review the draft ESIA report and a final validation meeting with the proponent.

# 2 BASELINE INFORMATION ON KISUMU PORT AREA AND MONITORING FINDINGS

## 2.1 Introduction

Under this section, the ESIA study provides baseline information on the physical environment, environmental quality, biological communities including fisheries, socio-economic profile of the area and infrastructure. The physical information focuses on Lake Victoria where the port is located, topography and soils, climate, water resources and land use patterns. Environmental media includes water quality at the lake, air and noise levels while the biological communities include fish and invertebrates, macro fauna such as hippopotamuses and other wildlife, birds, aquatic macrophytes (e.g. Water hyacinth) and floral communities. The baseline information will provide for a benchmark for implementation of monitoring plans to assess the impact of the revitalization activities and the operational phase of the Kisumu Port on the environment.

## 2.2 Overview of Lake Victoria

Lake Victoria is Africa's largest lake by area occupying a surface area of about 60,000 square kilometers holding 2,424km$^3$ of water at an average depth of 40m (Figure 18). It's also the world's largest tropical lake and the world's second largest fresh water lake by surface area after Lake Superior in North America. The lake's area is divided among three countries which are; Kenya (6%), Uganda (45%) and Tanzania (49%). Its catchment area within the three countries covers 169,858km$^2$ and the shoreline is 7,142km including the islands. Despite the substantial catchment area drained by major rivers and streams, the Lake receives 80% of its water from rainfall. The Lake is drained solely by River Nile whose corridor constitutes the Nile Basin and serves other countries in Africa including South Sudan, Ethiopia, Sudan and Egypt.

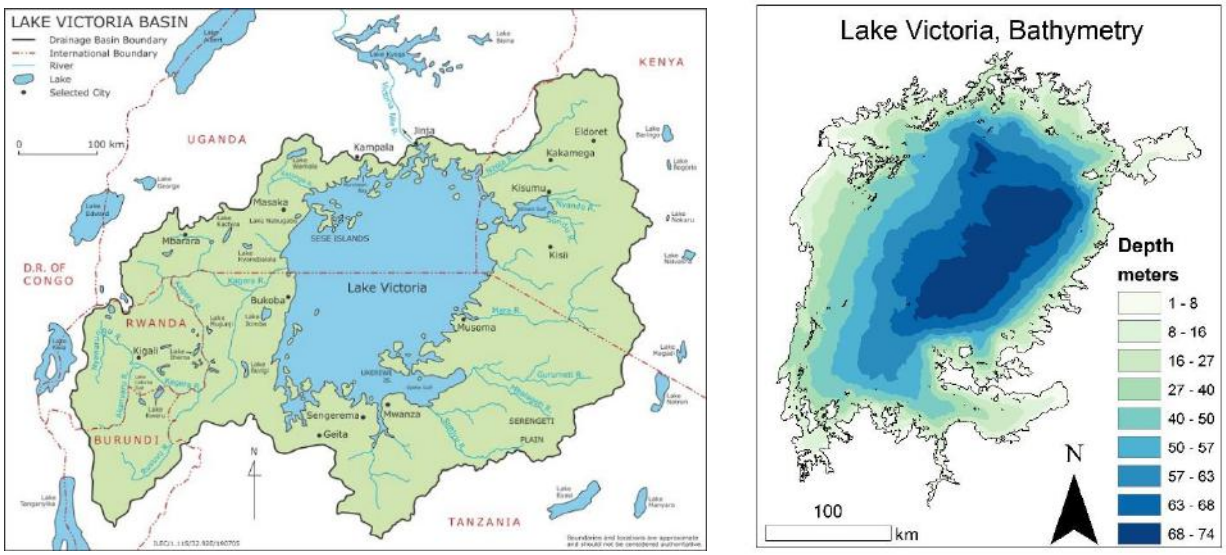


**Figure 18. A map showing Lake Victoria Basin (left) and the Lake Victoria Bathymetry (Right) (Source: Wikipedia, Accessed November 2019).**

The lake is an important habitat supporting a thriving artisanal fishery and facilitates the shipping of goods and people within the basin. Historically, it has enabled trade between the three riparian states of Kenya, Uganda and Tanzania in what is popularly referred to as the triangle trade. Other benefits include tourism, providing water for domestic use and irrigation.

Kisumu Port is located on the Kisumu Bay where the average depth of the lake was recently established as 3.5 m during a recent survey by Kenya Navy (July 2019).

## 2.3 Topography

Topographically, Kisumu City is divided into two, the hilly North and the southern plain. The southern plain is the floor of the geographically complex Nyanza Rift System. Originally, the town only covered the residual hill at the tip of Winam Gulf, which has better drains and therefore attracted earlier settlements. Most of this land is liable to flooding, mainly because of the topography and soils. Generally, the topography features modest variations in elevation, with a maximum elevation change of 213 feet and an average elevation of 3,789 feet above sea level. Kisumu Port falls within down warped part of the large lowland surrounding the Winam Gulf, and at the North Eastern fringe of Kano plains (Figure 19). Kisumu Port area lies on isolines of 1,135 to 1,150 meters above sea level.

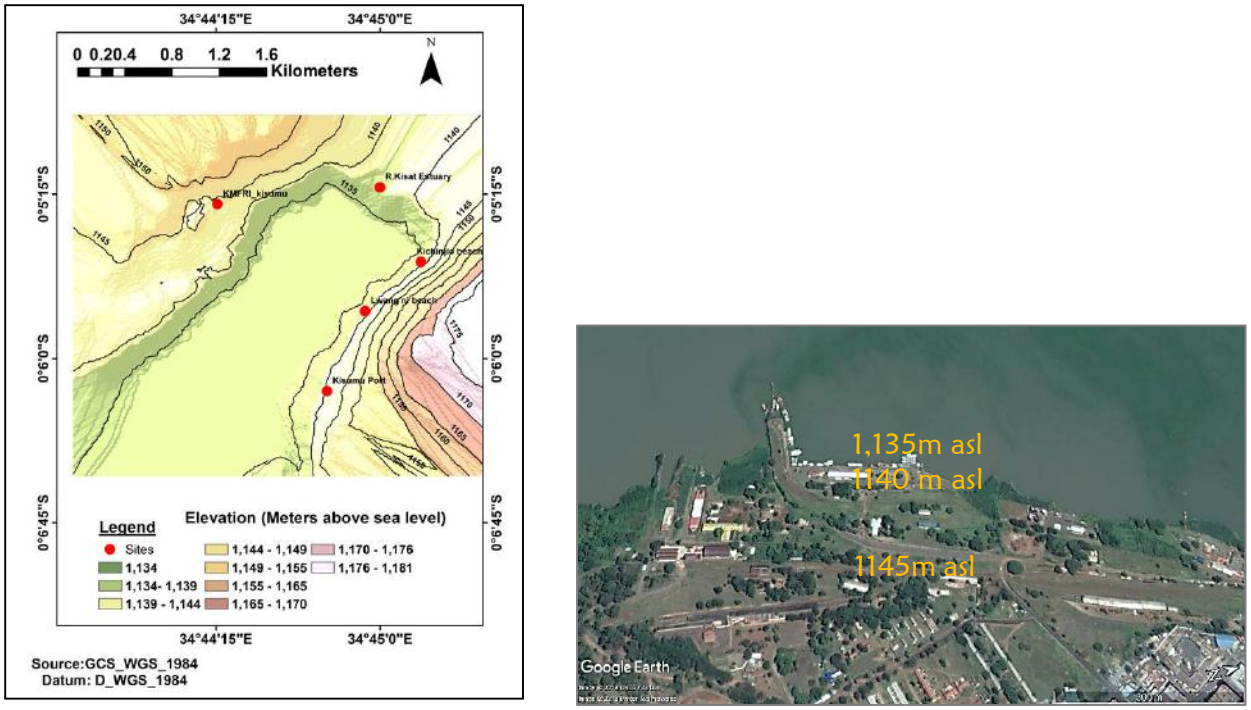


**Figure 19. The topography of Kisumu Port (left) and google image showing approximate locations of the isolines (GCS_WGS_1984 and Google Earth respectively).**

## 2.4 Soils and sediment quality

The soil types that occur in the Lake Victoria Basin are Cambisols, Planosols, Vertisols, Regosols, Arenosols and Ferralsols. Within the port area, the soil types are dominated by Vertsols, Cambisols, and Gleysols. Vertisols (black cotton soils/ clayey soil) are found on the low-lying areas of poor drainage and in non-paved areas. Nitisols (well drained loam soil) were observed transported and spread on lower side where a seasonal stream flows through the port into the lake. The Cambisols (sandy loam or finer, with small % clay by mass) were observed at the Port Immigration Office area. The Gleysols were observed within the swampy areas along the shoreline especially to the east of the port, at Impala Park and Hippo Point. The soil types will inform the engineering aspects of the revitalization of Kisumu Port as areas with loose or clayey soils will need substantial reinforcements of any structures to be erected and paving of the cargo yards.

The results of analysis of sediment samples collected from River Kisat Estuary and the Pier water front indicated the presence of hydrocarbons and several heavy metals in the soils. At Kisat Estuary Total Petroleum Hydrocarbons (TPH) were 3.07mg/kg while heavy metals were zinc (2.44mg/kg),

copper (1.38mg/kg), Chromium (0.21mg/kg) and Nickel (0.3mg/kg). At the port area, TPH was 4.04 while heavy metals were zinc (2.03mg/kg), copper (1.73mg/kg), Chromium (0.18mg/kg) and Nickel (0.01mg/kg). The presence of TPHs and heavy metals can be explained by both upstream sources through drainage systems that could channel oils, grease and effluent into the Bay as well as port operations and ship, vessels, and machinery maintenance activities.

## 2.5 Climatic conditions

The climate of Kisumu City is tropical characterized by hot and humid days. It receives relatively significant rainfall throughout the year with two peaks in April (228mm) during the long rains and November (126mm) during the short rains (Figure 20). The least rainfall falls with the month of January and averages 50mm. Temperatures are fairly constant throughout the year averaging highs of 29$^{0}$C and lows of 19$^{0}$C. The hottest months are between December to March with relatively cooler temperatures experienced during the two rainfall seasons. Humidity varies from a low of 4% in July to a high of 51% during the month of May. The windier part of the year lasts from November to March with average wind speeds of more than 9Km/hr. In December wind speeds of up to 12km/hr have been recorded (Reference). From March to October the wind speeds average about 7km/hr. The seasonal variations in the amount of rainfall received influences water volumes in Lake Victoria, sediment loads, agricultural and socio-economic activities and the growth and dispersal of aquatic macrophytes as a result of nutrient loading through river systems. Wind and currents are important drivers in the movement and dispersal of marshes of aquatic macrophytes in Lake Victoria and therefore influence navigation and socio-economic activities.

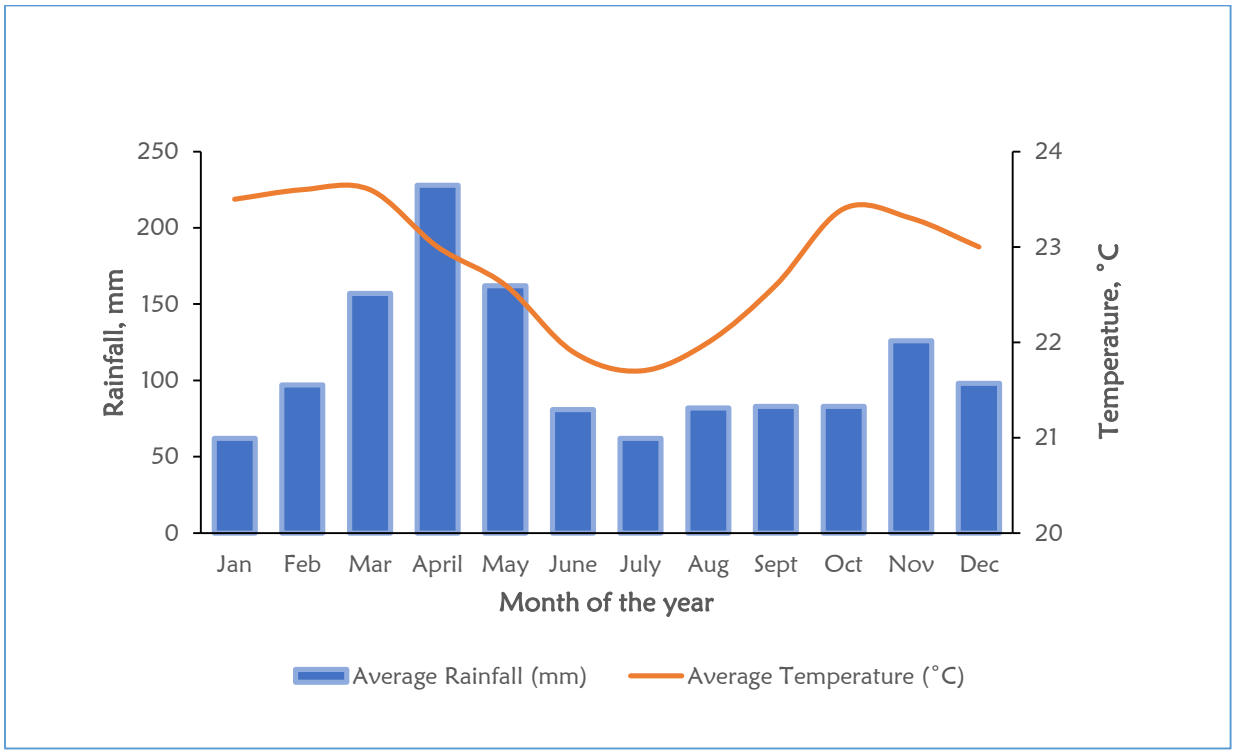


**Figure 20. Average rainfall and temperature distribution in Kisumu City (Source: Climate data.org).**

## 2.6 Biodiversity of Kisumu Bay

The ESIA team undertook surveys to document and profile the biodiversity of the port and neighbouring areas focusing on the key habitats provided by the Lake, the wetlands (Dunga

wetland) and the terrestrial shoreline areas (Kenya Wildlife Service Impala Park). Within the Lake, floral communities include floating macrophytes (hyacinth, hippo grass and papyrus) while the faunal communities include fish, mammals, birds, reptiles, amphibians and insects. The survey was implemented in collaboration with scientists from the Kenya Marine and Fisheries Research Institute as discussed under the methodology for the ESIA. The following section presents the findings of the survey as well as data and information obtained from literature review.

### 2.6.1 Water hyacinth spatial coverage and trends

Water hyacinth, *Eichhornia crassipes* is an invasive perennial free-floating aquatic weed which was introduced into Lake Victoria from South America. Kisumu Bay, where the Port is located has been consistent mapped as a water hyacinth hotspot with implications on accessibility, fishing, water supply and tourism (Figure 21). In the last five years, the acreage of water hyacinth in Winam Gulf exhibited a fluctuating trend. The lowest acreage (< 3000 ha) was observed in 2015 while the highest (> 6000 ha) recorded in 2018 (Figure 22).

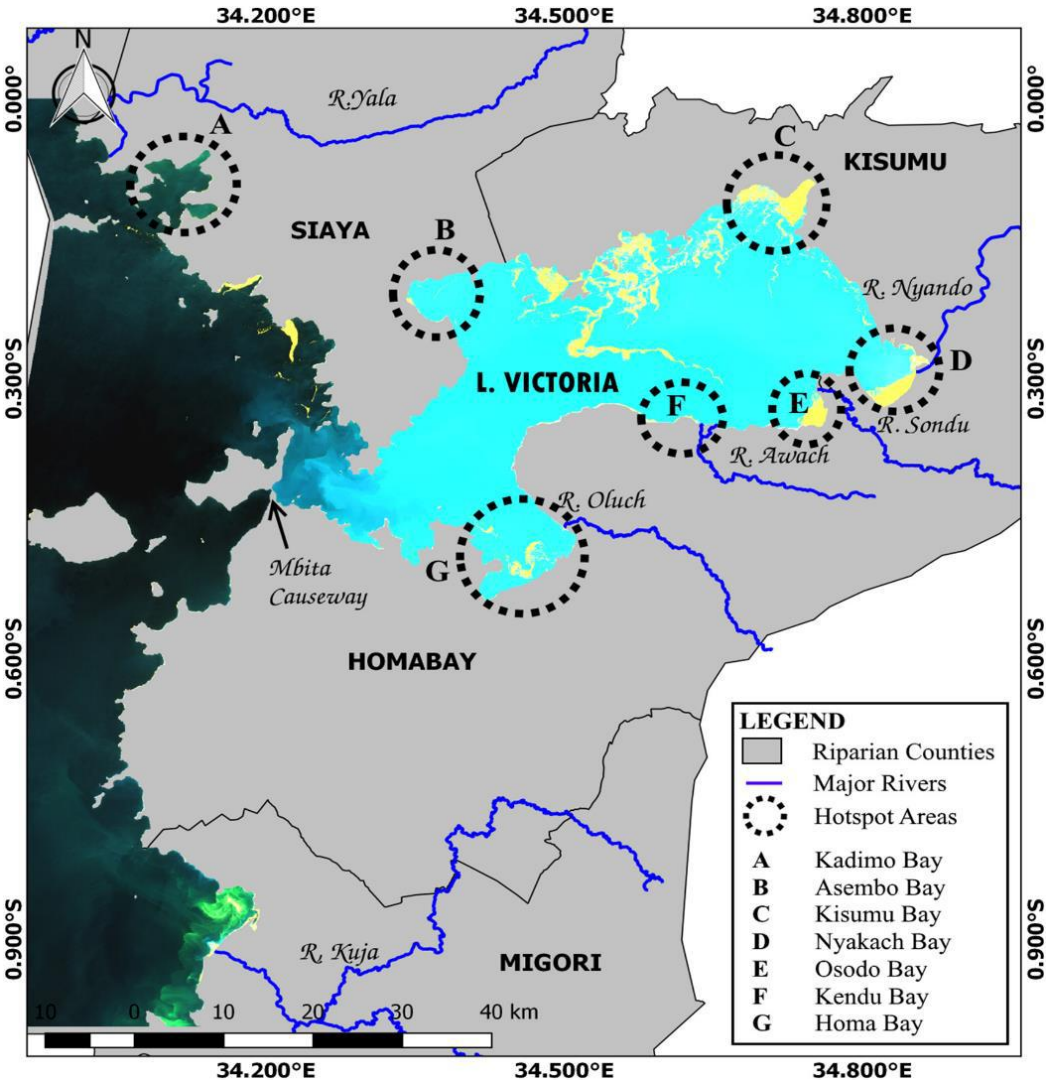


Figure 21. A map showing water hyacinth hotspot areas within the Kisumu Bay (Source: Ongore et.al., 2018).

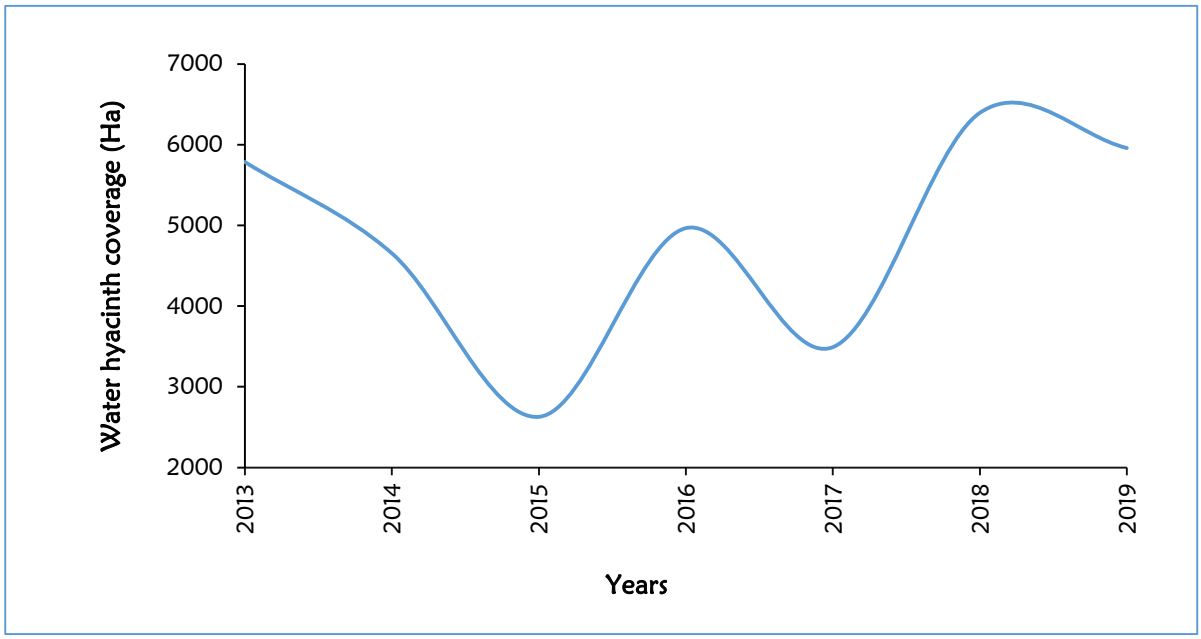


**Figure 22. Mean water hyacinth annual coverage 2013-2019 (Source: Ongare, et.al, 2018).**

distribution in Winam Gulf in January to June 2019 when Kisumu Port has water hyacinth and when it doesn't. It is evident that water hyacinth is highly dynamic i.e. the coverage fluctuates and moves from place to place. Kisumu, Nyakach and Osodo bays are water hyacinth hotspots exhibiting the highest acreage of the weed in most of the months of the year. The growth and movement of water hyacinth is associated with nutrient levels and water currents respectively.

### 2.6.2 Overall distribution and abundance of aquatic macrophytes

Table 6 shows the distribution and abundance of aquatic macrophytes in Kisumu Bay. *Eichhornia crassipes* (Water hyacinth), *Cyperus papyrus* and *Echinochloa stagnina* are the most widespread in the surveyed stations. S9 and S10 had no macrophyte cover. During the surveys it was observed that water hyacinth dieback is creating viable conditions for the establishment and secondary succession by hippo grass which in turn becomes the dominant aquatic macrophyte in such areas (Figures 23 - 26).

**Table 6. Percentage coverage of aquatic macrophytes per site at Kisumu Bay.**

| Macrophyte species | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S9 | S10 | S11 | S12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Aeschynomene elaphroxylon* | 0 | 0 | 0 | 5 | 20 | 0 | 20 | 0 | 0 | 40 | 60 |
| *Eichhornia crassipes (Water hyacinth)* | 10 | 20 | 25 | 20 | 10 | 20 | 40 | 0 | 0 | 20 | 10 |
| *Cyperus papyrus* | 0 | 30 | 40 | 30 | 5 | 10 | 10 | 0 | 0 | 0 | 25 |
| *Phragmatis karka* | 0 | 10 | 5 | 0 | 0 | 60 | 0 | 0 | 0 | 0 | 0 |
| *Phragmatis mauritanius* | 0 | 0 | 0 | 40 | 60 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Ipomoea aquatica* | 0 | 30 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 10 | 0 |
| *Echinochloa stagnina* | 0 | 10 | 20 | 5 | 5 | 0 | 20 | 0 | 0 | 20 | 5 |
| *Nymphia sp* | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

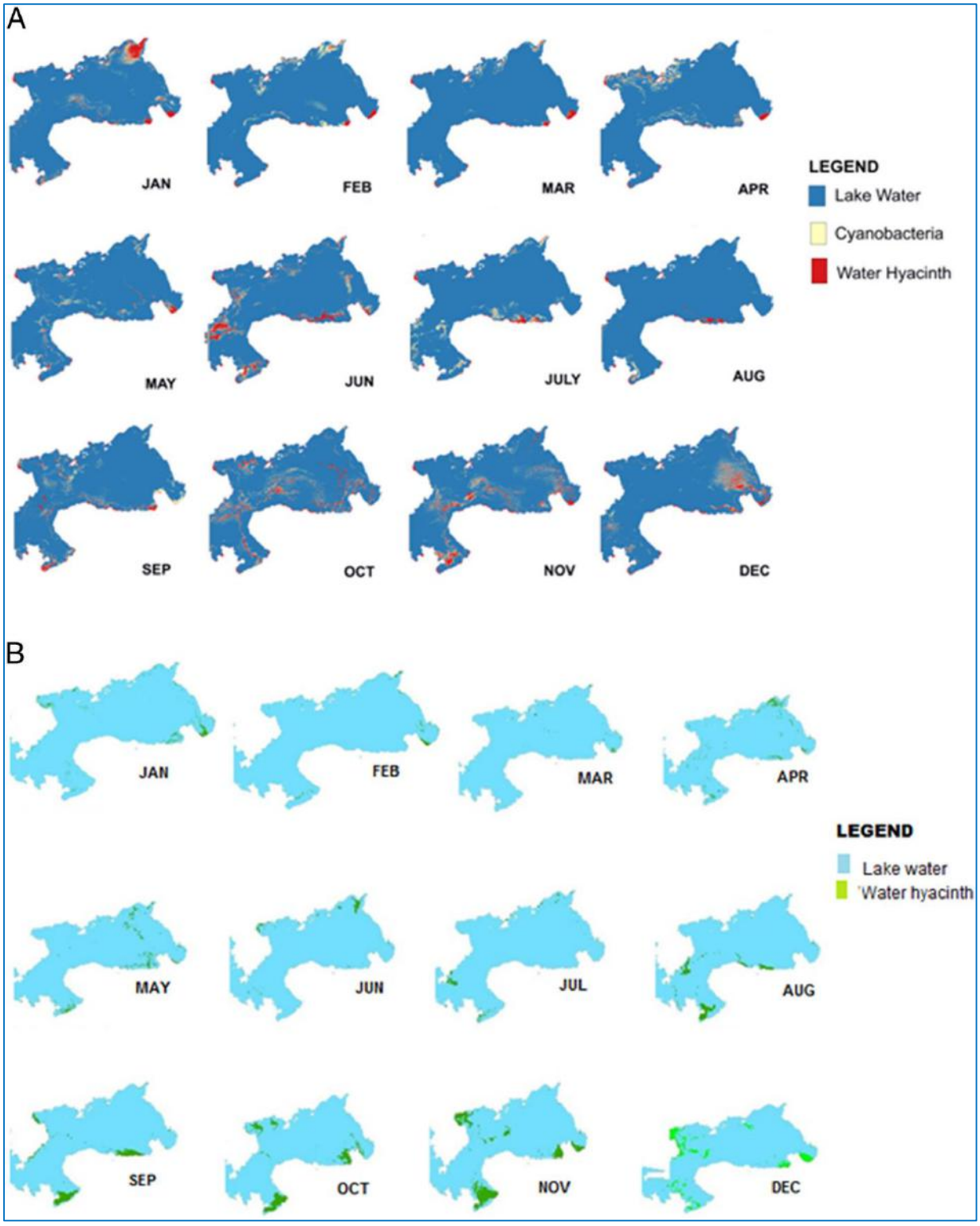


Figure 23. Classified satellite images showing spatio-temporal patterns of (A) water hyacinth and cyanobacteria in the Kenyan part of Lake Victoria (in 2015) and (B) water hyacinth in the Kenyan part of Lake Victoria (in 2016) (Source: Ongare, et.al., 2018).

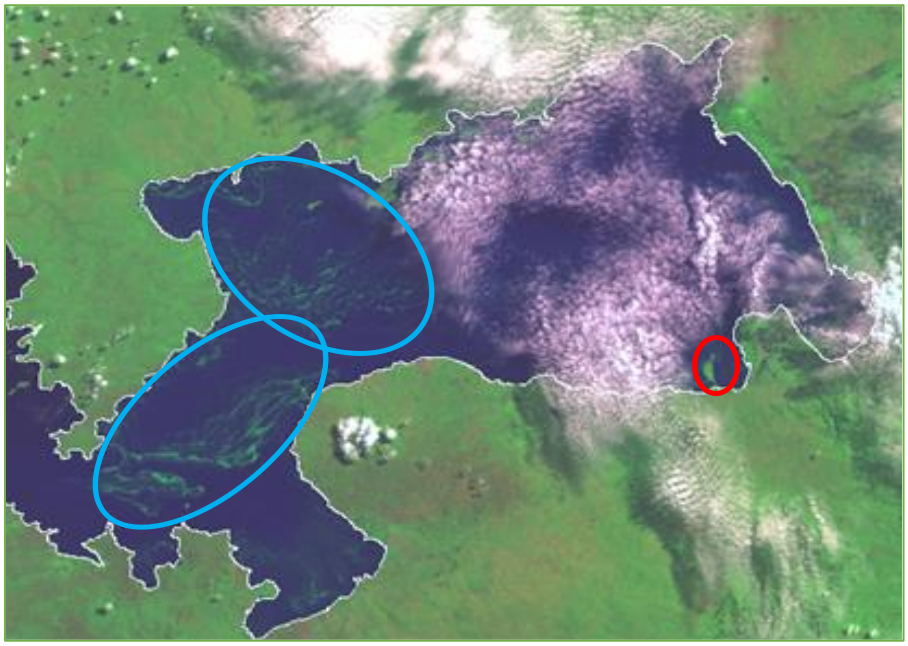

Figure 24. Landsat8 image of 23rd June 2019 showing water hyacinth wuthin Rakwaro beach (Osodo Bay), & Nyakach Bay. Fresh shoots of water hyacinth comprise 403.83 ha while other macrophytes (Vossia) cover 312.84 ha. Blue ellipses show areas of heavy algal bloom whereas red ellipses indicate sites with fresh shoots of water hyacinth (Source: KEMFRI GIS Database, November 2019

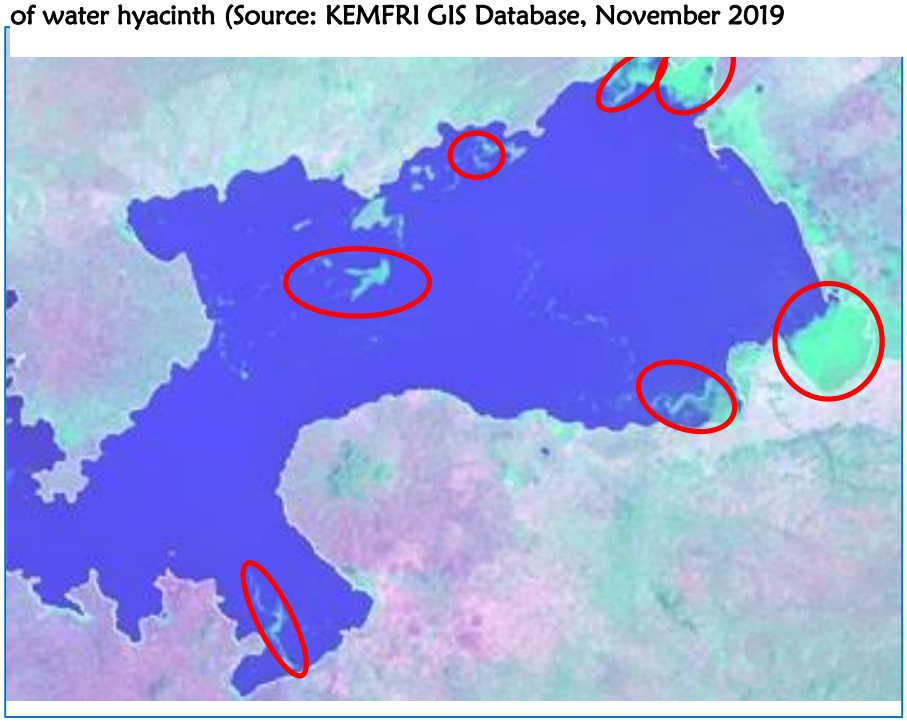

Figure 25. Landsat8 Image of 30th January 2019 Water showing water hyacinth coverage trend (8,174.25 ha. = 0.12%) in Kisumu Bay, Nyakach Bay, Osodo Bay, Ndere islands, Maboko Islands and Homa Bay (Source: KEMFRI GIS Database, November 2019).

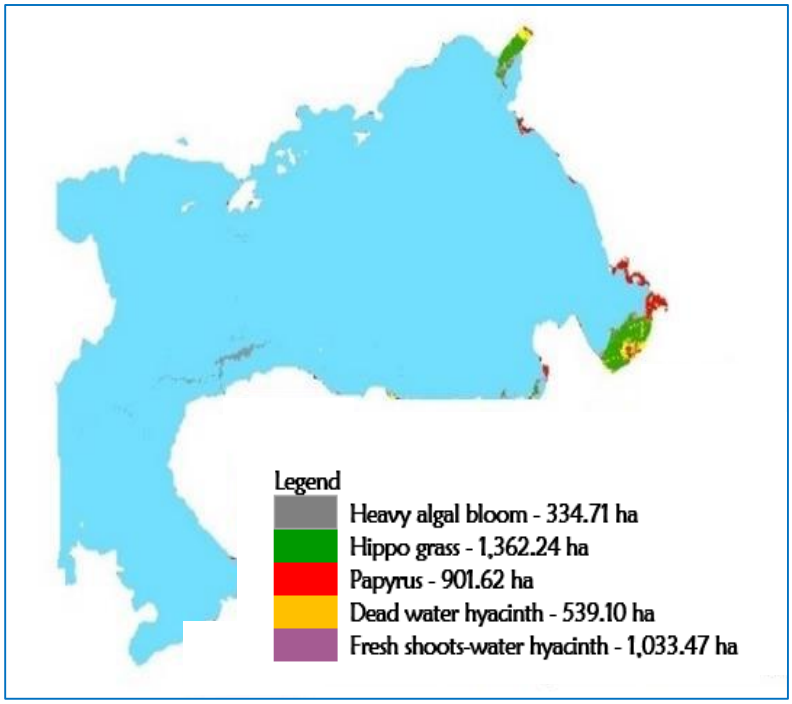


**Figure 26. The abundance and spatial distribution of hippo grass, papyrus and water hyacinth coverage within Winam Gulf; water hyacinth coverage is 2,169.63 ha; mixed hippo grass & papyrus is 3,110.31 ha (Source: KEMFRI GIS Database, November 2019).**

### 2.6.3 Fish diversity and relative abundance

All stations located in the innermost part of Kisumu bay (i.e. near Kisat river mouth, off Nyanza golf club and off Railway beach) registered the lowest number of fish per haul i.e. 98-171 individuals per haul (Figure 27). This can be attributed to very shallow water depth and effluent from River Kisat. Higher abundance of fish i.e. 389-462 individuals/haul was recorded off Luang'ni and Dunga beaches. These areas are fringed with macrophytes that could be critical for fish breading and hence the high abundance. The control site (S1, i.e. off Usoma) and off the oil jetty (S7) recorded moderate abundance of fish. Generally, the bay has relatively low abundance of fish as compared to the larger Winam Gulf.

#### 2.6.3.1 Fish diversity and distribution

Figures 28 and 29 depict fish species spatial distribution and their relative numbers in the sampled stations. *Lates niloticus* (Nile perch) is the most dominant fish and is distributed in all the sampled areas. This is followed by *Rastrineobola argentea* (Omena) that was also recorded in all the stations. *Oreochromis niloticus* (Nile tilapia) was the third most abundant fish species. The three are the most important commercial fish species in Lake Victoria.

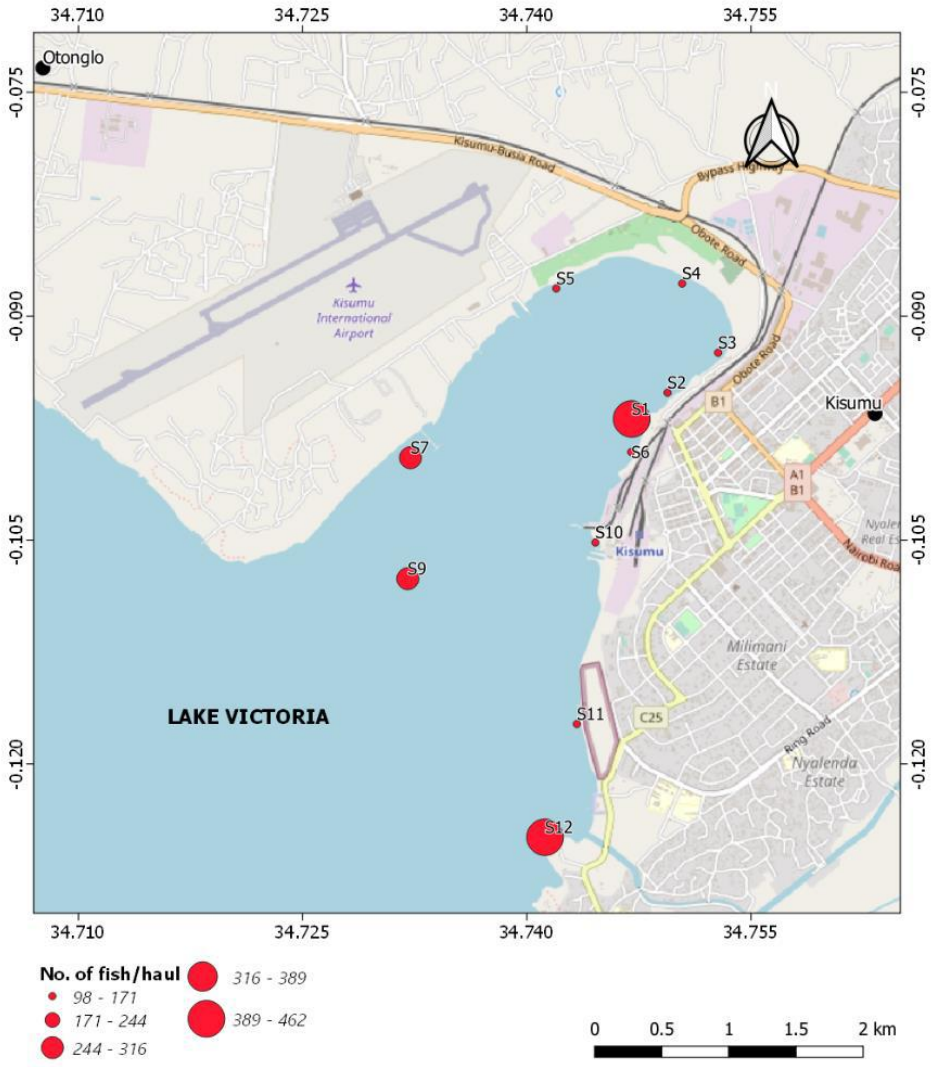


**Figure 27. Fish stock abundance in various station within Kisumu Bay based on number of fish per haul (Source: Site visit, November 2019).**

The relative abundance of the different fish groups is reflective of their reproductive strategies. Nile perch and Omena are broadcasters, producing many eggs to enhance chances of survival. As such the two species don't require specialized habitats for breeding. Nile tilapia enhances survival of their young by exhibiting parental care. Other fish species don't employ either of the mentioned reproductive strategies and hence their low numbers. These are the type that would require special breeding and nursery grounds. In total, only six fish species and haplochromine cichlids were recorded in the study area. Fish species diversity is quite low in this area compared to the rest of Winam Gulf due to the low depth and minimal habitat variability.

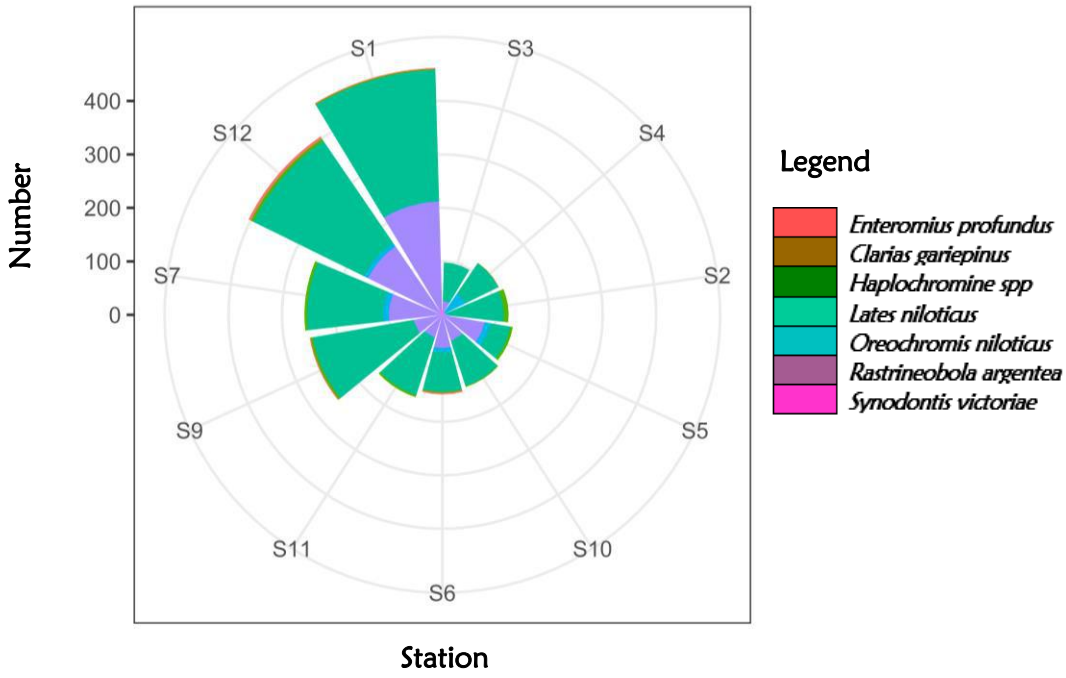


Figure 28. Fish species composition from pooled samples within the Kisumu bay of Lake Victoria (Site visits, November 2019).

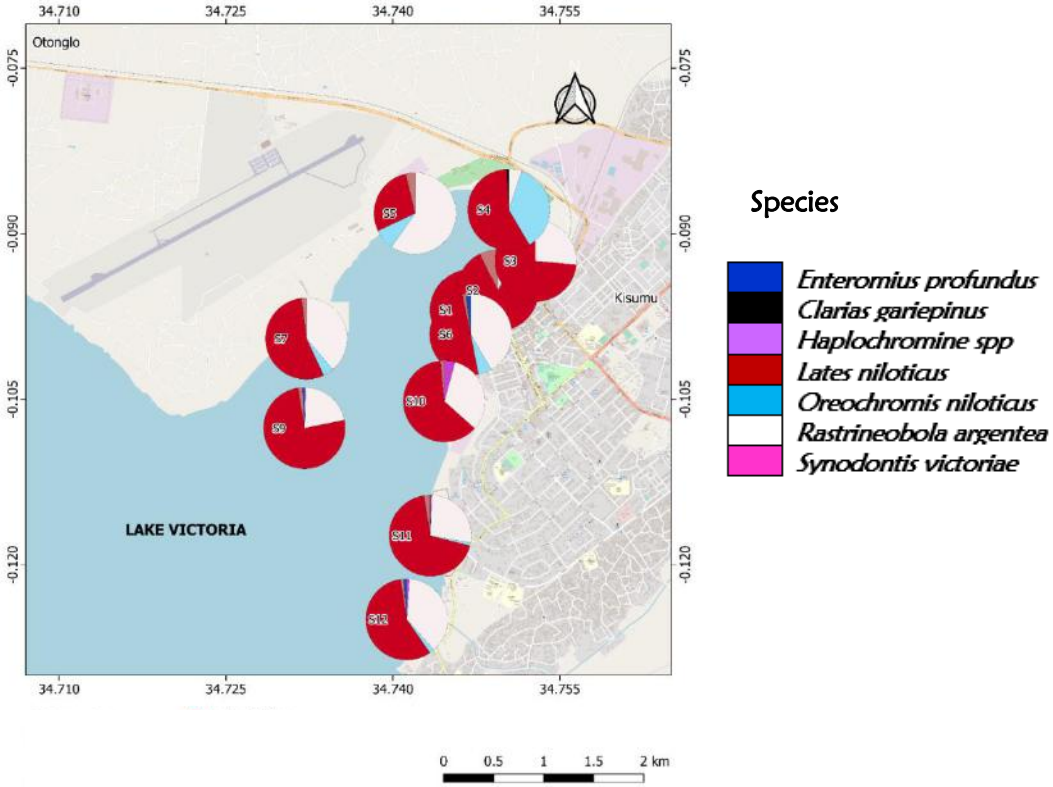


Figure 29. Spatial distribution and relative abundance of fish species within Kisumu bay of Lake Victoria (Source: Site visits, November 2019).

### 2.6.3.2 Fish landings at Kichinjio and Dunga beaches (Kisumu Bay) June 2018-April 2019

There are a number of active fish landing sites (beaches) in Kisumu county. Kisumu Port is located in Kisumu East subcounty which has two main fish landing sites namely Kichinjio and Dunga. The two landing sites, had only 10 and 7 and 105 and 155 active fishing boat according to Fisheries Frame survey 2016 & 2019 respectively. There are averagely close to 50 and 300 (fishers) people involved in active fishing at Kichinjio and Dunga beaches respectively. There is also a large population who rely on other fish related activities.

The fishing activities are sometimes hampered due to the presence of water hyacinth which hinders accessibility to both land and water which is likely to result in overall decline in fish catches especially for the fish found inshore as reflected in monthly fluctuation in number of active boats (Table 7).

**Table 7. Number of fishers and boats at Kichinjio and Dunga landing sites (Source: State Department of Fisheries and Blue Economy, Kisumu, 2019).**

| | Year | 2019 | | | 2018 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Landing site** | **Month** | April | Mar. | Feb. | Dec. | Nov. | Sept. | Aug. | July | June |
| Kichinjio | No.Fishers | 42 | 47 | 37 | 38 | 42 | 47 | 47 | 47 | 47 |
| | No. Boats | 8 | 7 | 7 | 6 | 10 | 14 | 13 | 14 | 14 |
| Dunga | No.Fishers | 200 | 200 | 300 | 250 | 280 | 280 | 300 | 300 | 300 |
| | No. Boats | 67 | 65 | 87 | 80 | 95 | 97 | 104 | 105 | 107 |

The boats fishing at Kichinjio only use boat seine 'Amouk' as the fishing gear while at Dunga, various fishing gears are in use (boat seines, Longlines, Gillnets, & Beach seine as the main gear type targeting various fish species (Nile perch, Nile tilapia, cat fish, lung fish, Dagaa, Synodontis spp e.t.c). Paddled boats (Parachute boats) here fish majorly with boat seines ('amuok') while other boat types (Sesse pointed at both ends) mostly propelled by sails, venture into the relative distant fishing grounds. It is important to note that fish landings at these two beaches (Dunga and Kichinjio) are not a direct indication of fish stocks within the bay. It is thus plausible to say that the fish landed here could be from other fishing grounds not necessarily within from the bay. Fish landings at Kichinjio and Dunga beaches July 2018-April 2019 are presented in table 8 and 9. The fish species are Tilapia (tialpiines), Nile perch (lates niloticus), African Catfish (Clarias gariepinus), lungfish (Protopterus aethiopicus), haplochromines, Omena (Rastrinebola argentea and Synodontis spp.

The quantity of fish landings at Kichinjio beach are less compared to Dunga given that the former has less fishing boats. There are variations composition of species landed by months. Landing of R. argentea (Omena) at Kichinjio ranged from 190 Kg in March 2019 to 1,861 kg August 2018, Tilapines from 369 to 1,196 and Nile perch from 355 to 811 kg respectively over the same period. Other species landed were Lungfish 370 kg in April 2019 and 752 in August 2018, Catfish 351 and 1,248 over the same period (Table 8). At Kichinjio, R. argentea (Omena) contributed between 18-34%, tilapia 9-20%, Nile perch 10-15%, mudfish 3-5 %, Catfish 6-10%, Synodontis spp 18-25% (Figure 30).

**Table 8. Fish landings (Kg) at Kichinjio beach landing site during August 2018 through April 2019 (Source: State Department of Fisheries and Blue Economy, Kisumu).**

| Fish Type | Omena | Tilapia | Nile perch | Lung fish | Cat fish | Haplochromine | Synodontis | Total |
|---|---|---|---|---|---|---|---|---|
| Aug-18 | 1,861 | 1,196 | 811 | 752 | 1,248 | 0 | 1,284 | 7,176 |
| Sep-18 | 857 | 870 | 466 | 649 | 834 | 0 | 590 | 4,245 |
| Nov-18 | 740 | 720 | 643 | 487 | 478 | 0 | 1,096 | 4,179 |
| Dec-18 | 488 | 225 | 208 | 307 | 334 | 0 | 474 | 2,036 |
| Feb-19 | 966 | 524 | 472 | 407 | 233 | 0 | 1,021 | 3,623 |
| Mar-19 | 190 | 92 | 116 | 148 | 159 | 116 | 153 | 974 |
| Apr-19 | 958 | 369 | 355 | 370 | 351 | 107 | 329 | 2,839 |

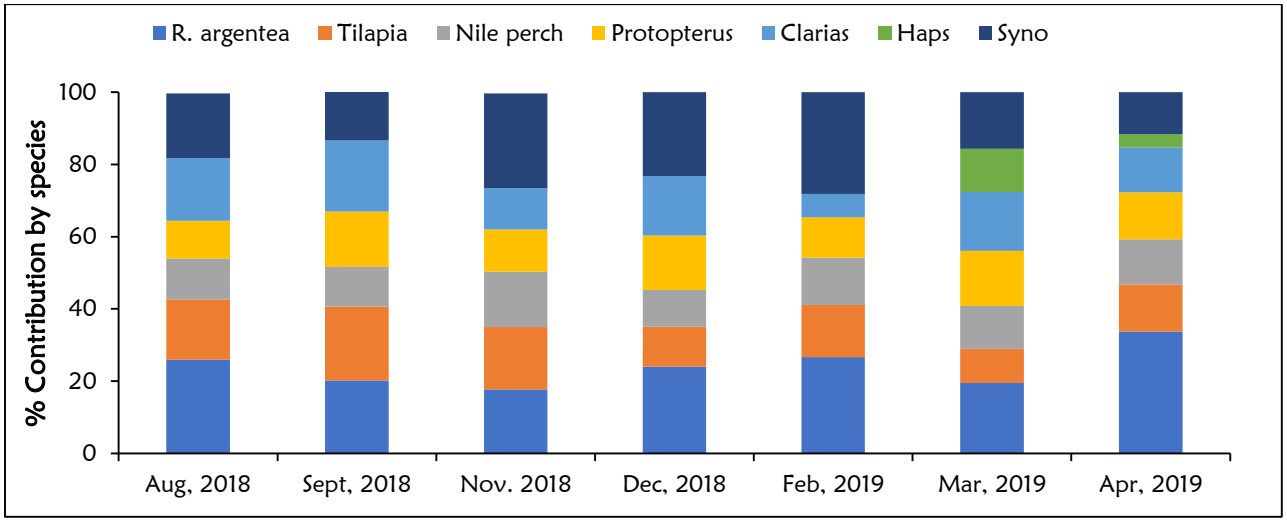


**Figure 30. Species composition of the fish landings at Kichinjio beach (Source: State Department of Fisheries and Blue Economy, Kisumu).**

Landing of R. argentea (Omena) at Dunga ranged from 5,390 Kg in April 2019 and 10,040 kg August 2018, Tilapines from 889 to 1,582 and Nile perch from 2,187 to 3,412 kg respectively over the same period. Other species landed are Lungfish 904 kg in April 2019 and 1,322 in August 2018, Catfish 1,319 and 2,140 over the same period (Table 9).

**Table 9. Fish landings (Kgs) at Dunga beach during July 2018 through April 2019 (Source: State Department of Fisheries and Blue Economy, Kisumu).**

| Fish | Omena | Tilapia | Nile perch | Lung fish | Cat fish | Haps | Syno | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| Jul-18 | 8,990 | 1,690 | 2,577 | 1,219 | 2,002 | 1,751 | 6,720 | 8,729 | 33,678 |
| Aug-18 | 10,040 | 1,582 | 3,412 | 1,322 | 2,127 | 2,140 | 7,990 | 9,290 | 37,903 |
| Sep-18 | 9,600 | 1,737 | 2,985 | 1,054 | 1,714 | 1,745 | 5,885 | 8,139 | 32,859 |
| Nov-18 | 9,630 | 1,361 | 3,106 | 1,111 | 1,812 | 1,855 | 7,990 | 8,820 | 35,685 |
| Dec-18 | 8,700 | 1,376 | 3,042 | 1,099 | 1,632 | 1,512 | 6,210 | 5,160 | 28,731 |
| Feb-19 | 8,140 | 1,418 | 2,165 | 1,415 | 1,657 | 1,973 | 6,175 | 5,255 | 28,198 |
| Mar-19 | 4,190 | 1,315 | 1,962 | 898 | 1,105 | 1,409 | 3,990 | 3,055 | 16,649 |
| Apr-19 | 5,390 | 889 | 2,187 | 904 | 1,319 | 1,545 | 5,355 | 3,515 | 21,104 |

The data showed temporal variation with a general decline of quantity of various species landed. At Dunga Beach, R. argentea (Omena) contributed between 25-30%, tilapia 0-5%, Nile perch 8-12%, mudfish 3-5 %v, Catfish -7%, Synodontis spp 18-25% (Figure 31).

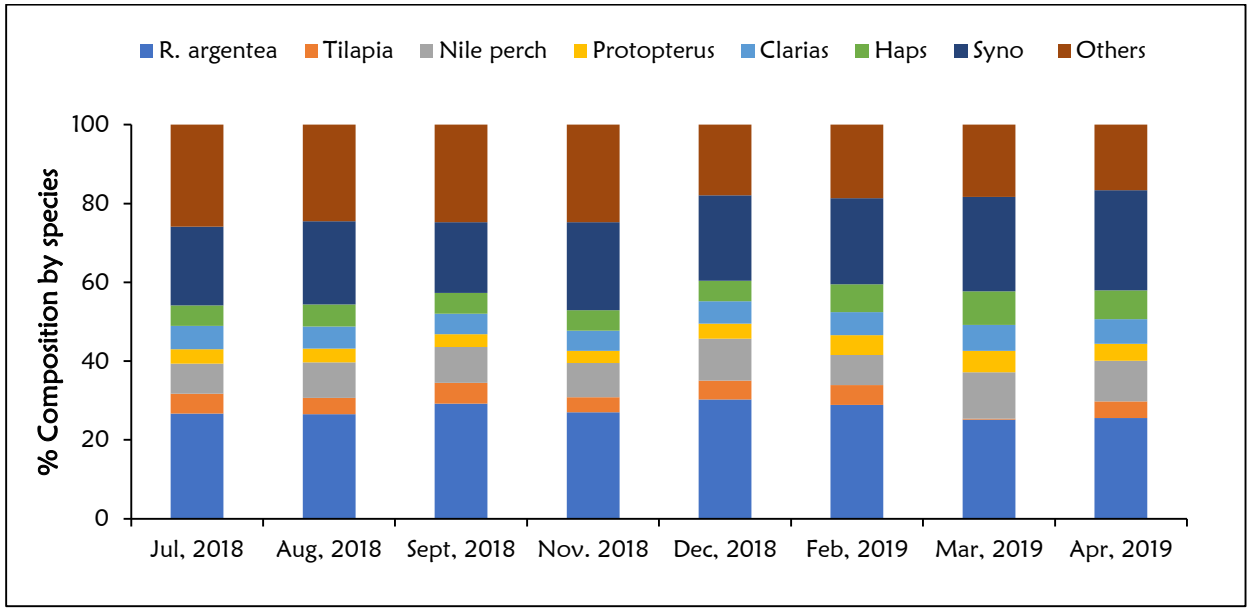


**Figure 31. Species composition of the fish landings at Dunga beach ((Source: State Department of Fisheries and Blue Economy, Kisumu).**

### 2.6.4 Macro invertebrates composition and distribution

A total of (251) orders representing (10) families and (10) genera were recorded during the survey (Appendix 4). The highest number of genera were recorded at S2(S) with a total collection of 48 and S12(S) with a total collection of 19. These points were at the shoreline's stations. Total counts from the offshore sites were as follows: S10 (55), S7 (17) with the lowest recording at S4 recording (1) and S6 with (4). During the study period, the highest no. of genera was recorded among the orders Haplotaxida (110) and Hirudinae (45) while the lowest genera recorded were represented by Araneae (1), Hirudinida (1) and Coleoptera (1) each. Taxa richness and Shannon's diversity indices were similar in all the stations with the exception of S10 that was dominated by one species indicating low habitat integrity (Figure 32).

Most stations were dominated by deposit feeders (Figure 33). This can be attributed to the habitat characteristics and available food. Deposit feeders were prevalent within the inner bay consistent with the high turbidity fueled by river effluents. Stations in the outer bay (S11 and S12) exhibited higher macroinvertebrate trophic diversity. These two stations had no pollution tolerant species (Figure 34) indicating relatively better water quality. The rest of the stations had pollution tolerant species, an indication of elevated levels of pollution.

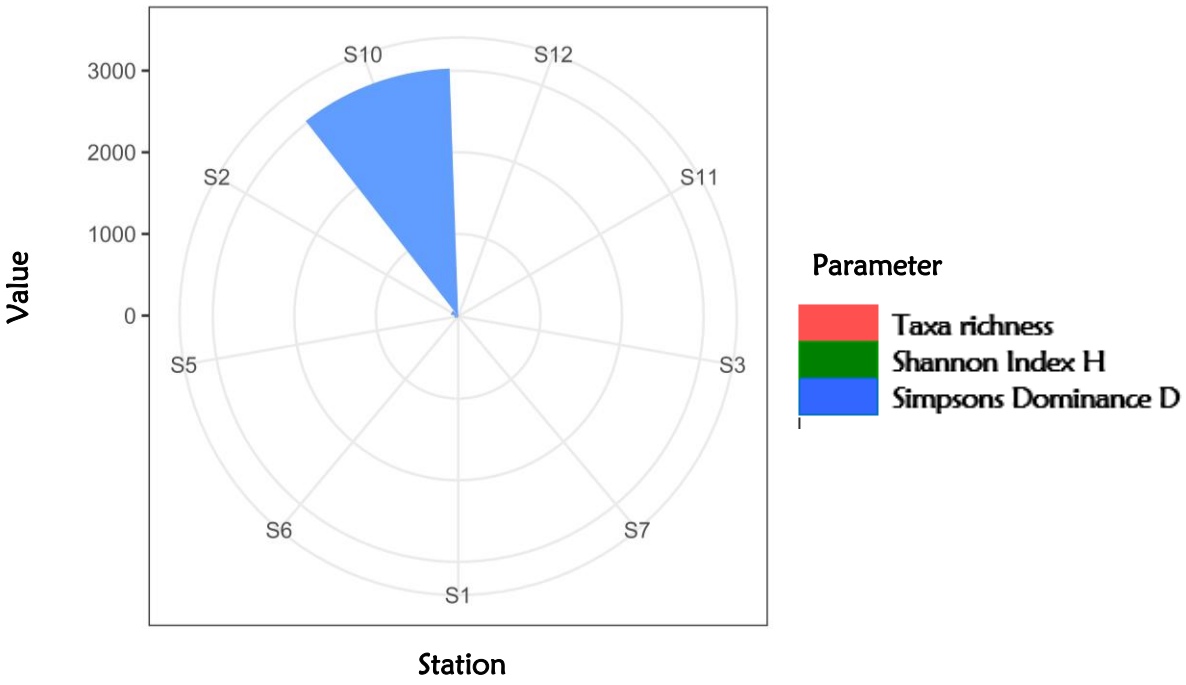


Figure 32. Macro invertebrate's diversity within Kisumu Bay of Lake Victoria (Source: Ongore et al, 2018).

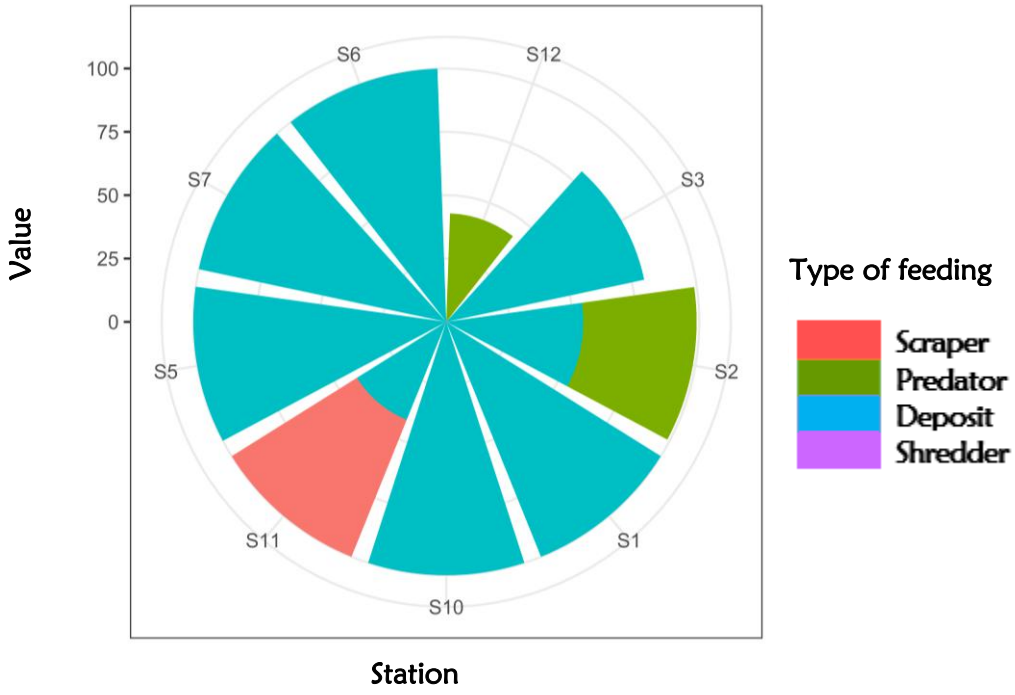


Figure 33. Characterization of macro invertebrate based of feeding habits (Source: Ongore et al, 2018).

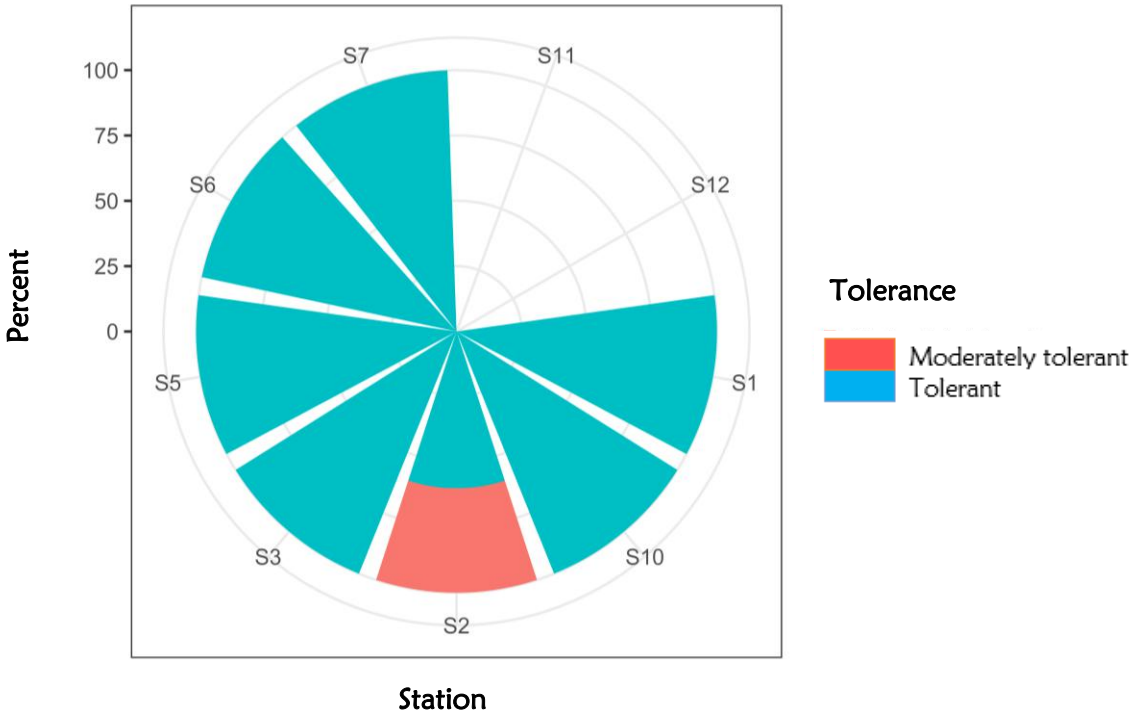


**Figure 34. Tolerance levels to pollution of macroinvertebrates sampled in Kisumu Bay of Lake Victoria (Source: Ongore et al, 2019).**

### 2.6.5 Biodiversity within the port

The port area has considerable biodiversity which was assessed based on 6 survey locations based on the different habitat types. These included wetlands, drainage channels, woodlots, shoreline and bare grounds. The targeted species included mammals, birds, reptiles and trees. The mammals sighted were Hilget's vervet monkey (Figure 35), *Chlorocebus pygerythrus* and Hippopotamus, *Hippopotamus amphibious.* Fifteen species of birds were recorded as per Table 10 below. Two reptiles were sighted which are Monitor lizard, *Varanus niloticus* and L.V. Clawed frog, *Xenopus victorianus.* The terrestrial vegetation cover is comprised of grass and trees. The survey identified 13 tree species as listed in Table 10 below. The aquatic vegetation was also assessed and is reported under water hyacinth and other macrophytes. There were no endangered species observed within the port area during the survey. However, it should be noted that there are three herds of hippos which reside within Kisumu Bay. Their habitats include areas near the Nyanza Golf Club, Hippo Point and Dunga Beach. These habitats are characterized by sandy substrate from rivers and streams flowing into the bay. Dredging of the access channel to the port may negatively impact on these habitats especially if mud and silt from the dredged areas is carried and settles into these areas.

**Figure 35. Vervet monkeys observed within the Port area during site visits and biodiversity survey (Source: Site visit, November 2019).**

**Table 10. Birds and trees observed during biodiversity survey at Kisumu Port on 2nd - 4th November 2019.**

| | | |
|---|---|---|
| **Birds** | | |
| 1 | Hadada ibis | *Bostrychia hagedash brevirostris* |
| 2 | Scopus umbrette | *Hamerkop bird* |
| 3 | Water Thick-knee | *Burhinus vermiculatus* |
| 4 | Double-toothed Barbet | *Lybius bidentatus* |
| 5 | African pygmy bulbul kingfisher | *Ispidina picta* |
| 6 | Giant kingfisher | *Megaceryle m. Maxima* |
| 7 | Pied kingfisher | *ceryle r. Rudis* |
| 8 | Common or Dark-capped bulbul | *Pycnonotus barbatus* |
| 9 | Black headed batis | *Batis minor* |
| 10 | African pied wagtail | *Motacilla aguimp vidua* |
| 11 | Ring-necked dove | *Streptopelia capicola* |
| 12 | Long tailed glossy starling | *Lamprotomispurpuropterus* |
| 13 | Gull-billed tern | *Sterna n. nilotica* |
| 14 | Speckled mouse bird | *Colius striatus kikuyuensis* |
| 15 | White-winged tern | *Chlidonias leucopterus* |
| **Trees** | | |
| 1 | Nile tulip (trumpet) | *Markhamia lutea* |
| 2 | Mango Tree | *Mangifera indica* |
| 3 | Malabar plum tree (Zambarau) | *Syzygium guineense* |
| 4 | Spotted gum | *Eucalyptus maculata* |
| 5 | Flame tree | *Delonix regia* |
| 6 | Siamese senna | *Cassia senna* |
| 7 | Wild fig | *Ficus thonningii* |
| 8 | Frangipani | *Plumeria rubra* |
| 9 | Umbrella tree | *Terminalia spinosa* |
| 10 | Whistling tree | *Cassuarina equisentifolia* |
| 11 | Avocado tree | *Persea americana* |
| 12 | Jackfruit | *Artocarpus heterophyllus* |
| 13 | Peacock flower | *Albizia gummifera* |

### 2.6.6 Other biodiversity hotspots near Kisumu Port

The port neighbors biodiversity hotspots which include Kisat Estuary, Dunga Wetland and the Impala Park which could potentially interact with the port area. Each of these are discussed briefly below.

#### 2.6.6.1 Kisat Estuary

Kisat Estuary is the location where River Kisat meets Lake Victoria, to the North West of Kisumu Port. It has a large wetland with a significant amount of flora and fauna biodiversity as well (Tables 11 and 12). The floral communities are dominated by aquatic macrophytes while birds are the dominant fauna (Figure 36).

**Table 11. List of vegetation types found at Kisat Estuary.**

| **Plants of Kisat Estuary** | |
|---|---|
| **Common Name** | **Scientific Names** |
| Giant reeds | *Arundo donax* |
| Papyrus reeds | *Cyperus papyrus* |
| Water hyacinth | *Eichhornia crassipes* |
| Napier grass | *Pennisetum purpureum* |
| Hippo grass | *Echinochloa stagnina* |
| Mango | *Mangifera indica* |
| Bulrush | *Typha latifolia* |
| Castor oil plant | *Ricinus communis* |

**Table 12. List of birds sighted at River Kisat Estuary.**

| **Birds of Kisat Estuary** | |
|---|---|
| **Common Name** | **Scientific Names** |
| Great egret (Figure 36) | *Ardea alba* |
| Sand martin / Bank swallow | *Riparia r, riparia* |
| Egyptian goose (Figure 36) | *Alopochen aegyptiaca* |
| Scopus umbrette | *Hamerkop bird* |
| Diving bird (white in colour) | |

#### 2.6.6.2 Impala Park Sanctuary

Impala Park Sanctuary is a gazetted site managed by the Kenya Wildlife Service whose objective was to provide sanctuary and grazing grounds for the impalas and hippos from the lake. The sanctuary covers a total area of 38.6 Ha which are split into two separate parcels; Impala A and Impala B. Impala B is a 10.3 Ha piece of land disconnected from the main Impala Sanctuary by privately owned parcels of land namely: Yacht club, Hare Krishna and Hippo point. The notable biodiversity of exceptional resource value includes impalas, sitatunga antelopes, Nile crocodiles, hippopotamus, reptiles, birds and lakeshore wetlands. Other than the free-range wildlife, it also has captive wildlife as listed in Table 13 below. The vegetation at the park comprises of trees, shrubs and herbaceous plants (Appendix 5).

**Figure 36. Some of the biodiversity observed at Kisat Estuary and its environs. Clockwise from top; Egyptian goose, Hippopotamus, Egrets and Hippo Grass (Source: Site visit, November 2019).**

**Table 13. List of Captive and Free-Range Wildlife of the Impala Sanctuary Kisumu (Source: Kenya Wildlife Service).**

| **Captive Wildlife of Impala Sanctuary** | |
|---|---|
| **Common Name** | **Scientific Name** |
| Lions | *Panthera leo* |
| Leopard | *Panthera pardus* |
| Cheetahs | *Acinonyx jubatus* |
| Serval cat | *Leptailurus serval* |
| Buffalo | *Syncerus caffer* |
| Ostrich | *Struthio camelus massaicus* |
| Duiker | *Cephalophinae* |
| Common Warthogs | *Phacocherus africanus* |
| African Gray Parrots | *Psittaus erithacus* |
| Olive baboons | *Papio Anubis* |
| Blue monkey | *Cercopithecus mitis* |
| Patas monkey | *Erythrocebus patas* |
| Spotted hyena | *Crocutta crocutta* |
| Maasai giraffe | *Giraffa camelopardalis* |
| | |
| **Free range Wildlife of Impala Sanctuary** | |
| **Common Name** | ***Scientific Name*** |
| Common Zebra | *Equus burchelis* |
| Impalas | *Aepyceros melampus* |
| Sitatunga | *Tragelaphus spekei* |
| Hippopotamus | *Hippopotamus amphibius* |

## 2.7 Land use and land cover

The land use types within the port are port developments such as the warehouse, railway lines, offices of KPA, KRA, immigration and security agencies. The Port is a transportation hub with interchange from land and rail to water transport. Key items being transported include among others people and petroleum products among other goods. This includes both local and international water transport. Land cover includes paved port areas and vegetation characterized by grass, thickets and trees. Around the port the land use and land cover comprise of buildings (residential, commercial and industrial), road network, vegetation, open grounds and Kisumu Bay (Figure 37). The land use patterns around the port area have been changing over the years owing to the growth of the economy of Kisumu City, increased population and devolution of resources under the Kenya Constitution 2010 (Figure 38). A comparison between 2015 and 2019 satellite imagery shows a 20% increase in built up areas around the Port. Revitalization of the Port will impact on the land use patterns in the area, as more support infrastructure is constructed and residential properties to service the workforce increases. Land cover includes recreational land uses near the port which include the Impala Sanctuary located to the southern side and conservation land uses including the Dunga Wetland located further south after the Impala Sanctuary.

**Figure 37. A view of a section of Kisumu Port and neighboring land use and land cover types comprised mainly of residential and commercial developments as well as shoreline trees in mid ground (Source: Site visit, November 2019).**

In terms of Land cover, the main typologies include low density developments interspersed by open green spaces, wetlands and lakeshore forests. The wetlands can be found along the shoreline at Kisat Estuary and Hippo Point. The lakeshore forests also run along the shoreline mainly between the southern boundary of the site through the KWS Impala Sanctuary to the Yacht Club near Hippo Point.

## 2.8 Water resources

The main water resources in Kisumu include Lake Victoria, river systems including streams, boreholes, springs and rainfall. There are ten (10) main rivers draining into Lake Victoria that originate from the surrounding highlands discharging water into the lake at volumes of approximately 800$m^3/s$ (Kairu). They are Rivers Nzoia - 39%, Gucha-Migori - 20%, Sondu - 14%, Yala - 13%, Nyando - 6% and Sio-4%. The remaining 4% comes from various streams such as Awach Seme, Awach Kibos, Awach Kano (clustered as North Awach) and Awach Tende and Awach Kibuon (clustered as South Awach) (LVEMP, 2002). The main rivers around Kisumu Port include River Kisat located about 1.5 km to the north of the site and River Wigwa located about 2.6km to the south. Both river systems drain into Lake Victoria and have wetland estuaries with rich biodiversity.

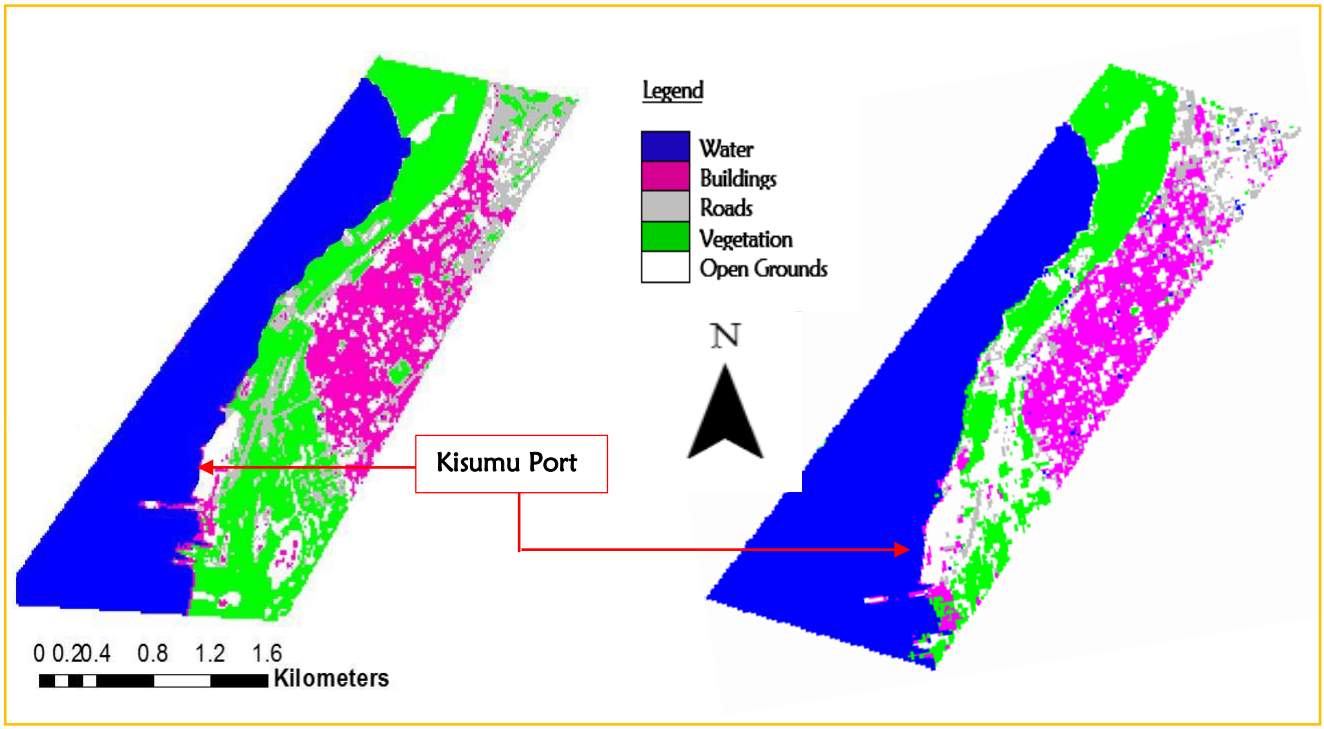


**Figure 38. Land-use/Land-Cover types within Kisumu Port area in 2015 and 2019 (Source: USGS, 2015 & 2019 Online Imagery).**

## 2.9 Municipal water supply

The Kisumu Water and Sewerage Company (KIWASCO) is the main source of water for the City and has two fresh water treatment plants in Dunga and Kajulu areas. Dunga and Kajulu water treatment plants intakes are located in Lake Victoria (Hippo point) and River Kajulu respectively (Figure 39). They have a combined capacity of producing 80,000m$^3$ per day i.e. Dunga 44,000m$^3$ and Kajulu 36,000m$^3$ per day against the current demand of the city which is 58,000m$^3$. The demand is therefore below the total treatment capacity. However, an interview with KIWASCO on 4$^{th}$ November 2019 indicated that they currently supply between 18,000-20,000m$^3$ of water per day to the City which falls below the demand. This supply is split between Dunga and Kajulu plants with Kajulu serving 60% of the demand while Dunga serves 40% through pumping and gravity respectively. The total water supply coverage stands at 70% of the City with 25,600 connections, 86% of which are domestic customers, 13% are commercial/industrial and 1% institutions.

Kisumu Port is supplied from the Dunga plant reticulation but the line is currently blocked. Since the revitalization of the port will lead to increase in labor force and demand for water, the port management is in the process of rehabilitating the supply line and addressing the potential increase in demand by installing a high capacity line (2-inch) and storage infrastructure. Other sources of water in the county include boreholes, rivers, streams, springs, rainfall and the users who draw water directly from Lake Victoria. According to a previous Environmental Impact Assessment Report available at KIWASCO Website, 18.5% of the City residents get their drinking and cooking water directly from private water operators or vendors, 11% water from boreholes,

**Figure 39. Municipal water intake point at Dunga beach on the shores of Lake Victoria (Source: Site visit, November 2019).**

16% directly from the rivers/lake/streams/springs, 5% harvest rain water and 6% from other sources. Majority of the alternatives to KIWASCO do not have treatment systems and could potentially lead to outbreak of water borne diseases in the City and its environs. During the rainy season water is sourced from collection points which are within the peri-urban homesteads such as ponds and surface runoff. Within the informal settlements, although some residents have access to piped water, most of them rely on water kiosks, handcart vendors and boreholes for their water supply (KIWASCO, 2019).

In order to address these challenges and improve water supply and sanitation in the County, KIMASCO in collaboration with Lake Victoria South Water Works Development Agency are working closely with development partners to prepare a Master Plan for implementation in the near future (KIWASCO, 2019).

## 2.10 Waste generation and management

### 2.10.1 Solid waste

Kisumu City generates 400 tonnes of solid wastes per day comprised of organic and inorganic forms. The main waste generation sources are domestic, commercial ventures, hotels, markets, industries, health facilities and social institutions. The types of waste that are generated include: Plastic waste comprised of papers and hard plastics, organic materials including food remnants and wooden debris, rubber, paper, metals, chemicals, glass and biomedical waste from health institutions and sanitary wastes. The solid waste management strategy for the city includes provision of waste bins, established central collection points and use of trucks and other vehicles to transport the collected waste from the municipal dustbins in mixed form and disposing them off at Kachok open dumpsite in the City (Figure 40). The County solid waste infrastructure collects 60% of the 400 tonnes while the rest are collected by the private sector who use hand carts, tuk tuks, pickups and trucks. Another management strategy involves law enforcement to prevent littering as well as illegal and indiscriminate dumping by the County Government of Kisumu and NEMA thus ensuring compliance with the Environmental Management and Coordination (Waste Management) Regulations, 2006.

**Figure 40. The remaining active section of the Kachok dumpsite on the left and a rehabilitated section in the mid ground which is landscaped (Source: Site Visit, November 2019).**

Challenges of solid waste management in the city include lack of adequate infrastructure for solid wastes management. Currently the County Government has 1 skip loader against a demand of 3 (two for the city and 1 for the sub-counties), 4 trucks against a demand of four (four for the city and four for the sub-counties) and 1 compacter at the dumpsite which has broken down against a demand for 2. A section of Kachok dumpsite has been closed, solid wastes cleared and rehabilitated through landscaping (Figure 40). However, the section that remains is still used as a dumpsite and poses health and security risks to the neighboring community and generally Kisumu City as dumpsites harbor disease causing pathogens such as mosquitoes and houseflies, pollute water resources, degrade land and cause air pollution. The County Government has already designated a new dumping site in Awasi comprised of an abandoned quarry for solid waste management. However, the proposed site will need to comply with the Environmental Management and Coordination Act Cap 387 of the Laws of Kenya prior to commissioning. This will include hydrogeological surveys to determine the water table levels and whether the site is suitable for establishment of a landfill as opposed to open dumping. Landfills have substantial environmental benefits that negate the challenges of open dumping and have potential to provide clean energy (biogas) to sections of the City.

At Kisumu Port solid wastes are generated by the workers as well as visitors. The main types observed were plastic bottles, paper, wrappings and organic wastes. The current waste management strategies include the use of litter bins which are later collected and disposed off at Kachok dumpsite by a NEMA licensed contractor. With the revitalization of the port, the solid wastes will include commercial and potentially hazardous categories meaning the handling infrastructure will be upgraded in line with the recommendations that are contained in the Environmental Management Plan (EMP) of this report.

### 2.10.2 Wastewater flows and management

Wastewater flows in Kisumu City includes domestic, commercial, industrial and institutional sources. Based on data provided by KIWASCO whose sewerage coverage of the population is at

16%, Kisumu theoretically generates 75,000m³ of wastewater per day. The wastewater management strategies include two (2) sewage treatment works i.e. Kisat Sewage Treatment Plant and Nyalenda Wastewater Stabilization Ponds (Figure 41). The two facilities have installed capacities of 8,000m³ and 12,000m³ per day respectively. However, the daily flows to these facilities are approximately 6,000m³ each for the two of them. Apart from the treatment plants, the rest of the population (84%) use septic tank-soak pit systems and pit latrines which can potentially contaminate ground water reservoirs or overflow when they are full, blockages and during the rainy season and lead to the outbreak of water borne diseases. Overflow concerns can be addressed through exhausting of the septic tanks and pits. Both KIWASCO and the private sector provide exhauster services and transport the sewage for disposal at the Nyalenda Wastewater Stabilization Ponds.

**Figure 41. A section of the Kisat Sewage Treatment Plant showing the settlement tanks (Source: Site visit, November 2019).**

Kisumu Port currently uses septic tanks in the management of wastewater from the facility. It has two septic tanks which serve the employees and visitors to the facility. They are usually exhausted on a need by need basis by a NEMA licensed contractor. During the ESIA surveys, the team visited both the Kisat and Nyalenda Sewage Plants to document their status. Kisat was particularly of interest because it's within the reach of Kisumu Port and can potentially provide it with sewage treatment services and address concerns of waste water discharge from vessels docking at the port. During water quality sampling and field surveys, the consultants noted two storm water channels that discharge raw effluent to the north west of the port directly into the bay leading to nutrient loading, algae blooms and fouling of the port. Two samples (Water Quality Station 1 and 2 respectively) were obtained from these discharge points and analyzed for compliance with the Environmental Management and Coordination (Water Quality) Regulations, 2006. Analysis of the samples confirmed that Station 2 is indeed raw sewage due to high levels of Chemical Oxygen Demand (80mg/l) and Biological Oxygen Demand (33mg/l) (Figure 42). Similarly, River Kisat Estuary (Water Quality Station 3) water sample had relatively high levels of Total Suspended Solids (39 mg/l), Chemical Oxygen Demand (64 mg/l) and Total Coliforms (1360mg/l) indicating potential discharge of raw effluent into the River. River flows into the lake, runoff and discharge

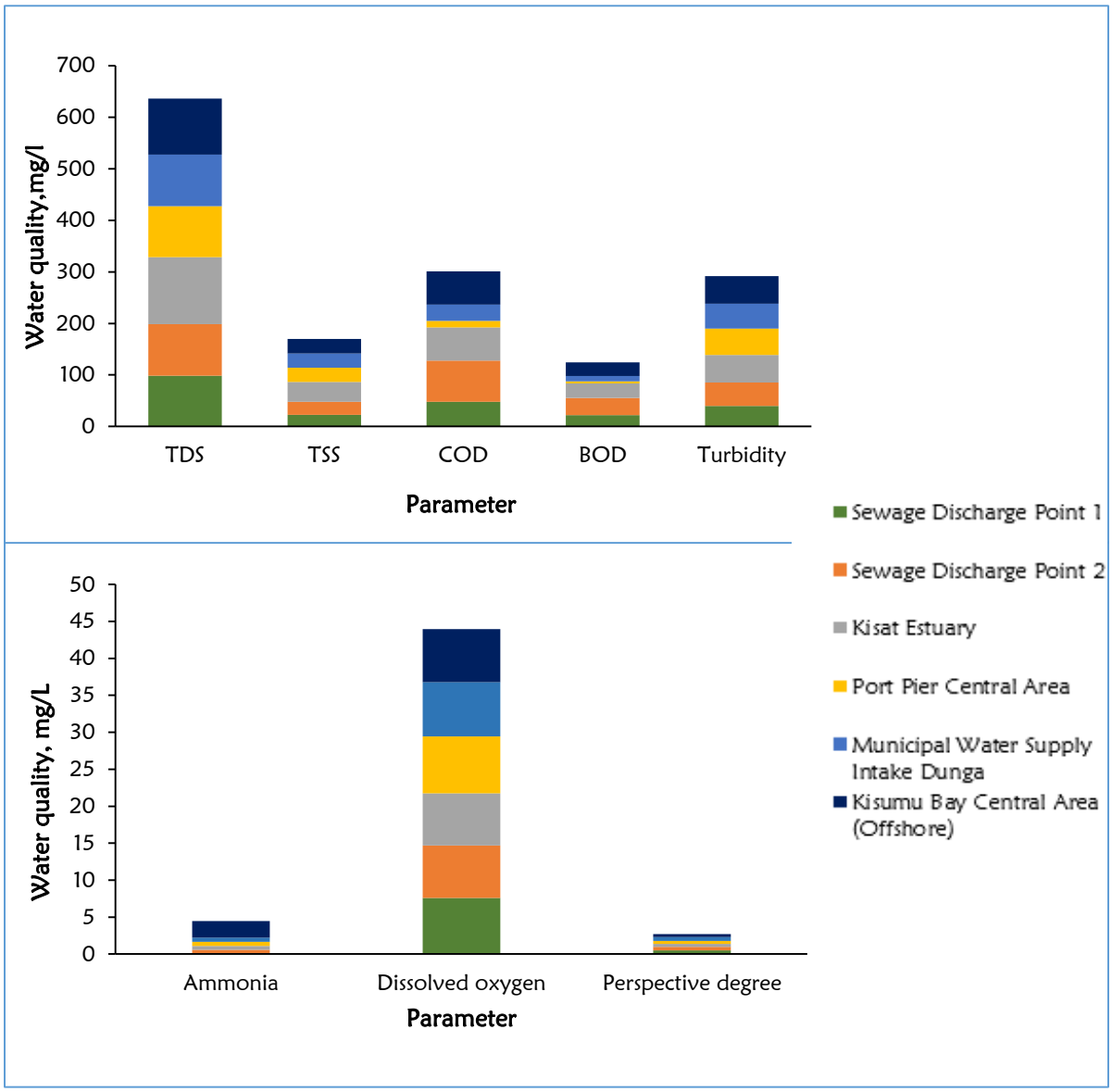


**Figure 42. Water quality across six sampling stations at Kisumu Bay (Source: Polucon Services (K) Limited).**

of untreated effluent into the bay has contributed to considerable turbidity levels which averaged 47mg/l across all the six water quality sampling stations.

Nutrient loading in the Bay is responsible for algae blooms observed during the site visit and provides suitable conditions for the proliferation of aquatic macrophytes such as water hyacinth. Dissolved oxygen which is a key factor in the productivity of the Lake averaged 7mg/l which is more than twice the critical level (3mg/l) for survival of fish within the bay. However continued discharge of raw effluent, sedimentation from dredging activities and traditional runoff may lead to reduced oxygen levels and could potential pose a risk to the productivity of the lake (Figure 43). The raw sewage discharging to the Bay is a health risk to the local population who depend on water from the lake for domestic use and horticulture which features short cycle crops.

**Figure 43. Green algae bloom at Kisumu Bay near Kisumu Beach Resort observed on 16th November 2019 (Source: Site visit, November 2019)**

A discussion with KIWASCO revealed that there were plans to construct a trunk sewer along the shoreline including the port area and connect it to either the Kisat Treatment Plant by installing a pumping station and a rising main. This would also address environmental concerns of raw wastewater discharge by shoreline developments into Lake Victoria leading to algae blooms and degradation of water quality. Lake Victoria South Water Works Development Agency has proposed the construction of another Sewage Treatment Plant near Kisumu Airport as part of the Master Plan to address wastewater management challenges. Kisumu Port could also potentially connect to this new facility.

## 2.11 Ambient air quality at the Port

Table 14 summarizes the findings of ambient air quality measurements at Kisumu Port. The findings show that the baseline values are within the limits prescribed under the Environmental Management and Coordination (Air Quality) Regulations, 2014.

**Table 14. Ambient air quality measurements for Kisumu Port (Source: Polucon (K) Services Limited, November, 2019).**

| Location | Runs | CO ($mg/m^3$) | $NO_2$ (ppm) | $PM_{2.5}$ ($\mu g/m^3$) | $H_2S$ ($\mu g/m^3$) | $PM_{10}$ ($\mu g/m^3$) | SO2 ($\mu g/m^3$) | VOCs ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|
| **Point 1** S--0.103608 E-4.745337 | Run 1 | 0.24 | 0.119 | 12 | 10 | 21 | 20 | 10 |
| | Run 2 | 0.21 | 0.115 | 14 | 17 | 22 | 20 | 15 |
| | **Average** | **0.23** | **0.12** | **13** | **13.5** | **21.5** | **20.00** | **12.5** |
| | **Precision** | **0.23±0.03** | **0.12±0.004** | **13±2** | **13.5±7** | **21±1** | **20±0** | **12.5±5** |
| **Point 2** S--0.106121 E-34.75337 | Run 1 | 0.23 | 0.12 | 10 | 11 | 18 | 40 | 13 |
| | Run 2 | 0.24 | 0.11 | 12 | 11 | 19 | 30 | 14 |
| | **Average** | **0.24** | **0.12** | **11** | **11** | **13.5** | **35.00** | **13.5** |
| | **Precision** | **0.24±0.01** | **0.12±0.01** | **11±2** | **11±0** | **13.5±1** | **35±10** | **13.5±1** |
| **Point 3** S--0.10612 E-34.739418 | Run 1 | 0.18 | 0.09 | 13 | 15 | 19 | **27** | 14 |
| | Run 2 | 0.16 | 0.09 | 16 | 12 | 15 | **22** | 13 |
| | **Average** | **0.17** | **0.09** | **14.5** | **13.5** | **17** | **24.5** | **13.5** |
| | **Precision** | **0.17±0.02** | **0.09±0.0** | **14.5±3** | **13.5±3** | **17±5** | **24.5±5** | **13.5±1** |
| **Air Quality Regulations, 2014 Limits** | | 4.0 $mg/m^3$ | 0.2 ppm | | 75$\mu g/m^3$ | 150$\mu g/m^3$ | | |

## 2.12 Noise level measurements

Table 15 summarizes the findings of noise level measurements at Kisumu Port. The findings show that the baseline values are within the limits prescribed under the Environmental Management and Coordination (Noise and Excessive Vibrations) Regulations, 2009.

**Table 15. Baseline noise level measurements obtained from three points at Kisumu Port (Source: Polucon (K) Services Limited, November, 2019).**

| Measurement Site | Measured Sound Pressure Level (Noise) (dBA) | | | EMCA Guideline | World Bank limits | WHO Limits | O.S.H Exposure Limits |
|---|---|---|---|---|---|---|---|
| | Daytime Period (0700-2200Hrs) | | | Day time | Daytime | Daytime | Day time |
| | LAeq | Lmax | Lmin | LAeq | LAeq | LAeq | LAeq |
| Point 1<br>S -0.10360<br>E-34.745337 | 54.6 | 77.6 | 50.7 | 55 | 70 | 85 | 90 |
| Point 2<br>S-0.106121<br>E-34.75337 | 53.3 | 75.2 | 52.2 | 55 | 70 | 85 | 90 |
| Point 3<br>S-0.10612<br>E-34.739418 | 54.1 | 76.1 | 53.1 | 55 | 70 | 85 | 90 |

## 2.13 Population of Kisumu City

According to the Kenya Population Census Results released in November 2019, Kisumu County has a population of 1,155,574 comprised of 560,942 males and 594,609 females. Of the total, 750,000 people live within Kisumu City. According to the Food and Agricultural Organization (FAO) the County has a high unemployment rate of over 50 percent which has contributed to high inequality and poverty levels, with the youth who make up over 70% of the population being the most affected.

## 2.14 Socio-economic profile

Fishing is one of the key economic activities around the port area and among the riparian communities (Figure 44). It contributes KES 30 Billion in annual fish export revenues to the economies of Kenya, Tanzania and Uganda who share the lake. According to the Fisheries Frame Survey 2017, there are 3,275 fishermen, and 189 fish farm families in the entire Kisumu County. The most common fish include omena, tilapia, and Nile perch, which generate incomes of KES12 million, 28 million, and 11 million per year, respectively. The fish is sold locally and also processed for export (GoK, 2014). With the introduction of aquaculture, households have been investing in cage farming on the shores of the lake as well as pond construction and maintenance within the riparian zones and terrestrial hinterlands. There are over 1,330 fish farms which have been established within the County and over 3,000 cage fish farms as of 2017 (Source: State Department of Fisheries and the Blue Economy, November 2019).

The economy of the peri-urban areas of Kisumu City and rural sub-counties is largely based on agriculture which accounts for 47% of household income. Generally, about two thirds (62%) of all households in Kisumu County depend on crop farming for their livelihoods (GoK, 2014).On average, agricultural income amounts to KES 82,482 per household per year and is generated from crop faming (40% of on-farm income), fish (23%), and livestock (11%). The agricultural sector also

**Figure 44. Sample Nile perch landings at Naya near Luanda K'Otieno (Source: Credit to Hilda Nyaboke, November 2019).**

provides raw materials to the manufacturing sector and therefore stimulates non-farm incomes and employment (GoK, 2012).

The main subsistence crops include maize, sorghum, rice, bean, finger millet, cassava, potato, groundnut, and kale (GoK, 2014). In 2012, major food crops produced in the County were valued at approximately KES10 billion; maize was the highest contributor, accounting for 56% of the total food crops' value (KES5.7 billion), followed by sorghum (KES1.9 billion, equivalent of 20% of the total food crops value), and beans (KES 1.4 billion, 14.6%) (GoK, 2014). Key cash crops cultivated in Kisumu are sugarcane, rice and cotton. Livestock production generates approximately KES1.5 billion annually (GoK, 2014). On average, 93% of the households in Kisumu County rear chicken, 47% keep cattle, and 39% keep goats and, 24% hold sheep. Some of the main non-agricultural (informal) activities in the County include *boda boda* (especially in Kisumu City), small-scale trading (shop vendors), tourism and to lesser extents recreational sailing and fishing.

The revitalization of the Port will enhance fishing, manufacturing, trade, agri-business and ease the movement of goods, services and people within the Lake basin. These activities will in turn create employment opportunities and greatly contribute to the growth of Kisumu and the regional economies.

## 2.15 Health institutions

Health in Kisumu County is provided by several institutions that are either private or government funded. The Kisumu County Integrated Development Plan (CIDP) 2018 – 2022 notes that there are a total of 210 registered health facilities which include 34 hospitals, 8 nursing/maternity homes, 45 health centers, 94 dispensaries and 29 clinics. Key health facilities in the County are Jaramogi Oginga Odinga Teaching and Referral Hospital, the Kisumu County Referral Hospital and the Aga Khan Hospital Kisumu all located in Kisumu City. The CIDP also notes that currently the Doctor to

population ratio is 1: 44,634 and Nurse to population ratio is 1: 2,383 against the recommended WHO standard Doctor or nurse Population ratio of 1:435. Therefore, a comprehensive approach, supported by strong County and National leadership, governance and information systems, is needed to ensure skilled and motivated health care workers are deployed in the right place.

## 2.16 Educational institutions

Kisumu County has several colleges and universities, including Maseno University, Great Lakes University, Nairobi University and several teaching and nursing colleges. Primary and secondary education is provided by 706 primary schools and 173 public secondary schools. A substantial number of private institutions also exist within the county and the Kisumu Port area.

## 2.17 Transport infrastructure

Kisumu County is served with an effective and reliable infrastructure. Historically, Kisumu County was connected to other major cities in Kenya by the Mombasa-Nairobi-Kisumu railway with a branch extension to Butere. There are three railway stations that fall within the city, namely Kibos station, Kisumu mainline station and Kisian station on the Butere branch. The narrow-gauge railway moves both passengers and cargo, linking Kisumu with other cities and towns along the railway line. Kisumu County has several paved roads, the major one being the Nairobi-Bondo Road, which has a branch at Kisian heading to Busia. The National roads are paved with asphalt while the County roads are mostly murram but provide all weather movement all year. Being the convergence point of the Great North Road, Kisumu is well connected to Uganda, Tanzania, and by extension Rwanda, Burundi and Democratic Republic of Congo in the west, Zambia to the south and Sudan to the north. The county is also served with an international airport which has the potential to be an entry port for the entire region with the capacity to handle local and regional flights, while steamer operations provide further communication to other lakeshore towns in Kenya, Tanzania and Uganda, across Lake Victoria. Water transport on the lake is provided mostly by private operators in wooden boats with outboard engines and a ferry. The services connect towns on the shores and also help in crossing the lake. They also link the county with the other three lakeside counties and the countries of Tanzania and Uganda. Lake Victoria offers potential for mass transport of goods and passengers across the region and beyond. At the moment, the port of Kisumu is very inactive but has the potential to become a regional center of lake transport and a gateway for Kenya into the rest of the African Great Lakes region. The government of Kisumu County plans to develop a dry dock port within Kisumu City.

# 3 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

## 3.1 Overview

The proposed revitalization of the Kisumu Port will have both socio-economic benefits and attendant negative environmental and social impacts. One of the key objectives of the ESIA process is to systematically assess the value of the benefits against the environmental and social concerns and provide measures to avoid, prevent or reduce the magnitude of the impacts. The following section identifies, predicts and analyzes these impacts and proposes mitigation measures to address them. The mitigation measures are based several EIA principles such as the entitlement to a clean and healthy environment and duty to enhance and safeguard the environment, polluter pays principle, precautionary approach, regional cooperation and stakeholder involvement in addressing environmental and social challenges of the proposed revitalization of Kisumu Port.

## 3.2 Positive impacts of the proposed project

A revitalized Kisumu port will contribute to the growth of the local, national and regional economies through increased capacity to handle exports and imports to and from Kenya. It will have a capacity to handle approximately 15,000 TEUs, petroleum and textile products among other conventional cargo. It will potentially support manufacturing which is one of the Big four agendas of the Kenya Government by providing cheap and efficient infrastructure for exports and imports in and out of the lake basin region. The port will also help attainment of the economic pillar of Vision 2030 which is the national long-term development blueprint to create a globally competitive and prosperous nation with a high quality of life by 2030 in a clean and secure environment.

### 3.2.1 Provision of employment opportunities and support to other businesses

Revitalization activities will include planning, implementation and operation of the port. At the planning stage the proponent has already provided employment opportunities to consultants such as architects, engineers and environmentalists. During the actual revitalization the project will provide direct employment opportunities to civil engineers and contractors who will be involved in dredging of the access channel and pier area, paving of the port yard, repairs of the warehouse and painting among other activities. It is expected that the contractors will source labour from the local community and elsewhere in the country when the skills required are not available locally. Direct employment opportunities are estimated at 100 people at this stage. Once the port becomes operational, the proponent will recruit personnel to oversee operations at the port. It is expected that the private sector will develop other port support infrastructure and services such as storage yards, clearing and forwarding agencies respectively which will lead to creation of additional direct employment opportunities. Ships and other crafts calling at the port will require crew and services such as desludging and disposal of wastes which will enhance the businesses of the companies which will be contracted and hence increased employment opportunities. Other businesses that stand to benefit from the revitalized port include tourism, hotels and commercial outlets selling spare parts and supplies to the ships docking at the port.

### 3.2.2 Generation of revenue to the government

Both the County and National Government will generate revenue from export and import taxes, inspection fees, licences and services rendered by suppliers to the port. The revenue will potentially finance the governments obligations to citizens and overall development of the region.

### 3.2.3 Servicing the hinterland

Kisumu Port is expected to open up the western Kenya market and boost regional trade with land locked countries such as Rwanda, Burundi, Democratic Republic of Congo and South Sudan by

facilitating exports and imports of goods. It will further potentially re-ignite the triangle trade that served the key ports of Mwanza and Port Bell and strengthen the economies of the riparian states of Kenya, Uganda and Tanzania.

## 3.3 Negative environmental and social impacts

Revitalization activities such as dredging and dumping, rehabilitation of the warehouse and paving of the yard area will have impacts on Lake Victoria, terrestrial environment and local livelihoods as well as the health and safety of the riparian communities and employees. At operational stage, the port will have negative impacts which include potential pollution of the lake and impact on fisheries, health and safety risks and socio-cultural impact. A decommissioning phase is possible but the possibility is remote owing to the socio-economic importance of the port and its strategic importance to the country. With the project increase in business and development of the area the KPA master plan envisions an expansion of the port rather than a decommissioning scenario.

### 3.3.1 Negative impacts at revitalization phase

#### 3.3.1.1 Impact of dredging on water quality

Dredging activities will upset sediments at the bottom of the lake. Dumping of dredged materials further within the Lake will generate sediment plumes. The sediment plumes will potentially alter the water quality by increasing turbidity which in turn will affect productivity of Lake Ecosystem mainly due to reduced light, temperature changes and reduced availability of dissolved oxygen. Suspended particles absorb more heat from solar radiation than water molecules and lead to oxygen sags and potential asphyxiation as heated water cannot hold as much dissolved oxygen as colder water.

**Recommended mitigation measures**

1. Scale down the proposed dredging area from the current 837ha to 150ha at this stage. The scaling down will involve restricting dredging to the existing access channel at 80m wide from the entry to the Bay to the port area which is currently being used (Figure 45). This will minimize the impacts on water quality, improve navigation and enhance water circulation as well address impacts on fisheries, livelihoods and biodiversity. The other area can be combined with the planned future dredging of the channel all the way to Mbita Causeway. The planned future dredging will be subjected to an ESIA study pursuant to Section 58 of the Environmental Management and Coordination Act Cap 387 of the Laws of Kenya.
2. Procure and deploy silt curtains during dredging to reduce turbidity in adjacent environments
3. Determine the acceptable critical limits for water quality during dredging based on the baseline values reported in this report and the Environmental Management and Monitoring Plan (EMMP) in consultation with NEMA, KMFRI, Kenya Fisheries Service and Key stakeholders
4. Develop and implement a Water Quality Monitoring Plan for dredging activities
5. Share results of the water quality monitoring plan with stakeholders on a weekly basis

#### 3.3.1.2 Re-suspension of heavy metals by dredging works

Dredging may cause re-suspension of already settled heavy metals such as lead, zinc, copper, chromium and nickel among others into the water column which will become available to aquatic organisms. Some of these heavy metals are very toxic to aquatic organisms at some levels. Even

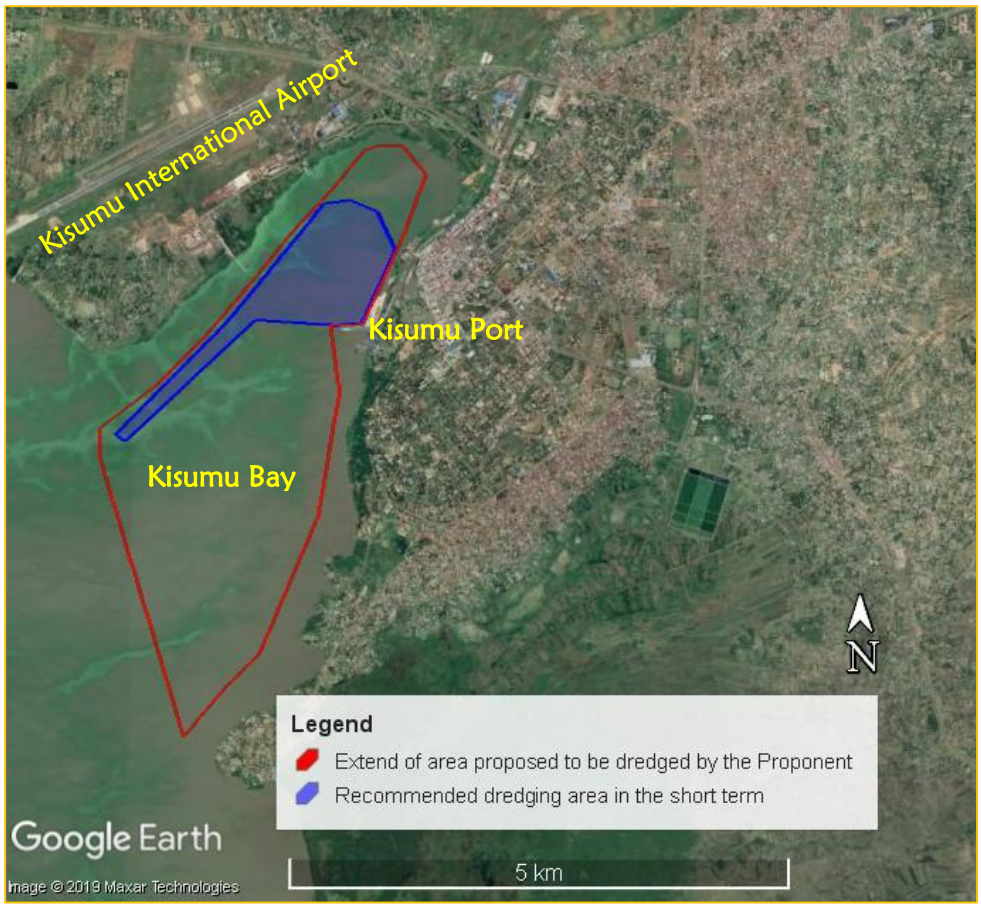


**Figure 45. Proposed scaling down of the initial area planned for dredging (Google Earth, Accessed November 2019).**

though the sediment analysis from Kisumu Bay showed that the current levels for the heavy metals are below the lethal concentration, when water is disturbed their levels might rise. Their concentration gradient will be high at the dredging site and diminishing with distance. Health concerns may affect fish markets both locally and internationally through cancellation of certifications such as Hazard Analysis and Critical Control Points (HACCP) for exports.

**Recommended mitigation measure**

1. Procuring and installing silt curtains to hold sediments within the dredging and dumping areas
2. Develop and implement a sediments quality and fish quality monitoring plans focusing on heavy metals and health risks
3. Share results of sediment quality monitoring plan with stakeholders on a weekly basis
4. Notify NEMA and potentially affected communities if high levels of heavy metal concentrations are reported in the monitoring plan for discussion on suitable intervention measures

### 3.3.1.3 Impact of dredging on biodiversity

Impact of dredging on water quality has a cascading effect on the biota and their habitats. Notable locations of significant biodiversity within the lake include Kisumu Bay, Kisat Estuary, Impala Sanctuary and Dunga Wetland. Disturbing the water and soil composition will change the nature

of aquatic habitat and reduce the biodiversity in the short run. Short term increase in the level of suspended particles will potentially have an adverse effect on growth of phytoplankton and submerged aquatic plants by blocking sunlight thereby halting or reducing photosynthesis. Nutrient level is also expected to rise when bottom sediments are suspended during dredging activity thus increasing growth of phytoplankton and aquatic plants for a short period, after which the population will decrease severely. There is a direct relationship between phytoplankton, zooplanktons, aquatic organisms and the terrestrial food chains. Sediment transport to the shoreline areas and wetlands could lead to the smothering of both flora and faunal communities and impact negatively on the biodiversity of the area.

Recommended mitigation measures

1. Use of silt curtains to localize turbidity to the dredging area
2. Develop and implement a biodiversity monitoring plan for both the areas to be dredged, dumping sites and the other critical wetlands identified in the baseline

#### 3.3.1.4 Impact of dumping of dredged material

As indicated in the baseline information, dumping of dredged material within the Winam Gulf will have deleterious effects on the Lake's ecosystem. This finding is informed by the fact that the Gulf is shallow, water circulation is poor, has high nutrient loading and the dumped material would potentially wash back into Kisumu Bay under the influence of currents. The Gulf is important in supporting local livelihoods through fisheries, transport, water supply and tourism among other benefits. Dumping of the dredge material in the Lake is a threat to these benefits as it would further degrade water quality, reduce light penetration in the water column as well as dissolved oxygen, perspective degree. Dissolved oxygen and light penetration are two very important parameters for the survival of the lake ecosystem. A study carried out in 2007 in the lake confirmed indications that a decline in dissolved oxygen is thought to have contributed to a decline in fish stocks (Njiru, et. al., 2007). The study indicates that low levels of dissolved oxygen (1.2mg/l) which were initially confined to the deeper waters of the lake (<40m) since the 1960's is now spreading into the shallow areas of the lake. Its further notes that the 3mg/l was the critical dissolved concentration of the lake below which most fish species in Lake Victoria will not survive.

Recommended mitigation measures

1. No dumping should occur in the lake at this stage as this option is not sustainable. This is due to the shallow nature of Kisumu Bay which averages -3.5m, impact on fisheries resources, biodiversity and livelihoods, the distance to cover and the cost implications to transport the dredged material to a suitable dumping site (where adequate depths are available >60m) (Figure 46). On the Kenyan side of Lake Victoria these depths are located at approximately 105Km from Kisumu Port and is potentially challenging in terms of cost given that the depths within the Bay can only allow relatively small capacity dredgers to carry out the proposed works.
2. In the absence of possible dumping in the lake, the study did an analysis of other disposal options including the lake and found concluded that dumping on land at an area to the north of the port is best alternative both environmentally, socially and economically (Table 16). Usoma area which lies to the South of Kisumu International Airport and has derelict land occasioned by sand harvesting had been proposed during the stakeholders meeting to review the draft report. It is however not recommended due to cost implications

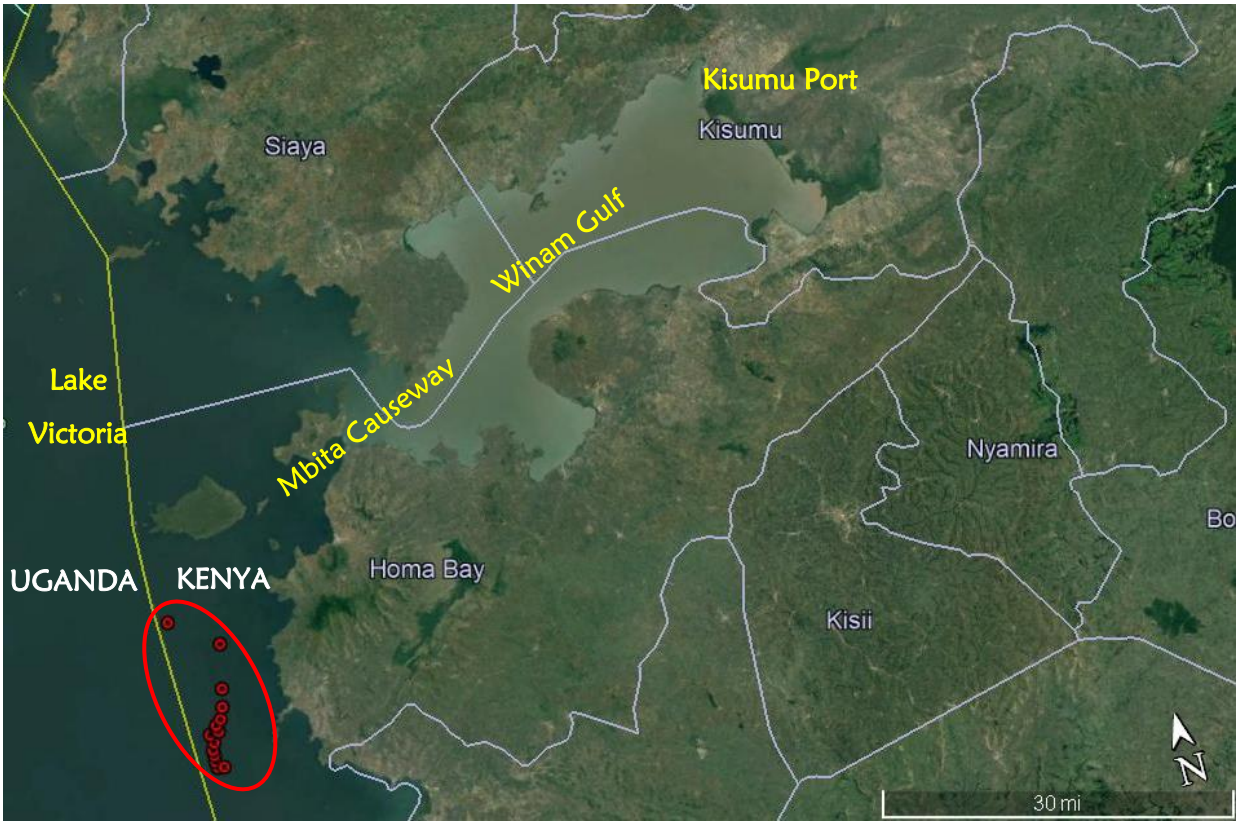


**Figure 46. Potential dumping area within Lake Victoria on the Kenyan side using depth of >60m as the only criteria (Source: Google Earth and Bathymetry Data from Kenya Marine and Fisheries Research Institute in Kisumu).**

3. Scaling down the proposed dredging area from 837ha which will generate approximately 13 million cubic meters of dredge material to 150ha which will generate approximately 2.3 million cubic meters will reduce the quantity of material to be dumped by over 80%.
4. The 2.3 million cubic meters will be dumped to the north of the port on a land owned by the proponent (Figure 47). According to the topographical map provided in the baseline, the isolines in this area rise from 1,135m to 1,145m above sea level providing an opportunity to use the dredged material for leveling of this area and resolving the potential environmental and social risks of dumping into the lake and reducing the cost of dumping. The available area measures 10.2ha and is sufficient to accommodate all the dredged material from the 150ha of the access channel and the proponent will construct a retaining wall along the shoreline to hold the dredged material in place to avoid being eroded back into the Bay.
5. If the levelled area will not be required for port development in the short term, it can be afforested and landscaped by planting fast maturing tree species such as casuarina and sediment binding grass to improve its aesthetic value and stabilize the area to prevent erosion.

**Table 16. An analysis of the dumping alternatives, advantages and disadvantages**

| Dumping alternatives | Advantages | Disadvantages |
|---|---|---|
| Dumping at the Lake | Can accommodate all dredging materials | Leads to water quality degradation and will affect integrity of lake ecosystem leading to environmental risks and conflicts with community and riparian states. |
| | | Expensive, estimated to cost over KES 1 billion for the reduced dredge area |
| | | Dredging will require a long period of time to complete due to distance to potential dumping site (105Km-straight line) and the depths of the Bay which can only allow small capacity dredgers |
| | | Dumped material could potentially wash back into the Bay and reverse the benefits of dredging |
| Dumping at quarries in Usoma and Mamboleo area | Environmental benefits of rehabilitation and reclamation of derelict land, presents an opportunity for afforestation of the areas | Relatively expensive, will require at least 55 trucks of 20 Tons working continuously for six months to complete the dredging of the reduced area, estimated to cost over KES 300 Million. KPA may have to pay to dump in these areas which will increase the cost |
| | Improved safety and security of the rehabilitated areas | Trucks will impact on roads and traffic especially if they are overloaded and they are using a busy route to access the dumping sites |
| | | Emissions and sound from trucks will contribute to air and noise pollution respectively |
| | | Poses a safety risk due to potential road accidents |
| Dumping on KPA land | No costs for dumping and hence economically most viable | A retaining wall is needed to stabilize the dumped material to prevent them from being eroded back into the lake. However, gabions and rock boulders can also be used, grass and trees planted at the leveled site to stabilize the dumped material |
| | Provides material for backfilling and leveling of the dumping area for future expansion of port | |


**Figure 47. Proposed dumping area of the dredged material within Kisumu Port area (Source: Google Earth accessed in November 2019).**

#### 3.3.1.5 Oil spills and bioaccumulation of polycyclic aromatic hydrocarbons (PAHs) from dredging activities

Potential oil spills from the dredging ship either form operational activities or potential running aground can affect aquatic organisms by the high toxic concentrations of the unmodified and photo modified polycyclic aromatic hydrocarbons (PAHs). Normally, bioaccumulation of PAHs by the aquatic organisms contributes to different levels of toxicity. Bioaccumulation of PAHs from sediments is thought to involve an intermediate step in which the PAHs dissolve or are released into solution from the solid matrix and then partitioned into the lipid-rich tissues of aquatic organisms. Bioaccumulation of PAHs is a concern to the health of human beings consuming fish from the Lake.

**Recommended mitigation measures**

1. Prevent oil spills from occurring through effective maintenance of the dredger and precautionary measures
2. Ensure that the dredger is serviceable and licensed to operate by International Maritime Organization (IMO) and the Kenya Maritime Authority (KMA)
3. Procure an oil spill response boom, equipment and train personnel on its use in the event of oil spills
4. Use of degreasers to dissolve localized oil spills during ship/equipment maintenance
5. Waste oil from the ship to be collected and disposed by NEMA Licensed contractors only
6. Keep records of all pollution incidents and notify NEMA and the proponent within 24 hours of occurrence
7. Comply with the provisions of the Marpol Convention 73/78, The Environmental Management and Coordination Act Cap 387 of the Laws of Kenya and The Kenya Maritime Act, 2012

#### 3.3.1.6 Impact on fisheries and livelihoods

Dredging activities will have an impact on fisheries due to degraded water quality which in turns affects productivity, the aquatic food chain and restricting access to traditional fishing grounds. Findings from the baseline survey indicate that the Bay is a habitat for juvenile fish which contribute to the thriving offshore fishery. Sediment plumes which could settle on their habitats who transported offshore by currents will impact on the fisheries productivity of the Bay. In addition, the washing up of dredged material and sediment to the shoreline areas will impact on the quality and aesthetic appeal of sandy beaches which are important for tourism. Apart from the socio-economic effects, these impacts may lead to conflicts between the dredging company, the local community, fishermen and the business community.

**Recommended mitigation measures**

1. Procure and use silt curtains to prevent sediment dispersal from the dredging areas
2. Establish a liaison committee between the dredging company, KPA, County Government of Kisumu, Beach Management Units, Kenya Fisheries Service and Hoteliers
3. Develop and implement a Grievance Redress Mechanism
4. In case of restricted access to traditional fishing grounds, KPA should consider compensation to the local fishermen

#### 3.3.1.7 Increased human-wildlife conflicts

Dredging activities may cause disturbance (vibrations/noise) to the hippopotamus herds and other wildlife fauna within the Bay. This is anticipated to result in an increased wildlife presence on land

leading to human wildlife conflicts. The bay supports a local/community based blue tourism industry that relies on hippo sightings. Three herds were observed during the assessment with the bay forming an important breeding ground at the fridges/mashes along the port area (Stations SS7 & SS8).

**Recommended mitigation measures**

1. A water buffer zone for the three herds of hippo has been introduced in the revised dredging area.
2. The proponent should fence off the outer fridges of areas where there is hippo grass which are the key foraging habitats for the hippos. This should be done in collaboration with the Nyanza Golf Club since one of the herd forages in that area and then the area to the north of the port.
3. In collaboration with Kenya Wildlife Service, develop a hotline/helpline on hippo and crocodile sighting within human settlements to allow to expedite response and action to deal with stranded or risky wildlife

These measures should be carried over during the operational phase of the revitalized port.

#### 3.3.1.8 Environmental risks of obtaining raw materials

The rehabilitation of workshops, offices, police station, store rooms, sanitation facilities and access road among others will require raw materials such as building blocks, aggregates, cement, steel, timber and sand among. The raw materials will be sourced from the environment and will have negative environmental impacts at their points of origin.

**Recommended mitigation measures**

1. Procure quantities of construction materials in line with the Bill of Quantities prepared by a Licensed quantity surveyor
2. Source raw materials from sites that are licensed as per the Environmental Management and Coordination Act Cap. 387 of the Laws of Kenya
3. Re-use and recycle construction materials where practical

#### 3.3.1.9 Destruction of the physical environment

Some of the revitalization works such as paving of the container or cargo stacking yard will involve clearing of vegetation cover which is predominantly grass and felling of existing tree species to pave way for construction activities. Approximately 5ha of the port terrestrial environment are covered by grass, shrubs and scattered trees (Figure 48). Vegetation cover provides significant environmental goods and services such as preventing soil erosion, carbon sequestration and climate regulation and is a habitat for birds and other fauna in the port area. Therefore, clearance of the vegetation would lead to the loss of these benefits. In addition, construction activities which will involve civil works such as excavations, grading and leveling will create loose soils that are susceptible to erosion. Eroded soils will lead to sediment load and water quality degradation at the Bay.

**Figure 48. Some of the tree species at the site that will be felled to pave way for the revitalization of Kisumu Port (Source: Site visit, November, 2019).**

### Recommended mitigation measures

1. Obtain authorization permits from Kenya Forest Service (KFS) and County Government of Kisumu prior to felling the trees at the site
2. Retain tree cover in areas that will not be revitalized
3. Greening the port by enhancing the tree cover in areas of the port that will not be revitalized. Of the 5ha covered by vegetation at the port and considering the possible expansion of the port as per the master plan, the ESIA recommends tree planting and landscaping of at least the immediate environment covering 2ha. The tree species to be replanted should be the same as the existing ones as provided in the baseline. However, in the event that exotic and fast maturing tree species are required, the ESIA recommends casuarina
4. Landscaping of the port by planting sediment binding grass (preferably Kikuyu grass) and establishing flower gardens in consultation with a qualified landscape architect
5. Compact loose soils resulting from civil works to prevent erosion and sedimentation of Kisumu Bay

### 3.3.1.10 Water consumption and effluent generation

During revitalization, water will be required for concrete mixing, casting and curing works, drinking and sanitation purposes which will lead to increased demand for water. This will be sourced from Kisumu Water and Sewerage Company (KIWASCO). Seventy percent (70%) of the water used for domestic purpose will generate effluent whereas the rest soaks into ground areas within the project site or drains to the lake. Poor disposal of the wastewater will have the potential to pollute underground aquifers and the lake.

Sanitary facilities will also be required to service the workforce at the project site.

**Recommended mitigation measures**

1. Sensitize workers and contractors on the need for water conservation and implement penalties for wastage such as running pipes when not in use
2. Contractors to procure mobile toilets for the workforce as the existing facilities are inadequate to service both KPA staff and the workers

#### 3.3.1.11 Solid waste generation and management

Revitalization activities will generate solid waste such as biomass, overburden, cuttings and rejected materials among others. Workers at the site will generate domestic waste such as food leftovers, plastics and wrappings among others. These will need to be disposed off appropriately. The dredger will also generate both domestic and commercial wastes which will need to be disposed off responsibly. Poor disposal of solid wastes has negative environmental impacts which would include pollution of the lake, providing habitat for disease causing pathogens and reducing the aesthetic value of the port environment.

**Recommended mitigation measures**

1. Use the generated overburden in backfilling and landscaping
2. Sensitize construction workers on the process of solid waste collection, segregation and proper disposal
3. Procure and strategically place adequate solid waste collection bins with a capacity for segregation within the construction sites
4. Procure the services of a NEMA licensed waste handler to dispose solid wastes from the construction sites and the ship
5. Comply with the provisions of Environmental Management and Coordination (Waste Management) Regulations, 2006

#### 3.3.1.12 Noise pollution

The construction works, delivery of construction materials by heavy trucks and the use of machinery will lead to high levels of noise and vibration within the construction site and the surrounding area. Noise may lead to hearing impairments which will reduce the workmanship of the employees and also affect their finances due to treatment and medication. Neighbors to the project site will also be exposed to noise during site preparation and construction activities.

Construction sites such as the proposed project which are near residential areas can only emit noise levels of up to 60 dB(A) during the day and 35dB(A) during the night as per the Second Schedule of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.

**Recommended mitigation measures**

1. Delivery of raw materials, excavation and construction work will be limited to day time hours only between 8am to 5pm
2. Locate machinery that are likely to produce noise as far as practical from neighboring properties
3. Procure and provide adequate earmuffs to workers and visitors to the site and enforce their use

4. Use serviceable machinery
5. Sensitize truck drivers to avoid unnecessary hooting and running of vehicle engines
6. Comply with the provisions of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009

#### 3.3.1.13 Air pollution

Air pollution will be as a result of dust generated during excavation, concrete mixing activities and exhaust fumes from heavy commercial vehicles accessing the site. The vehicle exhausts are known to contain sulphur dioxide, carbon monoxide and hydrocarbons and together with dust generated constitute major pollutants which can affect air quality. The most relevant pollutant considered is particulate matter because of its potentially significant increase during the construction phase. Respirable particulate matter may present respiratory diseases, cause eye irritation and visual intrusion to workers, visitors to the project site and the neighbors if it is in excess of 100 $\mu g/Nm^3$ as per the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014.

#### Recommended mitigation measures

1. Install appropriate and adequate dust screens around the project site
2. Sprinkle water at the excavation areas to suppress dust
3. Cover stock piles of construction materials (aggregates, sand and fill material) to reduce dust emissions especially during windy conditions
4. Procure, provide and enforce the use of dust masks to workers and visitors to the project site
5. Use of serviceable machinery/equipment and trucks
6. Monitor fugitive emissions to ensure compliance with the limits set under the First Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014
7. Comply with the provisions of Environmental Management and Coordination (Air quality) Regulations, 2014

#### 3.3.1.14 Safety and health risks

The operations of the dredger will employ personnel who will be exposed to potential occupational health and safety hazards. These include accidental falls, drowning and high noise levels especially those working in the engine rooms. Similarly, workers who will be involved in rehabilitation of the warehouse and paving of the port area as well as visitors will be exposed to occupational safety and health risks including accidents, high noise levels, air pollution and diseases. In addition, since Lake Victoria is a transport corridor locally and regionally, the dredger may pose navigational safety risks to other maritime traffic including local fishing boats.

#### Recommended mitigation measures

1. Ensure the dredger is licensed by the IMO and KMA
2. Create awareness among Lake users on the presence of the dredger and its activities as well as the require safety precautions
3. Dredger should have an early warning system for local fishermen within the Bay to prevent navigational accidents and loss of life in case of potential collision with the fishing boats
4. Hire qualified and well-trained personnel for the dredging and construction works
5. Contractors to obtain insurance cover for employees of the dredger and at construction sites and ensure appropriate compensation in the event of accidents
6. Provide Personal Protective Equipment (PPE) for ship crew, workers and visitors to the port

7. Contractors for both the dredging and rehabilitation works at the port should recruit qualified and experienced Occupational Safety Officers to train and enforce compliance with safety measures
8. Safety signage and boards should be erected at all construction zones showing the required safety measures and PPEs
9. Comply with the Merchant Shipping Act, 2009 (Part VII Section 117-168 on Safety, Health and Welfare of Seafarers)
10. Comply with the Occupational Safety and Health Act, 2007
11. All accidents should be reported, investigated and corrective action taken to prevent reoccurrence

### 3.3.2 Negative impacts at operational phase of the port

#### 3.3.2.1 Risks posed by aquatic macrophytes

Aquatic macrophytes such as water hyacinth and hippo grass pose risks to the port which include hindering navigation by making it difficult for ships and other crafts to access or leave the pier (Figure 49). Their management is complicated by their periodic cyclical pattern of decline and quick proliferation making them less predictable and amenable to response strategies. Hot spot areas within lake can have some salient environmental and geographical features like higher concentration of nutrients, closer proximity to river mouths i.e. River Kisat estuary and relative shallowness which make them conducive for water hyacinth growth and multiplication. Additionally, during heavy storms and wind activity, the population of the invasive macrophytes is sloughed off the sheltered bays into the lake resulting into floating islands.

Apart from navigation risks, the macrophytes curtail penetration of light into the aquatic ecosystem thus inhabiting the growth of phytoplankton hence adversely impacting the biodiversity, fish breeding and nursery grounds and access to landing sites. A study by Ongore, et. al., (2018) revealed that the temporal trend of tilapia landings fluctuated inversely with aquatic macrophytes coverage but there was no pattern of association between macrophytes coverage and total landings of any of the native species of fish (Figure 50).

**Figure 49. Water hyacinth (foreground) and a dredger ship at the Kisumu Port in May 2019 (Source: Envasses, 2019).**

In addition, the decay and decomposition of the macrophytes contributes to air pollution which may affect the touristic appeal of the port and neighboring facilities which could potentially host ship crews and other tourists.

The government and non-governmental organizations such as the Lake Victoria Environmental Management Project (LVEMP) have in the past and currently implemented various initiatives to eliminate the weed including mechanical removal and biological methods. However, these methods have not been successful due to the ability of the macrophytes to proliferate quickly, their cyclic and dynamic nature, wind and current systems, the costs of removal and other challenges.

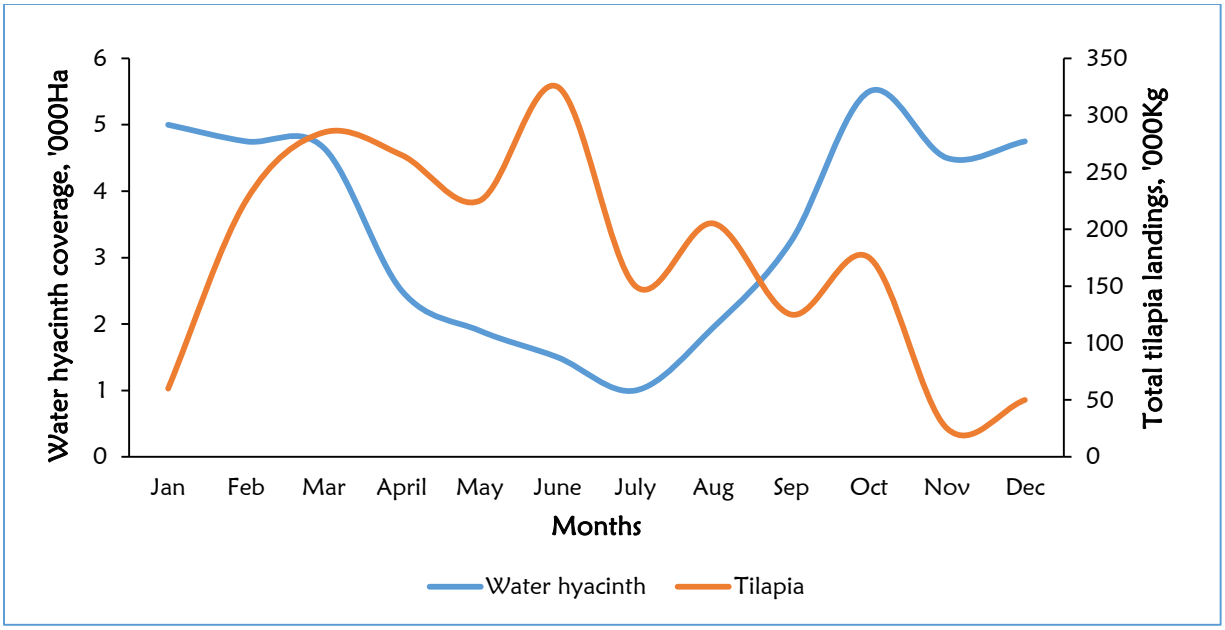


**Figure 50. Relationship between temporal trends in water hyacinth coverage and tilapia fish landings from the Kenyan part of Lake Victoria during 2013-2017 (Source: Ongore, C.O. et al., 2018).**

### Recommended mitigation measures

1. As an immediate measure and due to the navigational risks posed by water hyacinth and other macrophytes and their periodic cyclic nature throughout the year, the proponent will need to develop and implement an early warning system based on real time satellite data and GIS analysis to inform timely interventions.
2. The proposed timely interventions will include;
    a. Ground truthing and surveillance in collaboration with Kenya Coast Guard Services and local fishermen.
    b. Mechanical removal of the water hyacinth using the using the water hyacinth harvester owned by Lake Victoria Environmental Management Programme (LVEMP) (Figure 51) and/or KPA could procure one for Kisumu Port. During ESIA, the consultants obtained information that Kisumu Polytechnic have developed a water hyacinth harvester that can assist in management of the weed. The proponent can discuss possible collaboration with the University to manage water hyacinth and other macrophytes within the Bay (Figure 52).
    c. The proponent should support local initiatives such as making of handicrafts using water hyacinth by the youth and women groups, the mechanical harvesters can provide the harvested weeds to the community groups or KPA can facilitate the local initiatives by providing infrastructure such as boats that would land the harvested hyacinth at Kisumu Port (Figure 53). Interviews with stakeholders revealed that the major challenges in the use of the water hyacinth in commercial ventures include the high costs of transport to obtain the raw material and their

dynamic cyclic nature where the macrophyte marshes migrate to different areas of the lake at different times of the year.

d. Other initiatives by the private sector such as use of the macrophytes for biogas production could also be supported.

**Figure 51. Water hyacinth harvester belonging to Lake Victoria Environmental Management Programme at Kisumu Port in May 2019 (Source: Envasses, 2019).**

**Figure 52. A water hyacinth harvester built by Kisumu Polytechnic at the Port in November 2019 (Source: KPA, 2019)**

**Figure 53. Sample handicrafts made from water hyacinth by a local youth group (Photo Credit: Ms. Hilda Nyaboke, 2019).**

3. The proponent should liaise with the County Government of Kisumu and NEMA to stop the discharge of raw effluent into the Bay which causes eutrophication and subsequent proliferation of aquatic macrophytes
4. If socio-economic benefits can be realized, the invasive weeds will be consistently targeted for exploitation. A Nairobi based company; Homa Bay Biogas One Limited has expression interest to set up an 8MW electricity power plant in Kobala Homa Bay County using water hyacinth as feed stock. However, information on the viability of this option is not available but KPA can consult with the company on potential collaboration in management of water hyacinth in the bay.
5. In the long term the proposed dredging of Bay and opening of Mbita Causeway will improve water quality, circulation and habitat heterogeneity which will create less favorable conditions for the proliferation of water hyacinth and other aquatic microphytes.
6. Installation of retractable gates at Mbita Causeway once it is opened to prevent marshes of water hyacinth from drifting into the port area.

#### 3.3.2.2 Wastewater generation and management

Wastewater will emanate from the Port's - sanitation facilities, cleaning operations and ships docking at the port which will need to be desludged. Currently, the effluent from the sanitary facilities discharges into a septic tank -soak pit system. Poor effluent management will have the potential to pollute underground aquifers, the aquatic environment and can harbor disease causing pathogens such as mosquitoes. Toxic substances that may be included in the cleaning operations.

may contain oil and grease and heavy metals among other raw materials which will decompose to inorganic form, deplete the dissolved oxygen and lead to eutrophication of Kisumu Bay impacting on fisheries, health of the communities and livelihoods.

#### Recommended mitigation measures

1. Sustain current measures where the septic tank and soak pit system is desludged on a need basis by a NEMA licensed contractor in the meantime

2. Design and construct a biodigester to replace the septic tank and soak pit system and reduce the costs of effluent management
3. Engage the Kisumu Water and Sewerage Company to discuss the opportunities for connecting the Port to the Kisat Sewage Treatment Plant or designing and implementing a localized waste water treatment plant. This can be addressed within the larger framework on the implementation of the Kisumu Water Supply and Waste Water Master Plan.
4. Apply and obtain an Effluent Discharge License from NEMA pursuant to the provisions of Environmental Management and Coordination (Water Quality) Regulations, 2006
5. Comply with the provisions of the Environmental Management and Coordination (Water Quality) Regulations, 2006

#### 3.3.2.3 Oil, grease and storm water runoff from the port

Oil may be introduced within the port environment during maintenance and servicing of water vessels, illegal discharge of tank washings and oil-contaminated ballast water, tanker accidents, dumping of industrial wastes etc. Other sources of oil spillage will include offloading of oil products at the designated areas of the pier, refueling activities and leakages. Leaked oils, oily wastes and mixtures will potentially be transported downstream into the lake through runoff, cleaning activities or direct introduction by ships and maritime crafts leading to water quality degradation. Degraded water quality will in turn impact on fishery resources, aquatic biota and freshwater habitats. Some oils contain carcinogens and their contamination is biomagnified especially in fishery resources. Adverse health effects of consuming contaminated fish include liver damage, skin irritation, reproductive and developmental effects.

#### Recommended mitigation measures

1. Create awareness on oil spill prevention and training on containment if oil spills do occur
2. Establish a well-equipped pollution control center (with booms, dispersants etc.)
3. Procure a well-equipped pollution control boat and train port personnel on usage
4. Prepare and implement as need arises, an oil spill contingency plan for the port
5. Procure a NEMA licensed contractors to dispose, reuse or recycle waste oil
6. Report and document all oil spills incidents, action taken and the results of the action taken
8. All ships and maritime crafts to Comply with the provisions of the Marpol Convention 73/78, The Environmental Management and Coordination Act Cap 387 of the Laws of Kenya and The Kenya Maritime Act, 2012

#### 3.3.2.4 Solid waste generation and management

The operational phase of the project will generate waste in the form of plastics, paper, organic wastes, oil and grease containers used for machinery maintenance, cargo residues among others. Similarly, ships and other vessels using the lake and the harbor will generate wastes which include plastics, metal, glass, paper, organic wastes from kitchen areas, effluent and potential used oil and lubricants. Poor disposal of the wastes will cause pollution and degradation of water quality, harbor disease causing pathogens such as mosquitoes and flies among others thus leading to potential health challenges and reduce the aesthics of the port and its environs.

#### Recommended mitigation measures

1. Sensitize employees, visitors, ship crew and the community neighboring the port on the importance of proper solid waste management through reduction, re-use and recycling. This could be done through regular clean-up days involving the employees and crew.

2. Provide infrastructure for solid waste collection and storage at the port with capacity for segregation to support and enhance recycling initiatives. This should include infrastructure for handling solid wastes from ships and other vessels
3. Procure the services of a NEMA licensed waste handler to dispose off solid wastes from the port at scheduled intervals
4. Comply with the provisions of the Environmental Management and Coordination (Waste Management) Regulations, 2006
5. Ships and other vessels to comply with the provisions of the Marpol Convention 73/78, The Environmental Management and Coordination Act Cap 387 of the Laws of Kenya and The Kenya Maritime Act, 2012

#### 3.3.2.5 Air pollution

Sources of air pollution at the port will include smoke, vehicular emissions and fumes such as $NO_2$ and $NO_3$ which are generated by ships while maneuvering and berthing which may affect air pollution in the hinterland. Accidental leakage of gasses from ships and other Port related activities may cause problems such as toxic material emission, explosions, fumes, odors and hazardous airborne emissions. Dust dispersion on land may cover plants and change the terrestrial habitat. Air pollution and emissions above the limits set under the Third Schedule of the Environmental Management and Coordination (Air Quality) Regulations, 2014 can potentially cause health problems which include respiratory diseases, eye irritation and visual intrusion to receptors like KPA employees and visitors especially in areas neighboring the Port area.

**Recommended mitigation measures**

1. Sprinkle water in dusty areas during the dry season
2. Improve vegetation cover at the port as a measure to improve air quality and prevent fugitive dust
3. Provide dust masks to workers and enforce on their use
4. Implement the air quality monitoring plan proposed by the ESIA report on a quarterly basis
5. Comply with the provisions of the Environmental Management and Coordination (Air Quality) Regulations, 2014

#### 3.3.2.6 Noise pollution

The main sources of noise pollution during the operation of the Port will emanate from ships, cargo handling equipment and movement of vehicles within the project area. The noise levels produced may be above the stipulated Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009 limits and may lead to hearing impairments to workers, visitors to the site and neighbors.

**Recommended mitigation measures**

1. Provide earmuffs to employees working in peak noise areas
2. Reduce the time of exposure to employees working in peak noise areas
3. Use serviceable machinery and equipment
4. Comply with the provisions of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations 2009

#### 3.3.2.7 Portable water and energy demand

During the operation of the Port, water will be required for drinking, general cleaning and sanitation purposes among other day to day uses. Ships docking at the facility will also require

portable water. Currently the port is supplied with water from the Kisumu Water and Sewerage Company (KIWASCO). However, at the time of the ESIA study, the water supply to the port had been disconnected. It is also predicted that water demand will increase when the port is fully operational and therefore adequate and reliable supply will be required.

Energy will be required for lighting and operation of equipment and machinery. The port is connected to the national grid while generators and machines such as folk lifts and cranes are diesel powered. Just like water demand, energy use will increase once the revitalized port becomes operational. At this stage, it is not possible to quantify both the increments for water and energy but should be done at the initial audit of the port one year after it is commissioned.

**Recommended actions on water and energy demand**

1. Restore and increase the volume of reticulated water supply from KIWASCO to the port
2. Enhance water conservation through awareness creation among employees and visitors
3. Install solar panels at the warehouse and port offices for lighting purposes
4. Keep records on power consumption by the port including generators and other equipment to inform energy management and audit interventions

#### 3.3.2.8 Safety and health risks

The increased traffic within Kisumu Bay and the Winam Gulf as a result of the revitalized port may lead to accidents especially with the local fishermen's boats either fishing or conducting tours of the lake. Such accidents could lead to death, are a threat to livelihoods and could lead to conflicts between the proponent and the local community. Within the port, the safety and health of workers and visitors to the facility is of utmost importance. Occupational safety and health issues during this phase will include physical and chemical hazards which could cause adverse human health or loss of life. Physical hazards will include the potential for falls caused by slippery floors and stairs, injuries caused by unprotected machinery or moving parts and movement of Heavy Commercial Vehicles (HCVs). Chemical hazards will occur due to exposure of workers to hazardous substances through inhalation and exposure of eye or skin to toxic chemicals and inhalation of dust.

**Recommended mitigation measures**

1. Install navigational aids (Marker buoys) and early warning signage along the access channel to the port
2. Sensitize local fishermen and tour operators on the increased traffic at Kisumu Bay
3. Establish a control tower to guide traffic within Kisumu Bay
4. Create awareness among employees on the importance of their safety. This can be done by organizing awareness weeks
5. Develop and implement a safety action plan and set goals to ensure zero fatalities
6. Provide adequate PPE to workers and enforce on their use
7. Control access to the port area
8. Ensure regular and proper maintenance of equipment and work tools
9. Place appropriate safety and warning signage at strategic areas within the Port
10. Conduct first aid training among the workers and provide well-stocked first aid kits at different sections of the port area
11. Provide and keep an accident/ incident register
12. Provide insurance cover to all employees
13. Procure and equip an ambulance which should be stationed at the port all the time and fully manned
14. Construct a sick bay to serve the port community and their families

15. Undertake Occupational Safety and Health audits annually
16. Comply with the provisions of the Occupational Safety and Health Act, 2007

#### 3.3.2.9 Fire risks and emergencies

Fire risks and emergencies at the Port can occur due to operational negligence, electrical faults and spillage/leakage of flammable and ignitable chemicals. Hydrocarbons are volatile under certain conditions and their vapors in specific concentrations are flammable. Fire risks may also arise from facilities neighboring the port such as fuel depots and residential areas. If precautions are not taken to prevent their ignition, fire and subsequent safety risks may arise resulting in injuries, loss of lives and property.

#### Recommended mitigation measures

1. Develop, clearly display and implement a fire and emergency response action plan
2. Provide a fully equipped fire station, ambulances and firefighting equipment
3. Servicing of the firefighting equipment quarterly by a reputable firm
4. Train employees on the use of fire-fighting equipment
5. Display fire safety and warning signage at all sections of the Port
6. Ensure proper handling and storage of flammable materials
7. Ensure regular inspection and maintenance of electrical appliances
8. Conduct fire drills regularly
9. Conduct annual fire safety audit and implement the recommendations

#### 3.3.2.10 Potential sources of conflicts

Pollution of Kisumu Bay by the port can potentially lead to conflicts with the local fishermen as it directly impacts on water quality and fisheries resources. In addition, oil and oily wastes discharged from ships may reach nearby beaches and degrade recreational areas causing serious damage to tourism. Ship traffic may disturb pleasure boat cruising and fishery boat operations. The possibility of accidents from increased traffic at Kisumu Bay may become a source of concern and potential source of conflict between the proponent and the local community.

Ship calls create many related jobs including pilotage, tug services, stevedoring, bunker and crew services, however, they may bring considerable changes in the lifestyle of the local people. Port activities may result in the hiring of local labor and procurement of various commodities from a local market. The local economy will be boosted by port-related activities and be greatly involved in urbanization and industrialization. Labor from other areas may be a possible source of conflict with the community if there are locally available personnel for which other labor markets are sought.

#### Recommended mitigation measures

1. Develop and implement a Grievances Redress Mechanism (GRM)
2. Ensure maritime safety by implementing the measures recommended for addressing safety and health risks at operational phase
3. Sustain water quality monitoring activities and share the results with the stakeholders
4. Focus the labor policy on the local community i.e. prioritize employment opportunities to the local community

### 3.4 Possible decommissioning phase

The socio-economic importance and stature of Kisumu Port to both the County, National and Regional Governments makes decommissioning a remote possibility. Hence the ESIA study does

not consider the impacts at this phase as significant even in the long-term. However in the event that decommissioning becomes imminent possibly as a result of natural calamities, emergence of other competitive ports, lack of accessibility due to water hyacinth and sedimentation of the channel and people's preference on other means of transportation of goods such as roads and air transport, it is recommended that the proponent will prepare and submit a due diligence decommissioning audit report to NEMA for approval at least three (3) months in advance. For the purposes of prediction and information, the environmental and social concerns which may arise in this scenario will include;

1. Economic decline
2. Occupational safety and health risks
3. Fire risks and emergencies
4. Oil spills
5. Solid waste generation and management
6. Effluent generation and management
7. Insecurity

The decommissioning environmental audit report would prepare a detailed analysis of the impacts and propose an environmental management plan to address them.

## 3.5 Possible port expansion

Based on the projected growth of the local, national and regional economies as well as the corresponding increase in cargo being handled by the revitalized Kisumu Port, the most likely scenario will be the expansion rather than decommissioning of the port. The project expansion is also consistent with the Port Master Plan prepared by in 2019. The expansion activities will have an incremental effect on the environmental and social impacts discussed under the operational phase of the revitalized port. These will include water quality degradation, risks posed by aquatic macrophytes, waste generation, safety and health concerns, air and noise pollution and fire and emergencies. In addition, the demand for land may lead to relocation of the community around the port and restricted access to Kisumu Bay as well as traditional fishing grounds. To mitigate the incremental and emerging environmental and social impacts, the proponent will commission a substantive Environmental and Social Impact Assessment Study on the port expansion and in line with the KPA Master Plan and prepare a resettlement action plan (RAP) for the communities that may be affected. The ESIA could potentially be carried out to incorporate the other piers within the Winam Gulf so that rehabilitation of the infrastructure is carried out comprehensively.

## 3.6 Impact analysis

Potential project impacts are predicted and quantified to the extent possible. The magnitude of impacts on resources such as water and air or receptors such as people, communities, wildlife species and habitats is defined. Magnitude is a function of the following impact characteristics;

1. Type of impact (direct, indirect, induced)
2. Size, scale or intensity of impact
3. Nature of the change compared to baseline conditions (what is affected and how)
4. Geographical extent and distribution (e.g. local, regional, international)
5. Duration and/or frequency (e.g. temporary, short-term, long term, permanent)

Magnitude describes the actual change that is predicted to occur in the resource or receptor. It takes into account all the various impact characteristics in order to determine whether an impact is negligible or significant. Some impacts can result in changes to the environment that may be immeasurable, undetectable or within the range of normal natural variation. Such changes can be

regarded as essentially having no impact and are characterized as having a negligible magnitude (Table 17). The levels of impacts are defined using the following terms

1. **Negligible impact (very low) -** Where a resource or receptor would not be affected by a particular activity or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background variations.
2. **Less than significant impact (Low**) - Is a minor impact where a resource or receptor would experience a noticeable effect but the impact magnitude is sufficiently low (with or without mitigation) and /or the resource or receptor is of low sensitivity. In either case, a less than significant impact must be sufficiently below applicable standard threshold limits.
3. **Potentially significant impact (moderate) -** A moderate impact that meets applicable standards but comes near the threshold limit. The emphasis for such moderate impacts is to demonstrate that the impact has been reduced to a level that is as minor as reasonably practicable so that the impact does not exceed standard threshold limits.
4. **Significant impact (high) -** One where an applicable standard threshold limit would or could be exceeded or if a highly valued or very scarce resource would be substantially affected.

**Table 17. Risk and impact significance matrix for the proposed revitalization of Kisumu Port.**

| Environmental impact | Magnitude of impact at revitalization phase | Magnitude of impact at operational phase |
|---|---|---|
| Impact of dredging on water quality | 3 | 0 |
| Bioavailability of heavy metals from dredging activities | 3 | 0 |
| Impact of dredging on biodiversity | 3 | 0 |
| Impact of dumping of dredged material on the lake | 3 | 0 |
| Human-Wildlife conflicts | 1 | 1 |
| Oil spills and bioaccumulation of PAHs from dredging | 2 | 0 |
| Impact of dredging on fisheries and livelihoods | 2 | 0 |
| Environmental risk of obtaining raw materials | 2 | 0 |
| Destruction of the physical environment | 1 | 0 |
| Water demand | 1 | 1 |
| Wastewater generation | 1 | 1 |
| Energy demand | 2 | 1 |
| Solid waste generation and management | 1 | 1 |
| Noise pollution | 2 | 1 |
| Air pollution | 2 | 1 |
| Safety and health risks | 3 | 3 |
| Risks posed by aquatic macrophytes | 3 | 3 |
| Oil, grease and runoff from the port | 3 | 3 |
| Fire risks and emergencies | 1 | 3 |
| Conflicts with the local community | 3 | 3 |

**Legend**

| Magnitude | Impact score |
|---|---|
| Negligible | 0 |
| Low | 1 |
| Moderate | 2 |
| High | 3 |

## 3.7 Public participation

During the preparation of the ESIA, the consultants organized and held three consultative meetings. Two meetings were held at Acacia Hotel in Kisumu i.e. a Kick off meeting and a meeting to review

the draft ESIA report on 1st and 26th November respectively. Participants were drawn from government agencies, Non-Governmental Organizations (NGOs), Beach Management Units (BMUs), the Private Sector and the consultants in line with the stakeholder identification process carried out in consultation with the proponent (Figure 54). The programme and proceedings of both meetings are annexed to this report (Appendix 6 and 7). Table 18 below summarizes the Key comments from stakeholders during the Kick off and draft ESIA review meetings. A third and final meeting was held between the consultants and the proponent to validate the ESIA study and ensure that stakeholder comments from the two consultative meetings were fully incorporated.

**Table 18. Key comments from stakeholders during the Kick-off and review of ESIA draft meetings held at Acacia Hotel in Kisumu on 1st and 26th November 2019.**

| Main comments during Kick-off meeting | Main Comments during Review of the draft report |
|---|---|
| Report to address impact of dredging and dumping on the Lake's biodiversity | Impacts section to include Human-Wildlife Conflicts and how they will be handled |
| Consultants to undertake baseline water quality sampling and analysis | Report to comprehensively address impact of dredging and dumping on hippos |
| Report to address concerns and risks posed by Water hyacinth to the Port | Report to be specific on the area to be dredged and where the dredged material will be dumped and the EMP updated accordingly |
| Report to address impact of the project on fisheries and make recommendations | Report to provide specific analysis on possible dumping alternatives, the advantages and disadvantages and recommend the most suitable |
| | Report to specify the specific water hyacinth intervention measures that should follow the early warning system results |

**Figure 54. A section of the participants who attended the stakeholder consultative meeting to review the draft ESIA report at Acacia Hotel, Kisumu on 26th November 2019 (Source: Consultants, November 2019)**

## 3.8 Analysis of alternatives

### 3.8.1 The No project alternative

Revitalization of Kisumu Port infrastructure is Kenya Government project aimed at restoring the socio-economic benefits that were historically provided by the facility. The project is being implemented in collaboration with other regional riparian states who are also in the process of revitalizing key infrastructure to facilitate trading with Kisumu Port. The import of this is that the No project alternative is not viable, and it would lead to continued dilapidation of the port and deny the local, national and regional economies the socio-economic benefits that would accrue from a revitalized port.

### 3.8.2 The Yes project alternative

The yes project alternative is the most feasible considering the investment by the Kenya Government and the socio-economic importance of the port. The port will spur trade locally and regionally which will also create employment and improve the socio-economic profile of Kisumu City as well as achieve the national development agenda outlined under Kenya's Vision 2030.

# 4 ENVIRONMENTAL MANAGEMENT PLAN

## 4.1 Introduction

The preceding section identified and analyzed the potential environmental and social impacts of the proposed revitalization of Kisumu Port and proposed mitigation measures to address the impacts. Under this section, two Environmental Management Plans (EMPs) are proposed to guide the proponent in implementing the mitigation measures. These are EMPs for the revitalization activities and operational phase of Kisumu Port. As discussed earlier, decommissioning phase EMP has not been provided as the possibility is remote and, in the event, that it becomes imminent the proponent will prepare a detailed decommissioning audit and submit it to NEMA for approval, three (3) months in advance. Each of the two EMP is organized into five sections comprising of the environmental impact, the recommended mitigation measures, responsibility, timeframe and budget. The strategies for mitigation include preventing the impact from occurring in the first place, minimizing the impact, taking corrective action where impact occurs among others.

## 4.2 Environmental Management Plan for the revitalization phase

At the revitalization phase, the focus on the EMP is on addressing the impact of dredging and dumping activities on water quality, biodiversity, environmental risks of obtaining raw materials, destruction of the physical environment, solid waste generation and management, noise and air pollution and safety and health risks (Table 19).

## 4.3 Environmental Management Plan for the operation phase

The main issues of concern at operational phase of the project are invasive aquatic macrophytes, water demand and wastewater generation and management, oil spillage and management, solid waste generation and management, air and noise pollution, energy demand, safety and health risks, fire risks and emergencies and socio-cultural impacts (Table 20).

**Table 19. Environmental Management Plan for the revitalization phase of Kisumu Port.**

| Impact | Recommended mitigation measures | Responsibility | Timeframe | Costs (KES) |
|---|---|---|---|---|
| Impact of dredging on water quality | Scale down the area proposed for dredging from 837ha to 150ha to reduce impacts on the lake ecosystem | KPA | Immediate | Nil |
| | Procure and deploy silt curtains during dredging to prevent sediment transport in adjacent areas | Contractor/KPA | During dredging | Tender |
| | Determine the acceptable critical limits for water quality as per baseline and EMMP | Contractor/KPA/NEMA/ KMFRI/Fisheries | Prior to dredging | Nil |
| | Develop and implement a Water Quality Monitoring Plan in collaboration with NEMA Lead Experts | Contractor/KPA/NEMA Laboratory | Prior and during dredging | 5,000,000/ Year |
| | Share results of the water quality monitoring plan with stakeholders | Contractor/KPA/NEMA | Weekly | Nil |
| Bioavailability of heavy metals from dredging | Procure and deploy silt curtains during dredging to prevent sediment transport in adjacent areas | Contractor/KPA | During dredging | Procured above |
| | Develop and implement a sediment and fish quality monitoring plans focusing on heavy metals | Contractor/KPA/NEMA Laboratory | Prior and during dredging | 5,000,000/ Year |
| | Share results of sediment and fish quality monitoring plans with stakeholders | Contractor/KPA/NEMA | Weekly | Nil |
| | Notification to proponent, NEMA and stakeholders if high levels of heavy metal concentrations are reported | Contractor/KPA | During dredging | Nil |
| Impact of dredging on biodiversity | Procure and deploy silt curtains during dredging to prevent sediment transport in adjacent areas | Contractor/KPA | During dredging | Procured above |
| | Develop and implement a biodiversity monitoring plan for both the areas to be dredged | Contractor/KPA/Fisheries and Wildlife Experts | Prior and during dredging | 5,000,000 |
| | Share results of sediment quality monitoring plan with stakeholders | Contractor/KPA/NEMA | Weekly | Nil |
| Impact of dumping of dredged material | Do not dump within the lake ecosystem | Contractor/KPA | During dredging | Nil |
| | Scaling down the size of the area to be dredged | KPA | During dredging | Nil |
| | Dumping onshore at the port, leveling and compacting of the area for potential future expansion of port | Contractor/KPA | During dredging | 10,000,000 for leveling |
| | Construction of a retaining wall or gabions and rock boulders to prevent erosion of the leveled area | Contractor/KPA | Prior to dumping | Tender |

| | | | | |
|---|---|---|---|---|
| | Afforestation of the levelled area by planting grass and fast maturing trees | Contractor/KPA | Upon completion of dumping | 10,000,000 |
| Human-wildlife conflicts | Revised dredging area has provided buffer zones for hippo habitat of more than 500m | Consultants/KPA | During dredging | Nil |
| | Fencing the fridges of hippo grass habitats | KPA/KWS | Prior to dumping | Tender |
| | Setting up a hotline in collaboration with KWS for reporting of sightings of hippos and sharing the same with stakeholders | KPA/KWS | Prior to dredging | 20,000 |
| Oil spills and bioaccumulation of polycyclic aromatic hydrocarbons (PAHs) from dredging activities | Prevent oil spills from occurring through effective maintenance of the dredger and precautionary measures | Contractor/KPA | During dredging and dumping | Nil |
| | Ensure that the dredger is serviceable and licensed to operate by IMO and KMA | Contractor/KMA/KPA | Prior and during dredging and dumping | Tender |
| | Procure an oil spill response boom, equipment and train personnel on its use in the event of oil spills | Contractor | Prior to dredging and dumping | Tender |
| | Use of degreasers to dissolve localized oil spills during ship/equipment maintenance | Contractor/Crew | During dredging and dumping | 100,000 |
| | Waste oil from the ship to be collected and disposed by NEMA Licensed contractors only | Contractor/NEMA Contractor | During dredging and dumping | 1,200,000 |
| | Keep records of all pollution incidents and notify NEMA and the proponent within 24 hours of occurrence | Contractor/KPA | During dredging and dumping | 120,000 |
| | Comply with the provisions of the Marpol Convention, EMCA and KMA Acts | Contractor/KPA | During dredging and dumping | Nil |
| Impacts of dredging on Fisheries | Procure and use silt curtains to prevent sediment dispersal from the dredging areas | Contractor/KPA | During dredging | Procured above |
| | Establish a liaison committee between the proponent, contractor and the local Beach Management Units | Contractor/KPA/County Government/BMUs | During dredging | Nil |
| | Develop and implement a grievance redress mechanism | Contractor/KPA/County Government/BMUs | During dredging | Nil |
| | Compensation for local fishermen for restricted or loss of access to traditional fishing grounds | Contractor/KPA/County Government/BMUs | During dredging | TBD |
| Sourcing of raw materials | Procure materials in line with the Bill of Quantities | Contractor | During revitalization | Nil |
| | Source raw materials from sites that are EMCA Compliant | Contractor/KPA | During revitalization | Nil |
| | Re-use and recycle construction materials where practical | Contractor | During revitalization | Nil |

| | | | | |
|---|---|---|---|---|
| Destruction of the physical environment | Obtaining permits to fell trees from KFS and County Government | Contractor/KPA | Prior to revitalization | 20,000 |
| | Retain tree cover in areas that will not be revitalized | Contractor/KPA | During revitalization | Nil |
| | Greening the port by planting 5,000 trees in areas of the port that will not be revitalized at least 2ha @ 2,500 trees/ha | KPA/KFS | During and after revitalization | 5,000,000 |
| | Landscaping by planting grass and flowers | KPA/Landscape Architect | After revitalization | 1,000,000 |
| | Compacting loose soils to prevent erosion during revitalization | Contractor/KPA | During revitalization | Nil |
| Water use and sanitation | Sensitize workers and contractors on the need for water conservation and implement penalties for wastage | Contractor | During revitalization | Nil |
| | Contractors to procure mobile toilets for the workforce | Contractor | During revitalization | 200,000 |
| Solid waste generation and management | Use of overburden in backfilling and landscaping | Contractor | During revitalization | Nil |
| | Sensitize construction workers on the process of solid waste collection, segregation and proper disposal | Contractor | During revitalization | 20,000 |
| | Procure adequate solid waste collection bins with capacity for segregation | Contractor | During revitalization | 500,000 |
| | Procure the services of a NEMA licensed waste handler to dispose solid wastes from revitalized areas and the dredger | Contractor | During revitalization | 100,000 |
| | Comply with the Waste Management Regulations, 2006 | Contractor | During revitalization | Nil |
| Noise Pollution | Limit revitalization works to day time hours only | Contractor | During revitalization | Nil |
| | Locate machinery that are likely to produce noise as far as practical from neighboring properties | Contractor | During revitalization | Nil |
| | Procure and provide adequate earmuffs to workers and visitors to the site and enforce their use | Contractor | During revitalization | 100,000 |
| | Use of serviceable machinery and equipment | Contractor | During revitalization | Nil |
| | Sensitize truck drivers to avoid unnecessary hooting and running of vehicle engines | Contractor | During revitalization | 20,000 |
| | Comply with Noise Regulations, 2009 | Contractor | During revitalization | Nil |
| Air pollution | Install appropriate and adequate dust screens around the Revitalization areas | Contractor | During revitalization | 500,000 |
| | Sprinkle water at the excavation areas to suppress dust | Contractor | During revitalization | 100,000 |

| | | | | |
|---|---|---|---|---|
| | Cover stock piles of construction materials to reduce dust emissions especially during windy conditions | Contractor | During revitalization | 500,000 |
| | Procure, provide and enforce the use of dust masks to workers and visitors to the project site | Contractor | During revitalization | 100,000 |
| | Use of serviceable machinery/equipment and trucks | Contractor | During revitalization | Nil |
| | Monitor fugitive emissions to ensure compliance | Contractor | Quarterly | 400,000 |
| | Comply with Air quality Regulations, 2014 | | During revitalization | Nil |
| Safety and health risks | Ensure the dredger is licensed by the IMO and KMA | Contractor/KPA/KMA | During dredging | Nil |
| | Create awareness among Lake users and required safety measures | Contractor/KPA/KMA | During dredging | 500,000 |
| | Dredger should have an early warning system for local fishermen within the Bay | Contractor/KPA/KMA | During dredging | 1,000,000 |
| | Hire qualified and well-trained personnel for the dredging and construction works | Contractor | During dredging and revitalization | Nil |
| | Obtain insurance cover for all employees and the construction site | Contractor | During dredging and revitalization | Tender |
| | Provide Personal Protective Equipment (PPE) for ship crew, workers and visitors to the port | Contractor | During dredging and revitalization | 1,000,000 |
| | Recruit qualified and experienced EHS officers | Contractor | During dredging and revitalization | Nil |
| | Install safety signages and boards at all construction zones showing the required safety measures and PPEs | Contractor | During dredging and revitalization | 200,000 |
| | Comply with the Merchant Shipping Act, 2009 | Contractor | During dredging | Nil |
| | Comply with the Occupational Safety and Health Act, 2007 | Contractor | During dredging and revitalization | Nil |
| | All accidents should be reported, investigated and corrective action taken to prevent reoccurrence | Contractor | During dredging and revitalization | 250,000 |

**Table 20. Environmental Management Plan for the operational phase of the proposed project.**

| Impact | Recommended mitigation measures | Responsibility | Timeframe | Costs (KES) |
|---|---|---|---|---|
| Risks posed by macrophytes (Water hyacinth, Hippo grass, papyrus etc.) | Develop and implement an early warning system on water hyacinth and other macrophytes occurrence in Kisumu Bay | KPA | Immediate | 300,000 |
| | Employ or deploy a resident GIS analyst to implement the early warning system using remotely sensed data | KPA | Immediate | 2.5 Million per year |
| | Ground truthing and surveillance activities based on the early warning in collaboration with Kenya Coast Guard Services and local fishermen | KPA/KCGS/Local Fishermen | Based on early warning system | TBD |
| | Mechanical removal of the water hyacinth using a water hyacinth harvester | KPA/LVEMP/Kisumu Polytechnic | Based on early warning system | Harvester exists |
| | Support local initiatives using water hyacinth to make handicrafts, biogas and power production | KPA/CBOs/ Private Sector | On a need basis | TBD as part of CSR |
| | Enforce compliance with Water Quality Regulations, 2006 to prevent discharge of raw effluent into the Lake | NEMA/County Government of Kisumu | Immediate | Ongoing |
| | In the long term implement the proposed dredging of Kisumu Bay and opening up of the Mbita Causeway. | KPA/National and County Governments | <5 years | Tender |
| | Installation of retractable gates at Mbita Causeway once it is opened to prevent marshes of water hyacinth from drifting into the port area. | KPA | Immediate | Tender |
| Waste water generation and management | In the short term sustain use of septic tank and soak pit system | KPA | Continuous | 100,000/ year |
| | Installation of a biodigester to replace the septic tank and soak pit system | KPA | 1 Year | Tender |
| | Connection to the Kisat Sewage Treatment Plant reticulation in the long-term | KPA/KIWASCO | 3 Years | Tender |
| | Apply and obtain an Effluent Discharge Licence from NEMA | KPA | Immediate | 50,000 |
| | Ensure compliance with the Water Quality Regulations, 2006 | KPA | Continuous | Nil |
| | Create awareness on oil spill prevention and training on containment if oil spills do occur | KPA | Continuous | 100,000/ Year |

| | | | | |
|---|---|---|---|---|
| Oil, grease and runoff from the port | Establish a well-equipped pollution control center (with booms, dispersants etc) | KPA | 6 Months | Tender |
| | Procure a well-equipped pollution control boat and train port personnel on usage | KPA | 6 Months | Tender |
| | Prepare and implement as need arises, an oil spill contingency plan for the port | KPA | Immediate | Nil |
| | Procure a NEMA licensed contractors to dispose, reuse or recycle waste oil | KPA | Immediate | Tender |
| | Report and document all oil spills incidents, action taken and the results of the action taken | KPA | Continuous | Nil |
| | Ensure compliance with Marpol Convention 73/78, EMCA and KMA Acts | KPA/KMA/NEMA | Continuous | Nil |
| Solid waste generation and management | Sensitization on importance and good solid waste management practices | KPA | Continuous | 100,000/ year |
| | Provide adequate infrastructure for solid waste collection, segregation, storage and disposal | KPA | Immediate | 500,000 |
| | Procure the services of a NEMA licensed waste handler to dispose off solid wastes from the port regularly | KPA | Immediate | Tender |
| | Ensure compliance the Waste Management Regulations, 2006 | KPA | Continuous | Nil |
| | Ensure compliance with Marpol Convention 73/78, EMCA and KMA Acts | KPA | Continuous | Nil |
| | Support the County Government to establish sanitary landfill as part of the Ports CSR | KPA/County Government | Continuous | TBD |
| Air pollution | Watering dusty areas of the revitalized port during the dry season | KPA | At dry season | 20,000/ Season |
| | Provide dust masks to employees working in dusty areas and enforce on their use | KPA | Continuous | 50,000/ Year |
| | Develop and implement a policy on the age and condition of traffic that can service the port | KPA | Immediate | Nil |
| | Tree planting and landscaping of the port to improve air quality and prevent fugitive dust | KPA | Continuous | Provided under EMP 1 |

| | | | | |
|---|---|---|---|---|
| | Implement the air quality monitoring plan proposed by the ESIA study | KPA | Quarterly | 400,000/ Year |
| | Ensure compliance with the Air Quality Regulations, 2014 | KPA | Continuous | Nil |
| Noise pollution | Undertake noise mapping to identify peak noise producing areas in the port | KPA | Quarterly | Nil |
| | Provide PPEs to employees working in peak noise areas | KPA | Continuous | 50,000/Year |
| | Reduce the time of exposure to employees working in peak noise areas | KPA | Continuous | Nil |
| | Use of serviceable equipment and machinery | KPA | Continuous | Nil |
| | Ensure compliance with Noise Regulations, 2006 | KPA | Continuous | Nil |
| Increased water and energy demand | Restore and increase the volume of reticulated water supply to the port | KPA/KIWASCO | Immediate | TBD |
| | Enhance water conservation through awareness creation among employees and visitor | KPA | Continuous | 20,000 |
| | Install solar panels at the warehouse and port offices for lighting purposes | KPA | 1 Year | Tender |
| | Keep records on power consumption by the port to inform energy management and audit interventions | KPA | Monthly | Nil |
| Safety and health risks | Install navigational aids (Marker buoys) and early warning signage along the access channel to the port | KPA/KMA | Ongoing | Tender |
| | Sensitize local fishermen and tour operators on the increased maritime traffic at Kisumu Bay | KPA/County Government/Kenya Fisheries Service | Immediate | 500,000 |
| | Establish a control tower to guide maritime traffic within Kisumu Bay | KPA | Six months | Tender |
| | Create awareness among employees on the importance of their safety | KPA | Continuous | 50,000/ Year |
| | Develop and implement a safety action plan and set goals to ensure zero fatalities | KPA | After revitalization of the port | 50,000 |
| | Provide adequate PPEs to workers and enforce on their use | KPA | Continuous | 2,000,000 |
| | Control access to the port area | KPA | Continuous | Nil |

| | | | | |
|---|---|---|---|---|
| | Ensure regular and proper maintenance of equipment and work tools | KPA | Continuous | Nil |
| | Place appropriate safety and warning signage at strategic areas within the Port | KPA | After revitalization of the port | 500,000 |
| | Conduct first aid training and provide well-stocked first aid kits | KPA | After revitalization of the port | 100,000 |
| | Provide and keep an accident/ incident register<br>Provide insurance cover to all employees | KPA | Continuous | Nil |
| | Procure and equip an ambulance which should be stationed at the port all the time and fully manned | KPA | After revitalization of the port | 10,000,000 |
| | Construct a sick bay to serve the port community and their families | KPA | After revitalization of the port | Tender |
| | Undertake Occupational Safety and Health audits | KPA | Annually | 500,000 |
| | Ensure compliance with the Occupational Safety and Health Act, 2007 | KPA | Annually | Nil |
| Fire risks and emergencies | Develop, clearly display and implement a fire and emergency response action plan | KPA | After revitalization of the port | 100,000 |
| | Identify and designate a suitable fire assembly point | KPA | After revitalization of the port | 50,000 |
| | Provide a fully equipped fire station and firefighting equipment | KPA | 1 Year | Tender |
| | Servicing of the firefighting equipment | KPA | Quarterly | 50,000 |
| | Train employees on the use of fire-fighting equipment | KPA | Annually | 100,000 |
| | Display fire safety and warning signage at all sections of the Port | KPA | After revitalization of the port | 500,000 |
| | Ensure proper handling and storage of flammable materials | KPA | Continuous | Nil |
| | Ensure regular inspection and maintenance of electrical appliances | KPA | Continuous | 200,000/ year |
| | Conduct fire drills | KPA | Bi-annually | |
| | Conduct fire safety audit | KPA | Annually | |
| Potential conflicts | Develop and implement a Grievances Redress Mechanism | KPA/Stakeholders | Immediate | 200,000 |

| | | | | |
|---|---|---|---|---|
| | Identify and document suitable restitution measures to address conflicts | KPA/County Government of Kisumu/Other Stakeholders | Immediate | 500,000 |
| | Ensure maritime safety | KPA/KMA | Continuous | Nil |
| | Sustain water quality monitoring activities and share the results with the stakeholders | KPA/NEMA Accredited Lab | Monthly | 600,000 |
| | Focus the labor policy on the local community | KPA | Continuous | Nil |

# 5 ENVIRONMENTAL MONITORING PLANS

## 5.1 Introduction

Effective implementation of the Environmental Management Plan (EMP) requires the development and implementation of a suite of monitoring plans for the environmental media and socio-economic issues identified during the baseline survey. The objective of the monitoring plans is to enhance the environmental performance of the proposed project by providing data and information on compliance with legislative standards, conservation and preservation of the environment and determining the levels of deviation from the values obtained during the baseline monitoring. This is in turn informs the corrective measures if any that need to be implemented to comply with the legislative standards and environmental restoration. For the proposed project, seven monitoring plans are proposed. These are;

1. Water quality monitoring plan
2. Sediment monitoring plan
3. Biodiversity monitoring plan
4. Aquatic macrophytes monitoring plan
5. Fisheries monitoring plan
6. Air quality monitoring plan
7. Noise monitoring plan

## 5.2 Water quality monitoring plan

### 5.2.1 Introduction

The potential sources of water quality degradation will be sediment loads from construction and dredging activities as well as pollution from the port's activities such as ship maintenance, oil handling and storage, release of bilge water from ships among others. Effluent generated from the sanitation facilities may also pollute the lake if not well managed. Poor water quality will affect both the groundwater aquifers and freshwater habitats and fauna including the benthic communities due to reduced light and dissolved oxygen. The objective of the monitoring plan is to provide data and information to improve water quality and management of the effluent by assessing the variation of water quality parameters from the baseline data and with the standards prescribed under the Environmental Management and Coordination (Water Quality) Regulations, 2006.

In addition, the proponent should have in place a domestic water quality monitoring plan which will involve keeping records of consumption by the port.

### 5.2.2 Monitoring locations

Water quality monitoring should be carried out at the six stations within the lake based on the baseline sampling points. These are Station 1; sewage discharge point 1, Station 2; sewage discharge point 2, Station 3; River Kisat Estuary, Station4; at the Port, Station 5; offshore (midway of the access channel based on width of Bay) and Station 6; Municipal water supply intake. The GPS coordinates for these monitoring points are provided. In addition, the proponent should monitor the quality of portable water from KIWASCO to the port.

### 5.2.3 Monitoring parameters

The water monitoring parameters and the specified target values to be monitored at the lake during revitalization and subsequent operations of the port will be the same as the ones provided during the baseline monitoring which are based on the Environmental Management and Coordination (Water Quality) Regulations, 2006 (Table 21). The standards for monitoring of water from KIWASCO will be the Kenya Standards KS EAS 153:2014 for drinking water.

If the port eventually connects to the Kisat Sewage Treatment Plant, the monitoring parameters and the specified target values for effluent discharge to the public sewer will be monitored as per

the Fifth Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006 (Table 21).

**Table 21. Water quality monitoring parameters and the standards prescribed under the Third Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006.**

| Parameter | Standards |
|---|---|
| PH Value | 6.5-8.5 |
| BOD mg/L | 30max |
| Chemical Oxygen Demand mg/L | 50 max |
| Total Suspended Solids mg/L | 30 max |
| Ammonia-NH+;mg/L | 100 Max |
| Total Dissolved Solids mg/L | 1200 Max |
| E. Coli Colonies count/100ml | Nil |
| Total coliform count/100ml | 30mg/L |

**Table 22. Water quality monitoring parameters and the standards prescribed under the Fifth Schedule of the Environmental Management and Coordination (Water Quality) Regulations, 2006.**

| Parameter | Maximum levels permissible |
|---|---|
| Suspended solids (mg/L) | 250 |
| Total dissolved solids (mg/L) | 2000 |
| Temperature (°C) | 20-35 |
| pH | 6-9 |
| Oil and grease (mg/L) | 10 |
| Oil and grease (mg/L)- where pond is a final treatment | 5 |
| Ammonia Nitrogen (mg/L) | 20 |
| Substances with obnoxious smell | Shall not be discharged into the sewers |
| BOD, days at 20°C (mg/L) | 500 |
| COD (mg/L) | 1000 |
| Arsenic (mg/L) | 0.02 |
| Mercury (mg/L) | 0.05 |
| Lead (mg/L) | 1.0 |
| Cadmium (mg/L) | 0.5 |
| Chromium VI (mg/L) | 0.05 |
| Chromium (Total) (mg/L) | 2.0 |
| Copper (mg/L) | 1.0 |
| Zinc (mg/L) | 5.0 |
| Selenium (mg/L) | 0.2 |
| Nickel (mg/L) | 3.0 |
| Nitrates (mg/L) | 20 |
| Phosphates (mg/L) | 30 |
| Cyanide Total (mg/L) | 2 |
| Sulphide (mg/L) | 2 |
| Phenols (mg/L) | 10 |
| Detergents (mg/L) | 15 |
| Colour | Less than 40 Hazen units |
| Alkyl Mercury | Not Detectable (nd) |
| Free and saline Ammonia as N (mg/L) | 4.0 |
| Calcium Carbide | Nil |
| chloroform | Nil |
| Inflammable solvents | Nil |
| Radioactive residues | Nil |
| Degreasing solvents of mono-di-trichloroethylene type | Nil |

### 5.2.4 Monitoring frequency
Water quality sampling and analysis should be undertaken monthly in collaboration with a NEMA designated laboratory.

## 5.3 Sediment monitoring plan
### 5.3.1 Introduction
Benthic contamination may result from runoff from upstream areas, river systems, quay and storage area, spills from bulk cargo operations and windblown dust. Sediments reflect processes in the water column. They act as sinks for trace pollutants such as heavy metals and persistent organics when environmental conditions change and directly influence the quality of the overlying water. In addition, they are natural habitats for aquatic organisms, like snails, mussels and aquatic flora. Further, sediment imbalance reduces navigation possibilities and loss of biodiversity within the lake. For this reason, sediment monitoring assesses the ecological status of the lake, to detect toxic constituents and to control their effect.

### 5.3.2 Monitoring location
Sediment monitoring should be conducted at the River Kisat Estuary and the Port area. Other monitoring stations may be added in due course to enhance coverage of Kisumu Bay.

### 5.3.3 Monitoring parameters
The monitoring parameters for sediments should include testing for the presence of hydro carbons and heavy metals such as lead, zinc, copper, chromium and nickel as per the baseline monitoring.

### 5.3.4 Monitoring frequency
Sediment sampling and analysis will be carried out in collaboration with a NEMA designated laboratory on an annual basis.

## 5.4 Biodiversity monitoring plan
### 5.4.1 Introduction
Water quality varies spatially in Lake Victoria. Gulfs, near-shore areas adjacent to big human settlements and river mouth areas are relatively turbid and eutrophic. In addition, the diverse topography/terrain, prevailing weather/climatic conditions as well as river inflows and out- flows influences water circulation patterns. This in turn determines the temporal-spatial water quality which can be linked to the distribution of biota in the lake. The objectives of the biodiversity monitoring plan will therefore be to determine the impact of water quality degradation from the operations of the revitalized Port on the biological communities compared to their status and condition reported in the baseline chapter to inform mitigation measures and environmental management decisions by the Port.

### 5.4.2 Target population
Biological monitoring will target fisheries, macro-invertebrates and general biodiversity especially with focus to hippopotamuses, crocodiles and birds among other riparian wildlife similar to the baseline survey.

### 5.4.3 Monitoring location
The monitoring stations for target biodiversity should coincide with the twelve stations within the lake identified during the baseline survey. These areas have varying physico chemical water quality characteristics which greatly influence the abundance of biodiversity.

### 5.4.4 Monitoring parameters
Biodiversity monitoring should focus on % cover for critical habitats and species diversity and abundance.

### 5.4.5 Monitoring frequency
Monitoring frequency should be annually or bi-annually depending on the status of the aquatic environment or in the event of significant environmental risks such as oil spills which could impact on the biodiversity of the lake.

## 5.5 Aquatic macrophytes monitoring plan
### 5.5.1 Introduction
Invasive aquatic macrophytes in the lake exhibit a cyclical pattern of decline and proliferation with attendant ecological and economic impacts such as transport challenges and water quality degradation. Therefore, there is a need for sustained monitoring of the invasive macrophytes to clearly identify the ecological factors that drive the macrophytes dynamics including the water hyacinth and predict more precisely their impacts on navigation, fisheries and tourism/recreation.

### 5.5.2 Monitoring parameters
The proposed monitoring will include monitoring of the macrophytes distribution, their coverage, patterns of dispersion over time as well as their socio-economic impact on the port and riparian communities

### 5.5.3 Monitoring strategy
KMFRI has conducted routine monitoring and mapping of water hyacinth coverage in Nyanza gulf since 2013 to date. The proponent should therefore collaborate with the institution for monitoring of aquatic macrophytes in the lake. In addition, the proponent should have in place an early warning system for recognition of impending water-hyacinth infestations to inform interventions and avoid risks to the port.

### 5.5.4 Monitoring stations
The monitoring stations should target the hot spots including areas receiving nutrients loads, areas in proximity to river mouths and shallow areas within the lake. The monitoring stations identified during the baseline survey are considered hot spots.

## 5.6 Fisheries monitoring plan
### 5.6.1 Introduction
The revitalization of the Port and subsequent operations are likely to deteriorate the water quality of the lake. Poor water quality may directly impact negatively on fisheries due to reduced oxygen and destruction of their breeding habitats. The objective of the fisheries monitoring plan is to track changes in fisheries so as to inform mitigation measures and environmental management decisions by the Kisumu Port.

### 5.6.2 Monitoring location
Fisheries monitoring should be carried out at the twelve fish stations based on the baseline sampling points.

### 5.6.3 Monitoring methods
The monitoring of fisheries will replicate the baseline methodology which will include sampling and analysis of catch from the Bay. The proponent should liaise with the Kenya Marine and Fisheries Research Institute (KMFRI) and the County Fisheries Department to implement the fishery monitoring plan for the Port.

### 5.6.4 Monitoring parameters
The monitoring parameters should include percentage cover for critical habitats, fisheries species diversity, abundance, catch per unit effort and landings.

### 5.6.5 Monitoring frequency
The monitoring frequency should be monthly throughout the project life.

## 5.7 Air quality monitoring plan
### 5.7.1 Introduction
Potential sources of air pollution at the project site are dust during construction activities, emissions from machinery/ equipment and vehicular traffic and poor disposal of waste which can foul the air. Air pollution and emissions above the acceptable level can potentially cause health problems which include respiratory diseases and visual irritants. The purpose of the air quality monitoring plan is to therefore measure the concentrations of dust and gaseous emissions emanating from the project activities and compare with the results obtained during the baseline survey. In addition, the results will be used to evaluate if the adopted air pollution controls and management are effective.

### 5.7.2 Monitoring location
Air quality monitoring should be conducted at the slipway, port area and next to the Kenya Revenue offices. These locations are sensitive receptors of air pollution above the prescribed limits.

### 5.7.3 Monitoring parameters
Port activities are a source of fugitive emissions. Therefore, the proponent should monitor fugitive emissions during the revitalization and operational phases as per the First Schedule of the Environmental Management and coordination (Air Quality) Regulations, 2014 (Table 23).

**Table 23. Baseline air quality results and ambient air quality tolerance limits (Source: Polucon Services (K) Limited, November 2019).**

| Pollutant | Limits as per EMC (Air Quality) Regulations, 2014 |
|---|---|
| Sulphur Oxides ($SO_X$) | 80 $\mu g/m^3$ |
| Nitrogen Dioxide | 150 $\mu g/m^3$ |
| Suspended Particulate Matter | 360 $\mu g/m^3$ |
| Respirable Particulate matter (< 10$\mu$m) (RPM) | 70 $\mu g/m^3$ |
| PM $_{2.5}$ | 35 $\mu g/m^3$ |
| Non methane hydrocarbons | 700ppb |
| Total VOC | 600 $\mu g/m^3$ |
| Oxides of Nitrogen | 80 $\mu g/m^3$ |
| Carbon monoxide/ carbon dioxide | 10 $mg/m^3$ |

## 5.8 Noise monitoring plan
### 5.8.1 Introduction
Potential sources of noise pollution will emanate mainly from the machinery and equipment operations and vehicular movements. Noise may lead to hearing impairments which will reduce the workmanship of the employees and also affect their finances due to treatment and medication. The purpose of noise monitoring plan is to therefore ascertain the extent of the impact due to the operation of the Port in compliance with the Environmental Management and Coordination (Noise and Excessive Vibrations pollution) (control) Regulations, 2009 (Tables 24 and 25).

### 5.8.2 Monitoring location
Noise level measurements should be conducted within the peak noise producing sections of the Port.

### 5.8.3 Monitoring frequency

Noise monitoring should be done on a quarterly basis in collaboration with a NEMA designated laboratory. Noise levels will be measured in dB (A).

**Table 24. Maximum permissible intrusive noise levels for construction sites as stipulated in the Second Schedule of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.**

| Zone | | Maximum Noise Level Permitted (Leq) in db(A) | |
|---|---|---|---|
| | | Day | Night |
| (i) | Health facilities, educational institutions, homes for disabled etc. | 60 | 35 |
| (ii) | Residential | 60 | 35 |
| (iii) | Areas other than those prescribed in (i) and (ii) | 75 | 65 |

**Table 25. The Maximum permissible intrusive noise levels stipulated in the First Schedule of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009.**

| Zone | | Sound Level Limits dB (A) Leq, 14 h | | Noise Rating Level (NR) Leq, 14 h | |
|---|---|---|---|---|---|
| | | Day | Night | Day | Night |
| A | Silent Zone | 40 | 35 | 30 | 25 |
| B | Place of worship | 40 | 35 | 30 | 25 |
| C | Residential: Indoor<br>Outdoor | 45<br>50 | 35<br>35 | 35<br>40 | 25<br>25 |
| D | Mixed Residential (with some commercial and places of entertainment) | 55 | 35 | 50 | 25 |
| E | Commercial | 60 | 35 | 55 | 25 |

Day: 6.01 a.m. – 8.00 p.m. (Leq, 14 h) Night: 8.01 p.m. – 6.00 a.m. (Leq, 10h)

## 5.9 Grievances redress mechanism

### 5.9.1 Introduction

The affected persons by the proposed project may raise their grievances and dissatisfactions about actual or perceived impacts in order to find a satisfactory solution. These grievances, influenced by their physical, situational and/or social losses, can emerge at the different stages of the project cycle. Not only should the affected persons be able to raise their grievances and be given an adequate hearing, but also satisfactory solutions should be found that mutually benefit both the affected persons and the project. It is equally important that the affected persons have access to legitimate, reliable, transparent and efficient institutional mechanisms that are responsive to their complaints.

### 5.9.2 Grievances prevention

Grievances cannot be avoided entirely, but much can be done to reduce them to manageable numbers and reduce their impacts. This will be achieved by;

1. Providing sufficient and timely information to communities. Many grievances arise because of misunderstandings; lack of information; or delayed, inconsistent or insufficient information. Accurate and adequate information about a project and its activities, plus an approximate implementation schedule, should be communicated to the communities, especially affected parties, regularly.
2. Conduct meaningful community consultations. The project proponent should continue the process of consultation and dialogue throughout the implementation of the project.

Sharing information, reporting on project progress, providing community members with an opportunity to express their concerns, clarifying and responding to their issues, eliciting communities' views, and receiving feedback on interventions will benefit the communities and the project management.

3. Overall good management of the port will ensure a reduction in potential conflicts with the local community and other stakeholders.

# 6 GOVERNANCE FRAMEWORKS

## 6.1 Introduction

The Third Schedule of EIA/EA Regulations requires that environmental guidelines and standards which include Kenya government policies and strategies, national legislation, multi-lateral environmental agreements and the institutional arrangements to render them should be incorporated in an ESIA report. The legal and institutional frameworks provide important safeguards for protection and conservation of fragile environments and vulnerable communities and enhance the implementation of the EMPs. Under this section, the ESIA will therefore review the applicable sets of laws, international agreements and institutions which environmental compliance requirements for the proposed revitalization of Kisumu Port Infrastructure.

## 6.2 Policy Framework

### 6.2.1 National Environment Policy

Kenya has a National Environment Policy prepared and approved in 2013 by the Ministry of Environment, Water and Natural Resources. Its overall goal is to provide better quality of life in Kenya for present and future generations through sustainable management and use of freshwater resources and wetlands. This policy elaborates the use of environmentally- friendly development strategy that integrates and promotes cohesion of development and environmental policies and enhances transfer of environmentally sound technologies. Chapter 5 of the policy elaborates on environmental stewardship and specifically part 5.6 states that environment impacts of Infrastructural development like ports are distinct and unique such as effects on flora and fauna, social and psychological disruption and vegetation clearance among others. Chapter 6 of the policy elaborates on environmental quality and health and the need to ensure a clean and health environment for all. The relevant policy statements for the revitalization of Kisumu Port include; 1) Develop and implement integrated freshwater and wetland resources management strategies and action plans, 2). Promote and institutionalize payment for environmental services schemes to support catchment protection and conservation, 3). Promote sustainable use of freshwater and wetland resources and the conservation of river and lake ecosystems through development and implementation of river basin management plans, and 4). Involve and empower communities in the management of fresh water and wetland ecosystems.

### 6.2.2 KPA Environment Policy

The proponent, Kenya Ports Authority has an environmental policy statement in place. It strives to improve and attain the highest standards of environmental performance for the benefit of the port communities under its stewardship. Some of the policy statements to achieve this goal include; adoption of green port initiatives, providing and maintaining a clean, safe and healthy working environment and compliance with the current national and international standards among others.

### 6.2.3 Other relevant policies

Other than the National Environment Policy and the KPA Environment Policy, there are other policies which are relevant to the proposed revitalization of the Kisumu Port as shown in Table 26.

**Table 26. Summary of the National Policy Frameworks and their relevance to Kisumu Port.**

| Policy Framework | Relevance to Kisumu Port |
|---|---|
| National Oceans and Fisheries Policy, 2008 | To enhance the fisheries sector's contribution to wealth creation, increased employment for youth and women, food security, and revenue generation through effective private, public and community partnerships |
| National Climate Change Framework Policy | To enhance adaptive capacity and resilience to climate change, and promote low carbon development for the sustainable development of Kenya |
| National Forest Policy, 2014 | Ensure sustainable development, management, utilization and |

| | |
|---|---|
| | conservation of forest resources and equitable sharing of accrued benefits for the present and future generations of the people of Kenya |
| The National Water Policy, 1999 (under review) | Enhances water resources management and pollution control through abstraction permits and standards for effluent discharge |
| National Wetlands Conservation and Management Policy, 2015 | Fostering an integrated approach that would promote conservation and sustainable use of wetlands by securing and ensuring the sustainable use of wetlands for Kenya's posterity. |
| National Wildlife Conservation and Management Policy, 2017 | Provides a framework for conserving Kenya's rich diversity of species, habitats and ecosystems for the benefit of its people and the global community. |
| National Land Policy, 2009 | Sets guidelines for sustainable land use and management practices. |

## 6.3 Legal framework

### 6.3.1 The Kenya Constitution, 2010

The Constitution of Kenya 2010 is the supreme law of the land. Under Chapter IV, Article 42 provides for the right to a clean and healthy environment for all. Further, Chapter V of the Constitution deals with Land and Environment. Specifically, Part 2 elaborates on the obligations of the proponent in respect to protection of the environment and enforcement of environmental rights.

**Relevance to the proposed project**

- The proponent should ensure that port operations do not infringe on the right to a clean and healthy environment for all.
- The proponent must ensure that the operations are carried out in an ecologically, economically and socially sustainable manner.
- The proponent is entitled to a fair administrative decision-making process from NEMA and other State organs.

### 6.3.2 Kenya Ports Authority Act, 2014

It is an Act of Parliament that creates the Kenya Ports Authority (KPA). The Authority is responsible for all the port infrastructure in Kenya. Kenya Ports Authority maintains, operates, improves and regulates all scheduled ports on the coastline and hinterland of Kenya, including principally Kilindini Harbour at Mombasa, as well as other ports include Lamu, Malindi, Kilifi, Mtwapa, Kiunga, Shimoni, Funzi, Vanga and Kisumu.

**Relevance to the proposed project**

The proponent is mandated to maintain, operate, improve and regulate the Kisumu port and other ports set out in the Second Schedule of the Act.

### 6.3.3 Kenya Railways Corporation Act, 2012

It is Act of Parliament to provide for the establishment of a Corporation to be known as Kenya Railways, for the transfer to the Corporation of the undertakings of the East African Railways Corporation within Kenya, for the functions of the Corporation and for purposes connected there with.

**Relevance to the proposed project**

Kisumu Port was handed over to KPA by KRC in year 2018. This is consistent with the provisions of the Act which gives power to KRC to enter into any arrangement with the KPA which, in the opinion of the Board, will promote or secure the provision, or improved provision, of any service or facilities which they may separately provide and without prejudice to the generality thereof any such arrangement or agreement may include provisions relating to the following;

(i) The use by either party of the facilities or equipment maintained by the other;

(ii) The temporary employment of staff of one party by the other on secondment or otherwise;
(iii) The charges made in respect of the use of any service or facility to which the arrangement or agreement relates;
(iv) The financing of any project by either or both parties;
(v) Research connected with any existing service or facility provided by either party or in relation to any service or facility under consideration; and
(vi) The joinder in the arrangement or agreement by any other person.

### 6.3.4 The Kenya Maritime Authority Act, 2012

The Government of Kenya established Kenya Maritime Authority (KMA) in 2004, for the purpose of transferring areas of responsibility over shipping concerns from the Merchant Shipping Department of Kenya Ports Authority to an independent Governmental Authority. Thus, KMA under the Incorporation Order is responsible for Port and Flag State implementation of various international instruments relating to maritime transport. The Regulatory role of KMA therefore aims to broaden and modernize the institutional and legal framework for the implementation of maritime safety, security and the preservation of the aquatic environment.

#### Relevance to the proposed project

The proposed project will involve dredging of the lake and associated civil works within the port area. These works have safety implications on navigation at the water body as well as potential pollution which KMA has a direct oversight obligation as follows;

- National maritime legislation i.e. the KMA and the Merchant Shipping Acts remain the primary tools for attaining international standards in safety and security and the preservation of the marine environment. Only through such regulations can the Government enforce international maritime conventions, especially those emanating from the International Maritime Organization (IMO). Such rules and regulations are also relevant for the implementation of national maritime safety, security and marine environment conventions/programmes.
- KMA is the designated national competent oil spill authority responsible for the development and provision of guidelines for the management of oil spills in the maritime environment. Under Section 5 (i) of the Act, KMA is required to enforce safety of shipping, including compliance with construction regulations, maintenance of safety standards and safety navigation rules.

### 6.3.5 The Merchant Shipping Act, 2009

The Merchant Shipping Act is administered by the Kenya Maritime Authority. It is an Act of Parliament to make provision for the registration and licensing of Kenyan ships, to regulate proprietary interests in ships, the training and the terms of engagement of masters and seafarers and matters ancillary thereto; to provide for the prevention of collisions, the safety of navigation, the safety of cargoes, carriage of bulk and dangerous cargoes, the prevention of pollution, maritime security, the liability of ship-owners and others, inquiries and investigations into marine casualties; to make provision for the control, regulation and orderly development of merchant shipping and related services; generally to consolidate the law relating to shipping and for connected purposes.

#### Relevance to the proposed project

The proponent will collaborate with KMA in implementation of the Merchant Shipping Act in terms of ensuring ships and other maritime crafts accessing the port are licensed, prevention of pollution and in improving port and navigational safety.

### 6.3.6 The Environmental Management and Co-ordination Act Cap. 387 of the Laws of Kenya

The Act is the framework environmental law and aims to improve the legal and administrative co-ordination of the diverse sectoral initiatives in the field of environment so as to enhance the national capacity for its effective management. The Act harmonizes the sector specific legislations touching on the environment in a manner designed to ensure greater protection of the environment in line with the National Environment Policy, 2013.

**Relevance to the proposed project**

Section 58 of the Act requires proponents of a development likely to have deleterious effects on the environment to prepare and submit an EIA report to NEMA for consideration for decision making. This study report is prepared to comply with the provisions of this section. In addition, several Regulations have been enacted by the line Ministry to operationalize the Act as discussed below.

1. **Environmental Management and Coordination (Impact Assessment and Audit) Regulations, 2003**
   It describes how experts should conduct the EIA process including guidelines and standards to be met by reports. The regulations were reviewed in 2016 to align them to the Kenya Constitution 2010. They were also recently amended (2019) to address challenges that have been reported since they were gazetted. This report complies with the provisions of these Regulations.

2. **Environmental Management and Coordination (Water Quality) Regulations, 2006**
   Water Quality Regulations are meant to address the challenges of pollution of water resources as well as their conservation. They consist of VI parts and Eleven Schedules dealing with protection of sources of water to miscellaneous provisions. Part II, 6, (a) specifies the need for an effluent discharge licence. It states in part that "No person shall discharge any effluent from sewage treatment works, industry or other point sources without a valid effluent discharge license issued in accordance with the provisions of the Act. Part III, 12 (1 & 2), 13 and 14 sets out the need for adherence to the discharge standards specified in the Third, Fifth and Sixth Schedules. The port discharges its effluent into a septic tank soak pit system.

3. **Environmental Management and Coordination (Waste Management) Regulations, 2006**
   The Regulations focus on management of solid wastes, industrial wastes, hazardous wastes, pesticides and toxic substances and radioactive substances. The regulations are aimed at addressing the impact of pollution from wastes on the environment which become important sources of disease-causing pathogens. In compliance with these Regulations, the proponent will ensure proper waste disposal throughout the project cycle and procure the services of a NEMA licensed contractor for solid waste management.

4. **Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management) Regulations, 2009**
   These Regulations were enacted pursuant to the provisions of Section 42 (3) of EMCA. One of the key objectives of the Regulations is to facilitate the sustainable utilization and conservation of resources on river banks, lake shores, and on the seashore by and for the benefit of the people and community living in the area.

5. **Environmental Management and Coordination (Controlled substances) Regulations, 2007**
   These Regulations aim to regulate the production, trade and use of controlled substances and products; provide for a system of data collection to facilitate compliance with

relevant reporting requirements under the Montreal Protocol on Substances that Deplete the Ozone Layer; promote the use of ozone friendly substances, products, equipment and technology; and ensure the elimination of substances and products that deplete the ozone layer. Ozone Depleting Substances are chemicals that destroy the stratospheric ozone layer in the atmosphere by increasing the ultra violet rays from the sun to the earth's surface. Kenya is currently a consumer of ODS and therefore relies on importation and exportation of ODS. Any importer or exporter is required under these regulations to obtain an import license or export license respectively. An importer or exporter of any ODSs in piecemeal must obtain a permit for the same. It is a requirement to comply with the license and permit conditions.

6. Environmental Management and Coordination (Noise and Excessive Vibration Pollution) (Control) Regulations, 2009
   These Regulations were gazetted to manage noise levels to levels that do not cause a disturbance to the public. The operations at the port are likely to generate noise above the acceptable limits within the neighborhood. Noise level measurements were obtained on 1st November, 2019 to provide a benchmark for continued monitoring. Appropriate PPE should be provided for employees engaged in activities that may produce noise above the acceptable limits within the facility.

7. Environmental Management and Coordination (Air Quality) Regulations, 2014
   These regulations were aimed at controlling, preventing and abating air pollution to ensure clean and healthy ambient air. Potential sources of emissions during the operation of the Kisumu Port would include emissions from ships and locomotives as well as vehicular traffic. Air Quality measurements were obtained on 1st November, 2019 to provide a benchmark for continued monitoring. The proponent should therefore undertake quarterly air quality monitoring.

### 6.3.7 The Fisheries Management and Development Act, 2016

The Fisheries Management and Development Act provides the framework for the development, management, exploitation, utilization and conservation of fisheries and for connected purposes. Article 49 (1) and 50 (1) of the subsidiary Regulation fisheries conservation, management and development has provisions for the prevention of pollution and protection of fish breeding areas. The overall objective of this Act is to protect, manage, use and develop the aquatic resources in a manner which is consistent with ecologically sustainable development, to uplift the living standards of the fishing communities and to introduce fishing to traditionally non-fishing communities and to enhance food security. As part of the implementation of the Act and improve community participation in the conservation and management of fisheries, the Kenya Government gazetted the Beach Management Units (BMUs) Regulations in 2007.

#### Relevance to the proposed project

Kisumu Port is located on the shores of Lake Victoria, which supports a thriving fishery and local livelihoods. The proponent will implement measures to prevent pollution of the lake by both solid wastes and effluent generated by port operations which would degrade water quality and affect fisheries.

### 6.3.8 The Wildlife Conservation and Management Act, 2013

It is the law charged with the responsibility of providing for the protection, conservation, sustainable use and management of wildlife in Kenya and for connected purposes. It designates protected areas, lists and provides for the protection of endangered, vulnerable and protected species as well as invasive species. It is critical in the study of biodiversity as it is the most comprehensive database alongside the IUCN red list of endangered species.

**Relevance to the proposed project**
The Lake Victoria Basin is incredibly rich in wildlife including hippopotamuses and birds. The proponent should implement measures to prevent pollution from the port operations which would degrade water quality and affect the wildlife.

### 6.3.9 The Water Act, 2016
The Constitution acknowledges access to clean and safe water as a basic human right and assigns the responsibility for water supply and sanitation service provision to the 47 established counties. The purpose of the 2016 Water Act is to align the water sector with the Constitution's primary objective of devolution. The Act establishes several organs to ensure development and sustainable use of water resources. These include the Water Resources Authority (WRA), the Water Sector Trust Fund (WSTF), Water Resources Users Associations (WRUAs), Water Services Providers (WSPs) and Water Works Development Agencies among others.

**Relevance to the proposed project**
The Water Act provides for the management, conservation, use and control of water resources and for the acquisition and regulation of rights to use water, to provide for the regulation and management of water supply and sewerage services.

### 6.3.10 The Forest Conservation and Management Act, 2016
It is an Act of parliament that gives effect to Article 69 of the constitution with regard to forest resources, to provide for the development and sustainable management and rational utilization of all forest resources for the socio-economic development of the country and for connected purposes.

**Relevance to the proposed project**
The proponent should obtain a permit from the Kenya Forest Service to cut down trees to pave way for the development. In addition, he should plant trees in areas within the facilities that will not be developed to compensate for loss during revitalization.

### 6.3.11 The Climate Change Act, 2016
The Climate Change Act provides a regulatory framework for the development, management, implementation and regulation of mechanisms to enhance climate change resilience and low carbon development for the sustainable development of Kenya. It provides for mainstreaming of climate change responses into development planning, decision making and implementation as well as resilience and adaptation in all governance sectors.

**Relevance to the proposed project**
The proponent should implement measures to ensure low carbon foot at Kisumu Port. This could be through installation of renewable energy infrastructure for lighting and energy efficient machines during the rehabilitation of the port. Additionally, the proponent should support local communities in climate change adaptation measures through investments in capacity building e.g. in agriculture, forestry, conservation and fisheries as part of KPAs Corporate Social Responsibility (CSR).

### 6.3.12 The Kenya Coast Guard Service Act, 2018
The Kenya Coast Guard Service was established by The Coast Guard Service Act 2018, and was operationalized on 22nd October 2018. The Coast Guard Service is responsible for protecting the country's waters against dumping of harmful wastes and pollutants, search and rescue services, and the arrest of illegal fishermen.

### Relevance to the proposed project
The proponent will collaborate with the Kenya Coast Guard by reporting illegal activities and in prevention of pollution of the lake and trafficking.

### 6.3.13 Physical and Land Use Planning Act, 2019
The Act provides for the planning, use, regulation and development of land and for connected purposes. It was enacted to ensure that every person engaged in physical and land use planning shall promote sustainable use of land and livable communities which integrates human needs in any locality. The Act allows the County Government to prepare a local physical and land use development plan in respect of a County, Sub-County, or unclassified urban area.

### Relevance to the proposed project
The proponent will obtain applicable planning approvals from the County Government of Kisumu for revitalization activities. The County is in the process of preparing physical and land use development plans for Kisumu and the sub-counties. Future port expansions and support infrastructure should be aligned to the completed physical plans.

### 6.3.14 The Public Health Act, 2012
The Act aims at prohibiting activities that may be injurious to the general public. It outlines the responsibilities for the County Government to maintain a safe and clean environment by controlling the operation activities of any facility.

### Relevance to the proposed project
The proponent should ensure compliance with Act by providing clean, healthy and safe environment during revitalization and operation of Kisumu Port.

### 6.3.15 Occupational Safety and Health Act, 2007
OSHA, 2007 commenced on 26th October 2007. It is an Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces. Although the OSHA, 2007 repealed the Factories and Other Places of Work Act Cap. 514 of the Laws of Kenya, it inherited all the subsidiary legislation issued under Cap. 514. Examples of subsidiary legislation inherited include:

- Docks Rules L.N. 306 of 1962
- Eyes Protection Rules L.N. 44 of 1978
- Building Operations and Works of Engineering Construction Rules L.N. 40 of 1984
- Electric Power Special Rules L.N. 340 of 1979
- First Aid Rules L.N. 87 0f 1964
- Cellulose Solutions Rule L.N. 87 of 1964
- Health and Safety Committee Rules L.N. 31 of 2004
- Medical Examination Rules L.N. 24 of 2005
- Noise Prevention and Control Rules L.N. 25 0f 2005
- Fire Risk Reduction Rules L.N. 59 0f 2007
- Hazardous Substances Rules L.N. 60 of 2007

### Relevance to the proposed project
Under OSHA, the proponent should register the site as a workplace with DOSHS and ensure timely renewal of the same. In addition, the proponent should provide the workers with adequate and appropriate PPE and enforce their use at work, and carry out occupational safety and health audit annually.

### 6.3.16 The County Government Act, 2012
The new constitution grants County Governments the powers to grant or to renew business licenses or to refuse the same. To ensure implementation of the provisions of the new

constitution, the County Governments are empowered to make by-laws in respect of all such matters as are necessary or desirable for the maintenance of health, safety and well-being of the general public.

### Relevance to the proposed project

The Act gives the right to access all property at all times by the County Government officers and servants for inspection purposes. The Port Management will be under obligation to allow County officers and inspectors at the premises and comply with the by-laws of the County.

## 6.4 Institutional arrangements to implement the legal framework

To implement the above legal framework the government has established a number of institutions with varying mandates of implementation as shown in Table 27.

**Table 27. Institutions and their legislative mandate as it applies to the Kisumu Port**

| Institution | Legislative mandate |
|---|---|
| Kenya Ports Authority | To implement the KPA Act |
| Kenya Railways Corporation | To implement the Kenya Railways Corporation Act, 2012 |
| Kenya Maritime Authority | To implement the KMA Act and the Merchant Shipping Act |
| National Environment Management Authority | To implement the Environmental Management and Coordination Act and Associated Regulations |
| State Department of Fisheries and Blue Economy | To implement the Fisheries Management and Development Act and subsidiary regulations |
| Kenya Marine and Fisheries Research Institute | It is mandated to conduct aquatic research covering all the Kenyan waters and the corresponding riparian areas including the Kenyan's EEZ in the Indian Ocean waters. |
| Kenya Wildlife Service | To implement the Wildlife Conservation and Management Act, 2013 |
| Water Resources Authority | To implement the Water Act, 2016 |
| Kisumu Water and Sanitation Company Limited | Provides water and sanitation services to the residents of Kisumu County including Kisumu Port |
| Lake Victoria South Water Works Development Agency | Responsible for efficient and economical provision of water and sanitation services |
| Kenya Water Towers Agency | Coordinate and oversee the protection, rehabilitation, conservation and sustainable management of all the critical water towers in Kenya |
| Kenya Forest Service | To implement the Forest Conservation and Management Act, 2016 |
| Kenya Coast Guard | To implement the Kenya Coast Guard Service Act, 2018 |
| County Government of Kisumu | To implement the County Government Act, 2012, its by-laws and the Physical Planning and Land Use Planning Act, 2019 |
| Kenya Revenue Authority | Responsible for the assessment, collection and accounting for all revenues that are due to government, in accordance with the laws of Kenya |
| Kenya Bureau Standards | Provision of the country's Quality Infrastructure for facilitation of trade. It will ensure that goods to and from the Port are compliant to international standards through an internationally recognized Standards Measurement Systems. |
| Department of Immigration | Responsible for population registration and maintenance of an inclusive population register, migration management, border control and refugees welfare supervision |
| Kenya Pipeline Company Limited (KPCL) | Operates a pipeline system for transportation of refined petroleum products. One of the transportation mode for the Kisumu KPCL is the lake transport |
| Department of Public Health | To implement the Public Health Act |
| Directorate of Occupational Safety and Health Services | To implement the Occupational Safety and Health Act alongside the subsidiary legislation |

| | |
|---|---|
| Lake Basin Development Authority | To provide an avenue for a quicker, meaningful and coordinated development in the Kenyan portion of the Lake Victoria Basin |
| Civil society and conservation organization | Non-state, not for profit voluntary entities who play a various role in the implementation of a project including advocacy, conservation, safeguarding the environment and funding among others |

## 6.5 Multilateral Environmental Agreements

Kenya is a signatory to several international conventions, protocols and treaties and is therefore bound by the requirements of these conventions and protocols. The relevant ones in respect of the proposed project are aimed at ensuring a sustainable environment. They include;

1. The Nile Agreement 1929 and 1959
2. Convention on Biological Diversity, 1992
3. The Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1963
4. Bonn Convention on the Conservation of Migratory Species
5. Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention)
6. International Convention for the Prevention of Pollution from Ships (MARPOL) 1973/78
7. Ramsar Convention
8. The World Bank and IFC Safeguard and Sustainability Policies
9. United Nations Framework Convention on Climate Change (UNFCC)

### 6.5.1 The Nile Agreement 1929 and 1959

The 1929 agreement was signed between Egypt and Britain, which represented four countries at the time Uganda, Kenya, Tanzania and Sudan. The agreement recognized on the one hand that the Sudan needs more water for its development, and on the other hand that Egypt has historic rights in the Nile waters. In 1959, Egypt and Sudan signed a bilateral agreement, which effectively reinforced the provisions of the 1929 Treaty to increase water allocations to both Egypt and Sudan. The 1959 agreement, like the 1929 Treaty, did not make any allowance for the water needs of the other riparian states.

In 1999, the Nile River riparian states, except Eritrea, signed the Nile Basin Initiative (NBI) in an effort to enhance cooperation on the use of the common Nile Basin water resources. Under the auspices of the NBI, the riparian states began work on developing a permanent legal and institutional framework for governing the Nile River Basin. The Cooperative Framework Agreement (CFA), formally introduced the concept of equitable water allocation into discussions about Nile governance, as well as water security. The CFA was ready for signature beginning May 10, 2010; Kenya, Burundi, Ethiopia, Rwanda, Tanzania, and Uganda have signed it.

With the CFA in place, all 11 riparian states can negotiate in good faith to agree an allocation formula that is acceptable to all of them and considered fair, equitable, and reasonable.

#### Relevance to the proposed project

Lake Victoria basin is shared among Kenya, Uganda and Tanzania and is the source of River Nile which starts near Jinja, Uganda. It is therefore imperative that developments which are implemented by the riparian states take into account the need for sustainability of Lake Victoria. To achieve this, there is need for transboundary corporation in the use of the resources provided by the lake area and its catchment.

### 6.5.2 Convention on Biological Diversity, 1992

The Convention was opened for signature at the Earth Summit in Rio de Janeiro on 5 June 1992 and entered into force on 29 December 1993. Kenya ratified the Convention in 1994. The objectives of this Convention are the conservation of biological diversity, the sustainable use of

its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

The Convention on Biological Diversity gives the responsibility of conservation and protection of biodiversity to the signatories. As such, it is imperative for developments within the Kenyan jurisdiction to be cognizant of the objectives of the Convention. The Kenya's National Focal Points for the Convention are Ministry of Environment and Forestry, National Environment Management Authority, Kenya Wildlife Service and National Museums of Kenya.

### Relevance to the proposed project

The use of natural resources within the lake involves dual imperatives that are often in conflict: the need to meet the increasing requirements of an exponentially growing human population and the need to maintain existing genetic, ecological, and ecosystem biodiversity. The fulfillment of human needs for food, goods, and services involves the disruption and often degradation of natural habitats. The proponent should ensure that the Port's activities do not pollute the lake ecosystem thus maintaining biological diversity.

### 6.5.3 The Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1963

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a multilateral treaty to protect endangered plants and animals. It was drafted as a result of a resolution adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN). The convention was opened for signature in 1973 and CITES entered into force on 1 July 1975.

Kenya ratified the Convention on 13th December 1978 and it entered into force on 13th March 1979. Therefore, the country is obliged to protect endangered plants and animals. The Kenya's Focal Points are Kenya Wildlife Service and National Museums of Kenya.

### Relevance to the proposed project

The Lake Victoria Basin is internationally recognized for its high levels of freshwater species diversity and endemism and includes endangered species like Labeo, Barbus, Schilbe, Alestes and Clarias. The proponent should implement measures to prevent the degradation of habitats and threats to the biodiversity within the lake and riparian areas.

### 6.5.4 Bonn Convention on the Conservation of Migratory Species

As a result of international concern over the threats to migratory species, the Conservation of Migratory Species of Wild Animals (Bonn Convention) was adopted in 1979 and entered into force on 1 November 1983. It is an environmental treaty under the aegis of the United Nations Environment Programme that provides a global platform for the conservation and management of terrestrial, aquatic and avian migratory species throughout their range. Kenya ratified the Convention in 1999, hence the country is obliged to protect migratory species that live within or pass through the Kenya's jurisdictions. Kenya Wildlife Service is the focal point and implementing agency for the Bonn Convention.

### Relevance to the proposed project

Lake Victoria is a major migratory destination for several large fauna species in East Africa which are vulnerable to a wide range of threats, including habitat shrinkage in breeding areas and degradation of their feeding grounds. The proponent should ensure that the Port's activities do not pollute the lake.

### 6.5.5 Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989

The Basel Convention was adopted in March 1989 in Basel, Switzerland, and entered into force in 1992. It was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries. It does not, however, address the movement of radioactive waste. The Convention is also intended to minimize the amount and toxicity of wastes generated to ensure their environmentally sound management as closely as possible to the source of generation, and to assist less developed countries in environmentally sound management of hazardous and other wastes they generate.

Kenya ratified the convention on 30th August, 2000. Therefore, the country is obliged to comply with the import and export bans of hazardous waste and ensure wastes generated are kept within the country's boundary and as close as possible to the source of generation and provide incentives for waste reduction and pollution prevention. The National Focal Point for the Convention is the Ministry of environment and Mineral Resources.

#### Relevance to the proposed project

The proponent should ensure that hazardous wastes are not exported from or into the port and waste generated within the facility is properly managed.

### 6.5.6 International Convention for the Prevention of Pollution from Ships (MARPOL) 1973/78

The MARPOL Convention is the main international convention covering prevention of pollution by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and also includes the Protocol of 1997 (Annex VI). MARPOL has been updated by amendments through the years. The Convention covers pollution by oil & oily water, noxious liquid substances in bulk, harmful substances in packaged form, sewage and garbage and air pollution from ships. The Convention includes regulations aimed at preventing and minimizing pollution, both accidental pollution and that from routine operations.

Kenya became a signatory to the convention in 1973. Therefore, the country is obliged to comply with the provisions of the Convention in preventing pollution of the environment by ships from the discharge of harmful substances or effluents containing substances in contravention of the convention. The designated national competency authority responsible for prevention of ship pollution is the Kenya Maritime Authority.

#### Relevance to the proposed project

Pollution originating from ships, including oily sludge, food packaging and food waste will need to be managed as per the requirements of the convention during the revitalization and operation of port.

### 6.5.7 The World Bank and IFC Safeguard and Sustainability Policies

The financing institutions (The World Bank through its IFC branch) have also developed a policy on social and environmental sustainability that calls for positive development outcomes in the public and private sector. In order to achieve this, the World Bank has set up performance standards on environmental and social sustainability as well as general and industry specific environmental, health and safety guidelines against which projects are reviewed. The thrust of the standards is to ensure that projects financed by the bank are developed in a manner that is socially responsible and reflect sound environmental management practices.

### Relevance to the proposed project

The World Bank Safeguard Policies to be considered include; OP/BP 4.01 Environmental Assessment, OP/BP 4.04 Natural Habitats, OP/BP 4.10 Indigenous Peoples, OP/BP 4.11 Physical Cultural Resources, OP/BP 4.12 Involuntary Resettlement and OP/BP 4.36 Forests (Table 28). On the IFC Policy and Performance Standards the project will need to comply with performance standards 1, 2,3,4,6 and 7 (Table 29).

**Table 28. Summary of World Bank Environmental and Social Safeguard policies.**

| Safeguard and sustainability policy | Focus |
|---|---|
| OP/BP 4.01 Environmental Assessment | The Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable and thus improve decision making |
| OP/BP 4.04 Natural Habitats | To promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions |
| OP/BP 4.10 Indigenous Peoples | To design and implement projects in a way that fosters full respect for indigenous peoples' dignity, human rights, and cultural uniqueness, so that they:<br>● Receive culturally compatible social and economic benefits; and<br>● Do not suffer adverse effects during the development process. |
| OP/BP 4.11 Physical Cultural Resources | To assist in preserving physical cultural resources and avoiding their destruction or damage. Physical cultural resources include resources of archaeological, paleontological, historical, architectural, and religious, aesthetic, or other cultural significance. |
| OP/BP 4.12 Involuntary Resettlement | To address and mitigate economic, social, and environmental risks the community, institutions and social networks faces when they are weakened or lost |
| OP/BP 4.36 Forests | To harness the potential of forests, reduce poverty in a sustainable manner, integrate forests into sustainable economic development and protect the vital local and global environmental services and values of forests. |

**Table 29. Summary of IFC sustainability and performance safeguards.**

| Performance Standard | Focus |
|---|---|
| No. 1 | Social and Environmental Assessment and Management System |
| No. 2 | Labor and Working Conditions: Focus is on forced and child labor as well as occupational health and safety |
| No. 3 | Pollution prevention and abatement |
| No. 4 | Community health, safety and security |
| No. 6 | Biodiversity conservation and sustainable natural resource management |

### 6.5.8 United Nations Framework Convention on Climate Change (UNFCC)

The ultimate objective of this convention is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. It should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, so as to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Kenya is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), its Kyoto Protocol and its Paris Agreement and therefore decisions taken under the UNFCCC are binding to the country. Kenya ratified the UNFCCC on 30th August, 1994 and subsequently it entered into force on 28th November, 1994. The country accented to The Kyoto

Protocol on 25th February 2005, leading to its entry into force on 26th May 2005 and ratified The Paris Agreement on 28th December, 2016 which entered into force on January 27th 2017. Climate change has the potential to compromise infrastructure design, function and performance across a range of settings. Reliable water transport infrastructure in Kenya facilitates smooth and faster movement of goods and services and national and regional integration. This, boosts trade within and across Kenyan borders, promotes economic development, and contributes to poverty reduction and wealth creation.

The National Climate Change Secretariat is the National Focal Point for the United Nations Framework Convention on Climate Change. It also works with climate change coordination units in different ministries, departments and agencies to ensure that climate change is mainstreamed in the different sectors of the economy

### Relevance to the proposed project

Lake Victoria gets most of its water from rain and therefore precipitation variations significantly influence water levels in the Lake which in turn influence the transportation. This problem is expected to intensify under the conditions of future climate change, specifically increasing variability in rainfall patterns and increasing mean annual temperatures. Due to the importance of transport in the development of Kenya and the region, and as recommended in the National Climate Change Action Plan (NCCAP), Kenya aims to address climate change in the transport sector by working to reduce greenhouse gas emissions while encouraging development of transport infrastructure that accounts for the effects of climate change. The proponent should implement measures to ensure low carbon foot at Kisumu Port through collaborative initiatives with the riparian and catchment area communities.

# 7 CONCLUSION AND RECOMMENDATIONS

The revitalization of Kisumu Port Infrastructure will have substantial socio-economic benefits for Kisumu County, Kenya and the regional economies of riparian states which include Uganda and Tanzania as well as land locked countries such as Rwanda, Democratic Republic of Congo and South Sudan. These benefits will include increased exports and imports, reduced costs of doing business, enhanced efficiency in transportation of goods and services across the region, supporting industrial and agricultural growth and creating thousands of direct and indirect jobs. Thousands of business will find opportunities to trade with the port either as suppliers or users of the revitalized infrastructure. In Kenya the revitalization of the port will contribute to the Presidential Big Four Agenda by supporting manufacturing through exports of finished products and imports of raw materials and input. The growth of the port and the supporting industries adds to the socio-economic pillar for attainment of Kenya's development blue print, Vision 2030.

Against these benefits, there will be negative environmental and social impacts that can potentially affect the overall performance of the revitalized port. The impacts will occur at phases of the project cycle i.e. during the actual revitalization and operation of the Kisumu Port. At revitalization, the environmental concerns include the impacts of dredging and dumping on Lake Victoria ecosystem, fisheries and local livelihoods, destruction of the physical environment, water use and sanitation, solid waste generation and management and safety and health risks among others. At operational stage, environmental and social issues include the risks posed by water hyacinth and climate change, waste generation and disposal, air and noise pollution, safety and health risks and fire risks and emergencies. A decommissioning phase of the project cycle is a remote possibility as the Port Master Plan actually proposes an expansion of Kisumu Port in tandem with business growth. It is on this basis that decommissioning was not considered in the ESIA study but potential impacts were identified and listed. To address the environmental and social impacts of the two phases, the ESIA study has provided a suite of two Environmental Management Plans (EMPs) corresponding to the revitalization and operational phases respectively. In addition, the study has reviewed the relevant governance and institutional frameworks which the proponent should comply or collaborate with in implementation of the EMPs. The compliance should enhance the level of environmental performance of Kisumu Port at revitalization and operational phases. The study has also recommended seven monitoring plans that will compare the baseline conditions against the impacts and mitigation measures and determine the efficacy of the EMPs. The implementation of the monitoring plan should therefore provide opportunities for adaptive environmental management strategies consistent with the EMPs.

Dredging and dumping pose the highest risk to the Lake Victoria Ecosystem. However, their impacts are temporal but irreversible in terms of bathymetric changes and water circulation which ironically is beneficial to the ecological integrity of Kisumu Bay. The mitigation measures proposed by the ESIA study are considered adequate to address the impact of dredging and dumping both in the short term and eventual recovery of potentially affected biological communities. The monitoring plans on water and sediment quality, fisheries and biodiversity should inform the performance of the mitigation measures and changes introduced as appropriate to address any emerging concerns or risks. Going forward there will be need for sustained stakeholder engagement to avoid conflicts with local fishermen and riparian businesses in case of lack of compliance with the mitigation measures by the contractor and also on account of safety risks posed by increased traffic to and from the port. We have recommended that the proponent develops and implements a grievance redress mechanism during the preparation of the detailed Environmental Management and Monitoring Plan by the contractor.

Based on the foregoing, the ESIA study recommends the issuance of an EIA Licence subject to committed implementation of the EMP and other conditions prescribed by the Authority.

# 8 APPENDICES

1. Copy of Acknowledgement and Approval of TOR for the ESIA Study
2. Copy of KPA Environment Policy Statement
3. Copies of reports of baseline environmental monitoring by Polucon Services (K) Limited (Water, sediment and air quality and noise level measurements)
4. Draft letters of Invitation and Evidence of Receipt of the invitations to stakeholders during the Kick-Off Meeting and Draft ESIA Report Review
5. Proceedings of the Kick-off meeting held at Acacia Hotel on 1st November 2019
6. Proceedings of the stakeholder meeting to review the draft ESIA report held at Acacia Hotel on 26th November 2019
7. Copy of NEMA Practicing Licence for Envasses Environmental Consultants Limited
8. Copy of NEMA Practicing Licence for Eco Plan Management Limited
9. Copy of NEMA Practicing Licence for Mr. Simon Nzuki
10. Copy of NEMA Practicing Licence for Ms. Irene Keino

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