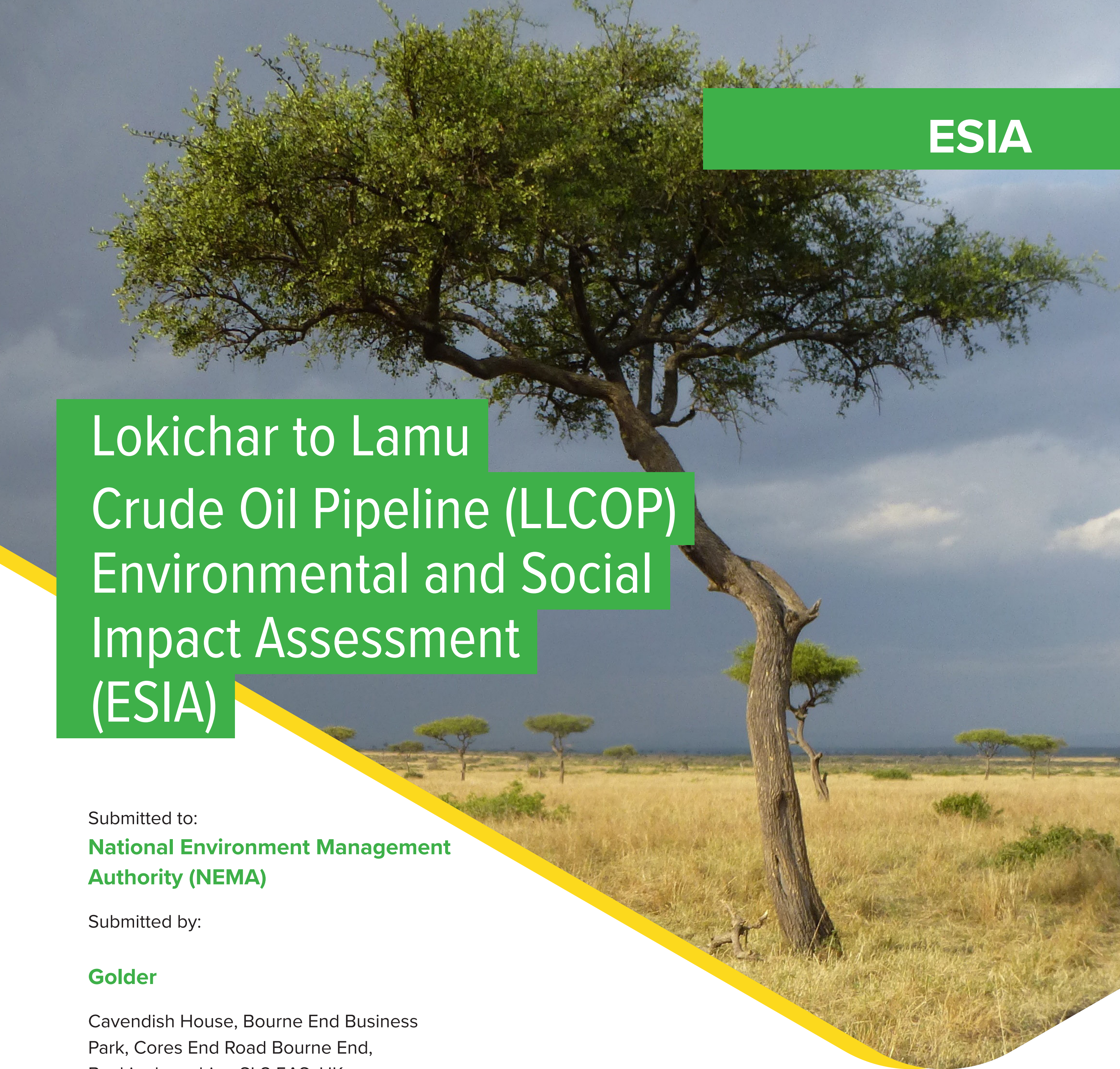

ESIA

Lokichar to Lamu Crude Oil Pipeline (LLCOP) Environmental and Social Impact Assessment (ESIA)

Submitted to:

National Environment Management Authority (NEMA)

Submitted by:

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NON-TECHNICAL SUMMARY

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1.0 INTRODUCTION

This Non-Technical Summary provides a summary of the Environmental and Social Impact Assessment (ESIA) carried out for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Project, Kenya.

The LLCOP Project will be designed and constructed to transport crude oil from the oil fields in the South Lokichar Basin, Turkana to a Storage and Load-out Facility at the new Port in Lamu, via an 824 km long pipeline.

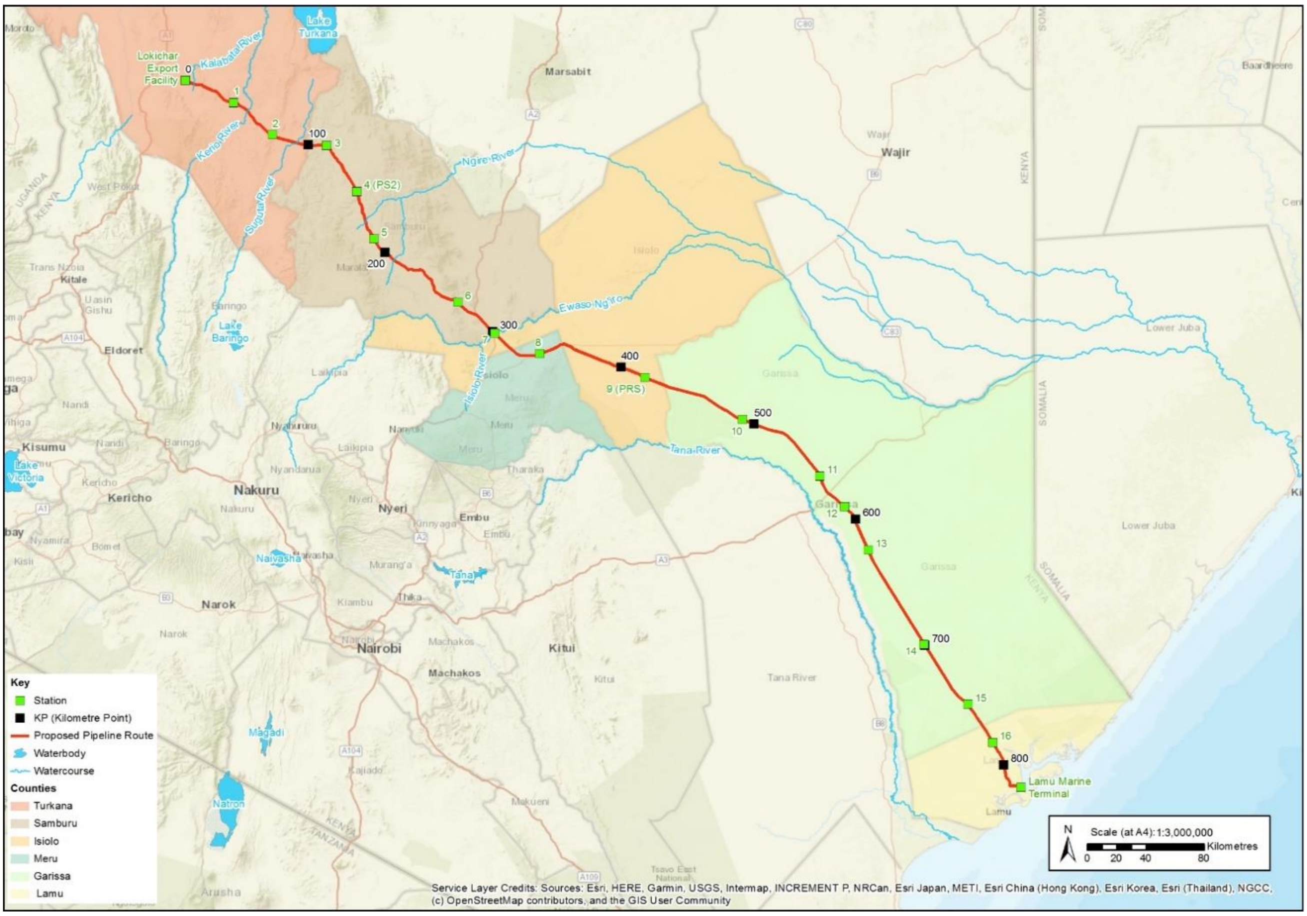

Figure 1: LLCOP Route and Station Locations

1.1 Background

The Pipeline Project Management Team (PPMT) is managing the development of the LLCOP Project on behalf of the following Joint Development Agreement (JDA) parties:

- The Government of Kenya represented by the Ministry of Petroleum and Mining;
- Tullow Oil Kenya B.V.;
- Africa Oil Kenya;
- Africa Oil Turkana;
- Total EP International K2; and
- Total EP International K3.

The LLCOP Project is a stand-alone element of the *Lamu Port, South Sudan, Ethiopia Transport Corridor* (LAPSSET), a key component of the Kenya 2030 strategic vision. Land required for the LAPSSET Corridor will be acquired by the Government of Kenya (National Lands Commission, supported by Ministry of Lands and Physical Planning) by compulsory acquisition under the terms of the Land Act (2012) and transferred to the LAPSSET Corridor Development Authority (LCDA) who will then lease land required for the pipeline corridor to the Project.

The LLCOP Project will be constructed in the 500 m wide LAPSSET Corridor, which will accommodate roads and a standard gauge railway (Lamu/Garissa/Isiolo and Isiolo/Lokichar) and oil pipeline utilities (water and power transmission lines). The LLCOP Project component will require a 26 m right of way (RoW) 'working width' for construction and a permanent 6 m wide easement for operations during the life of the Project, in addition to other land required for temporary construction facilities and a number of permanent pumping and other above ground installations (Stations) along the length of the pipeline.

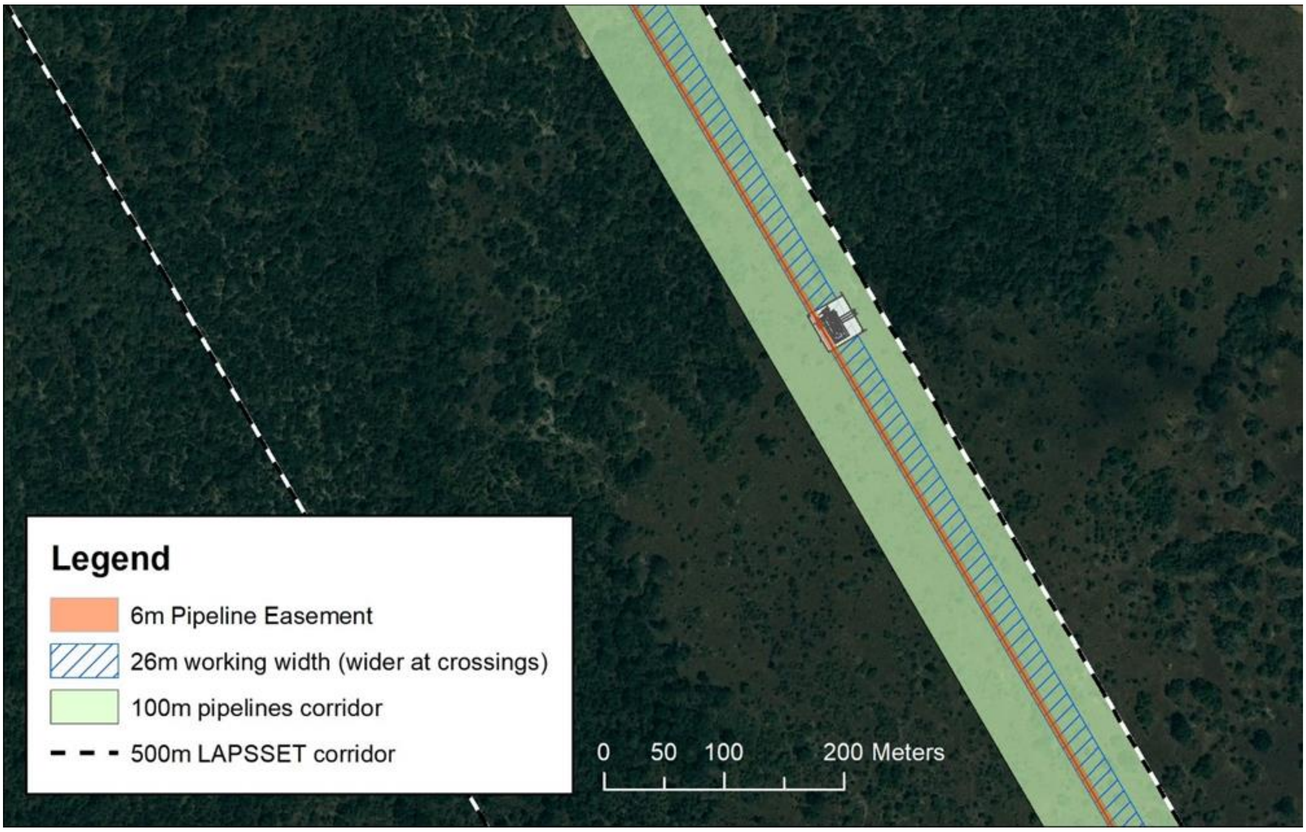

Figure 2: LLCOP pipeline and example station alignment within LAPSSET Corridor

1.2 Policy, Legal and Administrative Framework

The LLCOP Project ESIA has been prepared to comply with Kenyan legislative, regulatory and policy requirements, and relevant Good International Industry Practice (GIIP). The National Environment Management Authority (NEMA) is the administrative body responsible for the coordination of environmental management activities in Kenya. NEMA is responsible for the implementation of all environmental policies and is also responsible for reviewing and approving ESIAs.

1.3 ESIA Methodology

The objective of the ESIA is to identify and quantify impacts that the Project may have on the biophysical and socio-economic environments through reference to the baseline conditions prior to project implementation. The ESIA sets out potential mitigation and management measures to prevent unacceptable impacts and where possible enhance benefits for stakeholders, affected communities and the environment. The following describes the key phases of the LLCOP ESIA Project:

- Scoping Stage: Scoping is used to determine how the ESIA will be undertaken, as well as which potential impacts should become the focus of the ESIA.
  - The aim of scoping is to identify at a high level the potential impacts on environmental and social receptors likely to arise from Project activities that will need to be further considered in baseline data collection and the impact assessment.
  - The primary output is the Terms of Reference (ToR) and supporting Project (Scoping) Report.
- Baseline: A baseline report is undertaken to characterise the existing environmental and social conditions within a defined 'Area of Influence' or AoI (an area defined for each technical discipline to be the geographical area that covers the potential interaction of the project with the particular topic of interest) and to identify trends in such conditions, including:
  - Establish baseline conditions – determine baseline conditions through primary data collection and a desk-based review of existing published and available site-specific information and surveys; and
  - Establish the key receptors and their importance and sensitivity.
- Impact Assessment: Identify and quantify potential Project impacts on the biophysical and socio-economic environments through reference to the baseline conditions and develop measures to reduce and manage these impacts (mitigation), including:
  - Characterise the magnitude of the impact to the receptor – determine the potential changes to receptors brought about by the Project and assign a magnitude of impact; and
  - Assess the impact significance – determined by the nature and magnitude of the impact, combined with the importance of a receptor.
- Management Plans: Bring together mitigation and management measures and consider the need for monitoring – used to monitor the success and effectiveness of any mitigation.

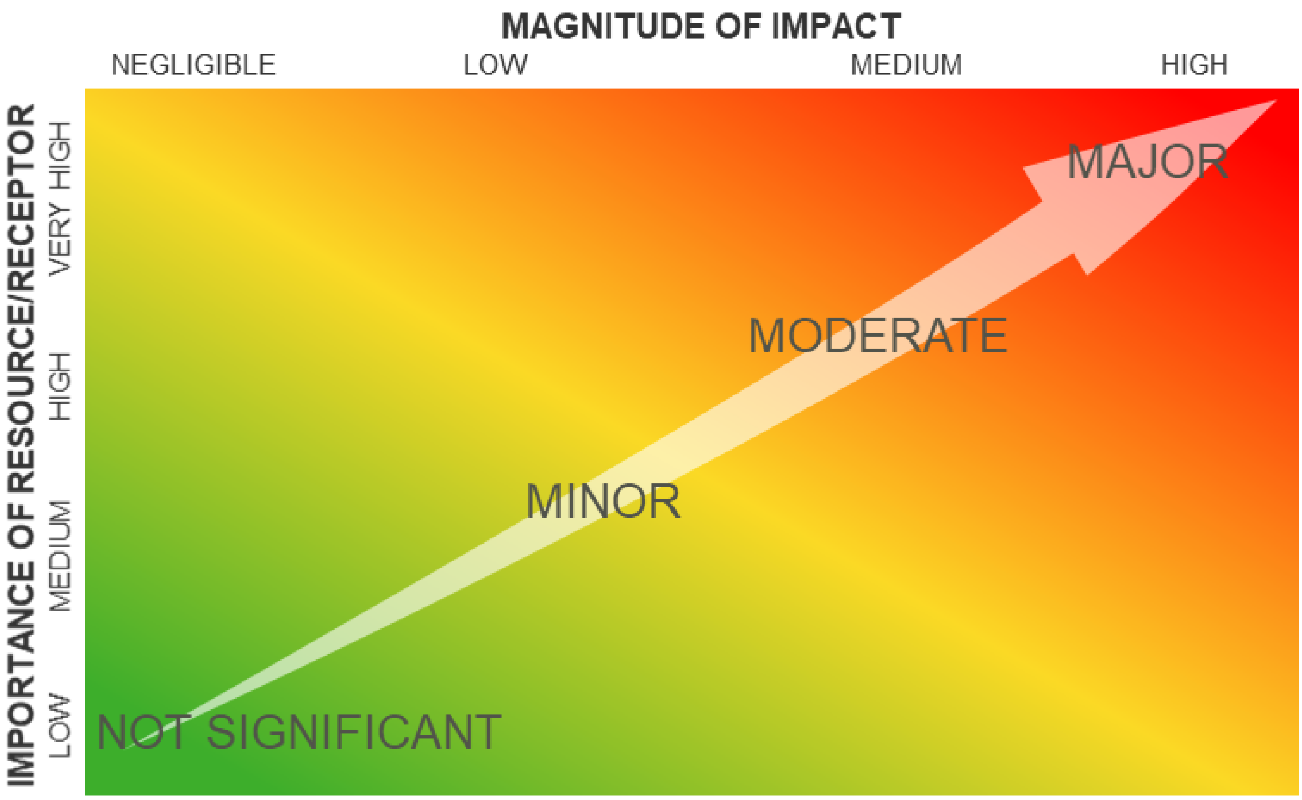

Figure 3: Impact Classification

1.4 Stakeholder Engagement and the Design Interface

The objective of stakeholder engagement is to ensure that legislative requirements are met; sources of information and expertise are identified; stakeholder concerns and expectations are registered and addressed; and affected communities have the opportunity to discuss project risks and impacts, and proposed mitigation and monitoring measures as part of the ESIA process.

Throughout the ESIA process the ESIA consultants have worked very closely with the Front-End Engineering Design (FEED) Engineers to ensure that the engineering design considered environmental and social constraints ahead of their evaluation in the ESIA and addressed where possible stakeholder concerns.

These interactions have made for an effective iterative process of design and assessment that enable impacts to be avoided through design, avoiding redundant design work and reducing the need for excessive mitigation proposals in the ESIA.

2.0 PROJECT DESCRIPTION

The LLCOP project is designed to provide transportation, storage, and export facilities for crude oil produced at from the South Lokichar Basin and processed at the Central Processing Facility (CPF) at Lokichar, to a Load-Out Facility (LOF) at the Lamu Marine Terminal (LMT), located within the new Lamu Port development. The pipeline will be heated and insulated to maintain the oil at a temperature to maintain its optimum flow characteristics. The pipeline will be buried along its entire 824 km length, the minimum depth of cover along the majority of its length will be 0.9 m, however, in rocky areas, the minimum depth of cover may be reduced to 0.6 m. There will be a number of above-ground installations or ‘Stations’ (infrastructure facilities that help with the oil transportation process) at specific locations along the route. The exact locations of these Stations have been determined by the design and operational requirements of the Project.

The LLCOP will be located for its entire length within the LAPSSET Corridor. The Project pipeline corridor will comprise a 26m wide Right of Way (RoW) for construction and a 6m wide permanent easement to provide access during operation.

The export facilities at Lamu will include the LMT within the existing Lamu Port and a Very Large Crude Carrier (VLCC), an oil tanker that will act as a floating storage and offloading (FSO) vessel permanently moored at Berth 3 of Lamu Port. Tankers will dock alongside the VLCC and crude oil will be offloaded into the tankers for export.

The project is anticipated to take approximately 38 months to construct from the award of an Engineering, Procurement and Construction (EPC) contract. Once the decision to proceed with the Project has been taken and the contract awarded, it will take approximately 12 months before line pipe starts to arrive in Kenya.

2.1 Pipeline Routing

The pipeline corridor will pass through six Counties (Turkana, Samburu, Isiolo, Meru, Garissa and Lamu). The route selection process has incorporated engineering design, constructability, accessibility and logistical factors into the final route selected. Various field surveys were undertaken to verify desktop studies. As far as possible, the selected route option avoids settlements and sensitive areas of biodiversity and community importance. The route also avoids agricultural land and areas of high flood risk identified during routing studies. The LLCOP route crosses three permanent rivers (Kerio, Sugata and Ewaso Ng'iro) and passes through the floor of the Rift Valley. Other crossings include seasonal rivers as well as existing surfaced and unsurfaced roads.

2.2 Station Locations

There are 16 Stations between the CPF (not within the scope of this ESIA) and the LMT. The first pump station (PS1, which houses oil transportation pumps used to pump oil along the pipeline) is located at the Lokichar Export Facility (LEF), with 16 intermediate stations including a booster pump station at Station 4 (PS2), a pressure reduction station (PRS) at Station 9, and various other stations serving multiple functions that are co-located (e.g. power generation, block valves, launcher/receiver stations etc).

Where possible, facilities have been located to make use of existing infrastructure and to facilitate construction without any significant increase in overall route length. Some stations will be in remote areas which will require the construction of a total of 31.4 km of new access track where access is not available using existing roads.

2.3 Pipeline Design and Technology

The key design parameters for the Project include the following:

- Design-life of 25-years;
- The pipeline will be designed to operate on an annual throughput of approximately 65 kbopd (thousand barrels of oil per day), up to a maximum of approximately 80 kbopd;
- To maintain oil temperature at an acceptable level to ensure the oil remains in a suitable liquid state for pumping and transport (at or above 57 °C as a minimum), a trace heating system (heating cables running in physical contact along the length of the pipe) along with appropriate thermal insulation will be installed along the entire length of the pipeline;
- The construction technique will be conventional excavation of a trench and back-fill of excavated materials;
- Main rivers will be crossed using open cut construction techniques in periods of low river flow (i.e. in the dry season);

- Where applicable, Project facilities will be designed using closed drain systems that will collect discharge from drains and equipment within stations during operations and maintenance and direct any discharges to a specified storage vessel to prevent release to the environment;
- The pipeline and its facilities will be designed to comply with all applicable Kenyan Laws and Regulations, and applicable international design codes and HSE standards, as well as GIIP; and
- Where appropriate, Best Available Technology will be used – the Project will be designed so that all construction and operation related emissions and discharges meet defined project environmental standards.

2.3.1 Material Design

The pipeline will be made of 18” diameter carbon steel, coated with an anti-corrosion layer and will be insulated with foam as well as having an outer resistant, protection coating. The overall external diameter will be 24”.

2.3.2 Leak Detection

Early detection of a leak and identification of the leak location using a leak detection system permits time for safe shutdown and a minimisation of potential spill volumes.

2.3.3 Power Generation

Electrical power for pumping and heating will be sourced from the national grid and generated at a number of locations along the pipeline for pumping the crude oil, powering the trace heating system and other control systems.

Crude oil will be used to fuel generators and small volumes of crude oil will be stored locally in heated tanks prior to use. The main power supply will serve all normal and emergency electrical functions during normal operation.

2.4 Construction Techniques

Pipeline construction is a sequential process and comprises a number of distinct operations, beginning with initial survey work and concluding with restoration, as shown in Figure 4. The technique for installation of the pipeline will be open-cut trenches, which are about 1.5 m wide. The standard RoW needed for safe installation using this technique is 26 m, but in certain locations it may be reduced to 18 m.

A large pipeline project is typically divided into manageable lengths called “spreads", and uses highly specialised and qualified workgroups. The LLCOP pipeline will have five main spreads and a specialised mountain spread. Each spread comprises various specialist teams, each with their own responsibilities. Station construction will be divided between several Station teams.

2.5 Waste Management

Waste materials will be generated during the construction and operation of the Project. This will include generation of both non-hazardous and hazardous wastes. Construction waste will include spoil, metal, and hazardous waste, as well as wastewater. During operations, small quantities of general solid waste, sanitary wastewater and hazardous waste will be generated. The majority of this will be generated at manned Stations and the LMT. Appropriate transport and disposal routes we will be identified for all waste streams.

1. PRE-CONSTRUCTION SURVEY
Before construction begins, environmental features are surveyed along the proposed pipeline segments. Utility lines and agricultural drainage's are located and marked to prevent accidental damage during pipeline construction. The pipeline's centreline and the extent of right of way and workspace is staked.

2. CLEARING AND GRADING
The pipeline right of way is cleared of vegetation. Temporary erosion control measure are installed prior to any earth-moving activities. Topsoil is then removed and stockpiled before the ROW is graded and the running track/strip prepared.

3. PIPE STRINGING AND BENDING
Individual joints of pipe are strung along the right of way adjacent to the pipeline centreline and arranged so they are to be accessible for construction personnel. A mechanical pipe-bendng machine bends individual joints of pipe to the desired angle at locations where there are significant changes in the natural ground contours or where the pipeline route changes direction.

4. WELDING, FIELD JOINT COATING AND X-RAY INSPECTION
After the stringing and bending are complete, the pipe sections are aligned, welded together, and placed on temporary supports along the edge of the trench. All welds are then x-rayed. The coating on the line pipe is cut back to allow welding to take place. Once the weld and inspection are complete the field joint coating is applied. The entire pipe coating is then electronically inspected.

5. TRENCHING
Backhoes and trenching machines are then used to excavate the trench.

6. LOWERING PIPE IN AND BACKFILLING
The pipe assembly is lowered into the trench by sidebooms. The trench is backfilled. No foreign materials are allowed in the trench.

7. TESTING
After backfilling, the pipe is filled with water and pressure tested. Tested water is obtained and disposed of in accordance with applicable regulations. The water source may be some distance away, requiring water to be tankered in.

8. RESTORATION
The policy is to clean up and restore the work area as soon as possible. Temporary environmental control measures are maintained until the area is restored, as closely as possible, to its original contour and condition.

Figure 4: Pipeline Construction Spread

2.6 Camps and Storage Facilities

Site storage facilities for the storage of pipe and other equipment will be located near the working area within the LAPSSET corridor where possible or at major facilities along the LLCOP route to ensure easy delivery to the construction site. Each storage facility will contain a camp within the facility boundaries. The basis for the ESIA assumed port of entry for imported line pipe is Mombasa Port, however, with the opening of Lamu Port, the new Port will also be considered.

Potential locations for camps and storage facility locations have been identified and confirmed as viable locations, subject to further investigation, permitting and feasibility assessments. Existing brownfield sites will be used wherever possible. It will be the responsibility of the EPC contractor to finalise the location and permit the camp and storage facilities. Camps will be managed in a way to minimise influx and prevent local impacts to the local economy in terms of inflated prices for goods and services.

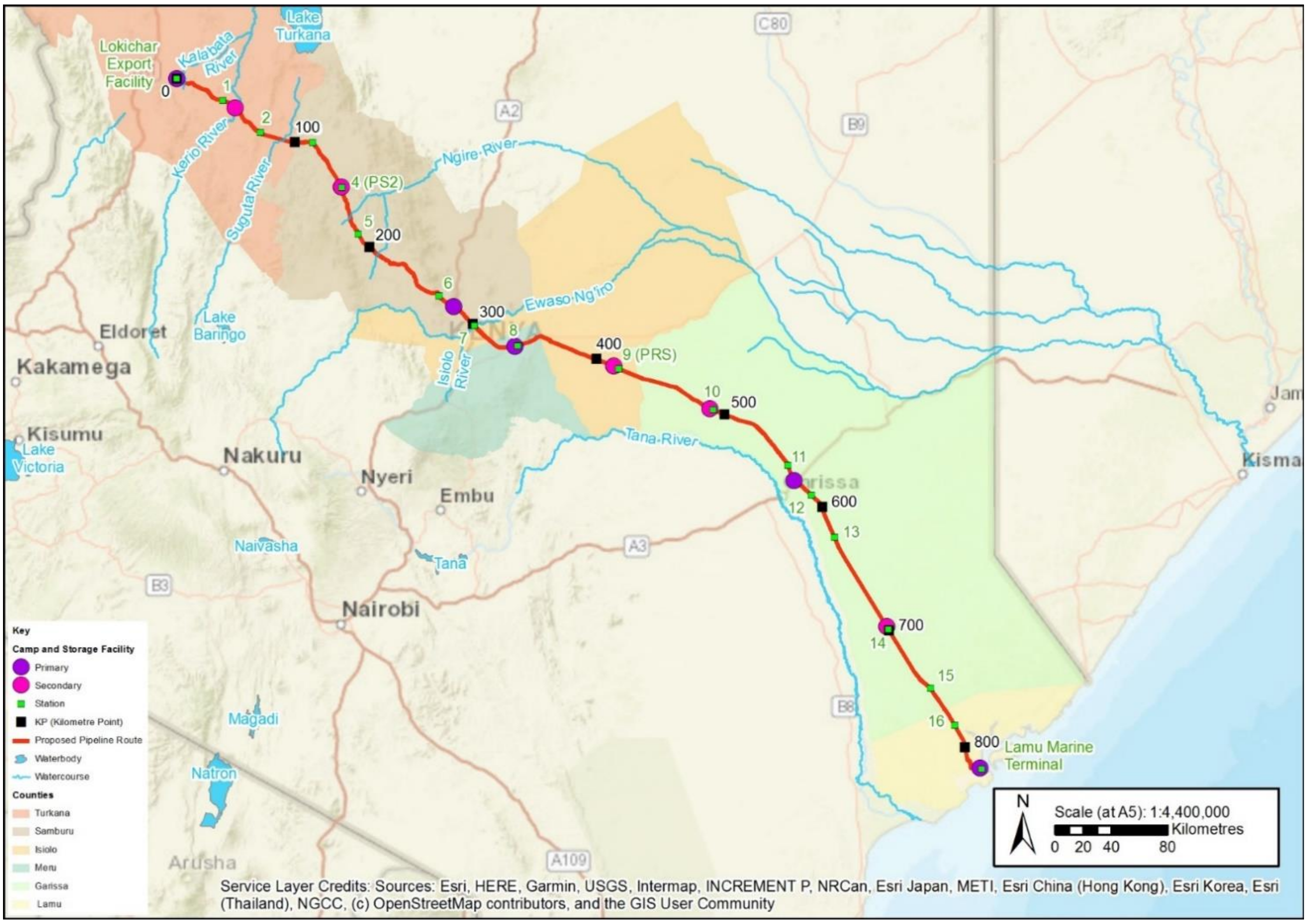

Figure 5: Proposed Camp and Storage Facility Locations

2.7 Workforce

The construction workforce will peak at approximately 7,000 workers, including management staff, skilled, semi-skilled and unskilled workers. The operations workforce will number approximately 280 workers, comprising both company staff and local contract workers. Where possible, the overall approach to recruitment will be to employ local workers who possess the qualifications and experience required for the performance of the relevant work and will follow Kenyan legislative requirements on local content.

2.8 Pre-Commissioning and Commissioning

Pipeline pre-commissioning activities include cleaning, testing (system pressure testing or 'hydrotesting') and drying. Commissioning activities will also be undertaken for the project facilities located at the Stations and the LMT. Activities will be performed by the EPC contractor to ensure the pipeline is ready for overall commissioning.

2.9 Operations

The pipeline will be controlled and operated through an Integrated Control and Safety System (ICSS) consisting of a process control system, safety systems and overall security systems. An emergency response facility will be located at the LMT.

2.10 Decommissioning

The pipeline has a design life of 25 years. At this stage it is not possible to anticipate the available technologies for decommissioning at the end of the project's useful life, however, the following approach will be adopted:

- All underground equipment (pipeline) will be emptied of oil product, left in a clean state and left *in situ*;
- All above ground infrastructure will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with affected communities and County Governments;
- All marine facilities will be emptied of oil product and removed from the site for safe disposal/recycling; and
- Five years prior to the planned End of Project, a Decommissioning Plan will be developed for agreement with the appropriate authorities.

2.11 Analysis of Alternatives

The Project has been developed through an iterative design process, which considered a variety of project alternatives for the transportation, storage and export of crude oil from the oil fields at Lokichar. The adoption of a buried crude oil pipeline (as opposed to road or rail transport options) emerged as the favoured and most feasible method, partly due to efficiency and more significantly, safety factors, for transporting the crude oil to the coast for export. Lamu was favoured over Mombasa as the point of export as it aligns with the objectives of the LAPSSET project and the already high shipping volumes and associated marine traffic at Mombasa have the potential to impact tanker operation and loading. The option of using a floating offshore mooring point at Lamu Port was discounted in favour of the permanently moored FSO vessel due to unfavourable weather and sea conditions experienced during the rainy season.

As the design process progressed, a wide range of pipeline route alternatives were considered between 2012 and 2019 to achieve the optimal design. The final route avoids settlements, protected or sensitive areas of biodiversity and community importance, agricultural land, and areas of high flood risk wherever possible. An example of the sensitivity of the approach with which the route has been selected is where the proposed route was relocated to avoid an area of biodiversity importance for Grevy's Zebra, an endangered species.

3.0 STAKEHOLDER ENGAGEMENT

Participation in engagement activities is an integral part of the ESIA process to ensure that the views, knowledge, and concerns of Project stakeholders are taken into account in the assessment of potential impacts as well as in Project decisions. Stakeholder engagement activities occurred throughout the course of the LLCOP ESIA with strong focus on local communities, government, civil society organisations and non-government organisations (NGOs). County and community level engagement was completed within each of the Project counties, with national government and NGO meetings held in Nairobi.

The stakeholder engagement programme was designed to consult with interested and affected parties throughout the Project AoI during the ESIA process, providing organisations and individuals with an opportunity to raise concerns and make comments and suggestions regarding the proposed project. By being part of the assessment process, stakeholders had the opportunity to influence the project in all phases of the ESIA process.

The ESIA comprised the following phases:

- Scoping – Initial field and baseline data reviews as well as early stakeholder engagement to define the scope of the ESIA;
- Socio-economic Baseline Data Collection – During this phase, the framework and proposed methodology for the assessment of environmental and social impacts were developed. The ToR phase included a presentation of the project, proposed ESIA process, and the stakeholder engagement process; and
- ESIA Disclosure – This phase entailed disclosure of the ESIA process and addressing the issues raised during the previous phases. The draft ESIA Report was disclosed and key outcomes presented to the I&APs for review and discussion. The ESIA was subsequently finalised and submitted to NEMA for approval (the decision-making phase).

Several common themes were evident throughout consultation rounds. Land acquisition processes and issues of land titling and compensation dominated much of the discussion about the Project. In addition, all county level engagement meetings received questions about project benefits, climate change assessment and the project's plans for handling accidents and malfunctions (i.e. oil leakage or pipeline rupture).

4.0 ENVIRONMENTAL AND SOCIAL BASELINE

4.1 Introduction

The ESIA baseline describes in detail the existing environmental and social conditions in the Project AoI, so that impacts can be predicted with reference to the existing situation and so that the pre-project situation has been recorded for management and monitoring purposes throughout the Project's life.

4.2 Meteorology and Climate

Meteorological data from five stations situated along the route of the pipeline has been used to present the different meteorological conditions along the pipeline route. While meteorological parameters show variation between different stations, the following general meteorological characteristics have emerged:

- Temperatures are generally high and show very little seasonal variations;
- Relative humidity increases from inland stations towards the coastal areas;
- Total precipitation follows annual monsoon patterns over Kenya with a dry season at the beginning of the year, the 'long rains' from April to June, another dry season from July to September followed by the 'short rains' in October to December;

- Wind speeds are generally low; and
- Prevailing wind directions are from the north-east at the northern most part of the pipeline however shift to south/south-eastern directions further south. The prevalence of easterly wind directions is linked to the northeast and southeast monsoons over equatorial Eastern Africa.

Current climate trends in Kenya show that average ambient air temperatures are increasing together with the number of hot days and nights occurring each year. The number of cold days and cold nights on the other hand are showing a declining trend. An increase in the proportion of rainfall occurring in heavy events is indicated. Further observations indicate a potential shift in monsoon patterns with a decline of rainfall during the spring 'long rains' and an increase of rainfall during the autumn 'short-rains'. Uncertainty does however exist in the complex precipitation projections for Kenya.

4.3 Air Quality

Air quality data from seven stations situated along the pipeline route has been used to give a representative baseline of air quality. While some pollutants show variation between different stations, generally concentrations are similar at each station and are largely below the Air Quality Standard (AQS) limits:

- Concentrations of surface air pollution (NO_2, SO_2, O_3 and BTEX) are similar at each station and either fall well below the relevant AQS limit;
- Particulate matter (PM_{10} and $PM_{2.5}$) values exceed the AQS limits, however the data is considered representative; and
- Deposited dust concentrations fall below the AQS limit.

4.4 Noise

Noise baseline data collection was completed during three separate field visits and included six monitoring locations, all located within residential areas. As such, most of the monitoring data collected reflected influence from human activity, livestock and wildlife as would be expected.

4.5 Water Resources

The LLCOP AoI includes permanent and seasonal watercourses. The LLCOP route crosses three largely permanent rivers, the Kerio River, the Suguta River and the Ewaso Ng'iro River. It also crosses numerous seasonal watercourses (luggas) that hold water either seasonally or after individual intense rainfall events; these include 14 seasonal rivers and around 100 seasonal streams. The LLCOP route is subject to 'medium' to 'very high' river flood hazards. There is also a risk of coastal flooding.

Along the coast there is a system of tidal creeks, flood plains, coastal lakes and mangrove swamps. There are tidal creeks in the coastal section in Lamu and the Project design includes one creek crossing.

Water quality across the AoI can be described as good with no inexplicable exceedances of water quality standards. The concentrations of major ions were generally below the Project water quality standards.

There are a number of important aquifers along the route and both surface water and groundwater are important sources of water supply along the proposed LLCOP route.

Figure 6: Kerio River

4.6 Soils, Geology and Geohazards

4.6.1 Soils

The LLCOP route passes through areas of sandy soils in arid and semi-arid environments. Soil texture varies from sandy to clayey along the route. Soils are typically finer textured at the beginning of the route, becoming coarser around KP650 until the Lamu Marine Terminal. Most of the soils along the route have medium or high erosion potential. Those classified as low had higher erosion potential when present on slopes.

A site investigation has been undertaken as part the Project covering the majority of the pipeline route. The topsoil (the layer where most biological activity takes place) is typically 0.2 m to 0.6 m deep, although in some areas it is likely to be less than 5 cm deep. The soil is generally of low to moderate agricultural productivity, with low organic matter content, largely supporting grazing and subsistence farming.

4.6.2 Geology

The surface geology of the north-eastern section of the LLCOP (up to Station 9), comprises a complex sequence of metamorphic basement rocks, sediments and volcanic deposits. From near the Garissa County boundary to the LMT (about half the length of the LLCOP) the surface geology is dominated by sedimentary deposits.

4.6.3 Geohazards

The most significant geotechnical faults along the LLCOP route are those related to the East African Rift System (EARS) (specifically the Kenya Rift) and notably the Lokichar Fault and faults bounding the Suguta Valley. No clear evidence of seismic events directly attributed to the Suguta Valley was identified and the Lokichar Fault is thought to be inactive. Twenty locations were identified where the LLCOP route crosses a fault line indicating the pipeline is potentially at risk from active tectonic movement. A study has concluded that any movements of the faults would be small and could be accommodated by the pipeline without requiring special pipeline fault crossing design. However, further field evaluation will be undertakenfor the faults to the west of the Suguta

Valley and should any potential large fault movements be identified, then the pipeline will be further designed to accommodate this movement without risk of failure.

Kenya is vulnerable to seismic activity associated with the presence of the active EARS; however, the overall earthquake hazard level is considered low in Kenya in comparison to neighbouring countries. The highest hazard levels within Kenya are in the northwest and southwest of Kenya.

No active volcanoes were identified along the proposed LLCOP route. All volcanoes in proximity to the LLCOP are shield volcanoes and any historical eruptions have been effusive and non-explosive.

Landslides and slope instability can be caused by steeply sloping topography. Although the LLCOP crosses areas of relatively steep gradient, it does not to cross areas of significantly active landslides. Only one landslide crossing has been identified at the base of the Eastern Suguta valley escarpment.

4.7 Biodiversity

4.7.1 Terrestrial

Protected Areas

Protected areas ranging from national parks and reserves to community conservancies, reserves and private ranches are present within the Project AoI. A large conglomeration of protected areas is situated where the AoI crosses through the Samburu, Isiolo, and Meru Counties. Forty-nine such areas have been identified in total along the route.

All the protected areas are nationally designated reserves, except for Mount Kenya National Park/Natural Forest, which is a declared (UNESCO) World Heritage Site (WHS). The WHS includes the Lewa Wildlife Conservancy and Ngare Ndare Forest Reserve, which is connected to Mount Kenya National Park via a wildlife corridor. This corridor provides connectivity for elephants moving between Mount Kenya and the larger conservation complex of the Somali/Maasai ecosystem.

Habitats of Conservation Concern

The proposed 824 km pipeline route crosses six ecoregions. Of these, three are listed as Critical/Endangered (Northern Zanzibar-Inhambane coastal forest mosaic, East African mangroves and East African montane forests), and three as Vulnerable (Masai Xeric grasslands and shrublands, Northern Acacia-Commiphora bushlands and thickets and Somali Acacia-Commiphora bushlands and thickets).

Acacia-dominated communities dominated the vegetation present within the Project footprint with the exception of the easternmost portion of the AoI where it transitions to principally forest mosaic vegetation community. The proposed pipeline route traverses several Forest Reserves that are identified as Key Biodiversity Areas (KBAs).

Species of Conservation Concern

A number of Species of Conservation Concern (SoCC) are present within the AoI. Eight IUCN listed plant species were recorded during the baseline surveys, being listed as either vulnerable or near threatened.

Twenty-one percent of the bird species recorded in Kenya were observed during baseline surveys (235 of 1,100). Of these, eight bird SoCC were confirmed during the biodiversity baseline surveys, including Steppe Eagle and Somali ostrich, with observations concentrated in an area between Archer’s Post and Baragoi.

The mammal assessment identified 16 SoCC including areas of core and critical habitat for the endangered Grevy’s Zebra around the Wamba and Samburu regions. Sites with high mammal diversity corresponded with drainage lines and rivers including the Suguta Valley towards the north of the Project footprint and the Ewaso Ng’iro River in the central part of the AoI, as well as protected areas containing hotspots of mammal diversity, such as Kalama Community Wildlife Conservancy, Nakuprat-Gotu Community Conservancy and Rahole National Reserve and the forest mosaic vegetation community in the east of the AoI.

Two fish SoCC were recorded during the baseline field surveys; Neumayer's Barb recorded in the Kerio River; and a subspecies of Nile Tilapia recorded in the Suguta River. The presence of fish SoCC further confirms the importance and sensitivity of rivers and drainage lines as key biodiversity habitats.

4.7.2 Marine

Although the project has no direct physical footprint in the marine environment, other than the presence of the VLCC, a number of key biodiversity species, habitats and protected areas are of relevance to the wider AoI. These include the following:

Protected Areas

The AoI overlaps one protected area, the Pate Marine Community Conservancy, which includes significant areas of mangroves, coral reefs and seagrass beds.

Habitats

The AoI is located on a sheltered coastline, with dense mangrove coverage within a continuous mangrove system that forms a key biological component of the coastal and marine Lamu-Kiunga landscape and seascape. There is high connectivity between the Lamu-Kiunga mangrove belt and the nearby coral reefs and seagrasses, facilitating the use of mangroves as nursery grounds by fish species.

The AoI is also characterised by the presence of three types of benthic habitats. A wide range of algae, invertebrates and fish species, including threatened species, are found in these habitats:

- Coral reefs: typically, these are fringing coral reefs but also occur as patch reefs;
- Seagrasses: grow mostly on sandy sediments down to a depth of 20 m or more; and
- Soft bottom sediment: occur from the surface to the deepest zones (50 to 60 m).

Overall, survey results from the sampling stations around the Project footprint showed good water quality, with very few traces of human impact.

Species of Conservation Concern

A number of SoCC are present within the marine environment AoI, including Indian Ocean humpback dolphin (Endangered, IUCN), Dugong and Humpback whale (of conservation concern due to its migratory behaviour). Hawksbill and leatherback turtles are Critically Endangered and green turtle (the most common species nesting in the area) is Endangered. All are likely to forage on offshore seagrass beds, coral reef areas, and associated algal beds. Various other fish and bird species including species listed under the Kenyan Wildlife and Conservation Management Act, are also present in the area.

4.8 Landscape and Visual

The LLCOP route traverses a landscape of undulating grasslands and shrublands, with occasional forested areas, farmland and rockier terrain on higher ground, terminating at an open seascape.

Most of the route comprises areas of low landscape sensitivity. The Project footprint intersects with one protected area, Nyambene National Reserve, and two community conservancies, being Kalama Community Wildlife Conservancy and Namunyak Wildlife Conservancy Trust, which all have high landscape value.

A photographic field assessment was carried out from a number of locations along the LLCOP route. Seven representative viewpoints were identified, that were readily accessible, to provide a representative sample of the typical views experienced by the local population, varying from flat, wide open vistas, to limited views owing to natural vegetative screening.

4.9 Cultural Heritage

Cultural heritage is comprised of both tangible and intangible components. Tangible heritage includes objects, property, sites or structures, having archaeological (prehistoric), palaeontological, historical, cultural, artistic, and religious values; or unique natural features that embody cultural values, such as sacred groves, rocks, lakes and waterfalls. Intangible heritage, also known as “living heritage” or “living culture”, includes practices, knowledge and skills handed down from generation to generation. Living heritage sites are the tangible locations where intangible heritage is experienced or performed (e.g., spiritual ceremonies at religious monuments).

The tangible and intangible cultural heritage identified in the AoI is a representative sample, as due to constraints not all areas have been subject to field surveys and it is likely that additional sites may exist in those areas that were not reached. These will be identified by surveys and further consultations with local communities before and during construction.

The AoI contains sensitive cultural landscape with a diverse range of cultural heritage sites including many burial sites and archaeological sites of considerable antiquity. A total of 129 sites were documented, comprising three major site categories: archaeological (70 – largely comprising single burial sites), living heritage (48 – most common being sacred sites and settlements) and palaeontological (4 – fossil-bearing sites). Two additional hybrid categories, where more than one site type is present in a given locality were identified, namely archaeological/living heritage (5) and palaeontological/living heritage (2).

4.10 Social

4.10.1 Communities in the AoI

Communities identified in the Project’s AoI include 49 villages and towns located within a 25 km radius of the pipeline route. The Project will primarily affect the people living in these communities and their respective village and county governments. The communities identified in the AoI are shown in Figure 3.

4.10.2 Physical and Social Infrastructure

Water

Water availability and water supply infrastructure in the vast majority of communities is very limited or inadequate, due to their remote locations, climate, and poverty level. More developed water infrastructure such as piped water can only be found in urban communities and urban centres in Isiolo and Lamu. The rural AoI communities rely on more basic infrastructure that is often located at considerable distances from settlements. Unprotected sources of water (e.g. pond, lake, stream/river, unprotected springs and wells) in the communities generally have poor water quality and are at risk of contamination.

Wastewater infrastructure is also severely limited in all the six counties. The vast majority of the AoI communities do not have access to developed sanitation facilities.

Waste

Limited waste disposal infrastructure is found in the six counties. The AoI communities typically do not have suitable solid waste management facilities or adequate dumping sites as these are found mostly in urban areas. Major issues of concern include the lack of storage and transport and inappropriate disposal of waste.

Housing

Housing in the six counties is influenced by the availability of raw materials, cultural factors, climate and settlement patterns. Housing quality for communities is generally poor with housing units made of less durable materials.

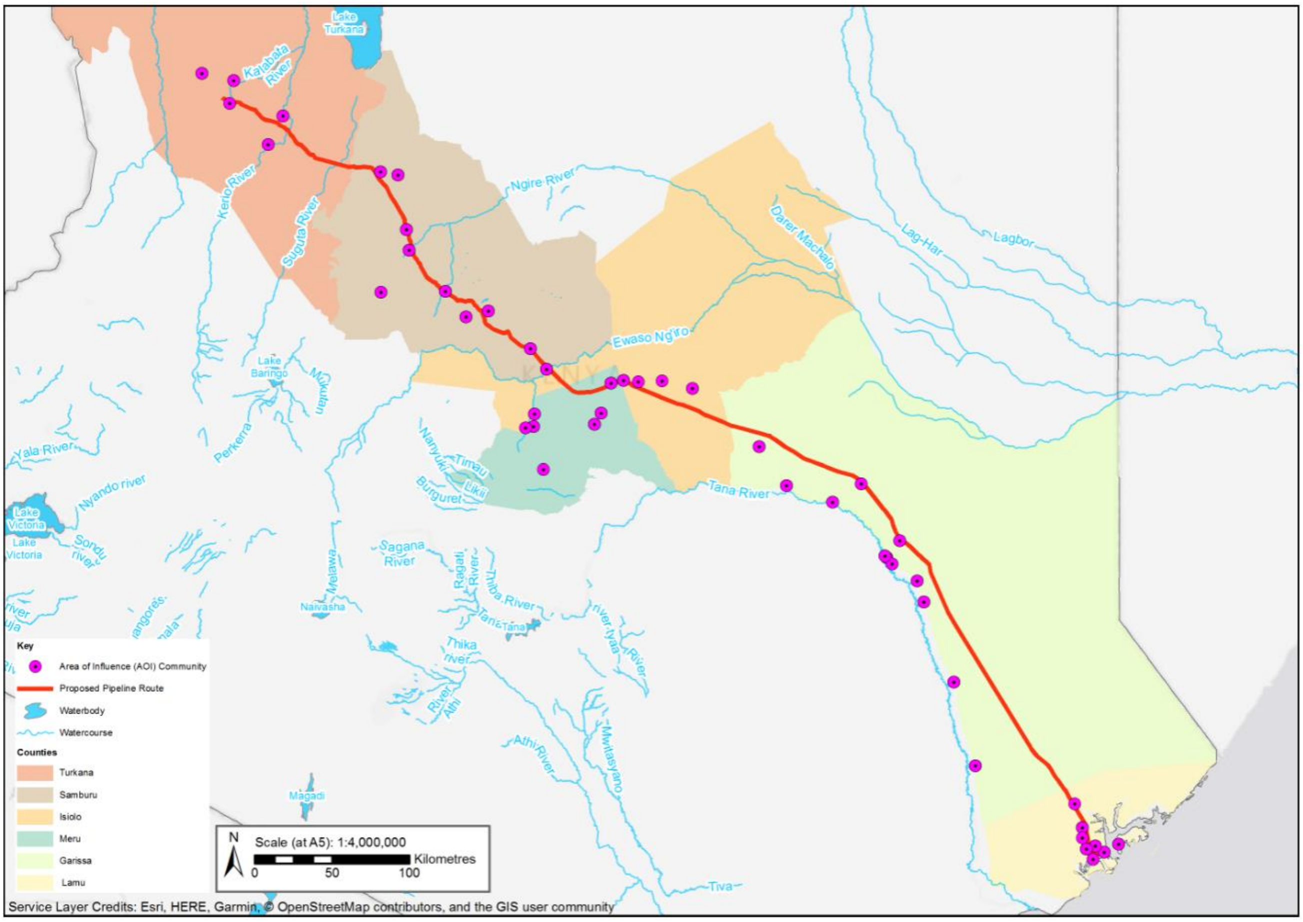

Figure 7: Communities Identified in the AoI

Energy Sources

Limited electricity infrastructure is found in the six counties. Lamu County has the greatest access to electricity, with electricity access for 17% of households. For the remainder of the counties, access to electricity is sparse and is primarily limited to the larger urban centres. Most households in the six counties rely on traditional fuels (i.e. firewood, paraffin, tin lamps, charcoal) for lighting. Fuel used for cooking is predominantly collected firewood.

Roads

Road infrastructure in the six counties is generally in poor condition with many roads in need of repair and maintenance. The roads in all counties are made predominantly of earth, with only a small proportion made of tarmac. Upgrades as part of the LAPSSET Corridor have been or are planned to be undertaken along the route.

Education

Education services (e.g. primary, secondary, higher learning institutions) are found in all six counties. Primary schools are the most prevalent type of learning institute. Most residents in the six counties have no formal education, ranging from 54.1% in Isiolo County to 82.1% in Turkana County.

4.10.3 Community Health, Safety and Security

Community Health

Primary (sub-county) hospitals, health centres, dispensaries and medical clinics are available in all six counties. The health facilities in the AoI communities are generally inadequate (in terms of resources and infrastructure), sparsely distributed and understaffed in the face of growing populations. Approximately half of the facilities are public (government owned).

The leading cause of morbidity in the AoI communities are respiratory infections and diseases, diarrhoeal diseases, skin diseases, pneumonia and unspecified fevers. HIV also remains one of the major causes of morbidity and mortality. Road traffic accidents contribute significantly to overall morbidity and mortality in Kenya with nearly one-third of road traffic accidents in the country being fatal.

Community Safety and Security

The existing security situation in northern Kenya is volatile due to ethnic rivalries, competition for resources and under-resourced state security. Marginalised populations, endemic poverty and transnational armed militants are important factors contributing to regional insecurity and safety issues. Insecurity is a major concern cited by locals in the six counties the Project will traverse.

The counties with prominent nomadic pastoral communities (i.e. Turkana, Samburu, Garissa, Isiolo) are generally under-developed with poor infrastructure, high levels of poverty, low literacy rates and low population density, with a history of conflict related to competition over resources.

4.10.4 Economics and Employment

Demographics

A diverse mix of ethnic groups reside in the six counties. The majority of the ethnic groups in the six counties are domestic pastoralists, the groups have distinct languages, religions and cultural practices. The counties of Meru and Turkana are the most populous counties, with Lamu and Isiolo being the least populous.

Shifting demographic patterns occur where people settle in towns as a result of the loss of livestock-based livelihoods and conflict from resource-induced competition.

Economic Activities and Employment

In relation to socio-economic development, the AoI counties are generally characterised by low human development (e.g. high poverty levels, low literacy, low employment), high growth rates, and poor infrastructure. Economic activities in the six counties, as in Kenya as a whole, are dominated by the informal sector; characteristic of lower-middle income economies. Formal sector employment plays a minor role in economic activities.

The main livelihoods in the AoI communities are generally centred around nomadic pastoralism and subsistence agriculture. The arid counties (Turkana, Samburu, Isiolo and Garissa) are predominantly pastoral with limited crop farming while the semi-arid counties (Meru and Lamu) are primarily agro-pastoral with integrated crop and livestock production systems. Fishing is a prominent industry in Lamu County and conducted on a smaller scale in the counties of Garissa and Turkana. Tourism is a growing industry in all counties, associated primarily with natural attractions and game conservancies, and is most developed in Lamu County. Changes in pastoral household mobility have encouraged a growth of pastoral settlements around service centres and water points, providing additional income activities in Turkana, Isiolo and Garissa.

Turkana, Samburu, Garissa, and Isiolo are included in the top ten poorest counties[1] in the country, with Turkana County having the highest rate of poverty.

4.10.5 Livelihoods

Pastoralism

Pastoralists in all counties follow grazing and herding calendars (managed by Elders) and experience seasonal changes due to rainfall irregularity. With the timings of the different seasons becoming increasingly difficult to

[1] Turkana is ranked first with 79.4%, Samburu is third with 75.8%, Garissa is fifth with 65.5%, and Isiolo is tenth with 51.9% (Development Initiatives 2018a; Standard Digital, 2018).

predict due to climate change, pastoral movements have become irregular, making grazing patterns difficult to determine.

Pastoralists will often have semi-permanent homes, such as the pastoralists in Barsaloi, Samburu County, who return to Barsaloi in the rainy season and migrate during the long dry season. Others have permanent homesteads like the pastoralists in Suyian who live in large homesteads as a security measure against threats from other hostile communities

Farming

Small-scale agriculture is the main economic activity in Meru and Garissa, and an important economic activity in Lamu. In many areas, soil quality is also poor, and land can only support certain types of crops. Subsistence farming (e.g. beans, cow peas, maize, sorghum, watermelon) is the primary type of farming practiced by communities in the AoI, with some cash crops (e.g. Miraa, mangoes, coconut, cotton, and *Bixa Orellana* ('annatto'). Farmers in these counties typically practice mixed farming where they grow many types of crops and keep livestock on the same piece of land. Issues associated with the possession of title deeds for legal ownership often inhibits the development of small-scale agriculture.

Fishing

Fishing is most prominent in Lamu County and is carried out only on a small scale in the counties of Turkana and Garissa. Access to fishing grounds in Lamu West, where AoI communities are located, is currently affected by the construction of Lamu Port and dredging activities relating to the approach channel.

4.11 Ecosystem Services

4.11.1 Identifying Ecosystem Services

Ecosystem Services are defined as natural products and processes that contribute to human well-being and the personal and social enjoyment derived from nature. Ecosystem services comprise four broad categories and data was captured for each category during baseline surveys and data collection for biophysical and social disciplines.

4.11.2 Provisioning Services

Provisioning services support human needs. Natural resources are particularly important for supporting livestock, which provide local assets and are raised for meat, milk, relying on grazing/browsing resources. Trees within the LLCOP AoI also offer important shade for livestock and their seedpods are used as animal fodder.

Figure 8: Example of provisioning ecosystem services in the Project AoI - livestock browsing resources (left) and a local fisherman (right)

Timber is harvested within the AoI for building and furniture making. Firewood is also gathered for personal and commercial use. Along the coast, mangrove forests provide fuelwood, building poles, charcoal, and medicines.

Local food sources are also important. Local communities grow crops, vegetables and fruit, and honey is produced for subsistence consumption and for small-scale commerce. Bushmeat and edible plant species are gathered in the wild. Fish are captured and consumed or used as a source of income.

Water is required for human and animal consumption, together with irrigation, washing, and recreational uses. Freshwater is obtained from local rivers (including Turkwel, Kerio, Barsaloi, Tana, Suyian, Seyia, Ewaso Ng'iro and Nachola). Other water sources include streams, luggas, traditional wells, natural water pans, bore holes, and rainwater collection, all of which are an important contributor to domestic and agricultural purposes.

A number of species of medicinal herb are available within the AoI, including aloe which is used to treat disease. Bark and sap may be used for medicinal purposes. Loonyeyok (gum from the Acacia Senegal tree) and honey are used as herbal medicines, and to enhance milk production in dairy cows. Miraa (khat), can be chewed for its' stimulative effect.

4.11.3 Regulating Services

Regulating services provide control of the natural environment. The AoI sits within a number of river catchments, and these hydrological systems will regulate water run-off, influence ground water recharge and maintain the water storage potential of the landscape. The natural landscape is also likely to regulate flooding during intense rainfall events. Along the coast, mangroves provide coastal protection from erosion and inundation by the sea during storm events.

Water systems provide drinking and irrigation water to local villages. Existing vegetation establishment controls suspended sediments and regulates the water cycle. Vegetation cover also plays an important part in soil retention on steep slopes, managing scour and soil erosion throughout the year.

There are abundant wildflowers growing within the AoI which are used by local bee colonies, which are likely to support crop pollination, for example pollination of fruit trees.

4.11.4 Cultural Services

Cultural services offer cultural value. Land use within the AoI includes arable, standing/running water, forestry and grasslands. All of these ecosystem features have provided intrinsic recreational pleasure for users over a number of generations. Generations of people will learn how to hunt, fish and forage within these areas.

Sacred sites and intangible cultural heritage, evident within the AoI, are intrinsically linked with natural ecosystems such as wetlands, rivers, lakes and forests. Some species of acacia trees are regarded as sacred and used during ceremonies and community members indicated that they should not be destroyed.

4.11.5 Supporting Services

Supporting services comprise natural processes essential to resilience and functioning of ecosystems. For example, mangrove habitats along the Lamu marine coast provide complex ecosystem functions for fish (e.g. spawning, nursery and foraging). Timber production is supported by the suitable weather and climate and appropriate growing conditions.

5.0 ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS

The following presents a summary of the analysis of impacts for the LLCOP Project and considers inherent mitigation measures as well as identifying any additional mitigation measures required.

5.1 Air Quality

The Project has the potential to impact the air environment through the increased generation and deposition of dust relating to the construction and operational phases, as well as by changing local air quality concentrations through air emissions produced by generators located at stations along the LLCOP route.

With inherent mitigation that has been incorporated into the design and with the additional mitigation proposed, there will be no potential residual impacts during construction, with appropriate dust management, as well as minor residual impacts during operation due to inherent measures including specific station stack (chimney) height measures and continued dust management.

5.2 Noise

The Project has the potential to impact noise levels during station and pipeline construction and during station operations. During construction and subject to consultation, appropriate measures (such as work times and phasing of work) will be undertaken to limit the impact of noise, or compensation will be considered under a Livelihood Restoration Framework, reducing residual impacts to minor during construction.

During operation there will be no potential residual impacts on local communities. In addition, no additional mitigation is required for the Project with regard to vibration.

5.3 Water Resources

The Project has the potential to impact the water environment by using existing water resources and changing the availability of water to users, by changing the quality of the water and by changing flows/flood risk. The Project itself could also be impacted by the water environment through flooding. Most impacts are also considered to be temporary, except when associated with physical changes to drainage, recharge or river channels, or with features/infrastructure constructed below ground.

Further mitigation measures will be stipulated in the Environmental and Social Management Plans (ESMP), specifically in the Water Management Plan (WMP), including requirements for local hydro-census and flow management techniques for river crossings during construction, as well as wastewater management/collection during construction and operation. After additional mitigation is applied, residual impacts classified as minor during construction are associated with the management of suspended solids and controlling the discharge of hydrotesting and the abstraction of construction water. Minor residual impacts which are applicable to both construction and operation include maintaining drainage patterns, managing water abstractions/availability and controlling the discharge of wastewater.

5.4 Soils, Geology and Geohazards

The Project has the potential to disturb soils on high and medium importance agricultural land and degrade the quality of soil resources by changing the erosion potential of the soil via disturbance, affecting the soil drainage patterns via alteration of the soil characteristics and by introducing the potential for leaks and spills that could result in soil contamination. Most impacts are considered to be temporary, except where they are associated with physical changes to drainage, which need to be monitored and rectified.

With inherent mitigation measures in place, as well as additional mitigation including the identification of high value agricultural land prior to construction through mapping and engagement with local land users and erosion management procedures presented in the ESMP, potential residual impacts to soil resources during construction and operation will be minor or negligible. Minor residual construction impacts include ground disturbance leading to increased exposure to erosion risk (which is also an issue during operation) and a short-term loss of agricultural land capability, as well as direct impacts of topsoil handling and storage on soil quality.

5.5 Biodiversity

5.5.1 Terrestrial

Predicted impacts on biodiversity relate to changes in habitat integrity as a result of disturbance and/or changes to protected areas (National Parks, Reserves and Community Conservancies) and the behaviour of species receptors. Animals of high importance which are likely to be impacted by the Project include large, medium and small mammals and bats, birds, reptiles and amphibians.

During construction, residual impacts on SoCC and protected areas are anticipated to be of minor or negligible significance, via the effective implementation of additional mitigation measures including the implementation of a Biodiversity Management Plan (BMP), Wildlife Rescue Procedure, Invasive Species Management Procedure, wildlife awareness component for workers, as well as having a Biodiversity Officer (BO) employed by PipeCo overseeing the construction phase with ‘stop work’ authority exercised where there is imminent risk to SoCC. Minor residual impacts include increased access with the Project RoW, encroachment on ecological connectivity, temporary changes to local hydrology/aquatic habitats and potential road collision of protected species.

Upon restoration of the Project during operation, residual impacts to SoCC’s and protected areas with appropriate measures in place, governed by the BMP, residual impacts during operation will be negligible.

5.5.2 Marine

With mitigation that has been incorporated into the design, or will take place during pre-construction, construction or operational phases, it is considered that sources of potential impacts to marine receptors are classified as minor or negligible. The BMP produced for the Project will ensure the adherence to good practice measures. All construction activities undertaken in mangroves will be overseen by the BO. As such, residual impacts will be reduced to minor.

During operation, impacts on crustaceans, marine invertebrates, mangroves, coral reef and seagrass includes spillage of oil, or other liquid and solid pollutants and contaminants, from Project tanker vessels. For sea turtles, marine mammals and fish, there is a risk of vessel collision. The implementation of an Emergency Preparedness and Response Plan, invasive species management, a no hunting or fishing policy, monitoring of mangrove restoration and procedural controls for Project and third-party vessels requiring adherence to international good practice standards will be undertaken to reduce residual impacts to minor.

5.6 Landscape and Visual

5.6.1 Landscape

Impacts on the landscape were identified at Stations 6, 7 and 8, attributed with community conservancies (Namunyak Wildlife Conservancy Trust and Kalama Community Wildlife Conservancy) and protected areas (Nyambene National Reserve). It is anticipated that there will be minor residual impacts during construction and operation, associated with the partial loss/damage to key landscape characteristics in the immediate setting of the Project component site and in an area of predominantly low-lying scattered scrub.

5.6.2 Visual

Predicted visual impacts were identified for 7 representative viewpoints at accessible stations along the LLCOP route. Additional studies will be undertaken pre-pipeline construction for the remaining station locations.

Archer’s Post (adjacent to Station 7) was identified as being particularly sensitive to the Project infrastructure, where the surrounding landscape has low-lying vegetation offering limited natural screening and resulting in high potential visibility of the station. Overall, with suitable inherent and additional mitigation in place, including a Grievance Management Procedure, vegetative screening (where appropriate) and lighting controls, the residual visual impact of the development will be moderate during construction and operation.

At Lamu Port, partial views of the VLCC will be possible from the beach and at hotels (such as Manda Bay Lodge). The potential visibility of the VLCC is low and overall, the residual visual impact of the Port development will be minor during both construction and operation, largely due to the distance to Project infrastructure.

5.7 Cultural Heritage

Within the AoI, 37 cultural heritage sites have been identified as having the potential to be impacted by the Project, of which nine are located within the RoW. These include receptors such as burial sites, sacred sites and abandoned settlements.

All of the potential impacts identified will occur during the construction stage, as a result of ground disturbance and activities such as vegetation clearing, soil stripping, stockpiling of materials and fill (compaction) and public access constraints to cultural heritage resources. These will be managed through the Project design, as well as good practice construction and management techniques. Inherent to the Project mitigation is the micro alignment of Project components to avoid identified cultural heritage receptors. In addition, further cultural heritage mitigation will be guided by a Site Clearance Procedure and Cultural Heritage Management Plan. Detailed mapping, documentation and consultation regarding identified cultural heritage sites will be undertaken prior to commencing ground disturbance. With the proposed mitigation in place, all impacts are expected to be reduced to minor.

Other undiscovered cultural heritage sites located in un-surveyed portions of the AoI (due to security or access issues) may also be impacted. A Chance Finds Procedure will be implemented when undocumented cultural heritage sites are encountered.

5.8 Social

5.8.1 Physical and Social Infrastructure

The Project's impacts on physical and social infrastructure are driven largely by population influx of opportunity-seekers, particularly those near camp accommodation, looking to capitalise on economic activity during construction and operations (i.e. influx-driven demand for educational services, water and waste, energy/fuel and transportation). This has implications for physical and social infrastructure present in communities along the RoW.

Appropriate additional mitigation will be undertaken by the Project via the implementation of an Influx Management Plan (IMP) aimed at stemming influx to the local area. This will include planning recruitment and procurement to boost local benefits. Residual impacts due to influx are therefore anticipated to be minor. Impacts on traffic volumes and composition during construction will be partially mitigated via an appropriate Traffic Management Plan (TMP) and traffic accident controls. Residual impacts are also anticipated to be minor, conditional upon the access roads that will be used.

5.8.2 Community Health, Safety and Security

The construction phase of the Project is likely to present the most significant health, safety and security impacts, due to impacts such as increases in communicable disease transmission along the LLCOP route, risk of accidents and injuries, impacts on environmental and social determinants of health, infrastructure management and Project induced in-migration. Project impacts from communicable disease transmission and accidents and injuries are anticipated to have the greatest impact, with minor to moderate residual impacts, mitigated via measures including occupational health and safety management (e.g. pre-deployment screenings, HIV/TB Management), an occupational health system and training programmes.

With the implementation of effective operational management plans, including Project Workplace Health and Safety plans (Medical Emergency Response Plan and Health Management Plans), residual operational impacts including spillages, burden of disease along transport corridors and conflict between community members and security personnel and are considered to be minor.

5.8.3 Economics and Employment

The Project is expected to represent a highly significant contribution to the Kenyan Economy through GDP impacts and national-level procurement. The Project's employment impact will be pronounced, but largely confined to the construction period, representing a moderately significant impact within the local and national labour forces. The adverse potential impact of the Project in terms of creating price inflation and disturbing tourism activities will be of moderate significance, extending into the early years of operations, while the adverse potential impact of employment destabilisation and temporary competition for labour with other, lower paying industries is expected to be of minor significance with mitigation.

5.8.4 Livelihoods

With the implementation of mitigation, the Project's adverse residual impacts on pastoralism are generally anticipated to be minor. Given the loss of grazing land and other natural resources during construction, and the long period of revegetation of temporarily disturbed areas, the Project's residual impact on grazing land and natural resources is however of minor to moderate significance depending on where the Project footprint overlaps with traditionally worked areas. Additional measures to mitigate these impacts include the presence of the BO during construction as well as the implementation of effective soil management procedures.

Increased competition for resources as a result of Project-driven in-migration of jobseekers, partially mitigated via measures such as the IMP, will be of minor to moderate significance, depending on the circumstance of the pastoralist impacted (e.g. having range of suitable and productive grazing areas/water sources or limited access to alternate communal lands).

The Project is expected to result in minimal residual impacts on other livelihoods. With appropriate mitigation in place including a Grievance Management Procedure, sustainable sourcing of Project water supply, as well as land and crop compensation for farmers, impacts on fishing and agriculture are expected to be of negligible to minor during construction and operation.

5.9 Ecosystem Services

Ecosystem services considered in the impact assessment include priority provisioning, cultural and regulating ecosystem services. Ecosystem services of particular importance include livestock/grazing resources, agricultural resources, freshwater (human and animal use), medicinal plants, mangroves and sacred and spiritual sites.

Most impacts to these are associated with the construction phase, with the most significant dependency being the need for effective management of water resources. Potential impacts on water availability or quality (e.g. through water abstraction, hydrotesting requirements, wastewater discharge and spills), and subsequently the supply of services that are directly or indirectly reliant on water (such as people, fish, arable, livestock) may occur. However, via mitigations such as completing local hydro-census to develop an understanding of local water users as part of the WMP, influx management measures, good practise contamination procedures and effective rehabilitation measures post-construction, these are expected to be minor or negligible.

Regarding terrestrial resources, much of the habitat in the Project RoW is already highly modified and degraded by erosion associated with overgrazing and the very high densities of livestock. In addition, disturbed areas will be naturally restored along the pipeline RoW after the pipeline is *in-situ*. Therefore, impacts associated with vegetation clearance, population influx, loss of land and resources and disruption to pastoral access to grazing/browsing resources are expected to be minor.

During the operational phase, the only residual impact relates to potential oil leaks and/or spills (from pipeline, station facilities, tanks, or during transfer between facilities) with minor impacts on freshwater (fishing) and marine (fishing and mangroves) environments.

5.10 Emergency, Accidental and Non-Routine Events

An assessment of emergency, accidental and non-routine events was undertaken evaluating natural and operational hazards and the probability of their occurrence to assess the risk of natural and unplanned operational events that could cause environmental or social impacts.

Natural Hazards relate to natural seismicity (earthquakes) and geohazards (landslide/mass movement), and operational hazards to marine oil spill events and thermal radiation/pool fire. The risk of an unplanned event occurring ranges from Low to High, depending on the consequence and probability of occurrence.

The most significant hazard, assessed as having the potential to cause major consequence, identified relates to the potential of oil spills from the unplanned or uncontrolled release of oil (loss of containment) of VLCC storage compartments resulting in oil entering marine environment.

Other significant hazards identified relate to the potential of oil spills from unplanned or uncontrolled release of oil during offloading (marine loading arm at LMT) and thermal radiation/pool fire, both assessed as having the potential to cause high consequence. The adoption of oil spill management procedures within an Oil Spill Contingency Plan and an Emergency Preparedness and Response Plan will however ensure that impacts are minimised in the event of a spill.

5.11 Cumulative Impacts

Cumulative impacts are those that may result from the collective impact on areas or resources used or directly affected by the LLCOP Project, from other existing, planned, or future developments, at the time the risks and impact identification process is undertaken.

Combined impacts associated with the LAPSSET Infrastructure Corridor present the greatest cumulative impacts. Cumulative impacts are largely expected to occur during the operation phase of the Project associated with the LAPSSET Transport Corridor (roads and railways), Lamu Port, Lamu Coal-fired Power Plant, the Wamba Dam and the Lokichar Upstream development. Significant cumulative impacts relate to the use and operation of Lamu Port, and potential implications on the marine environment associated with marine traffic and the risk of oil spills.

Lamu County is likely to experience a general economic boost due to the beneficial cumulative impacts from employment, infrastructure and purchasing associated with the LLCOP Project and LAPSSET component facilities, in particular the Lamu Port development, as well as other third-party developments. Ultimately the Project will endeavour to engage with other developers concerned, as well as with the relevant authorities, in order to work concurrently towards the minimisation of identified cumulative impacts.

6.0 ENVIRONMENTAL AND SOCIAL MONITORING AND MANAGEMENT PLAN

In accordance with the Environmental Impact Assessment Guidelines for the Energy Sector in Kenya, an Environmental and Social Management Plan (ESMP) is included as part of the ESIA.

An ESMP compiles a set of management, mitigation and monitoring measures to be taken during groundworks and installation, operation (including maintenance) and decommissioning of the Project to manage key potential environmental and social impacts identified in this ESIA. The ESMP contained within this ESIA therefore:

- Describes the PipeCo Environmental and Social Management System (ESMS) that will be developed to meet PipeCo objectives, to implement the requirements of the approved ESMP and to meet Kenyan regulatory requirements; and
- Sets out the key impacts and mitigations defined in the ESIA and allocates responsibilities for implementation and performance monitoring in an Environmental and Social Management Plan format.

The ESMP addresses the following topics:

- Air quality;
- Noise and vibration;
- Water resources;
- Soil, geology and geohazards;
- Terrestrial and aquatic biodiversity;
- Marine flora and fauna;
- Landscape and visual;
- Cultural heritage;
- Physical and social infrastructure;
- Community health, safety and security;
- Economics and employment;
- Livelihoods; and
- Ecosystem services.

In addition, strategies and frameworks are set out for the follow key issues:

- Waste management;
- Emergency preparedness and response; and
- Decommissioning.

The commitments, mitigations and management controls set out will be used by PPMT/PipeCo and the EPC Contractor to develop detailed implementing procedures for construction and operations. In addition, a detailed Oil Spill Contingency Plan will be developed for operations at Lamu Port.

ESIA REPORT

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TABLES

FIGURES

ACRONYMS

AADT	Annual Average Daily Traffic
ADM	Air Dispersion Modelling
AERMOD	Air Quality Dispersion Modeling
AEWA	African-Eurasian Water-bird Agreement
AGI	Above Ground Installation
AIDS	Acquired Immune Deficiency Syndrome
ALARP	As Low as Reasonably Practicable
AOC	Africa Oil Corporation
AoI	Area of Interest
API	American Petroleum Institute
ARI	Acute Respiratory Infections
AQS	Air Quality Standard
ASAL	Arid/Semi-Arid Landscape
ASAL	Arid and Semi-Arid Lands
BAT	Best Available Technology
BC	Before Christ
BCE	Before Common/Current Era
BCoW	Biodiversity Clerk of Works
Bd	Bushland
BMP	Biodiversity Management Plan
BMU	Beach Management Units
BOD	Basis of Design
BOPD	Barrels of Oil Per Day
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
BVS	Block Valve Station
CAD	Computer Aided Design
CadnaA	Computer Aided Noise Attenuation
CD	Chart Datum
CEC	County Environmental Committees
CEMP	Construction Environmental Management Plan

CFA	Central Facilities Area (Upstream Project)
CHMMP	Community Health Management & Monitoring Plan
CHMP	Cultural Heritage Management Plan
CHMT	County Health Management Teams
CIDP	County Integrated Development Plan
CITES	Convention on International Trade in Endangered Species
CM	Coastal Mosaic
CMS	Convention on Migratory Species
CP	Cathodic Protection
CPF	Central Processing Facility (Upstream Project)
CR	Critically Endangered (Species)
CRA	Commission on Revenue Allocation
CSO	Civil Society Organisation
DAS	Distributed Acoustic Sensing
DD	Data Deficient
DEM	Digital Elevation Model
DHIS	District Health Information System
DMRB	Design Manual for Roads and Bridges
DSM	Digital Surface Model
E&A	Exploration and Appraisal
EACC	East African Coastal Current
EACOP	East African Crude Oil Pipeline
EARS	East African Rift System
EBA	Endemic Bird Area
EBSA	Ecologically or Biologically Significant Area
ECC (SECC)	(South) Equatorial Counter Current
EDGE	Evolutionary Distinct and Globally Endangered
EHA	Environmental Health Areas
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIAAR	EMCA Impact Assessment and Audit Regulations
EMCA	Environmental Management and Coordination Act
EMP	Environment Management Plan
EN	Endangered (Species)

EOO	(Species) Extent of Occurrence
EOPS	Early Oil Pilot Scheme (Upstream Project)
EPC	Engineering Procurement and Construction
EPF	Early Processing Facility (Upstream Project)
EPRA	Energy and Petroleum Regulatory Authority
EPRP	Emergency Preparedness and Response Plan
ERC	Energy Regulatory Commission
ESDV	Emergency Shut Down Valve
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
F&G	Fire and Gas Systems
FAO	Food and Agriculture Organisation (of the United Nations)
FBE	Fusion Bonded Epoxy
FEED	Front-End Engineering Design
FID	Final Investment Decision
FOC	Fibre Optic Cable
FSD	Foundation Stage Development
FSO	Floating Storage and Offloading
GBV	Gender Based Violence
GDP	Gross Domestic Product
GEM	Global Earthquake Model
GIIP	Good International Industry Practice
GIS	Geographic Information System
GoK	Government of Kenya
GPS	Global Positioning System
GZT	Grevy Zebra Trust
HCR	Hydrocarbon Release
HDD	Horizontal Directional Drilling
HDI	Human Development Index
HDPE	High Density Polyethylene
HGV	Heavy Goods Vehicle
HIPPS	High Integrity Pressure Protection System
HIV	Human Immunodeficiency Virus
HMIS	Health, Management Information System

HSB	Health Seeking Behaviour
HSE	(UK) Health and Safety Executive
HVT	High Voltage Transmission Lines
IBA	Important Bird Areas
IBAT	Integrated Biodiversity Assessment Tool
ICD	Inland Container Depot
ICP	Informed Consultation and Participation
ICSS	Integrated Control and Safety System
IEC	Information Education and Communication
IFC	International Finance Corporation
IMP	Influx Management Plan
IP	Intersection Point
IPIECA	International Petroleum Industry Environmental Conservation Association
IPPC	Intergovernmental Panel on Climate Change
IRD	Institut de Recherche pour le Développement
ISC	International Seismological Centre
ISEE	International Society of Explosives Engineers
ISF	Import Storage Facility
ISO	International Standards Organisation
ISRIC	International Soil Reference Information Centre
IUCN	International Union for Conservation of Nature
JDA	Joint Development Agreement
KBA	Key Biodiversity Area
KeNHA	Kenya National Highways Authority
KETRACO	Kenyan Electricity Transmission Co
KFS	Kenya Forest Service
KII	Key Informant Interview
KIOSH	Kenya Institute of Occupational Safety and Health
KJV	Kenya Joint Venture
KMMN	Kenyan Marine Mammal Network
KMNFRI	Kenya Marine Fisheries Research Institute
KMW	Kenya Ministry of Works
KNMR	Kiunga Marine National Reserve
KP	Kilometre Point/Post

KPR	Kenyan Police Reserve
KPRL	Kenya Petroleum Refineries Ltd
KWS	Kenya Wildlife Service
LaMCot	Lamu Marine Conservation Trust
LAPSSET	Lamu Port and South Sudan Ethiopia Transport Corridor
LCA	Landscape Character Area
LCDA	LAPSSET Corridor Development Authority
LCDP	Local Content Development Plan
LCIDP	LAPSSET Corridor Infrastructure Development Project
LDS	Leak Detection System
LEF	Lokichar Export Facility (Battery Limit - Upstream/Downstream)
LLCOP	Lokichar to Lamu Crude Oil Pipeline
LLHTS	Long Line Heat Trace System
LLTC	Long Line Trace System
LMMA	Locally Managed Marine Areas
LMT	Lamu Marine Terminal
LOD	Limit of Detection
LOEL	Lowest Observable Effect Levels
LOF	Load-Out Facility
LRF	Livelihood Restoration Framework
MARPOL	International Convention for the Prevention of Pollution from Ships
Mb	Body-wave Magnitude
MBV	Manual Block Valve
MCA	Members of the County Assembly
MCC	Main Control Centre
MT	Marine Terminal
MTBE	Methyl Tertiary-Butyl Ether
MWS	Ministry of Water and Sanitation
NBSAP	National Biodiversity Strategy and Action Plan
NCC	National Complaints Committee
NCD	Non-Communicable Disease
NDMA	National Drought Management Authority
NDT	Non-Destructive Testing
NEAP	National Environment Action Plan

NEC	National Environmental Council
NEMA	National Environment Management Authority
NET	National Environment Tribunal
NGO	Non-Governmental Organisation
NLC	National Land Commission
NMK	National Museums of Kenya
NNL	No-Net-Loss
NOAA	National Oceanic and Atmospheric Administration
NRT	Northern Rangelands Trust
NT	Near Threatened (Species)
NTS	Non-Technical Summary
OEMP	Operational Environmental Management Plan
OGP	International Association of Oil and Gas Producers
OSCP	Oil Spill Contingency Plan
PAH	Polyaromatic Hydrocarbons
PAP	Project Affected People
PC	Process Contribution
PCS	Primary Camp and Storage Facility
PEC	Predicted Environmental Concentration
PEL	Probable Effect Level
PIDS	Perimeter Intrusion Detection System
PIIM	Project Induced In-Migration
PIP	Power Input Point
POI	Point of Interest
PPMT	Pipeline Project Management Team
PPV	Peak Component Particle Velocity
PRS	Pressure Regulating Station
PS	Pumping Station
PSC	Production Sharing Contract
PSD	Particle Size Distribution
PUF	Polyurethane Foam
QA	Quality Assurance
QC	Quality Control
QRA	Quantitative Risk Assessment

ROA	Right of Access
RoW	Right of Way
RRM	Risk Reduction Measure
SARA	Service Availability and Readiness Assessment
SAV	Secondary Acute Values
SC	Somali Current
SCADA	Supervisor Control and Data Acquisition
SCS	Secondary Camp and Storage Facility
SD	Standard Deviation
SEA	Strategic Environmental Assessment
SEP	Stakeholder Engagement Plan
SERC	Standard and Enforcement Review Committee
SoCC	Species of Conservation Concern
SPM	Single Point Mooring
SSA	Specific Site Assessment
SSEA	Safety, Sustainability and External Affairs
STI	Sexually Transmitted Infection
TB	Tuberculosis
TCG	Turkana County Government
TCN	Third Country National
TEL	Threshold Effect Level
TKBV	Tullow Kenya Business Venture
ToP	Top of Pipe
ToR	Terms of Reference
TPH	Total Petroleum Hydrocarbon
UKOOA	United Kingdom Offshore Operators Association
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Programme
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator (co-ordinate system)
VI	Value Improvement
VLCC	Very Large Crude Carrier
VPSHR	Voluntary Principals of Security and Human Rights

VU	Vulnerable (Species)
WaMP	Water Management Plan
WASH	Water, Sanitation and Hygiene
WAT	Wax Appearance Temperature
WCMA	Wildlife Conservation and Management Act
WDPA	World Database on Protected Areas
WDT	Wax Dissolution Temperature
WGS	World Geodetic System
WHO	World Health Organisation
WHS	World Heritage Site
WMA	Watamu Marine Association
WRA	Water Resources Authority
WRI	World Resource Institute
WT	Wall Thickness
WWF	World Wide Fund for Nature
ZTV	Zone of Theoretical Visibility

UNITS OF MEASUREMENT

"	inch
$	US Dollar
%	percentage
$<$	less than
$>$	greater than
≤	Less than or equal to
≥	greater than or equal to
°	degree
°C	degrees Celsius
µg	microgram
µPa	micropascal
µS	microsiemens
As	Arsenic
bbl	barrel (oil)
bgl	below ground level
BOD_5	biological oxygen demand
c/~	circa
Cd	Cadmium
cm	centimetre
CO	carbon monoxide
CO_2	carbon dioxide
COD	chemical oxygen demand
Cu	copper
Db	decibel
dBA	a-weighted decibels
ft	foot
g	gram

H_2	hydrogen
ha	hectare
hr	hour
kbopd	thousand barrels of oil per day
kg	kilogram
km	kilometre
KSh	Kenyan Shillings
kV	kilovolt
l	litre
L_{AEQ}	a-weighted equivalent continuous sound level in decibels
L_{AFMAX}	a-weighted fast response maximum sound level
L_{AFMIN}	a-weighted fast response minimum sound level
L_{APEAK}	a-weighted peak sound level
Lux	one lumen per square metre
m	metre
mAOD	metres above ordnance datum
masl	metres above sea level
mbar	millibar
mg	milligram
MJ	mega joules
ml	millilitre
mm	millimetre
MM	one million
mS	milli-siemen
NO	nitrogen oxide
NO_2	nitrogen dioxide
O_2	oxygen
O_3	ozone
OD	outside diameter
pH	potential of hydrogen
PM	particulate matter

ppm	parts per million
Sn	Tin
SO	sulphur oxide
SO_2	sulphur dioxide
t	metric ton
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
W	watts
yr	year
d	day
s	second

1.0 INTRODUCTION

This report presents the environmental and social impact assessment (ESIA) for the proposed Lokichar to Lamu Crude Oil Pipeline (LLCOP) Project. This has been prepared by Golder Associates (UK) Ltd and ESF Consultants Ltd based on Terms of Reference (1772867.523.A1, October 2018) approved by the National Environment Management Authority (NEMA).

The objective of the ESIA is to identify and quantify impacts that the Project may have on the biophysical and socio-economic environments through comparison to the ESIA baseline and Project standards. Where identified as necessary, the ESIA will prescribe potential mitigation and management processes to prevent unacceptable deterioration of environmental and social conditions, minimise negative impacts and enhance benefits to Kenya, local communities and other stakeholders. This ESIA has been prepared to meet Kenyan regulatory requirements and a separate non-statutory Supplemental Assessment will be prepared to address additional requirements of potential Project Lenders.

A separate ESIA is being prepared for the Upstream activities of the development.

1.1 Project Background

The purpose of the Project is to design and construct an 824 km long pipeline for transporting crude oil from the proposed oil fields near Lokichar in Turkana to a Storage and Load-out Facility at the new Port currently under construction in Lamu (Figure 1.1-1).

The LLCOP Project is a stand-alone element of the LAPSSET strategic corridor programme (Lamu Port, South Sudan, Ethiopia Transport Corridor), a key component of the Kenya 2030 strategic vision.

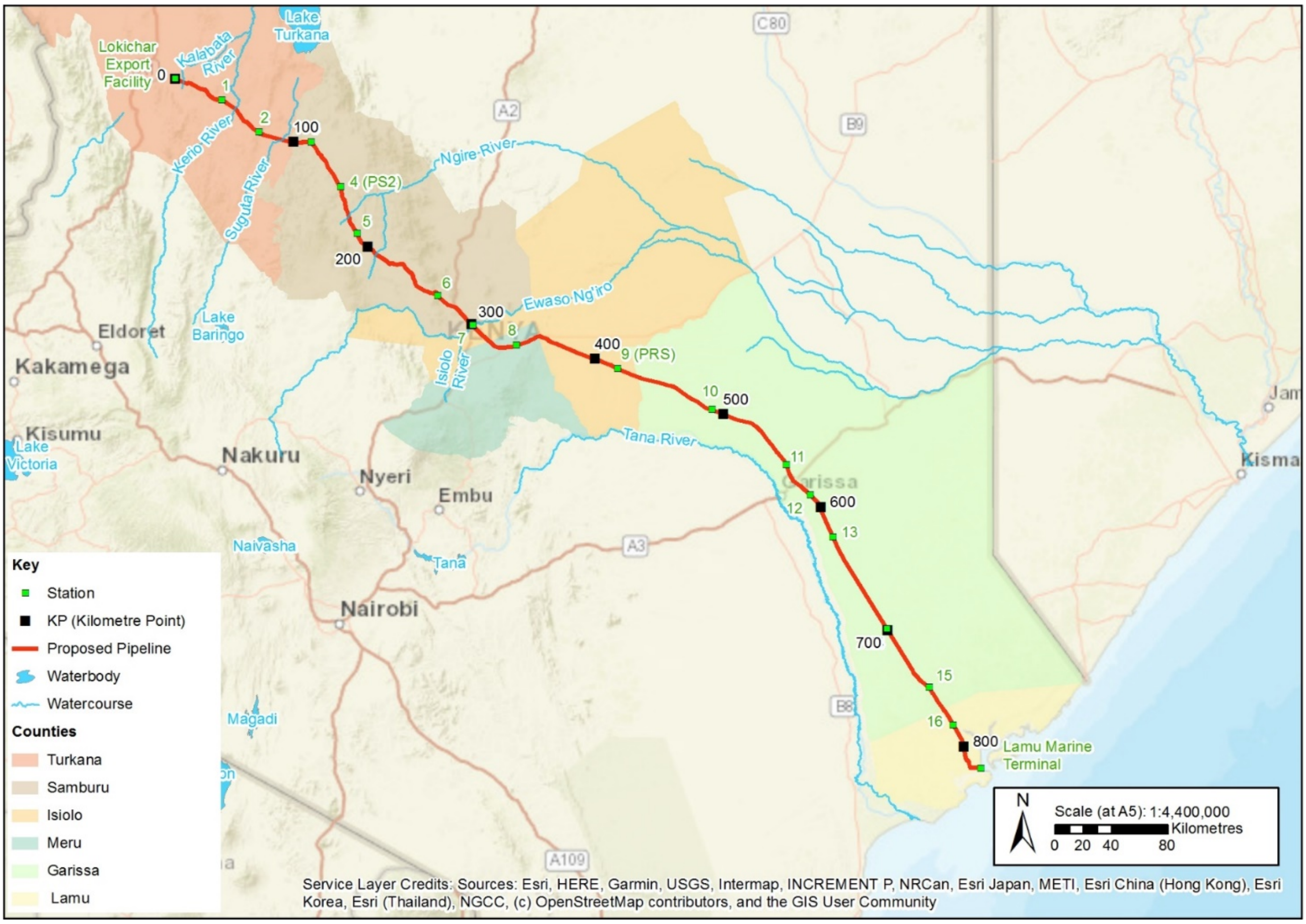


Figure 1.1-1: Project extent

1.2 Project Proponent

In October 2017, the following four parties executed a Joint Development Agreement (JDA) for the purpose of design (see Annex I: JDA for the LLCOP), assessment and permitting of the Lokichar Lamu Crude Oil Pipeline (LLCOP):

- The Government of Kenya represented by The Ministry of Energy (now Ministry of Petroleum and Mining);
- TOTAL Oil;
- Africa Oil; and
- Tullow Oil.

The scope of work contained within the JDA includes the preparation of the ESIA for the LLCOP Project. The implementing body established to deliver the JDA scope of work is the Pipeline Project Management Team (PPMT), which is the proponent for this ESIA as the representative of the parties to the JDA listed above.

As the PPMT is a project delivery mechanism, the Project Proponent is the JDA Partners. This means that the four members of the JDA are jointly responsible for the effective implementation of the approved Environmental and Social Management Plan (ESMP) and environmental license conditions.

In due course, the PPMT will be replaced by an incorporated pipeline company (PipeCo), which will then assume the rights and obligations of the PPMT.

The LLCOP Project is anticipated to take 33 to 36 months to construct from EPC contract award and the operational life is expected to be 25 years.

The National Land Commission (NLC) will be responsible for all land acquisition along the pipeline route. Land will be acquired by the Government of Kenya through this vehicle and a portion of it leased back to the PPMT for a period covering the construction and operation of the export pipeline. This land acquisition process is a separate initiative under the LAPSSET strategy and will therefore not form part of this ESIA.

1.3 This Report

The structure of this ESIA is as follows:

- ESIA Report:
  - Non-Technical Summary (NTS);
  - 1.0 Introduction (this section);
  - 2.0 Policy, Legal and Administrative Framework;
  - 3.0 Impact Assessment Methodology;
  - 4.0 Project Description and Analysis of Alternatives (including zero project option);
  - 5.0 Stakeholder Engagement;
  - 6.0 Baseline;
  - 7.0 Potential Impacts and Mitigation;
  - 8.0 Environmental and Social Management Plans;
  - 9.0 Conclusions.
- Annex I – Supplementary Information:

- Terms of Reference and Scoping Report (As approved by NEMA);
- Project Standards; and
- Underwater Noise Report

- Annex II – Baseline:
  - Physical Baseline and Field Reports;
  - Biodiversity Baseline and Field Reports;
  - Social Baseline and Focus Group Reports; and
  - Oil Spill Modelling Reports.
- Annex III – Stakeholder Engagement:
  - Stakeholder Engagement Plan; and
  - Minutes of Meetings.

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Background and Context

The LLCOP Project ESIA will comply with the Kenyan legislative, regulatory and policy requirement, and as appropriate, will refer to relevant Good International Industry Practice (GIIP) (i.e. IFC Performance Standards on Environmental and Social Sustainability (2012) and International Finance Corporation's (IFC) General EHS Guidelines (2007a, 2007b)). The following subsections provides an overview of the relevant policy, legal and institutional framework governing the LLCOP ESIA.

2.1.1 Governance and Administrative Structure

A list of administrative agencies that regulate the development of the oil and gas sector is shown below. These institutions have a key role in the LLCOP ESIA authorisation process, and includes the following:

Table 2.1-1: Administrative regulation agencies for oil and gas

Institution	Description	Project relationship
Ministry of Petroleum and Mining	The Ministry of Petroleum and Mining enhances commercialization of discoveries, develops the requisite skills and infrastructure for production in the oil, gas and other minerals and improves access to competitive, reliable and secure supply of petroleum products. Relevant departments include the State Department for Mining and the State Department for Petroleum.	State representative in the Joint Development Agreement (JDA) with Africa Oil (K), Tullow Oil (K) and TOTAL Oil (K)
Ministry of Energy	The Ministry of Energy facilitates the provision of clean, sustainable, affordable, reliable, and secure energy services for national development while protecting the environment. The relevant department includes the State Department for Energy which comprises semi-autonomous agencies such as the Kenya Power Lighting Company Limited, The Kenya Electricity Generating Company, and the Energy and Petroleum Tribunal and the Geothermal Development Company Following the enactment of the Petroleum Act, 2019 and the Energy Act, 2019, the Energy Regulatory Commission (ERC) was replaced by the Energy and Petroleum Regulatory Authority (EPRA) while the Energy Tribunal was replaced by the Energy and Petroleum Tribunal.	Key stakeholder and mandated in permitting of energy generation and distribution
Ministry of Environment and Forestry	The Ministry of Environment and Forestry's mission statement and key objective is to facilitate good governance in the protection, restoration, conservation, development and management of the environment and natural resources for equitable and sustainable development.	Key stakeholder in environmental permitting especially of largescale projects. Mandated to oversee and facilitate Government's sustainability agenda through development and implementation of appropriate policy instruments. NEMA, the implementing

Institution	Description	Project relationship
	Following the passage of the Environmental Management and Coordination Act (Environmental Management and Coordination Act) 1999, as amended from time to time (CAP 387, Laws of Kenya), several administrative structures were established under the Ministry. These include the National Environmental Council (NEC), National Environment Management Authority (NEMA), National Environment Tribunal (NET) the National Complaints Committee (NCC), and the Standard and Enforcement Review Committee (SERC).	institution for environmental compliance is a function of this ministry.
Ministry of Water and Sanitation	The Ministry of Water and Sanitation (MWS) mission statement is to contribute to national development by promoting and supporting integrated water resource management to enhance water availability and accessibility. The MWS has the following subsectors: Water Supply Services, Sewer & Non-Sewer Sanitation Services, Water Harvesting & Storage, Water Resource Management, Water Sector Investment Planning and Transboundary Waters.	Key stakeholder to the process with regards to water management and catchment conservation.
National Environment Management Authority (NEMA)	The National Environment Management Authority (NEMA) was established under the Environmental Management and Coordination (Environmental Management and Coordination Act), 1999 (CAP387, Laws of Kenya). NEMA's mandate is to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment in all the development projects in the country. NEMA is the administrative body that is responsible for the coordination of the various environmental management activities in Kenya. NEMA is also the principal government authority for implementing all environmental policies. NEMA's mandate in regulation and management of the petroleum sector in Kenya includes approval of ESIAS, Environmental Audit reports, licensing under different Environmental Management and coordination regulations which include Solid Waste management	Responsible for granting the ESIA approvals/License and for monitoring and assessing the project activities to ensure that there is compliance to laws and regulations and ensure that the environment is not degraded. This ESIA document will be submitted to NEMA for request of approval and permitting.

Institution	Description	Project relationship
	and water quality, Environmental Monitoring and Inspection for compliance. These functions are executed in collaboration with the relevant Lead Agencies, which would include Directorate of Occupational Safety and Health Services, Kenya Maritime Authority, Energy and Petroleum Regulatory Authority, Ministry of Energy, Ministry of Petroleum and Mining, National Museums of Kenya, Kenya Wildlife Service among others. NEMA is responsible for granting ESIA approvals/permitting and to ensure monitoring of applicable projects, in order to ensure that the projects are implemented in an environmentally sustainable and socially acceptable manner.	
Water Resources Authority (WRA)	WRA is a state corporation, established under the Water Act 2016 and charged with being the lead agency in water resources management. Among other functions, WRA is responsible for issuing permits for water use. The Authority is the predecessor to the Water Resource Management Authority (WRMA) established under Water Act, 2002.	Permit for water abstraction from surface water and or ground resources. Application for a permit shall be the subject of public consultation and where applicable an EIA will be conducted in accordance with the requirement of the EMCA 2015.
County Environmental Committees (CEC)	The CECs are responsible for the proper management of the environment within the county for which it is appointed. The Committee also develops county strategic environmental action plan for five years.	Monitoring of project activities at the county level.
National Environmental Department (NED)	The NED functions are to investigate any allegations or complaints against any person or against the Authority in relation to the condition of the environment in Kenya. NED may also on its own motion investigate any suspected case of environmental degradation and to make a report of its findings together with its recommendations to the Cabinet Secretary.	
The National Environment Tribunal	The National Environment Tribunal (NET) has a number of functions, including to hear and determine appeals from NEMA's decisions; to adjudicate over actions relating to the issuance, revocation or denial of Environmental Impact Assessment (EIA) licences; to determine the amount of money to be paid under the	

Institution	Description	Project relationship
	Act; to decide upon the imposition of restoration orders; to give direction to NEMA on any matter of complex nature referred to it by the Director General; and in accordance with the Forest Conservation and Management Act, No. 34 of 2016, NET is mandated to make determination on any matter that remains unresolved after reference to the lowest structure of devolved system set out in the County Government Act under section 70.	
Ministry of Sports and Heritage	The mission of the Ministry of Sports and Heritage is to develop, promote, preserve and disseminate Kenya's diverse cultural, artistic and sports heritage, through formulation and implementation of policies that enhance national pride and improve the livelihood of the Kenyan people. Of relevance to the Project are the Ministry's responsibilities for: ■ National Heritage Policy and Management; ■ National Archives/Public Records Management; ■ Management of National Museums and Monuments; and ■ Historical Sites Management. Following the passage of the National Museum and Heritage Act 2006, the National Museums of Kenya (NMK) was established under the Ministry, which has the following function: ■ Heritage promotion, collection and documentation; ■ Research; ■ Preservation and conservation; and ■ Information dissemination.	National Museum of Kenya (NMK) which falls under this ministry issues permits for movement of heritage items
Ministry of Transport, Infrastructure, Housing and Urban Development	The Ministry of Transport, Infrastructure, Housing and Urban Development has the following departments: ■ The State Department of Transport; ■ The State Department of Infrastructure ■ The State Department for Maritime and Shipping Affairs; ■ The State Department for Public Works; and ■ The State Department for Housing & Urban Development.	Under Department of Transport, issue permits for transportation of wide loads; bulk carriers and abnormal loads as described under Traffic Act Cap 403 part (V) and (VI); Kenya Roads Act Cap 2 of 2007 Department for Maritime and Shipping Affairs – licensing and registration of ships/ vessels which is conducted by Kenya Maritime Authorities (KMA) governed by Merchant Shipping Act, 2009.

Institution	Description	Project relationship
	The Ministry is mandated to perform several functions, including (amongst others): ■ National Roads Development Policy Management; ■ Transport Policy Management; ■ National Road Safety Management; ■ Development and Maintenance of Airstrips; and ■ National Transport and Safety Policy.	
Ministry of Interior and Coordination of National Government	The mission of the Ministry of Interior and Coordination of National Government is to create an enabling environment for Kenya's growth and prosperity via the provision of security and safety to people and property, maintain a credible national population registration system, promotion of national cohesion, facilitate administration of justice, provision of correctional services and coordination of national government functions. Of relevance to the Project are the Ministry's responsibilities for: ■ National government coordination at counties; ■ Disasters and Emergency Response Coordination; ■ Internal Security Affairs; and ■ Citizenship and Immigration Policy and Service.	Work permits to be acquired by foreign nationals or foreign company representatives working in the project will be applied from this ministry. The ministry is also a key stakeholder in security matters.
Vision 2030 Secretariat	Charged with the mandate of spearheading the implementation of Vision 2030 as the country's blueprint and strategy towards making Kenya a newly industrialising middle-income country. Lamu Port-South Sudan-Ethiopia Transport Corridor (LAPSSET) and its constituent projects including LLCOP form a key pillar to the Vision 2030.	Provide support towards the development of projects that fall within the vision.
Kenya Pipeline Company Limited	Established in September 1973 under the Companies Act Cap 486 it is 100% owned by the government which and its mandate is to provide effective, reliable, safe and cost-effective means of transporting petroleum products from Upstream to Downstream[1].	Key stakeholder to ESIA process and management of oil/petroleum resources

[1] For the avoidance of doubt, this has no connection to either the PPMT or PipeCo, which are governed by the JDA referenced in Chapter 1

Institution	Description	Project relationship
LAPSSET Corridor Development Authority (LCDA)	LAPSSET Corridor Development Authority (LCDA) was established In March 2013, the LAPSSET through the Presidential Order Kenya Gazette Supplement No. 51, Legal Notice No. 58, to plan, coordinate and manage the implementation of the LAPSSET Corridor. ▪ Tasked with establishing an integrated implementation plan and oversee the implementation of the proposed projects, especially the Crude Oil Pipeline, railway, highways. ▪ Will have the inter-ministerial coordination committees comprised of relevant ministries.	LAPSSET provides the land on which LLCOP is to be developed.
National Land Commission (NLC)	Manages public land on behalf of the national and county governments, initiates investigations into present or historical land injustices and recommend appropriate redress and monitor and have oversight responsibilities over land use planning throughout the country.	Responsible for Land acquisition process and compensation to persons affected by the project. Issue Land Title deeds
Kenya Marine and Fisheries Institute (KEMFRI)	Carries out biophysical and socio-economic research on fisheries, mangroves and marine. Source of aquatic research information, protection and management of aquatic resources and environmental patrols. Safeguarding sea lanes of communications, protection of offshore resources and aid to civil authorities.	KEMFRI monitors water quality and pollution in fresh and marine water environments. Lamu Marine Terminal is located within a marine environment.
Directorate of Occupational Health and Safety (DOSHS)	DOSHS draws its functions from the Occupational Safety and Health Act (OSHA), 2007 and the Work Injury Benefit Act, 2007. ▪ The role of Directorate of Occupational Safety and Health Services (DOSHS) is to inspect internal and external working environment and ensure the prevailing environmental conditions are favourable to human health. This will be needful during the construction of the pipeline to ensure workers are compliant with occupational health and safety requirement.	Issues workspace permits once Occupational Health and Safety audits are undertaken and application subsequently made to DOSHS. Work areas (where there are 20 or more persons requires permitting through the above process.
Energy and Petroleum Regulatory Authority (EPRA)	EPRA was established under the Energy Act, 2019. All responsibilities relating to ERC (established under the now repealed Energy Act of 2006) now fall under the	EPRA is mandated by law to take such action as is necessary to enforce the requirements in a petroleum agreement or any regulations and to protect the

Institution	Description	Project relationship
	remit of EPRA. EPRA's functions in relation to the Environment: ■ Develop guidelines for the protection of the environment and conservation of the natural resources in accordance with the environmental laws, maritime laws and international maritime treaties ratified by Kenya prior to licensing of entities operating midstream. ■ Work with the relevant statutory authorities to formulate, enforce and review environmental, health, safety and quality standards for the upstream petroleum sector; and ■ Take such action as is necessary to enforce the requirements in a petroleum agreement or any regulations and to protect the environment, the health and safety of workers and the public. EPRA's powers in relation to the Environment: ■ Formulate, set, enforce and review environmental, health, safety and quality standards for the energy sector in coordination with other statutory authorities.	environment, the health and safety of workers and the public It is also required to investigate complaints or disputes arising from petroleum operations as well as enforce local content requirements.
Environment and Land Court	The court is established under Section 4 of the Environment and Land Court Act No. 19 of 2011. It has original and appellate jurisdiction to hear and determine all disputes in accordance with Article 162(2)(b) of the Constitution and with the provisions of the Act or any other written law relating to environment and land.	ELC would adjudicate any disputes on land matters.
Kenya Forest Service (KFS)	The KFS is established under the Forest Conservation and Management Act (2016) to conserve, protect and manage all public forests and also to manage water catchment areas in relation to soil and water conservation, carbon sequestration and other environmental services in collaboration with relevant stakeholders. According to the Environmental Management and Co-ordination Act, The Cabinet Secretary has the authority to (in consultation with the relevant lead agencies and national and international treaties) to declare any are of land, sea, lake, forests, or river to be a protected natural environment.	Permits/licenses proponent to undertake prohibited activity in forest area. Issues conservation (orders) and ensures enforcement. Interested stakeholder especially within forested zones such as Boni.

Other Government Agencies

Other government agencies relevant to the ESIA at national level are:

- Kenya Wildlife Services;
- Kerio Valley Development Authority;
- Kenya Revenue Authority;
- Kenya Bureau of Standards;
- Kenya Petroleum Refineries Limited;
- Kenya Maritime Authority;
- Kenya National Highways Authority;
- Ministry of Lands and Physical Planning;
- Ministry of Health;
- National Construction Authority;
- National Disaster Operation Centre; and
- National Drought Management Authority.

2.1.2 Devolution in Kenya

The Constitution of Kenya 2010 remodelled the Kenyan state by creating two layers of government, the National Government and County governments (the later comprises County Assemblies and County Executives). With this new devolved governance system, the administrative governance has been decentralised into 47 counties, where county governors are elected by voters registered in the county. County executive committees are proposed by the county governor and these implement county and national legislation, manage and coordinate the functions of the county administration and its departments, and implement any other functions conferred by the Kenyan Constitution. The County Assembly is formed by members elected from different wards in the county and by a number of nominated members representing specific interests. The process of devolution transfer certain powers from the central government to the counties, being now the counties responsible of the following sectors: agriculture, health services, early childhood development, public amenities, county trade development and regulations, county planning and development. The national government continue managing issues related to security, education, and other relevant of national interests.

2.2 Kenyan Policy and Legislative Requirements

This subsection provides an overview of relevant Kenyan policy and national legislation applicable to the ESIA. This information is shown in the following two tables, respectively.

Table 2.2-1:Key Kenyan National Policy

Policy	Description
The National Environment Policy (2013)	The goal is to provide better quality of life for present and future generations through the sustainable management and use of the environment. It aims to (i) provide a framework for an integrated approach to planning and sustainable management of the environment; (ii) ensure sustainable management of the environment; and (iii) promote partnerships in the protection, conservation and sustainable management of the environment.
The National Environmental Action Plan (NEAP),1994 revised in 2007.	The National Environment Action Plan (NEAP) was first published in 1994, and the most recent document was revised in March 2009 with a scope ranging from 2009 - 2013. It provides a framework for the implementation of the Environment Policy and realisation of the National Millennium Sustainable Goals and Vision 2030. The plan outlines measures to combat climate change including mitigation and adaptation, improving inter-sectoral coordination, mainstreaming sustainable land management into national planning, policy and legal frameworks and undertake research on impact of climate change on environmental, social and economic sector. The plan also aims to increase the country's forest cover and adopt economic incentives for management of forest products and community participation in conservation strategy The NEAP has established the process of identifying environmental problems and issues, awareness raising, building national consensus, defining policies, legislation and institutional needs, and planning environmental projects. Furthermore, it has led to the formulation of An Environmental Action Plan for Arid and Semi-arid Lands (ASAL) and County-specific Environmental Action Plans which will form a baseline for reference during the development of the ESIA process.
The National Water Policy (2012)	The National Water Policy includes details of the national government's policies and plans for the mobilisation, enhancement and deployment of financial, administrative and technical resources for the management and use of water resources.
National Water Masterplan 2030 (2014)	The National Water Master Plan 2030 was launched on 26/03/2014. It is a product of an intensive study of Kenya's water resources and meteorological conditions to facilitate planning for development and management of the same. The objectives of the masterplan were: ■ To assess and evaluate availability, reliability, quality, and vulnerability of country's water resources up to 2050, while taking into consideration climate change, and Improve water and sanitation access to all by 2030; ■ To help Kenya be a nation that has a clean, secure and sustainable environment by 2030; and ■ To generate more energy and increase efficiency in energy sector.
The Wetland Policy (2013)	The Wetland Policy aims to provide a framework for mitigating the diverse challenges that affect wetlands conservation and use in Kenya. Adoption of the policy also fulfils Kenya's obligations under the Ramsar Convention.

Policy	Description
The Wildlife Policy (2012)	The Wildlife Policy makes provision for an overarching framework for the prudent and sustainable conservation, protection and management of wildlife and wildlife resources in Kenya, with incidental provision on access and the fair and equitable distribution of benefits accruing there-from, and its alignment with other sector-specific laws and the environment policy.
Kenya Vision 2030 (2010)	Kenya Vision 2030 is a national long-term development blue-print to create a globally competitive and prosperous nation with a high quality of life by 2030. The vision is anchored on three key pillars; economic, social and political governance.
National Land Policy (2009)	The goal of the Policy is to guide the country towards efficient, sustainable and equitable use of land for prosperity and posterity. This Policy framework defines the key measures required to address the critical issues of land administration, access to land, land use planning, restitution of historical injustices, environmental degradation, conflicts, unplanned proliferation of informal urban settlements outdated legal framework, institutional framework and information management. The policy will be helpful in this project in addressing the following aspects: ■ It also addresses constitutional issues, such as compulsory acquisition and development control as well as tenure. It recognises the need for security of tenure for all Kenyans (all socioeconomic groups, women, pastoral communities, informal settlement residents and other marginalised groups); ■ It also recognises and protects private land rights and provides for derivative rights from all categories of land rights holding; ■ Through the Policy the government will ensure that all land is put into productive use on a sustainable basis by facilitating the implementation of key principles on land use, productivity targets and guidelines as well as conservation; and ■ It will encourage a multi-sectoral approach to land use, provide social, economic and other incentives and put in place an enabling environment for investment, agriculture, livestock development and the exploitation of natural resources.
The National Forestry Policy (2014)	Policy provides a framework for improved forest governance; resource allocation, partnerships and collaboration with the state and non-state actors to enable the sector to contribute in meeting the country's growth and poverty alleviation goals within a sustainable environment. Among other objectives of the policy includes: ■ Mainstreaming of forest conservation and management into national land use systems; ■ Preparation of a national strategy to increase and maintain forest and tree cover to at least 10% of the total land area and for the rehabilitation and restoration of degraded forest ecosystems, and the establishment of a national forest resource monitoring system; ■ Adoption of an ecosystem approach for the management of forests, and recognition of customary rights and user rights to support sustainable forest management and conservation;

Policy	Description
	■ Establishment of national programme s to support community forest management and afforestation/reforestation on community and private land; and ■ Preparation of national standards for forest management and utilisation, and the development of codes of conduct for professional forestry associations.
Environment and Development (Sessional Paper No.6) (1999)	The Kenya's policy paper on the Environment and Development was formulated in 1999. The policy defined approaches that will be pursued by the Government in mainstreaming environment into development. The policy harmonised environmental and developmental objectives with the broad goal of achieving sustainable development. ■ The policy paper also provided guidelines and strategies for government action regarding environment and development. ■ About wildlife, the policy reemphasised government's commitment towards involving local communities and other stakeholders in wildlife conservation and management, as well as developing mechanisms that allow them to benefit from the natural resources occurring in their areas. ■ The policy also advocated for the establishment of zones that allow for the multiple use and management of wildlife.
The National Biodiversity Strategy (2000)	The National Biodiversity Strategy and Action Plan (NBSAP) was formulated in order to enable Kenya address national and international commitments defined in Article 6 of the Convention on Biological Diversity (CBD). ■ The strategy is a national framework of action for ensuring that the present rate of biodiversity loss is reversed, and present levels of biological resources are maintained at sustainable levels for posterity. ■ The general objectives of the strategy are to conserve Kenya's biodiversity; to sustainably use its components; to fairly and equitably share the benefits arising from the utilisation of biological resources among the stakeholders; and to enhance technical and scientific cooperation nationally and internationally, including the exchange of information in support of biological conservation.

Table 2.2-2: Relevant National Legislation

Name of Legislation	Description
Environmental Management and Coordination Act (1999) as amended in 2015 and the subsidiary Regulations	The Environmental Management and Coordination Act as amended in 2015 and its subsidiary regulations set out requirements and procedures for conducting EIAs, auditing and environmental monitoring in Kenya. Furthermore, they establish environmental standards for water quality, noise, fossil fuel emission, and waste management. It also regulates activities impacting wetlands, riverbanks, lake/seashores, and the conservation of biological diversity.
The Constitution of Kenya (2010)	The Constitution of Kenya has taken on board various issues that are related to environmental management. Article 42 of the Constitution provides that every Kenyan has the right to a clean and healthy environment, which includes the right to have the environment protected for the benefit of present and future generations through legislative and other measures: ■ Chapter 5 of the Constitution is dedicated to land and the environment. The constitution requires that land be used and managed in a manner that is equitable, efficient, productive and sustainable. Part 2 of Chapter 5 of the constitution is dedicated to Environment and Natural Resources. ■ Article 69 in Part 2 provides that the state shall provide encourages efforts towards sustainable of natural resources, increasing of the national forest cover public participation in the management, protection and conservation of the environment, protection of genetic resources and biodiversity, environmental impact assessment, environmental audit and monitoring of the environment, etc.
The Environmental Management and Coordination (Impact Assessment and Audit) Regulations (EIAAR) (2003) The Environmental Management and Coordination (Impact Assessment and Audit) Regulations (EIAAR) (Amendment) (2016)	These regulations contain rules relative to the content and procedures of an EIA, to environmental audit and to monitoring and strategic environmental assessment. These rules regulate other matters such as the appeal for, and registration of, information regarding EIA. The EIA/EA amendment revises and replaces the second schedule of projects required to undergo EIA by categorising projects into low, medium and high risk. Petroleum exploration and production are categorised as high risk. The draft ESIA and EA Guidelines for the Downstream Petroleum Sub-sector (2012) issued by ERC (now the responsibility of EPRA) provide advice on their interpretation to that sector.
The Environmental Management and Coordination (Wetlands, River Banks, Lake Shores and Sea Shore Management Plan) Regulations (2009)	These regulations require the protection of wetlands, riverbanks, lake shore and seashore areas which provide ecological habitats.
The Environmental Management and Coordination (Fossil Fuel Emission Control) Regulations (2007)	These regulations set emission standards for internal combustion engines, provide for the licensing of persons responsible for treating fuel, provide for the appointment of environmental inspectors required to inspect emissions, and authorise NEMA to enter into partnerships in order to conduct emission inspections.

Name of Legislation	Description
The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit Sharing) Regulations (2006)	These regulations ensure that activities do not have an adverse impact on any ecosystem.
The Environmental Management and Coordination (Water Quality) Regulations (2006)	These Regulations outline the water quality standards that should be met for different uses including effluent discharge. The following schedules in the Water Quality Regulation set out the relevant standards and monitoring requirements: ▪ First Schedule: Quality Standards for Sources of Domestic Water; ▪ Second Schedule: Quality Monitoring for Sources of Domestic Water; ▪ Third Schedule: Standards for Effluent Discharge into the Environment; ▪ Fourth Schedule: Monitoring Guide for Discharge into the Environment; ▪ Fifth Schedule: Standards for Effluent Discharge into Public Sewers; and ▪ Sixth Schedule: Monitoring for Discharge of Treated Effluent into the Environment. The Water Resources Management Authority and NEMA are key administering authorities.
The Environmental Management and Coordination (Noise and Excessive Vibration Pollution) Control Regulations (2009)	This regulation establishes environmental standards that should be met for noise. NEMA is a key administering authority. The following schedules in the Noise and Excessive Vibration Pollution Control Regulation set out the relevant standards and monitoring requirements: ▪ First Schedule – Maximum Permissible Intrusive Noise Levels; ▪ Second Schedule – Maximum Permissible Noise Levels for Construction Sites; ▪ Third Schedule – Maximum Permissible Noise Levels for Mines and Quarries; ▪ Fourth Schedule– Application for a License to Emit Noise/Vibrations in Excess of Permissible Levels; ▪ Fifth Schedule–License to Emit Noise/Vibrations in Excess of Permissible Levels; ▪ Sixth Schedule – Application for a Permit to Carry out Activities; ▪ Seventh Schedule – Permit to Emit Noise in Excess; ▪ Eighth Schedule – Minimum Requirements for Strategic Noise and Excessive Vibrations Mapping; ▪ Ninth Schedule – Minimum Requirements for Action Plans; and ▪ Tenth Schedule – Improvement Notice.

Name of Legislation	Description
The Environmental Management and Coordination (Waste Management) Regulations (2006)	These regulations set rules for general waste management and for the management of solid waste, industrial waste, hazardous waste, biomedical waste, radioactive waste, pesticides and toxic waste. These regulations prohibit the pollution of public places, provide for the granting of licences for waste transportation and waste disposal facilities, and require an EIA to be undertaken on any site disposing of or generating biomedical waste.
Environmental (Prevention of Pollution in Coastal Zone and Other Segments of the Environment) Regulations (2003)	The regulations provide a framework for the protection of coastal zone from the pollutants and effluents by ship activities at the port. The regulations further provide a requirement for certification in accordance with MARPOL, the International Convention for the Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978.
Environmental Management and Co-ordination (Controlled Substances) Regulations (2007)	The regulations provide a framework for controlled substances management including classification and controls in disposal, movement, export and import of controlled substances listed in the schedule. The regulations also provide for licensing.
National Environmental Tribunal Procedure Rules (2003)	The rules provide for the procedure for appeals and referrals to the tribunal for determination. The Tribunal hears appeals and complaints from the decisions of the National Environmental Management Authority.
The Water Act (2016) and subsidiary legislation	This is an Act of Parliament purposed to provide for the regulation, management and development of water resources and water and sewerage services in line with the Constitution. Part III of the Act provides for the Regulation of the Management and use of water Resources through the Water Resource Authority which is in charge of implementation of the policy. Part of this act, Section 23 provides for protection of catchment areas to conserve vulnerable water resource, Section 36 of the Act requires that a permit to be obtained for: any use of water from a water resource, except as provided by section 37; the drainage of any swamp or other land; the discharge of a pollutant into any water resource. The policy requires that an application for such a permit shall be subject to public consultation as well as an environmental impact assessment as per the Environmental Management and Co-ordination Act, 1999. Section 63 of the Act entitles every person in Kenya the right to clean and safe water in adequate quantities and reasonable standards of sanitation as stipulated in Article 43 of the Constitution.
The Wildlife Conservation and Management Act (WCMA) (2013)	An Act of Parliament to provide for the protection, conservation, sustainable use and management of wildlife in Kenya and for connected purposes. The Act provides that wildlife should be conserved to yield optimum returns in terms of cultural, aesthetic, scientific and economic benefits. The Act requires that full account be taken of the inter-relationship between wildlife conservation and land use. The Act controls activities within the national parks, which may lead to the disturbance of wild animals. Unauthorised entry, residence, burning, damage to objects of scientific interest, introduction of plants and animals and damage to structure are prohibited under this law.

Name of Legislation	Description
	It also regulates wildlife conservation and management in Kenya, through the protection of endangered and threatened ecosystems. Specifically, it prohibits the disturbance or harm of flora and fauna within public places, community and private land, and Kenyan territorial waters. The Act also establishes Kenya Wildlife Service (KWS) as the implementing agency.
The National Museums and Heritage Act (2006)	An Act of Parliament to consolidate the law relating to national museums and heritage; to provide for the establishment, control, management and development of national museums and the identification, protection, conservation and transmission of the cultural and natural heritage of Kenya. The Act also establishes a notification of discovery requirement and sets restrictions on moving objects of archaeological or palaeontological interest.
Physical Planning Act (1996)	An Act of Parliament to provide for the preparation and implementation of physical development plans and for connected purposes.
Public Health Act (2012)	The Act provides for the prevention of the occurrence of nuisance or conditions dangerous/injurious to humans. It also provides that the relevant local authority shall take all lawful, necessary and reasonably practicable measures for preventing any pollution dangerous to health of any supply of water which the public within its jurisdiction has a right to use and does use for drinking or domestic purposes (whether such supply is derived from sources within or beyond its jurisdiction).
Occupational Health and Safety Act (2007), and subsidiary legislations and rules.	An Act of Parliament to provide for the safety, health and welfare of workers and all persons lawfully present at workplaces, to provide for the establishment of the National Council for Occupational Safety and Health and for connected purposes. This Act includes requirements for the control of air pollution, noise and vibration in every workplace where the level of sound energy or vibration emitted can result in hearing impairment, be harmful to health or otherwise dangerous.
Work Injury Benefits Act (2007)	The Act of Parliament seeks to provide framework for compensation to employees for work related injuries and occupational diseases contracted in the course of their employment. The Act provides for, among other provisions, the right for compensation in case of injury related to work, or in case of death due to an accident at work.
Factories and Other Places of Work (Noise Prevention and Control) Rules (2005)	These rules require that where the noise level is above ninety dB(A), the employer shall put in place a noise conservation program that includes posting conspicuous signs reminding employees that hearing protection must be worn, supply hearing protection and ensure all employees wear hearing protection.
Prevention, Protection and Assistance to Internal Displaced Persons and Affected Community Acts (2012)	An Act of Parliament on internal displacement in Kenya that includes vital provisions to secure the participation of displaced people in decision-making that affects them.

Name of Legislation	Description
Agriculture, Fisheries and Food Authority Act (2013)	The Agriculture, Fisheries and Food Authority Act consolidate the laws on the regulation and promotion of agriculture and makes provision for the respective roles of the national and county governments in agriculture and related matters.
Traffic Act (Revised 2015)	The Traffic Act relates to traffic on all roads.
Kenya Roads Act (2007)	An Act of Parliament to provide for the establishment of the Kenya National Highways Authority, the Kenya Urban Roads Authority and the Kenya Rural Roads Authority, to provide for the powers and functions of the authorities and for connected purposes.
Subsidiary Legislation of Petroleum (exploration and Production) Regulations (1984)	These Regulations provide for access to land. A petroleum agreement or exploration permit cannot authorise a contractor to occupy or exercise any rights in any burial ground or land near a place of worship, any area situated within 50 m of any building, any public road, any area situated within a municipality or township and any area of land declared to be a national park.
The Petroleum Act (2019)	This Act applies in the regulation of upstream, midstream and downstream petroleum operations being developed in Kenya. It provides a framework for the contracting, exploration, development and production of petroleum and provides information on the establishment and functions of the National Upstream Petroleum Advisory Committee. Part VIII of the Petroleum Act (2019) provides for environment, health and safety, which covers environmental compliance, waste management, maintenance of property, venting and flaring of oil and natural gas, reporting of accidents and incidents, safety precautions, emergency preparedness measures, safety zones and liability of contractor for damage due to pollution.
The Forest Conservation and Management Act (2016)	An Act of Parliament to give effect to Article 69 of the Constitution about forest resources; to provide for the development and sustainable management, including conservation and rational utilisation of all forest resources for the socio-economic development of the country and for connected purpose.
The Environmental Management and Coordination (Air Quality Standards) Regulations (2014)	This regulation's objective is to provide for prevention, control and abatement of air pollution to ensure clean and healthy ambient air. It provides for the establishment of emission standards for various sources such as mobile sources (e.g. motor vehicles) and stationary sources (e.g. industries). The regulations provide the procedure for designating controlled areas, and the objectives of air quality management plans for these areas.

Name of Legislation	Description
Community Land Act (2016)	The Act provides for the recognition, protection and registration of community land rights; management and administration of community land; to provide for the establishment of and the powers of community land management committees; and county governments in relation to unregistered community land and for connected purposes. Part V to VIII of the Act are key to Oil and Gas Operations on Community Land. These parts give provisions on guidelines on: ▪ Conversion of community land for public use; ▪ Special rights and entitlements in the community land; ▪ Environment and natural resources management (natural resources on community land, benefit sharing, rules by-laws and regulation of community land use planning); and ▪ Settlement of disputes relating to community land such as dispute resolution mechanisms, mediation and arbitration.
Land Act (2012) as amended by the Land Laws (Amendment) Act, 2016	It is the substantive law governing land in Kenya and provides legal regime over administration of public and private lands. It also provides for the acquisition of land for public benefit. The government has the powers under this Act to acquire land for projects, which are intended to benefit the general public. The projects requiring resettlement are under the provision of this Act.
Land Registration Act (2012) as amended by the Land Laws (Amendment) Act, 2016	This is a procedural law and provides for revision, consolidation and rationalisation of the registration of titles to land, to give effect to the principles and objects of devolved government in land registration. It also provides for the registration of interests over land.
Environment and Land Court Act (2011)	The Kenya Constitution establishes the Environment and Land Court. Article 162 of the constitution provides for the creation of specialised courts to handle all matters on land and the environment. Such a court will have the status and powers of a High Court in every respect. Article 159 on the principles of judicial authority, indicates that courts will endeavour to encourage application of alternative dispute resolution mechanisms, including traditional ones, so long as they are consistent with the constitution.
National Land Commission Act (2012) as amended by the Land Laws (Amendment) Act, 2016	The Act establishes the National Land Commission with the purpose of managing public land and carrying out compulsory acquisition of land for specified public purposes.
County Government Act (2012)	The County Governments Act expounds on the functions of County Governments in Kenya and to clarify on the functions of county governments in Kenya. It also designates any other functions not assigned to the counties by the Constitution, or any other written law, as a national government function. It led to the constitution of the department of Environment, Water and natural resources responsible for environmental conservation in the county level.

Name of Legislation	Description
Climate Change Act (2016)	The objective is the development, management, implementation and regulation of mechanisms to enhance climate change resilience and low carbon development for sustainable development.
Access to Information Act (2016)	The Act upholds the right to information and enables citizens to access information from the state and private companies.
Energy Act (2019)	The Act provides for the establishment, functions and powers of EPRA under Part III. Energy Act also provides that a person engaged in any undertaking or activity pursuant to a licence under this Act shall notify the respective licensing authority and EPRA of any accident or incident causing loss of life, personal injury, explosion, oil spill, fire or any other accident or incident causing harm or damage to the environment or property which has arisen in Kenya, within 48 hours in writing, in the form and manner prescribed by EPRA.
Food, Drugs and Chemical Substances (Food Hygiene) Regulations (1978)	These regulations provide that no person shall use any premises or being the owner or occupier thereof permit or allow the premises to be used for the purposes of selling, preparing, packaging, storing, or displaying for sale any food unless that person is in possession of a licence issued under the Regulations.
Health Act (2017)	Private entities shall be permitted to operate hospitals, clinics, laboratories and other institutions in the health sector, subject to licensing by the appropriate regulatory bodies.
The Turkana County Water Act (2019)	This Act provides for the regulation and management of water and sewerage services in Turkana County, the development, regulation and management of county public works in relation to water and sewerage systems, the implementation of National Government Policies in water conservation in Turkana County and for connected purposes
The Environmental Management and Co-ordination (Noise and Excessive Vibration Pollution) (Control) Regulations (2009)	For an activity that will exceed the noise and/ or vibration limits stipulated in the Regulations ensure that a licence is secured before the undertaking of such activity (fireworks, demolitions, firing ranges or specific heavy industry).
Waste Management Regulations (2006)	A licence is required to transport waste in a vehicle approved by the Authority upon the recommendation of the relevant lead agency.
Water Quality Regulations (2006)	A permit is required to discharge a waste/ effluent disposal into the environment in a sound manner.
Environmental (Impact Assessment and Audit) Regulations (2003)	A holder of an environmental impact assessment licence may, on payment of the prescribed fee, transfer the licence to another person only in respect of the project to which such licence was issued.
Controlled Substances Regulations (2007)	A valid license is required to import controlled substances into Kenya.

The following draft policies, legislation and guidelines are relevant to the ESIA.

Table 2.2-3: Draft Policies, Legislation and Guidelines

Name of Legislation	Description
The Draft Environmental Management and Coordination (Strategic Assessment, Integrated Impact Assessment and Audit) Regulations (2018)	The draft regulations provide for the need to register environmental assessment experts and the requirement for an environmental assessment expert licence. The regulation spells out requirements for a project report as well as the submission comment and authorisation process. The regulations spell out the requirements for the integrated environmental impact assessment, environmental audit and monitoring, and strategic environmental assessment processes in some detail.
The Draft Environmental Management and Co-ordination (E-Waste) Regulations (2013)	The regulations provide an appropriate legal and institutional framework and mechanisms for the management of E-waste handling, collection, transportation, recycling and safe disposal of E-waste. It also provides for improved legal and administrative co-ordination of the diverse sectoral initiatives in management of E- waste as a waste stream, in order, to improve the national capacity for the management of the E-waste.
Draft Environmental Management and Coordination (Conservation and Management of Wetlands) Amendment Regulations (2017)	The overall objective of the draft Amendment Regulations, 2017 is to align it to the Constitution of Kenya, 2010, Environmental Management and Coordination Act, 1999 and the National Wetlands Conservation and Management Policy, 2015. The Regulations also seek to address emerging issues such as climate change and invasive species.
The Draft Environment Management and Co-ordination (Deposit Bonds) Regulations (2014)	The regulations are applicable to the activities, industrial plants and undertakings which have or more likely to have adverse effects on the environment. This is to ensure, among other things, good environmental practices, adequate remediation is achieved without adversely affecting economic viability. Any person operating or proposing to operate an industrial plant and undertaking an activity as stipulated in the Deposit Bonds. Register shall be required to prepare a Deposit Bond Assessment Report.
Draft Environmental Management & Coordination (Toxic & Hazardous Industrial Chemicals & Materials Management) Regulations (2018)	The regulations will provide for the sustainable management of chemicals in Kenya, specifically, labelling, classification, registration, manufacture, storage, transport (road, air and sea), distribution, handling, import, export, chemical use in mining, substances in articles/ chemicals in products, polluter release and transfer register, restrictions and banning, incidents, liabilities, waste disposal and offences of toxic and hazardous chemicals and materials.
Draft Petroleum (Local Content) Regulations, 2019	These regulations are made pursuant to the Petroleum Act, 2019. The regulations will apply to local content with respect to the upstream, midstream and downstream petroleum activities. The purpose of these regulations includes: a) To maximise value addition through local content development and local participation in the petroleum industry operations; b) To promote participation of Kenyan people and indigenous Kenyan companies in provision of goods and services in the petroleum industry value chain; c) To provide for a robust, transparent monitoring and reporting for local content obligations, among others

Name of Legislation	Description
Local Content Bill (2018)	The Bill seeks to provide for a framework to facilitate the local ownership, control and financing of activities connected with the exploitation of gas, oil and other mineral resources; and further to provide framework to increase the local value capture along the value chain in the exploration of gas, oil and other mineral resources.
The Draft National Energy Policy (2015)	The draft National Energy Policy set the policy for the provisions Clean, Sustainable, Affordable, Competitive, Reliable and Secure Energy Services at Least-Cost while Protecting the Environment.
Natural Resources (Benefit Sharing) Bill (2018)	The Bill seeks to establish a system of benefit sharing in resource exploitation between resource exploiters, the national government, county governments and local communities.
Physical Planning Bill (2017)	The Bill seeks to make provision for the planning use, regulation and development of land.
Land Value Index Laws (Amended) Bill (2018)	The Bill seeks to amend the Land Act, the Land Registration Act and the Prevention, Protection and Assistance to Internally Displaced Persons and Affected Communities Act; to provide for the assessment of land value index in respect of compulsory acquisition of land.
Draft Plastic Bags Control and Management Regulations (2018)	The Authority may authorize the manufacture, import, export or use of plastic flat bags for industrial packaging. An application for authorization to manufacture, import, export or use plastic flat bags shall be made in accordance with the first schedule.
Draft Environmental Management and Coordination (Waste Tyre Management) Regulations (2013)	No person shall be engaged in the collection, transportation, storage or disposal of waste tyres without a valid licence from the Authority.
Public Participation Bill (2018)	This Bill seeks to provide a framework for effective public participation, The Constitution of Kenya 2010, ushered in a new system of governance that places the people at the centre of governance.
Strategic Environmental and Social Assessment of the Petroleum Sector in Kenya	Presents a unique opportunity for the country to systematically address environmental and socio-economic management issues pertaining to oil and gas activities in the context of sustainable development.
Kenya National Petroleum Master Plan, Draft* (*To be confirmed)	Purpose of this is to integrate all elements of the oil and gas value chain, from exploration, production, transportation, processing, storage and distribution, and usage in domestic and export markets.

2.3 International Guidance and Standards

The LLCOP ESIA will follow, where appropriate, Good International Industry Practice (GIIP), including the following:

- IFC (2012). Performance Standards for Environmental and Social Sustainability and accompanying Guidance Notes;

- IFC (2007a). EHS General Guidelines including key sections on the following:
  - EHS Guidelines: Wastewater and Ambient Water Quality;
  - EHS Guideline: Air Emissions and Ambient Air Quality;
  - EHS Guideline: Occupational Health and Safety;
  - EHS Guideline: Noise; and
  - EHS Guidelines: Water and Sanitation.
- IFC (2007b) EHS Guidelines for Onshore Oil and Gas Development;
- IFC (2007) EHS for Crude Oil and Petroleum Product Terminals; and
- IFC (2015) EHS Guidelines for Offshore Oil and Gas Development.

Good Practice guidelines which will be referred to throughout the LLCOP ESIA includes, but are not limited to, the following:

- Business and Biodiversity Offsets Programme (2012). BBOP Standard on Biodiversity Offsets Guidance;
- IFC (2013) Good Practice Handbook: Cumulative Impact Assessment and Management – Guidance for the Private Sector in Emerging Markets;
- IFC (2017) Good Practice Note: Managing Contractors' Environmental and Social Performance;
- IFC (1998) Doing Better Business Through Effective Public Consultation and Disclosure;
- IFC (2007) Stakeholder Engagement: A Good Practice Guide for Companies Doing Business in Emerging Markets;
- IFC (2009) Good Practice Note: Addressing Grievances from Project-Affected Communities: Guidance for Projects and Companies on Designing Grievance Mechanisms;
- IFC and EBRD (2009) Workers' Accommodation: Processes and Standards;
- IFC (2015) Environmental and Social Management System Implementation Handbook;
- International Petroleum Industry Environmental Conservation Association (IPIECA) (2005);
- IPIECA (2007). An ecosystem approach to oil and gas industry biodiversity conservation;
- IPIECA (2010). Alien invasive species and the oil and gas industry Guidance for prevention and management;
- IPIECA (2014). Cross Sector Biodiversity Initiative Guidance;
- The Energy and Biodiversity Initiative (2006). Integrating Biodiversity into Environmental and Social Impact Assessment Processes and associated guidance;
- The Energy and Biodiversity Initiative (2006). Negative Secondary Impacts from Oil and Gas Development; www.theebi.org;
- The Energy and Biodiversity Initiative (2006). Biodiversity Indicators for Monitoring Impacts and Conservation Actions; www.theebi.org;

- The Energy and Biodiversity Initiative (2006). Opportunities for Benefiting Biodiversity Conservation; www.theebi.org;
- The Energy and Biodiversity Initiative (2006). Good Practice in the Prevention and Mitigation of Primary and Secondary Biodiversity Impacts; www.theebi.org;
- The Energy and Biodiversity Initiative (2006). Framework for Integrating Biodiversity into the Site Selection Process;
- World Resources Institute (WRI) (Landsberg F, Treweek J, Stickler MM, Henninger N and Venn 0) (2013). Weaving ecosystem services into impact assessment: A Step-By-Step Method;
- WHO (2011), Drinking Water Quality Guidelines – 4th edition;
- WHO (2005), Air Quality Guidelines Global. Guidelines on the standards that should be achieved for air, in the absence of national guidelines;
- WHO (1999), Guidelines for Community Noise; and
- Traffic Impact Assessments, Institute of Transportation Engineers Trip Generation Manual (2001).

2.4 International Conventions

Other relevant international agreements, treaties and conventions related to the social and/or environmental aspects, to which Kenya is a signatory or has acceded to/ratified, are detailed in the following table.

Table 2.4-1: International Conventions

Convention	Date Ratified/ Acceded to
International Convention for the Prevention of Pollution of the Sea by Oil (London Convention) (1954)	
African Convention for the Conservation of Nature and Natural Resources (Algiers Convention) (1968)	Ratified 1969
International Convention Relating to Intervention on the High Seas in Case of Oil Pollution Casualties (1969)	
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1971)	
International Convention of the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972) (London Dumping Convention)	
International Convention for the Prevention of Pollution from Ships (MARPOL) (1973)	
The African Commission on Human and People's Rights	Ratified 1972
International Covenant on Economic, Social and Cultural Rights	Ratified 1972
International Covenant on Economic, Social and Cultural Rights	Ratified 1972
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)	Acceded 1978

Convention	Date Ratified/ Acceded to
The African Charter on Human and Peoples" Rights (African Charter)	Ratified 1981
Convention for the Protection, Management and Development of the Marine and Coastal Environment of the East African Region (1985)	
Vienna Convention for the Protection of the Ozone Layer (1985)	Acceded 1988
Montreal Protocol on Substances that Deplete the Ozone Layer (1987)	Accepted 1988
International Convention on Oil Pollution Preparedness, Response and Co-operation (1990)	
Convention on Wetlands of International Importance (the Ramsar Convention) (1971)	Ratified 1990
UNESCO Convention for the Protection of the World Cultural and Natural Heritage	Acceded 1991
United Nations Framework Convention on Climate Change (1992)	Acceded 1994
Convention on Biological Diversity (1992)	Acceded 1994
Lusaka Agreement on the Cooperative Enforcement Operations Directed against Illegal trade in Fauna (1994)	Ratified 1997
Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (1979) ■ The African-Eurasian Water-bird Agreement (AEWA) ■ The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA)	Acceded 1999
Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (Basel Convention) (1989)	Acceded 2000
Bamako Convention on the Ban of the Import into Africa and the Control of Trans-boundary Movement and Management of Hazardous Wastes within Africa (1991)	Signed 2003
Convention on Persistent Organic Pollutants (2001)	Ratified 2004
Convention on Climatic Change and the Kyoto Protocol (1997)	Ratified 2005
UNESCO Convention on Intangible Cultural Heritage	Ratified 2007

2.5 Project Standards

The LLCOP Project will be designed, constructed and operated to the more stringent of Kenya regulatory requirements and applicable international standards and guidelines. Project Standards are set out for reference in Annex I.

3.0 IMPACT ASSESSMENT METHODOLOGY

This Section describes the impact assessment methodology used to undertake this ESIA and presents the following:

- The impact assessment process;
- Activities undertaken during the Scoping phase;
- Approach to baseline data collection;
- Methodology used for environmental and social impact assessment;
- Interactions between the ESIA and the design engineering process;
- Approach to stakeholder engagement; and
- Approach to the development of management plans.

3.1 Impact Assessment Process

The objective of the ESIA is to identify and quantify impacts that the Project may have on the biophysical and socio-economic environments through comparison to the ESIA baseline. The ESIA sets out potential mitigation and management processes to prevent unacceptable deterioration of environmental and social conditions, minimise negative impacts and enhance benefits for stakeholders, affected communities and the environment. The ESIA methodology used takes a staged approach presented in Table 3.1-1.

Table 3.1-1:Approach to Impact Assessment

Stage	Activity
1	Establish baseline conditions – determine baseline conditions through review of existing published and available site-specific information.
2	Establish the key receptors and their importance.
3	Characterise the magnitude of the impact to the receptor – determine the potential changes to receptors brought about by the Project (including inherent mitigation) and assign a magnitude of impact.
4	Assess the impact significance – determined by the nature and magnitude of impact, combined with the importance of receptor.
5	Consider the need for monitoring and management – used where there is a need to monitor the success of any mitigation.

This ESIA has be undertaken in accordance with the applicable requirements of:

- Kenyan EIA legislation and policy; and
- Good International Industry Practice (GIIP) as defined in Section 2.

The ESIA process in Kenya is shown schematically in Figure 3.1-1.

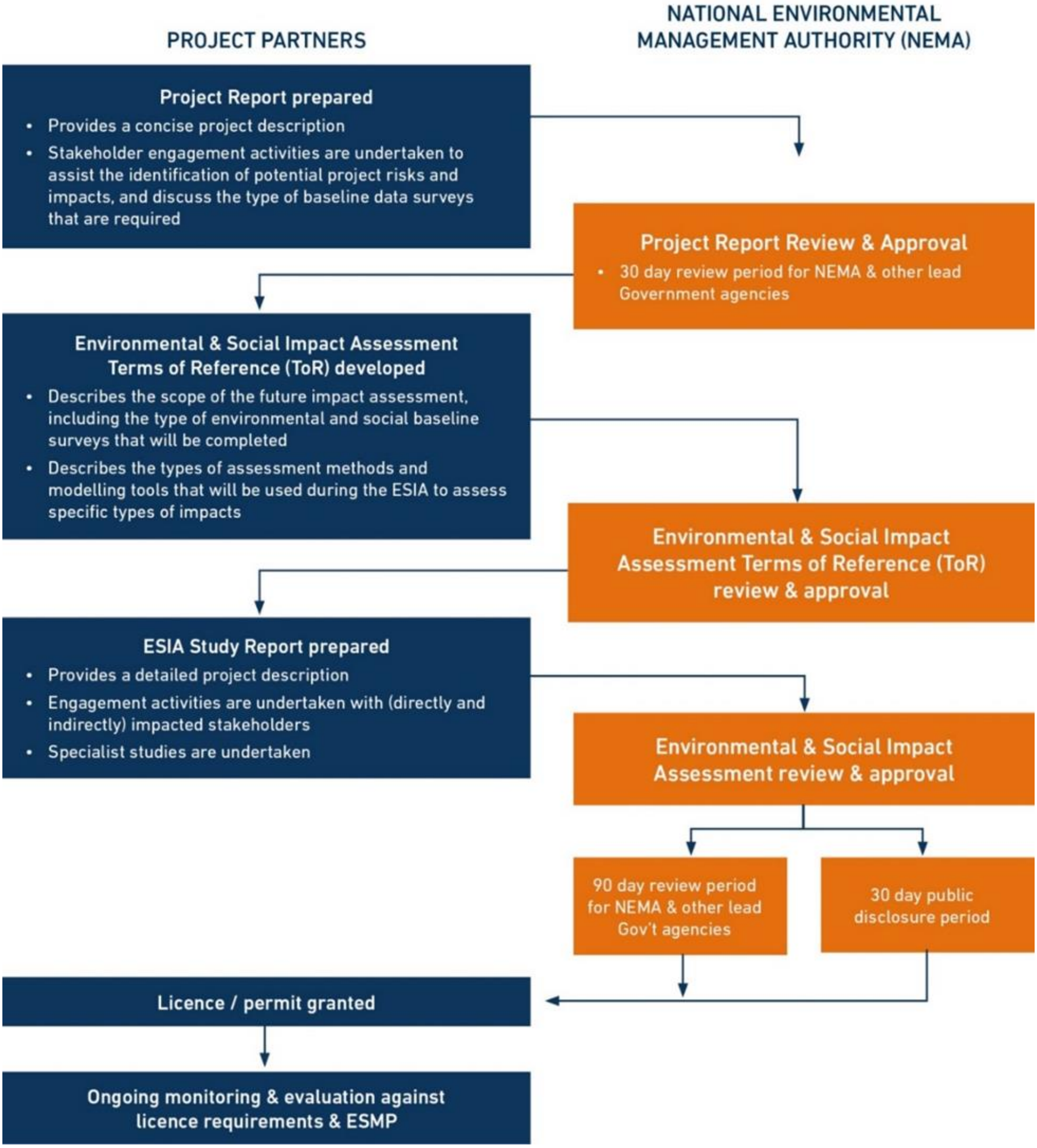


Figure 3.1-1: Overview of the ESIA process in Kenya

3.2 Scoping Phase

The aim of scoping is to identify at a high level the potential impacts on environmental and social receptors likely to arise from Project activities that will need to be further considered in baseline data collection and the impact assessment. Scoping is also used to determine how the ESIA will be undertaken.

The primary output of the LLCOP ESIA scoping stage was the preparation of a ToR (incl. in Annex I) and supporting Project Report. For those impacts scoped in, the proposed method and approach for predicting and evaluating their consequence or significance is presented in this ESIA report.

The ToR was submitted to NEMA for review and was approved by NEMA on 19 October 2018.

3.3 Baseline Data Collection

Baseline data collection is undertaken to characterise the existing environmental and social receptors and conditions in the potential Area of Influence (AoI) of LLCOP. The Project AoI and discipline-specific AoIs are presented in Figure 3.3-1 and Figure 3.3-2 respectively.

The discipline specific AoIs were determined by identifying the spatial area that may potentially be influenced by construction and operation of the pipeline on the discipline related receptors. The spatial extent of all the separate discipline specific AoIs are then collated and the widest geographical extent of all the discipline specific AoIs forms the basis of the Project AoI.

The baseline identifies trends in such conditions, including the situation that would prevail in the absence of the Project. Baseline data determination largely comprises:

- Review of existing published sources and other available secondary information, including those held by government agencies, Non-governmental Organisations (NGOs) and research agencies;
- Site reconnaissance visits and field surveys; and
- Subsequent analysis and interpretation of data.

Baseline data is documented in a series of detailed Baseline Reports, which are presented in Annex II of this ESIA. Summaries of the Baseline Reports have been included in this ESIA report in Section 6.

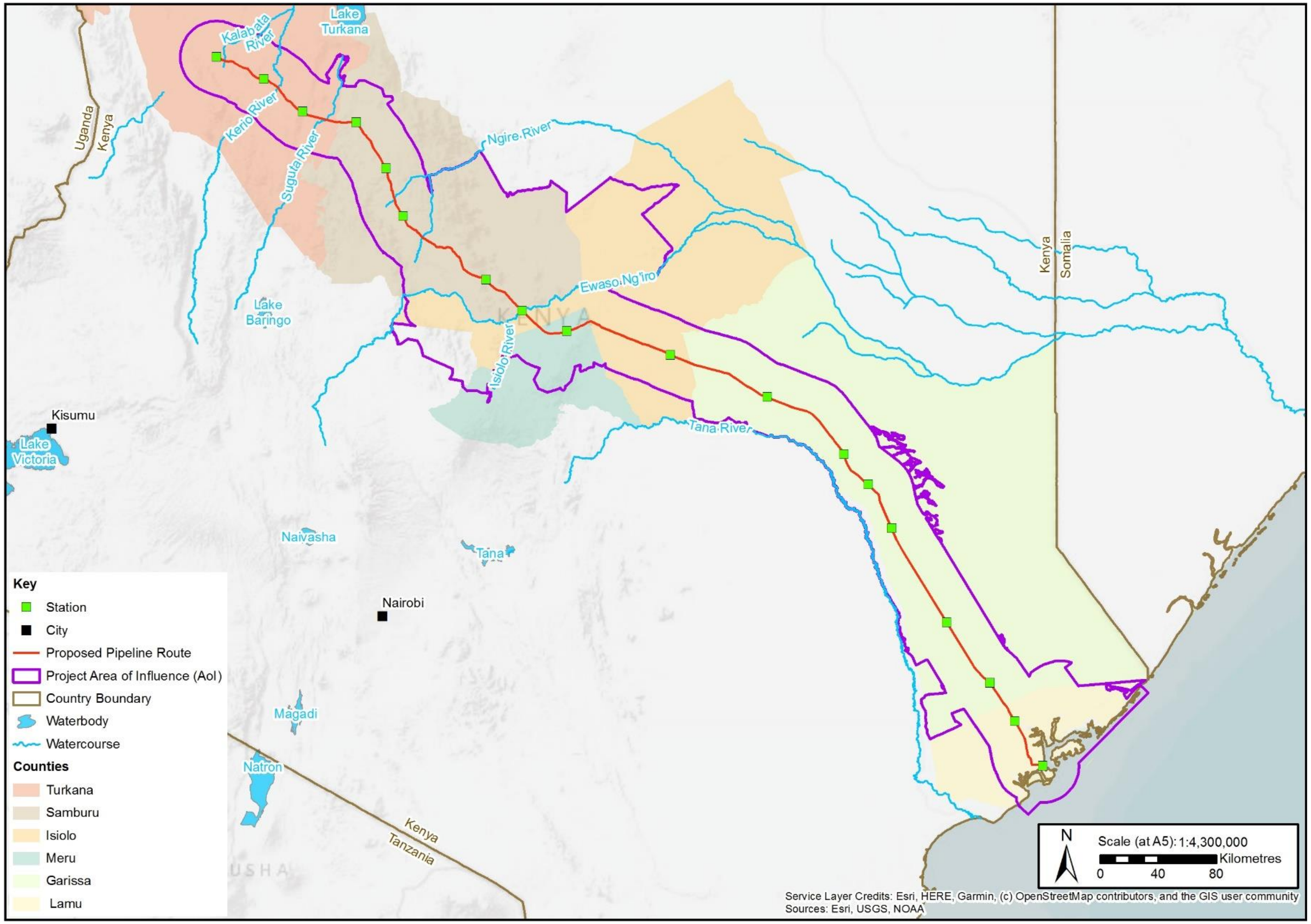


Figure 3.3-1: Project Area of Influence

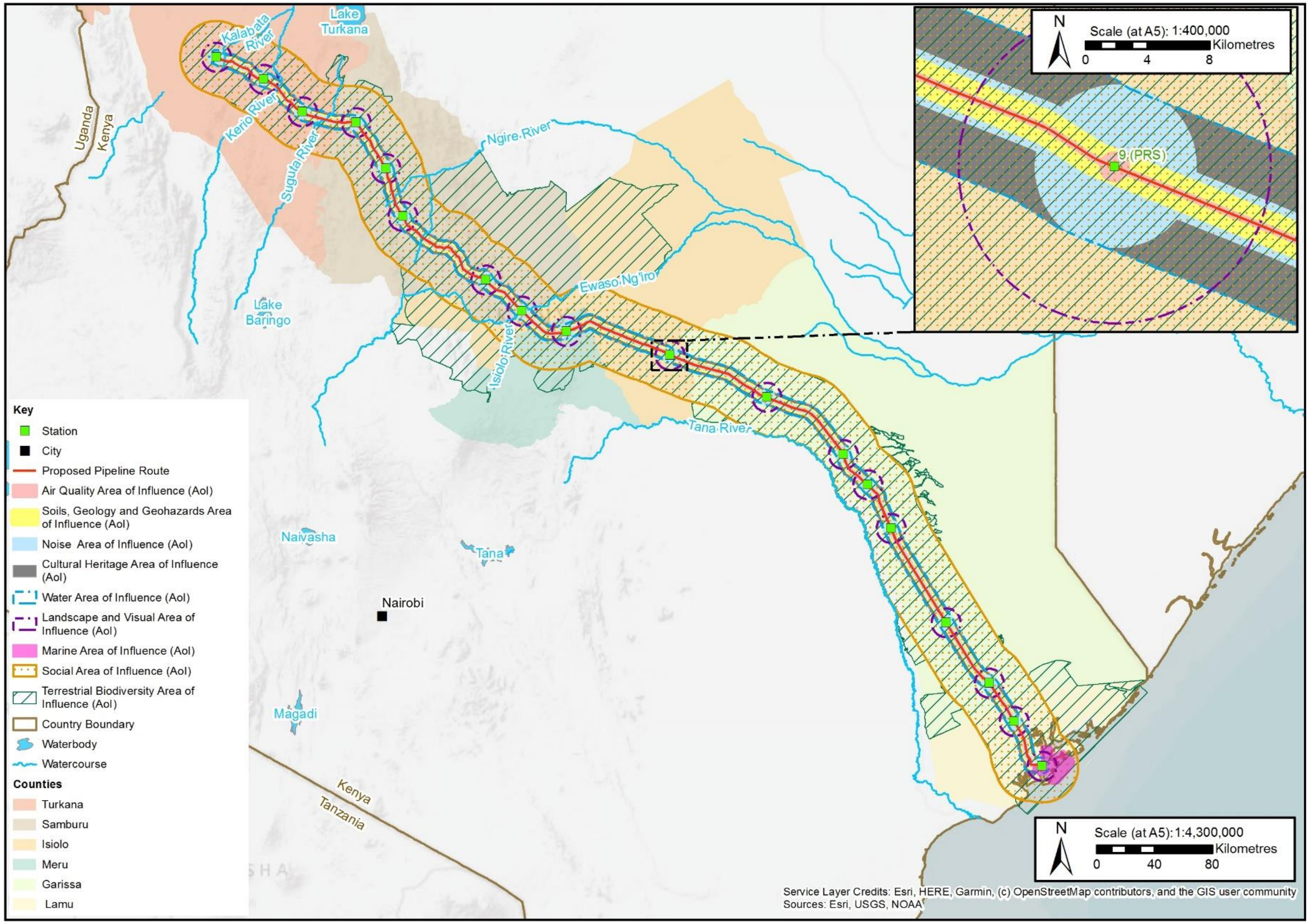


Figure 3.3-2: Combined discipline Area of Influence

3.4 Approach to Environmental and Social Impact Assessment

The impact assessment process has been based on a standard methodology, widely used nationally and internationally.

The term 'impact' will be used to describe a change the Project may make to the receiving environment and that results in a change to a receptor/resource taking into account the nature of the impact, i.e. the duration, frequency and scale. The term 'significance' will be used to describe the result of the impact taking into account the sensitivity or importance of the receptor/resource.

The types of impact that will be considered in the ESIA include:

- Direct – an impact that arises directly from activities that form an integral part of the Project (e.g. new infrastructure) and is within the control of the project proponent;
- Indirect – an impact that arises from activities not explicitly forming part of the Project but as a knock-on effect, which may not be within the control of the project proponent; and
- Combined – the combination of multiple direct or indirect impacts of the Project on any one or a group of receptors/resources.

3.4.1 Incorporated Environmental and Social Measures

Incorporated environmental and social measures are those measures that have been incorporated into the design or general management of the Project. These may include:

- Design changes (inherent mitigation) undertaken to remove or minimise impacts that are not considered to be mitigation in terms of ESIA; and
- Good management practice/Good International Industry Practise (GIIP), operational practices or construction techniques.

The impact assessment will be undertaken assuming that the above are applied as an integral element of the Project design and described in the Project Description section of the ESIA. These measures will be set out clearly within the Environmental and Social Management Plans (ESMP). Impacts of the project without these incorporated measures will not normally be assessed as part of the project as it is considered normal practice for them to be included and to assess impacts without them would be misleading.

3.4.2 Environmental Impact Classification

The classification of environmental impacts will be determined taking into account several parameters. These will vary by technical discipline, but typically include the following:

- Nature of the impact (what is affected and how);
- Magnitude of the impact (size, scale and intensity);
- Geographic extent of the impact and its distribution; and
- Duration of impact, frequency and reversibility.

This classification will be used for physical, biological, cultural heritage and Ecosystem Services type impacts.

3.4.3 Social Impact Classification

The evaluation of social impacts will differ from the evaluation of environmental impacts. Most social impacts will not be evaluated in the same qualitative way that can be applied to physical and biological impacts and determining the nature and magnitude of the impact will differ. Evaluation of social impacts will rely on development of a narrative that describes the relative importance of social impacts and will bring together the evaluation of the following four criteria to reach a conclusion for the overall social impact:

- Nature of the Impact:
  - Positive – impact provides a net benefit to the affected person(s); and
  - Negative – impact results in a net loss to the affected persons(s);
- Magnitude:
  - Negligible – no noticeable change anticipated;
  - Low – predicted to make a change, but not to impact the quality of life of the affected person(s);
  - Medium – predicted to impact the quality of life of the affected person(s); and
  - High – predicted to significantly impact quality of life;
- Geographic extent of impact; and
- Duration of impact, frequency and reversibility.

As can be seen from the list above, geographical extent and duration, frequency and reversibility are common across both environmental and social type receptors, although there are exceptions and qualifications. Each impact will be considered in relation to other impact topics and sub-topics (for the assessment of some social impacts, results of other discipline specific impact assessments must be considered – e.g. water resources). These are all qualified when assessing social impacts in social impact assessment – i.e. for magnitude, even a small increase in for example violent crime or traffic accidents is unacceptable. With respect to reversibility, many changes cannot be reversed (i.e. influx) but the effects can be managed over time.

3.4.3.1 Health Impact Classification

SHAPE Consulting Limited (SHAPE) has carried out the community health impact assessment following a thematic health area methodology based on the International Finance Corporation (IFC) Performance Standard (PS) of environmental and social sustainability. This methodology requires that the baseline health status of the Area of Influence (AoI) communities be effectively described, to better understand their specific vulnerabilities in relation to the project as well as serving as a departure point against which future comparisons in health status can be made.

Based on a World Bank analysis, the IFC methodology uses 12 Environmental Health Areas (EHAs) to support the systematic analysis of health considerations. This reductionist approach provides a linkage between project-related activities and potential positive or negative community-level impacts and incorporates a variety of biomedical and key social determinants of health.

In this systematic approach to the analysis of potential impacts, cross-cutting environmental and social conditions that contain significant health components or determinants in each EHA are identified and evaluated against specific Project activities to determine the likelihood, consequence and spatial distribution of potential health effects. This provides a holistic approach to evaluating community health impacts instead of an impact assessment focusing solely on disease-specific considerations. While every EHA may not be relevant to a given project, it is still important to systematically analyse the potential for project-related impacts (positive, negative or neutral) across the various EHAs. The 12 EHAs as well as a brief description of each are reflected in Table 7.10-1.

3.4.4 Evaluating Significance

The next step in the assessment is to take the information on the magnitude of impacts and explain what this means in terms of its importance to society and the environment, so that decision makers and stakeholders understand how much emphasis should be given to the particular issue in determining their view of the Project. This step is referred to as the 'evaluation of significance'. There is no agreed definition of significance (in the context of ESIA); however, for the purposes of the Lokichar Basin Development Upstream and Midstream ESIAs, the following practical definition is used:

> *An impact is significant if, in isolation or in combination with other impacts, it should, in the judgement of the ESIA team, be reported in the ESIA so that it can be taken into account by others in making decisions on the Project.*

This recognises that evaluation requires an exercise of judgement and that judgements may vary between parties involved in the process. The evaluation of impacts presented in the ESIA Report is based on the judgement of the ESIA Team, informed by reference to legal standards, Kenyan and regional government policy, lenders' requirements, current international good practice and the views of stakeholders.

In order to maximise the transparency of the ESIA, criteria for assessing the significance of impacts are defined for each issue and type of impact. Typically, these criteria take into account whether the Project will:

- Cause legal or accepted environmental standards to be exceeded, e.g. air, water or soil quality, noise levels, or make a substantial contribution to the likelihood of exceedance;
- Adversely affect protected areas or features, or valuable resources, e.g. nature conservation areas, rare or protected species, protected landscapes, historic features, high quality agricultural land, important sources of water supply, other key ecosystem services; and
- Conflict with established Kenyan government policy, e.g. to reduce CO_2 emissions, recycle waste, protect human health.

Figure 3.4-1 provides an example of categories of importance and/or sensitivity, the magnitude of the impact and the impact classification.

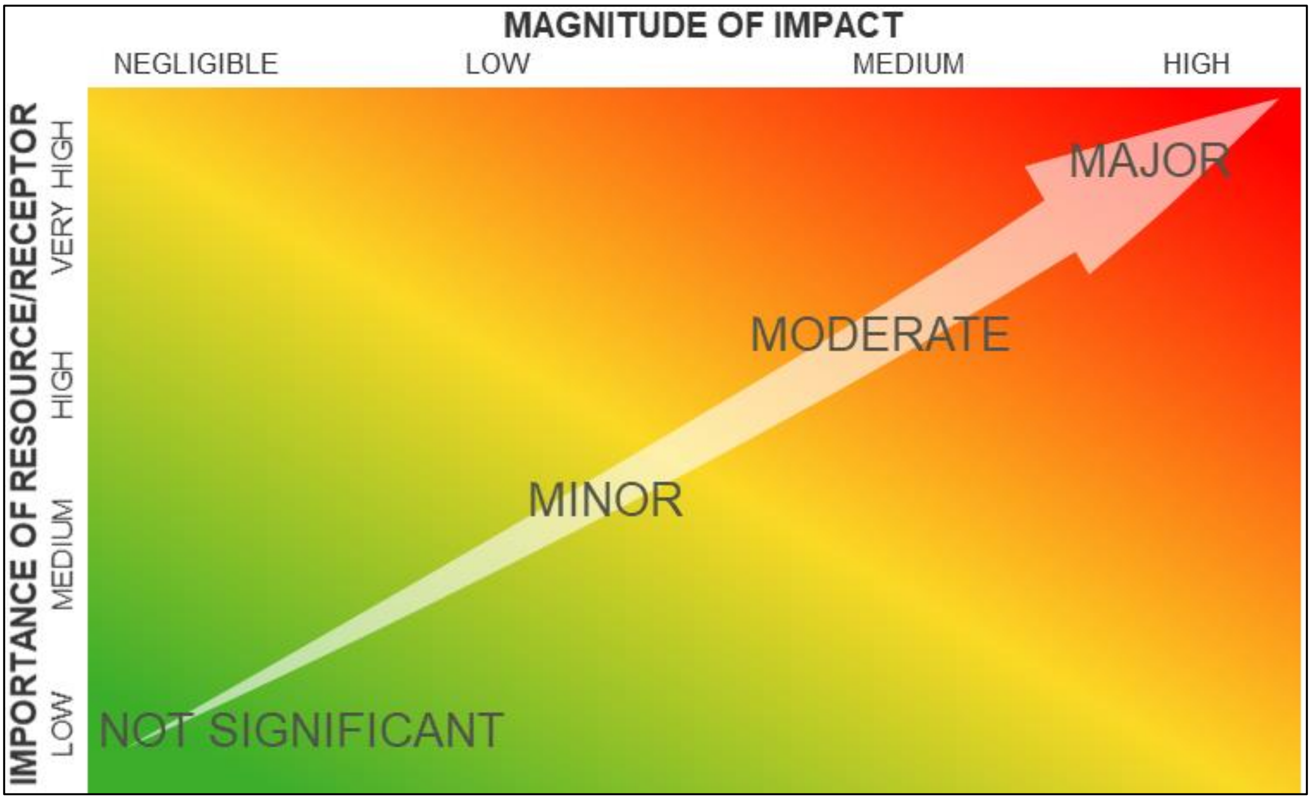


Figure 3.4-1: Figure summarising impact classification

3.4.5 Receptor/Resource Importance and Sensitivity

The term ‘receptors/resources’ will be used to describe features of the environment that are subject to the potential impacts of the project. The importance of a receptor/resource will be determined by a range of criteria depending on the topic under consideration, including: the economic, social and cultural value of the receptor /resource at local, national and international scales; any local, national or international designations; the rarity and sensitivity of the receiving environment; and the benefits or services provided. Receptor/resource sensitivity will be determined by the consideration of a receptors’/resources ability to resist or adapt to changes and its resilience to change. The category of the importance or sensitivity of a receptor/resource will be determined based on the professional judgement of technical topic leads; such judgement will need to be rigorously defended if necessary.

Figure 3.4-2 presents the matrix to be used to determine impact significance by combining the impact classification with receptor/resource sensitivity, where relevant (primarily for ecological and social receptors). The example given is for ecological receptors and biodiversity.

		MAGNITUDE OF IMPACT			
		NEGLIGIBLE	LOW	MEDIUM	HIGH
		Isolated impacts over a small area or to a few individuals	Minor impacts of a limited extent that are easy to recover through natural regeneration and/or reduction of a specific group of localised individuals in a population over a short time period	Area/region not adversely affected in the long-term & capable of natural regeneration and/or reduction in the distribution over one or more generations.	Adversely affect an area/region and/or substantial reduction in population that does not recover for several generations
IMPORTANCE OF RESOURCE/RECEPTOR — VERY HIGH	An attribute of high quality or one that is that is nationally or internationally rare.	Minor	Moderate	Major	Major
IMPORTANCE OF RESOURCE/RECEPTOR — HIGH	An attribute of medium quality or one that is regionally or nationally rare.	Negligible	Minor	Moderate	Major
IMPORTANCE OF RESOURCE/RECEPTOR — MEDIUM	An attribute of medium quality or one that that is regionally common.	Negligible	Minor	Minor	Moderate
IMPORTANCE OF RESOURCE/RECEPTOR — LOW	An attribute of low quality or one that is locally common.	Negligible	Negligible	Minor	Minor

Figure 3.4-2: Determination of impact significance for ecological receptors by receptor sensitivity & impact magnitude

A summary of the descriptions for the different significance classifications may be defined as:

- *Major*: If adverse, impacts with this significance represent key factors in the decision-making process. They are generally, but not exclusively, associated with human health or features of international or national importance and/or resources/features that are unique, which, if lost, cannot be replaced or relocated;
- *Moderate*: If adverse, impacts with this significance may contribute to the decision-making process. These effects are generally, but not exclusively, expected to be important at a regional or local scale;
- *Minor*: These effects may be raised as local issues but are unlikely to be of importance in the decision-making process. Nevertheless, they are of relevance in the detailed design of the project; and
- *Negligible*: Effects that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Probability is not considered in the impacts' analysis for most technical disciplines. An analysis of hazards associated with unplanned events will be reported in a section covering Emergency, Accidental and Non-Routine Events (Section 7.14) and will feed into Emergency Preparedness and Response Plans.

3.4.6 Mitigation

Should the results of the impact analysis show adverse impacts (e.g. material exceedance of the Project Standards or baseline conditions; negative effects outweighing positive effects), mitigation will be identified according to the mitigation hierarchy:

- Avoid - make changes to the Project's design or location to avoid adverse effects;
- Minimise - reduce adverse effects through sensitive environmental treatments/design;
- Restore - measures taken during or after construction to repair/reinstate and return a site to the situation prior to unacceptable long-term impacts;
- Defined mitigation, which may include:
  - Compensate - where avoidance or reduction measures are not available, it may be appropriate to provide compensatory measures. Compensatory measures do not eliminate the original adverse effect; they merely seek to replace it with a comparable positive one;
  - Offsetting - where demonstrating that biodiversity offsetting will be an effective mechanism to compensate for habitat loss or degradation due to unavoidable impacts; and
  - Improvement measures - projects can have positive effects as well as negative ones and the Project preparation stage presents an opportunity to enhance these positive features through innovative design.

Mitigation will be included for all impacts that are classified as moderate or high/major. These mitigations may also be effective in reducing low/minor impacts, however low/minor impacts will not be the same level of focus of specific or targeted mitigations.

3.4.7 Residual Impacts

Residual impacts are those that remain following the implementation of the proposed mitigation. These will be identified for each of the specialist topics by reviewing the predicted impacts against the mitigation measure proposed and then identifying any residual impacts. Residual impacts will be defined based on the same process applied to the evaluation of impacts.

3.4.8 Cumulative Impact Assessment

Cumulative impacts are defined as impacts that result from the incremental impact, on areas or resources used or directly impacted by the Project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted. Cumulative impacts will be assessed as part of an analysis of the Project and will be prepared as a separate section alongside the technical sections.

The assessment of cumulative impacts will consider the effects of other developments in the vicinity of the Project that are operating, under construction or have been consented, which, when combined with the effects of the Project, may have an incremental effect.

3.5 Project Description and Interaction with Design – the FEED Interface

The ESIA team, which comprises Golder, Environnementalistes Sans Frontiers (ESF) Consultants and other contractors, have worked with the Front-End Engineering Design (FEED) engineers to ensure that the engineering design can consider environmental and social constraints ahead of their evaluation in the ESIA. The interaction has comprised a number of workshops, constraints analyses spending significant time working with the FEED engineers to ensure key constraints are evaluated and appropriately incorporated into design and/or mitigations.

These interactions have made for an effective iterative process of design and assessment that enable impacts to be avoided through design, avoiding abortive design work and reducing the need for mitigation proposals in the ESIA.

3.6 Stakeholder Engagement

Stakeholder engagement supports the development of strong, constructive and responsive relationships that are critical for the effective management of a project's environmental and social impacts and successful project implementation. The objective of stakeholder engagement is to ensure that legislative requirements are met; sources of information and expertise are identified; stakeholder concerns and expectations are registered and addressed and affected communities have the opportunity to discuss project risks and impacts, and proposed mitigation and monitoring measures.

The Stakeholder Engagement Plan (SEP) and consultation materials are presented in Annex III. The SEP presents the grievance mechanism approach. However, the following subsections present a summary of stakeholder engagement to date relating to LLCOP.

In the context of the LLCOP, the stakeholders identified at scoping consultation could be grouped as follows:

- Project-affected stakeholders, including individual stakeholders as well as groups that may be at risk (elderly, women, the youth, people with disabilities, ethnic minorities);
- Adjacent Communities (including vulnerable groups);
- Civil society;
- County Government & Members of County Assemblies (MCAs);
- National government; (Including Relevant Ministries), Biodiversity and Conservation institutions (e.g. Kenya Forest Service; Kenya Wildlife Service; Ministry of Fisheries Development, Fisheries Department; National Museums of Kenya);
- Regional development Institutions (e.g. Ewaso Ng'iro Basin Development Authority, TARDA);
- NGOs at National, regional and local levels, including organised CBOs or interest groups (labour, youth, education, religious, business and so forth);
- Political leaders (Members of Parliament and County Assembly members);
- Traditional leaders;
- Development Authorities;
- International NGOs;
- Media; and
- Scientific community.

3.7 Environmental and Social Monitoring & Management Plans

An Environmental and Social Management System (ESMS) framework and series of Management Plans will be developed to guide the implementation of mitigation measures and project commitments presented in the ESIA.

4.0 PROJECT DESCRIPTION AND ANALYSIS OF ALTERNATIVES

4.1 Project Description

4.1.1 Introduction

The Lokichar to Lamu Crude Oil Pipeline (LLCOP) Project (the Project) comprises the design, construction and operation of an 824 km buried crude oil pipeline and ancillary infrastructure. The pipeline will be insulated to maintain temperature and flow characteristics. The LLCOP project is designed to provide transportation, storage, support and export facilities for the waxy crude oil, from the oil fields and associated Central Processing Facility (CPF) at Lokichar, to the Lamu Marine Terminal (LMT) and Load Out Facility (LOF), located within the existing Lamu Port.

Figure 4.1-1: LLCOP Route

The upstream boundary for the LLCOP project is the Lokichar Export Facility, which is located in the Central Processing Facility in Lokichar, Turkana County. The Central Processing Facility is part of the Upstream oil production project for the initial Foundation Project, which is being developed by Tullow Oil Kenya BV on behalf of the Kenya Joint Venture (comprising Tullow Oil, Africa Oil and Total) under the terms of the Production Sharing Contracts for Blocks 10BA, 10BB and 13T. As the Upstream project is being developed by a different set of shareholders and will be implemented by a different commercial organisation to the LLCOP project, a separate ESIA is being prepared for the Upstream oil production project.

As illustrated in Figure 4.1-2, all facilities downstream of the LLCOP Pump Station 1 (PS1) pumps, will be within the scope of the LLCOP project and are addressed by this ESIA.

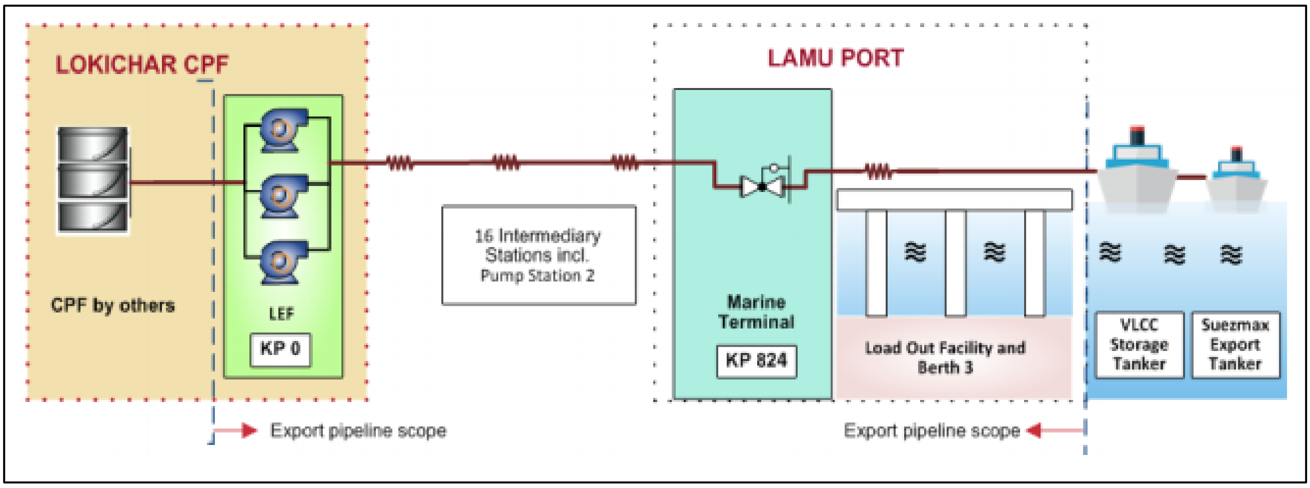


Figure 4.1-2: LLCOP Project Scope[1]

The pipeline will be buried throughout its length but will have a number of above-ground installations (Stations) at locations determined by the design requirements of the Project. The pipeline and ancillary infrastructure will be located for its entire length within the LAPSSET Corridor.

The LAPSSET Corridor is a linear multi-spoke land corridor selected by the Government of Kenya for strategic infrastructure development as part of the Vision 2030 process and is a major initiative for Kenya and the East African region. Land required for the LAPSSET Corridor will be acquired by the Government of Kenya (National Lands Commission, supported by Ministry of Lands and Physical Planning) by compulsory acquisition under the terms of the Land Act (2012) and transferred to the LAPSSET Corridor Development Authority (LCDA) who will then lease out the land required for the pipeline corridor to the Project and similarly for other LAPSSET projects.

The proposed pipeline will require a 26 m working width or 'Right of Way' (RoW) for construction and a permanent 6 m easement width (to provide right of access) for operations during the life of the Project, in addition to other land required for temporary construction facilities and a number of permanent pumping and other Stations along the length of the pipeline (all located within the LAPSSET Corridor).

The base case for the export facilities at Lamu will include the Lamu Marine Terminal (LMT) within the existing Lamu Port and a Very Large Crude Carrier (VLCC) that will act as a floating storage and offloading (FSO) vessel permanently moored at Berth 3 of Lamu Port. Tankers will berth alongside the VLCC and crude oil will be offloaded into third-party tankers for export by the purchasers of the crude oil. At the point of sale (transfer of the crude oil into the export tanker), responsibility for the crude oil will be transferred to the new owner.

4.1.1.1 Project Overview

The LLCOP Project comprises the following elements:

- A pipeline corridor (26 m wide Right of Way (RoW) for construction and a 6 m wide permanent easement for operations) which is wholly contained within the LAPSSET Corridor;
- Installation of an 18" steel pipeline (824 km) coated with an external anti-corrosion coating of fusion bonded epoxy (FBE), an insulating layer of polyurethane foam (PUF), and an outer protective jacket of high density polyethylene (HDPE) (giving an overall diameter of approx. 24"), buried to a depth of cover of 0.9 m along

[1] Central Processing Facility (CPF), Lokichar Export Facility (LEF), Kilometre Point (KP), Very Large Crude Carrier (VLCC)

the majority of its length; this may be reduced in rocky areas to a minimum of 0.6 m and increased in areas with high potential for soil erosion.

- Construction of a number of above-ground Stations to support pipeline operations. All these are located wholly within the LAPSSET Corridor and entail:
  - Pump Station (PS1) also referred to as Lokichar Export Facility (LEF) and located within the Central Facilities Area (CFA) for the Upstream oil production project;
  - 16 intermediate Stations, including:
    - Booster Pump Station at Station 4 (PS2) in Samburu County;
    - Pressure Reduction Station (PRS) at Station 9 (PRS) and the Lamu Marine Terminal (LMT); and
    - Various other Stations serving multiple co-located functions (power generation, block valve, launcher/receiver Stations).
- Construction and operation of the Lamu Marine Terminal, located within the existing Lamu Port area;
- Installation and use of a permanently moored tanker (1.45 MM barrel storage capacity) acting as an FSO Vessel and supporting facilities;
- Temporary import facilities, laydown areas, construction camps, offices, and additional facilities to support construction activities. Laydown areas and camps will be located within the LAPSSET corridor where feasible; and
- Following completion of construction, the 26 m RoW will be handed back to LAPSSET and can revert back to its prior usage during operations. However, no trees, deep rooted crops or permanent structures will be permitted within the 6 m easement (centred on the pipeline) for safety purposes.

All of the above features and facilities are an integral part of the LLCOP Project and are therefore included in scope of this ESIA report.

4.1.1.2 Time Schedule – Planning and Execution

The project is anticipated to take 33-36 months to construct from the award of an Engineering, Procurement and Construction (EPC) contract. Once the decision to proceed with the Project has been taken and an EPC contract awarded, it will take approximately 12 months before lengths of pipe start to arrive in Kenya. Figure 4.1-3 indicates the anticipated project schedule.

The average rate of pipeline laying is estimated around 1 km per day, with slower progress in more challenging areas, such as mountainous areas and river, lugga and road crossings. The construction schedule will also take account of weather constraints, particularly during the peak rainy season. The construction process seeks to minimise the amount of time that an open trench is present in any one area, minimising disruption to local communities and wildlife.

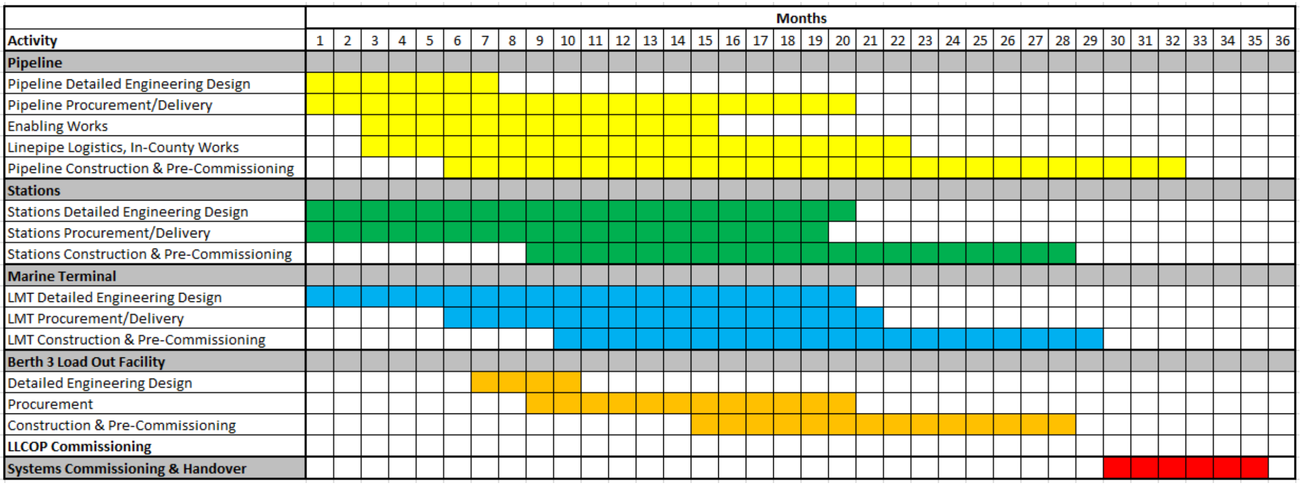


Figure 4.1-3: Summary of LLCOP Project Schedule

4.1.2 Pipeline Route

The pipeline corridor will pass through six counties (Turkana, Samburu, Isiolo, Meru, Garissa and Lamu). Figure 4.1-1 illustrates the proposed pipeline route and the Counties impacted by the Project.

From the LEF in Turkana, the pipeline route extends for a distance of 824 km to the southeast, routed through Samburu, Isiolo, Meru and Garissa County to the LMT located in Lamu County. It should be noted that whilst the current pipeline length is 824 km based on the FEED Engineering, there may be some very minor changes to the length as the Project progresses through detailed design and construction, due to potential minor realignments at crossings or micro re-routing to avoid cultural heritage sites such as sacred trees. Any changes made to the overall length are not anticipated to be significant.

Table 4.1-1: Pipeline Route - Distances and Elevations per County

County	Location (KP)	Minimum Elevation (mAOD)	Maximum Elevation (mAOD)
Turkana	0 – 99	293	739
Samburu	99 – 303	663	1383
Isiolo and Meru	303 – 433	493	1055
Garissa	433 – 769	36	494
Lamu	769 – 824	5	45

KP – Kilometre Point
mAOD -Meters Above Ordnance Datum

4.1.2.1 Development of the Pipeline Route

The route selection process has incorporated engineering design, constructability, accessibility and logistical factors into the final route selected. The route selection process has employed data from various sources, including up-to-date high-resolution satellite imagery, digital elevation models and other open source information such as data on soils, geohazards and environmentally protected zones. The route selection process was undertaken using a range of criteria as outlined below:

- Make use of the existing LAPSSET corridor as far as possible;
- The route will avoid:

  - International Union for Conservation of Nature (IUCN) Category II reserves (which includes nationally designated protected areas);
  - Large sections of slope over 45 degrees;
  - Areas of excessive elevation; and
  - Populated urban areas.
- The route is refined to take account of:
  - Terrain (slopes, floodplain, salt pans etc.);
  - Geohazards (regional faults, volcanoes, geothermal activity etc.);
  - Hydrology (river crossings, lugga crossings);
  - Land use/cover (bare ground, vegetation, agriculture etc); and
  - Additional environmental and social baseline constraints.
- Identify hot spots and refine the route post site visits to account for the improved data regarding the areas of interest.

Further details on the development of the pipeline route are discussed in the *Analysis of Alternatives* (Section 4.2).

As far as possible, the selected route option avoids settlements and sensitive areas of biodiversity and community cultural heritage and livelihoods importance. The route avoids agricultural land and areas of high flood risk identified during routing exercises. The pipeline route crosses three permanent rivers and traverses the floor of the Rift Valley. Further major crossings include seasonal rivers as well as existing surfaced roads.

Table 4.1-2 provides a summary of the terrain and land cover conditions along the selected pipeline route.

Table 4.1-2: Route characteristics summary

Description	Quantity
Length	824 km
Maximum elevation	1,381 m
Permanent rivers	3
Ephemeral river crossings	14
Natural vegetation cover	795.9 km
Agriculture	3.1 km
Floodplain/areas at risk of waterlogging	22.5 km
Marine	0.5 km
Urban	2 km

Detailed county by county maps are presented in Figure 4.1-4 to Figure 4.1-9.

The route profile is presented in Figure 4-1.4 and illustrates the varying relief across w hich the pipeline will traverse.

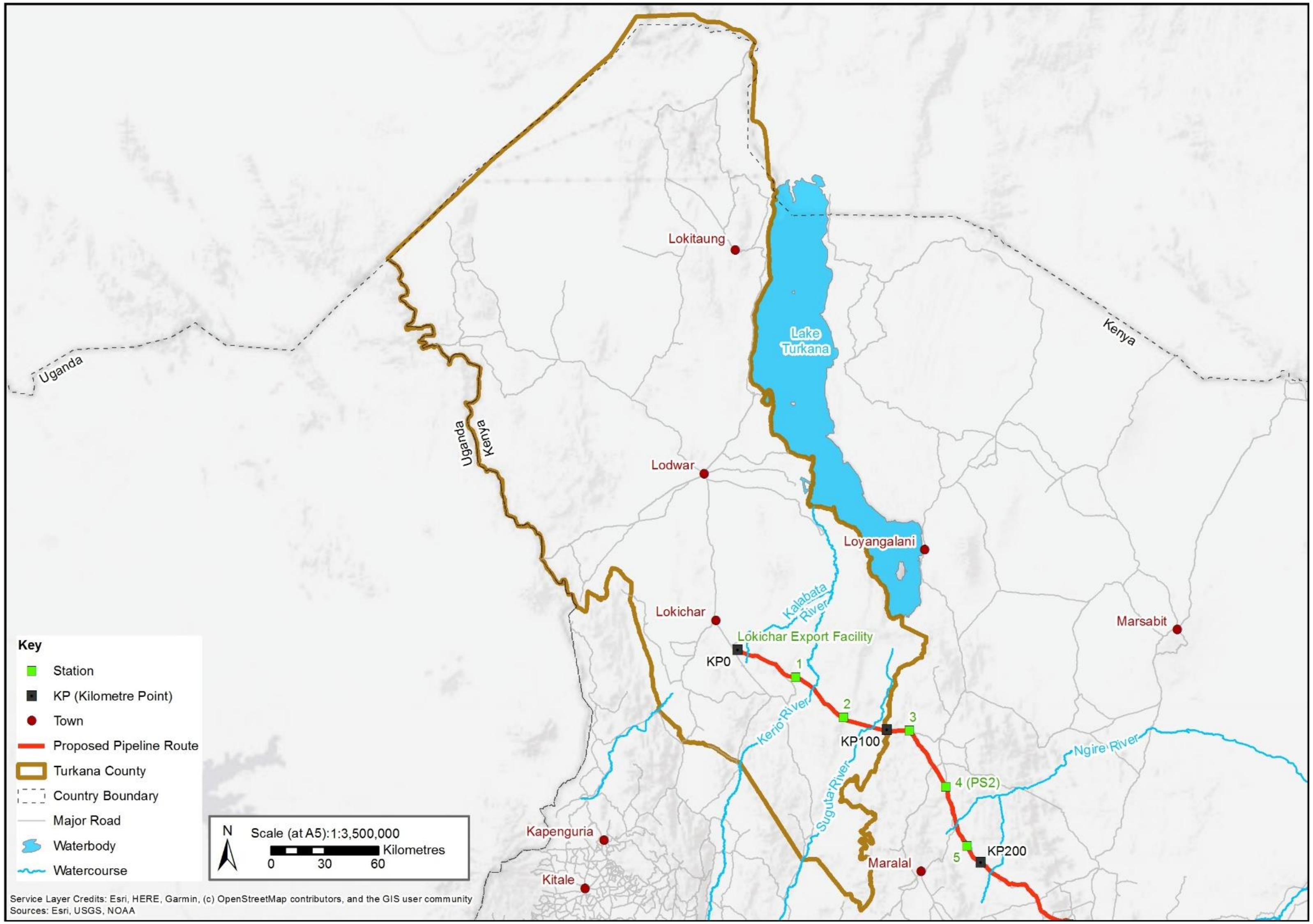


Figure 4.1-4: Pipeline County map - Turkana

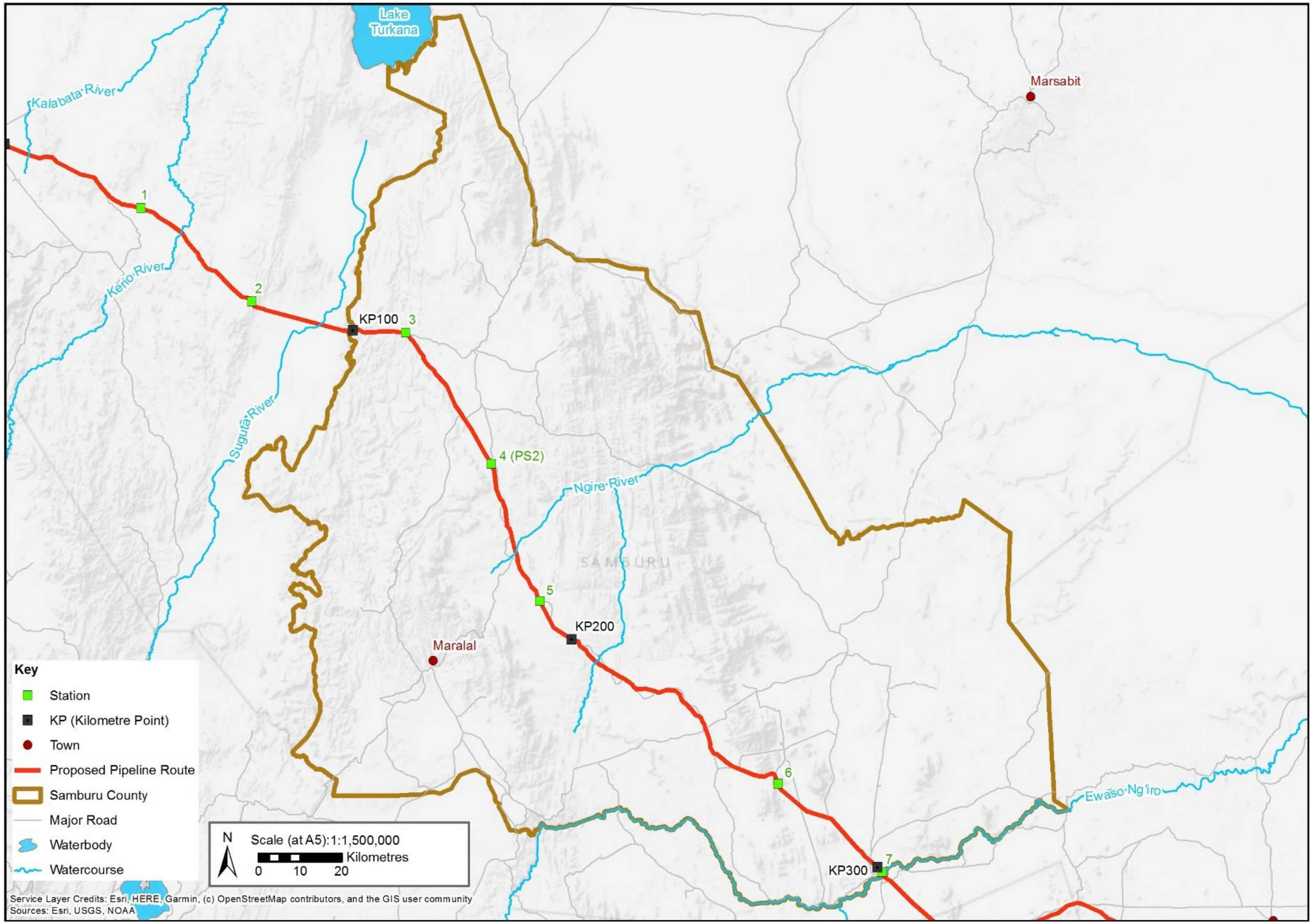


Figure 4.1-5: Pipeline County map - Samburu

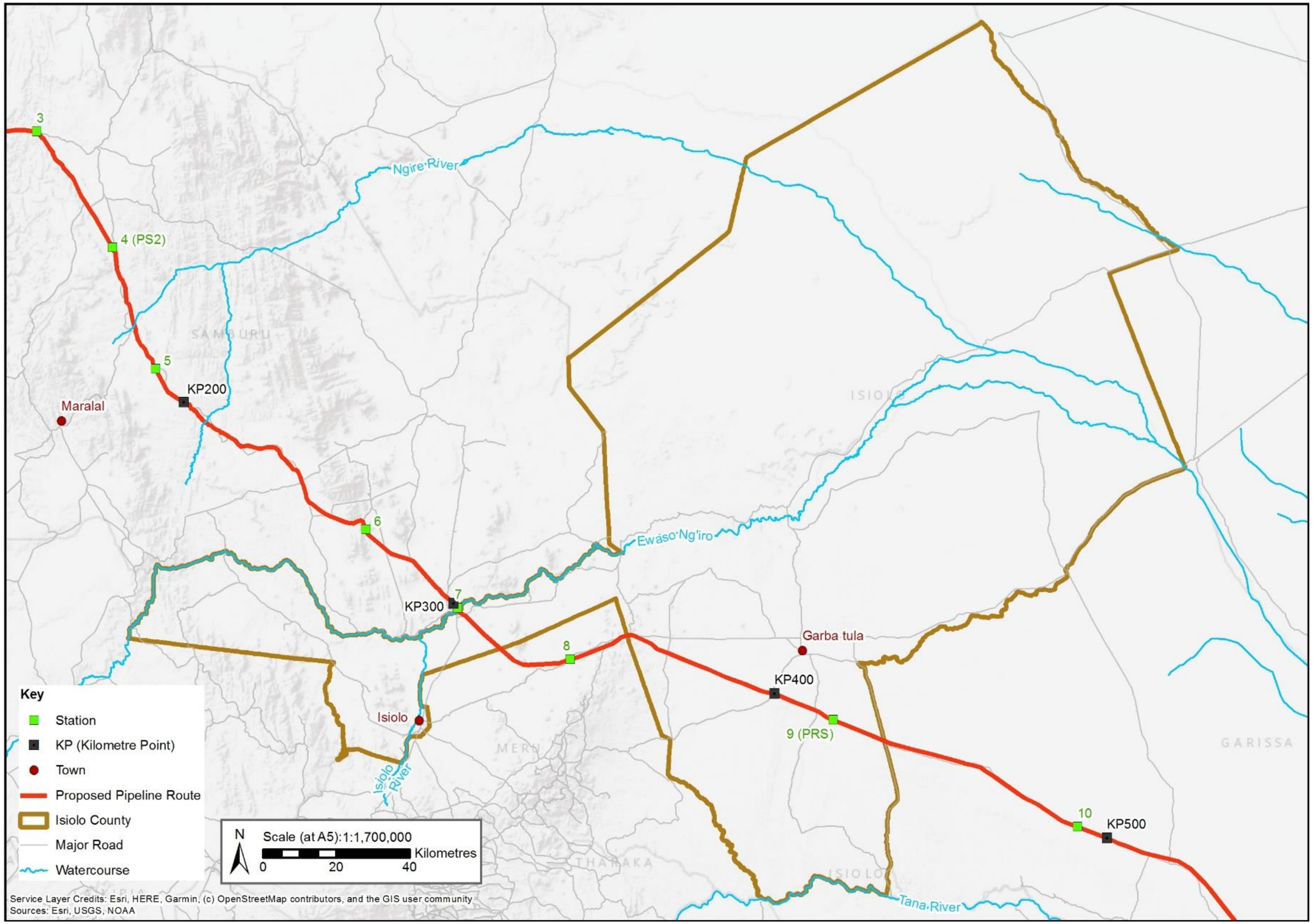


Figure 4.1-6: Pipeline County map - Isiolo

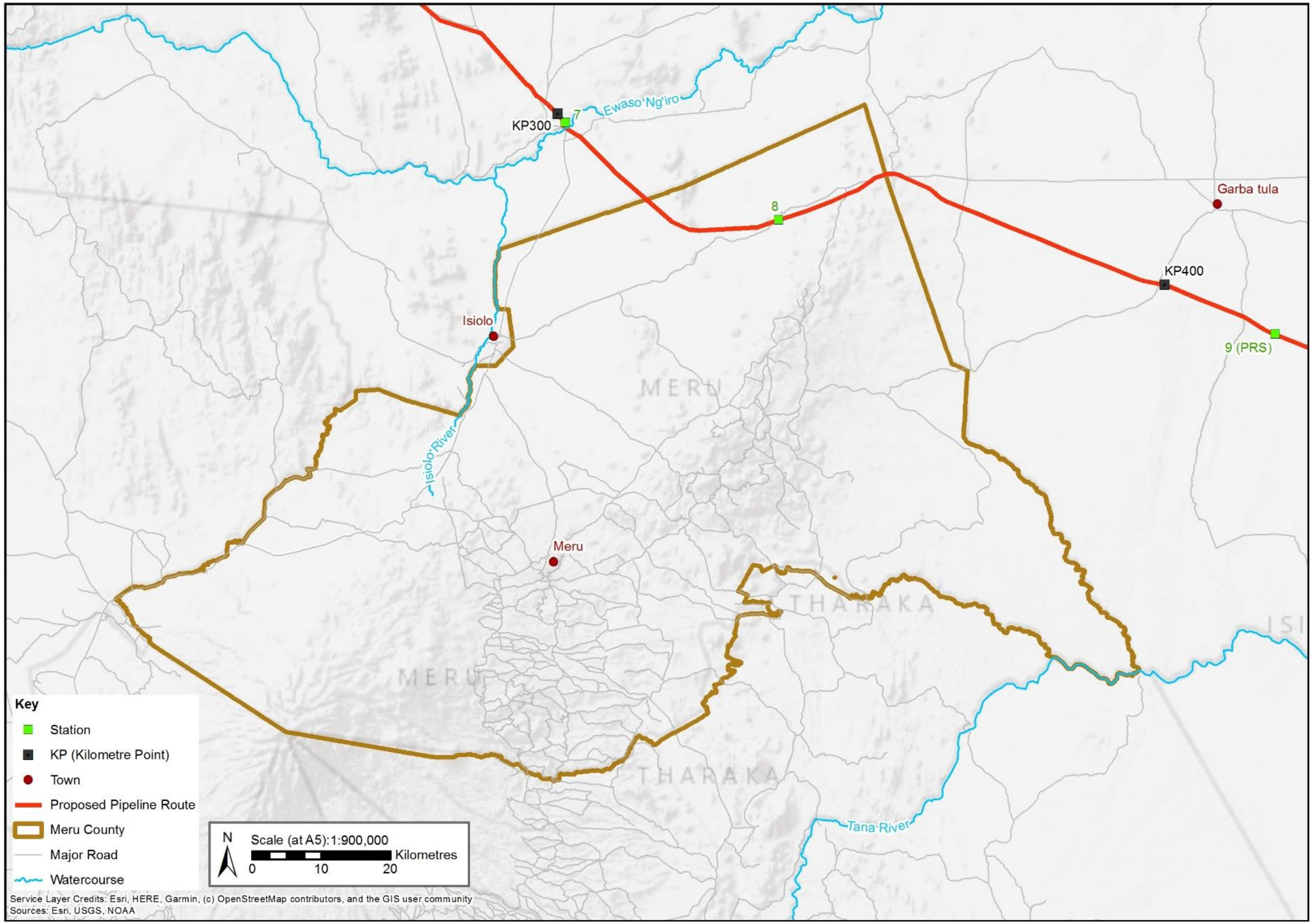


Figure 4.1-7: Pipeline County map - Meru

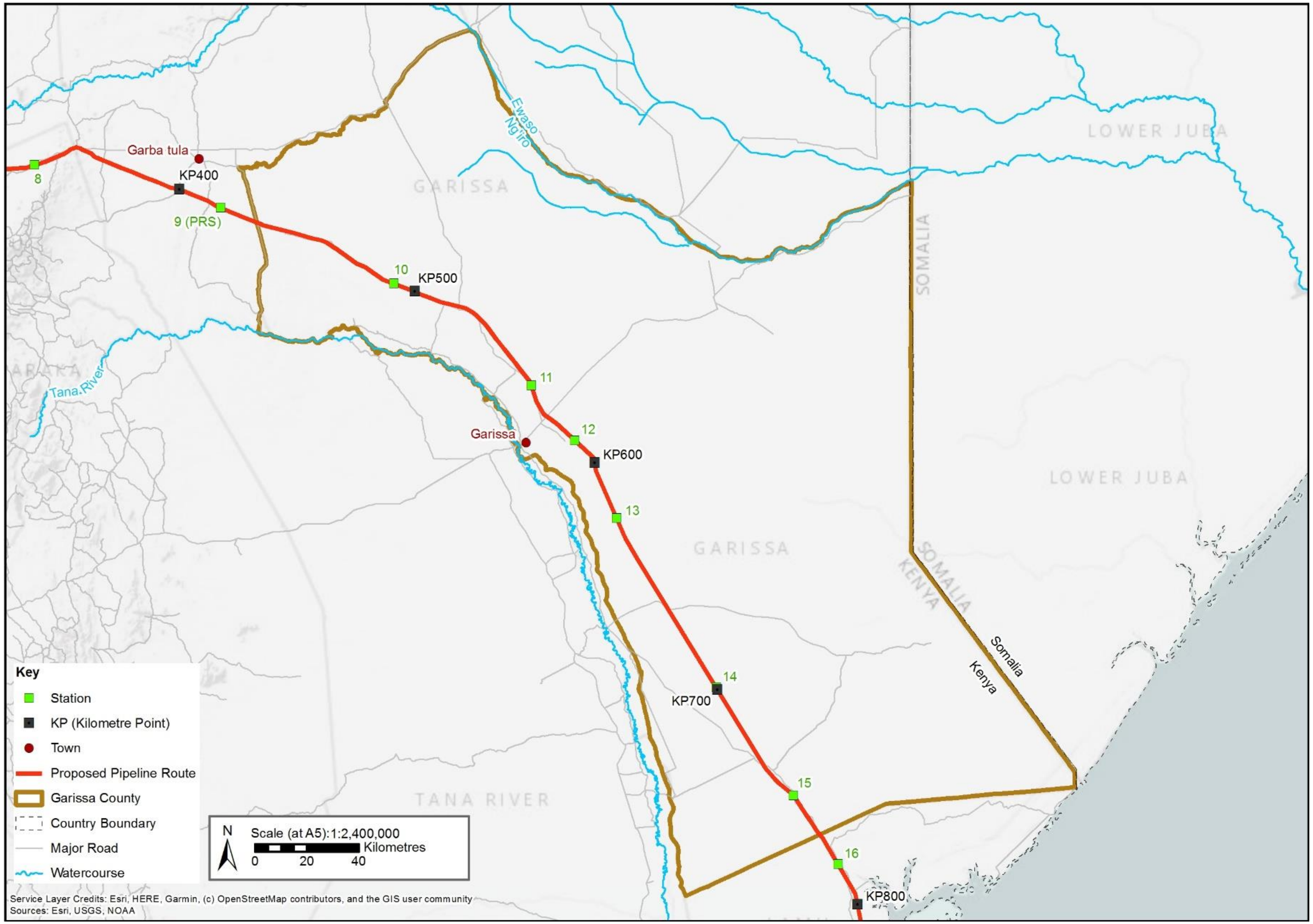


Figure 4.1-8: Pipeline County map - Garissa

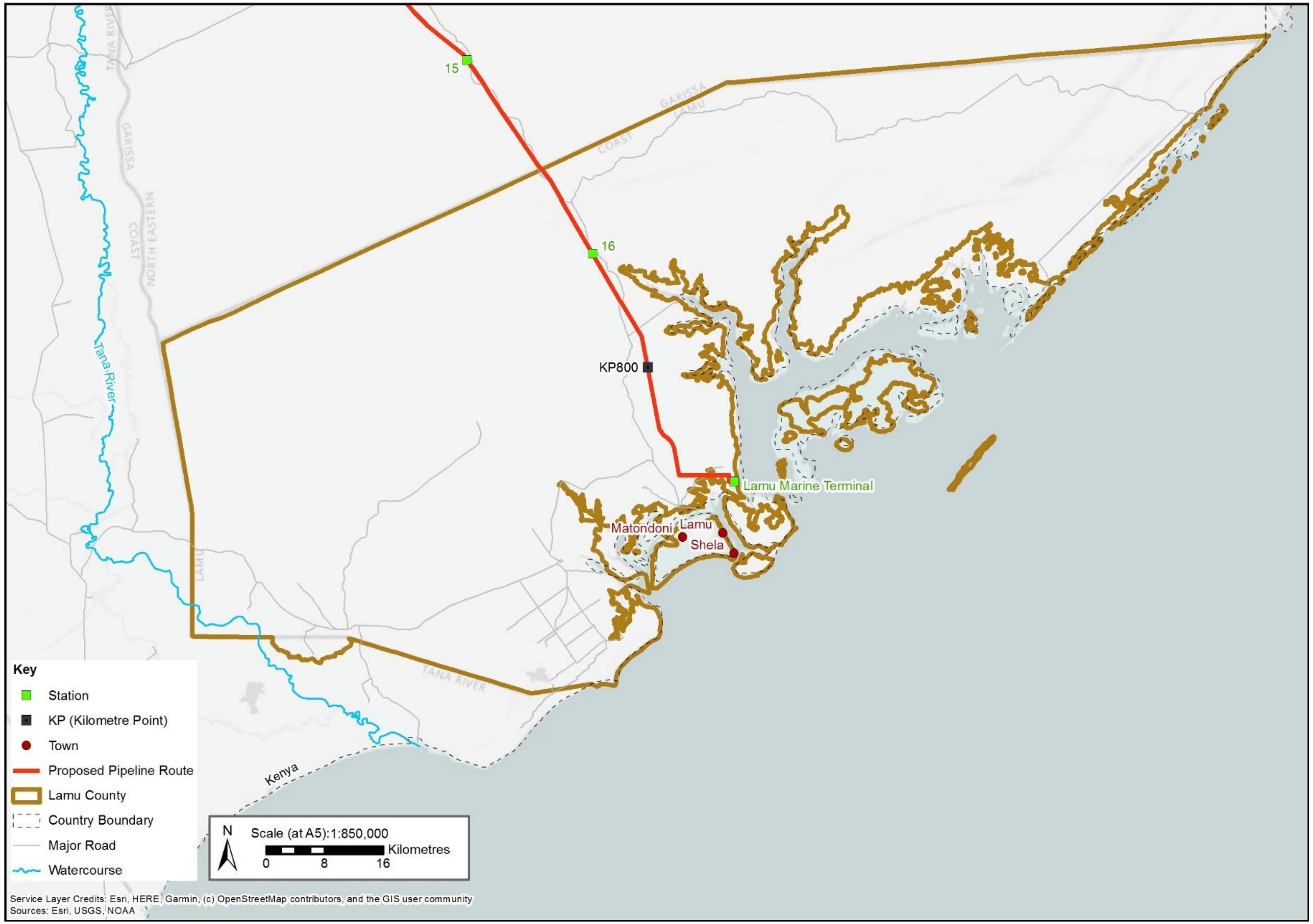


Figure 4.1-9: Pipeline County map - Lamu

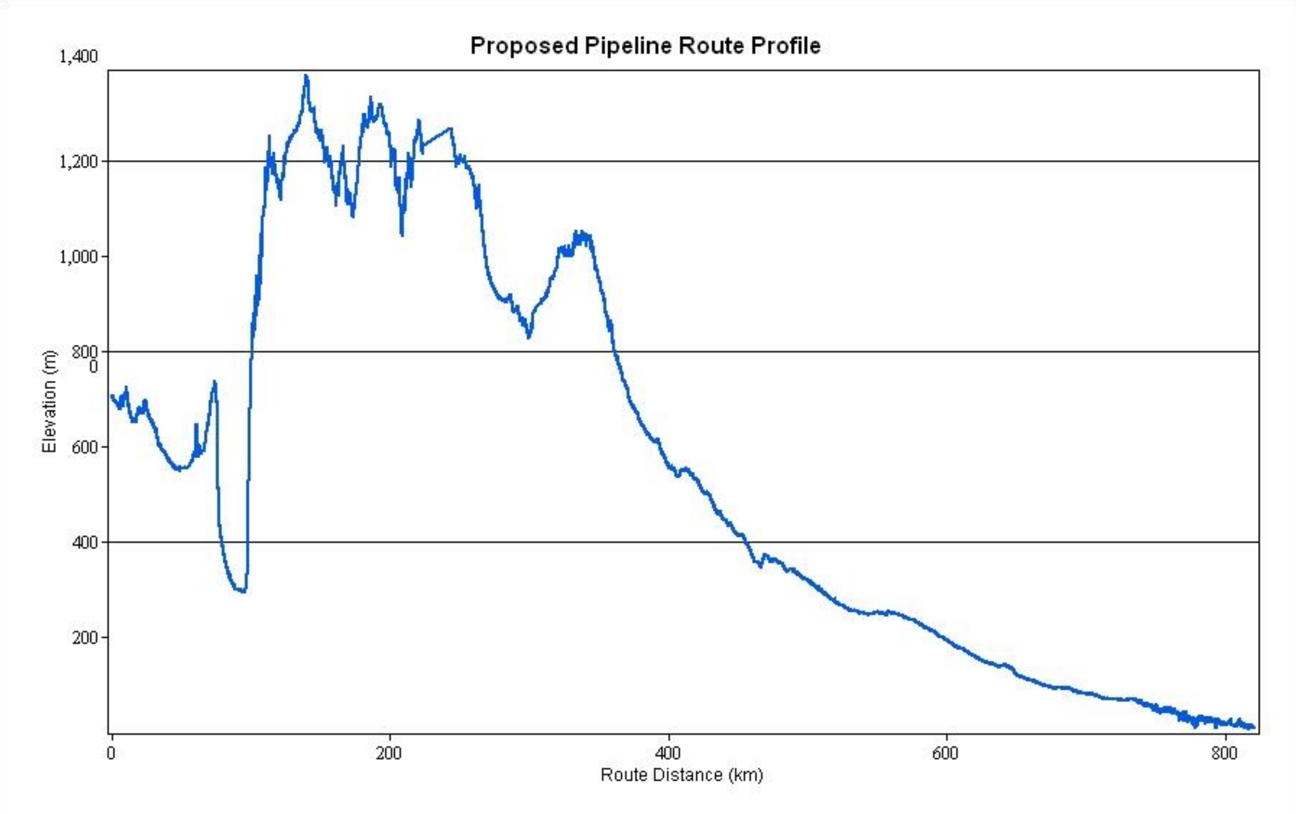


Figure 4.1-10: Route elevation profile from Lokichar to Lamu

4.1.3 Detailed Design

The key design parameters for the Project include the following:

- Designed to comply with all applicable Kenyan Laws and Regulations, and applicable international design codes and UK Health and Safety Executive (HSE) standards, as well as follow international good practice – specifically the Work Bank Group EHS Guidelines and IFC Performance Standards;
- Designed for a 25-year operational life;
- An 18” outside diameter steel pipeline, coated with an external anti-corrosion coating of fusion bonded epoxy (FBE), an insulating layer of polyurethane foam (PUF), and an outer protective jacket of high-density polyethylene (HDPE) giving an overall diameter of approx. 24”;
- Designed to operate on an annualised basis of 65 kbopd (thousand barrels of oil per day), up to a maximum of 80 kbopd;
- Maintain oil temperature at an acceptable level to maintain the oil in a liquid state for pumping (at or above 57 °C as a minimum). For this purpose, a trace heating system (Long Line Heat Trace (LLHT) system) along with appropriate thermal insulation will be installed along the entire length of the pipeline;
- Designed to be suitable for pigging using all type of inspection and cleaning pigs;
- The construction technique will be conventional open cut trenching and back-fill.
- Main rivers will be crossed using open cut construction techniques in periods of low flow. Owing to the nature of these rivers i.e. shallow and with very little flow during the dry season, engineering design indicates that an open-cut crossing method is appropriate;

- The Load Out Facility (LOF) for crude oil export will be located on Berth 3 of the Lamu Port;
- All structures will be design in accordance with appropriate Code of Practice standards in relation to earthquakes and potential seismic activity;
- The pipeline will be buried, only coming above ground for short sections within some pipeline Stations;
- Where applicable, Project facilities will be designed using closed drain systems that will collect discharge from pipework and equipment within Stations during routine operations and maintenance and direct any discharges to a dedicated storage vessel to prevent discharge to the environment;
- The Project will be designed so that all construction and operation related emissions and discharges meet project environmental standards as defined in Annex I; and
- The Project, and construction activities, will be designed and implemented in line with the environmental mitigation measures defined in this ESIA and conditions of the Environmental License as issued by NEMA.

4.1.3.1 Pipeline Design

Pipeline Materials Design

- The pipeline will be made of carbon steel (an industry standard material used worldwide for pipelines);
- No cathodic protection will be provided on the buried pipeline due to the integrity and thickness of the applied insulation coatings. However, tanks and other facilities will have cathodic protection at Station locations for non-insulated buried pipework and tanks;
- Minimum vertical separation distances to foreign services, including underground pipelines and cables (e.g. electrical power, telecoms for both LLCOP and third party) will be 500 mm;
- Running in the same trench as the pipeline for around 25% of its length will be a 33kV power supply cable to supply electrical power to the trace heating cables (the remainder of the pipeline has directly sourced power); and
- Line pipe for potential areas of flooding or river crossings will be concrete weight coated, based on a risk assessment of flooding potential.

Pipeline External Coating

Design parameters for the pipeline and pipeline external coating, as presented in Table 4.1-3, include:

- Layer of fusion bonded epoxy (FBE) as anti-corrosion layer;
- Polyurethane foam (PUF) as insulation layer. The pipeline is intended to be insulated along its entire length. A vapour barrier to prevent PUF aging will be incorporated; and
- Topcoat of High-density polyethylene (HDPE) as an outer protection jacket.

The external diameter of the steel pipe is 18”, with the total diameter including external coating resulting in an overall diameter of approximately 24”. This is illustrated in Figure 4.1-11, which also shows the location of the LLHT cable within the insulated coating.

Table 4.1-3: Pipeline Parameters

OD (inches)	Wall Thickness (mm) [a]	Anti-Corrosion Coating, FBE (mm)	Insulation Layer, PUF (mm)	Protective Topcoat, HDPE (mm)
18	Varies from: 7.9 - 12.7 mm (general) 11.1 mm - 15.9 mm (crossings)	0.35	70	3 - 4

[a] The wall thickness varies along the pipeline due to the different design pressures used to account for the significant changes in elevation along the pipeline route. This avoids excessive wall thickness and saves on cost.

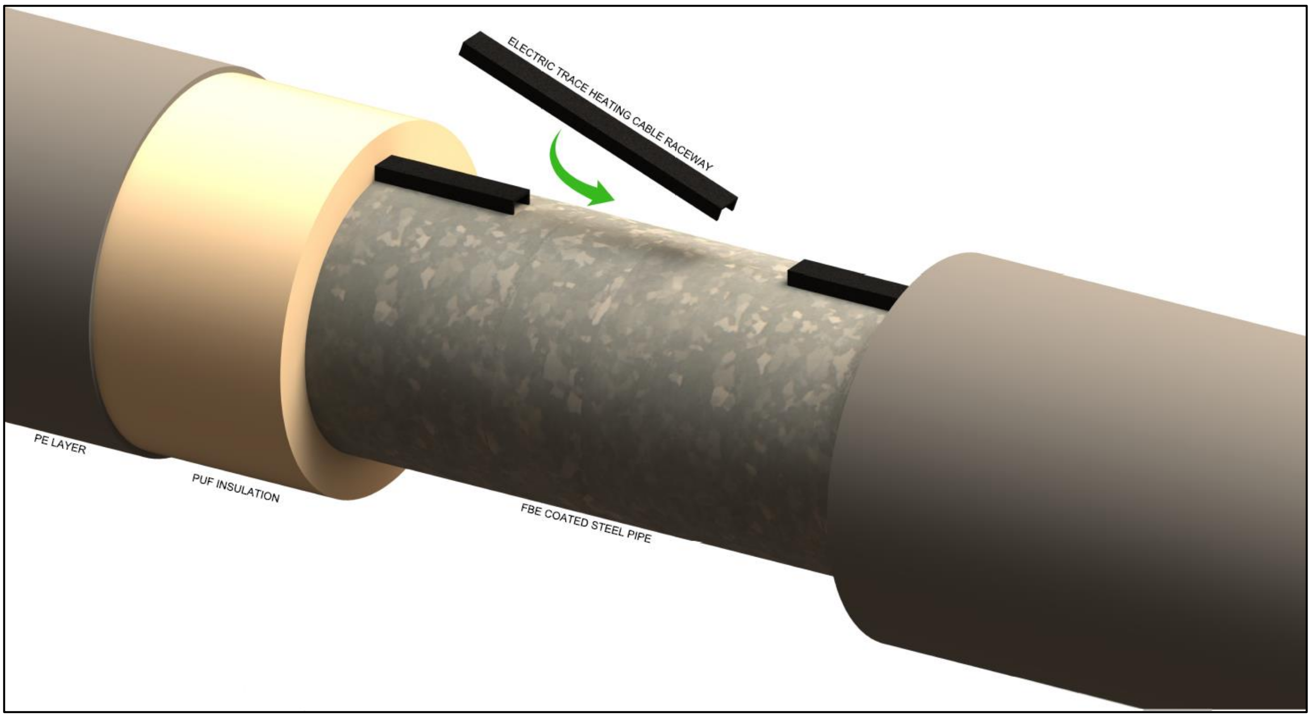


Figure 4.1-11: Pipeline Insulation and Coating

Leak Detection

Early detection of a leak and identification of the leak location using a leak detection system (LDS) permits timely safe shutdown and a minimisation of spill volumes, as well as the dispatch of emergency response teams to assess and clean up any leakage. The leak detection system is software-based using flow metering and temperature and pressure monitoring.

The LDS will be supplemented by a hardware based (fibre optic) system, using Distributed Acoustic Sensing (DAS). DAS uses transducers installed on the pipeline and is primarily used for detecting precursor events along the pipeline such as vehicle movements, digging and other third-party activities. In addition to this, DAS has a degree of leak detection capability by listening for a leak’s acoustic footprint.

The ability of DAS to provide both third party interference detection and pipeline leak detection makes DAS a critical component to the safe operation of the LLCOP system. This process will be augmented by regular operation surveys along the pipeline alignment.

4.1.3.2 *Power Supplies*

Electrical power for pumping and heating will be generated at a number of locations along the pipeline for pumping the crude oil, powering the long line trace heating system and other control systems. Crude oil will used to fuel electrical generators and small volumes of crude oil will be stored locally in heated tanks prior to use. The main power supply will serve all normal and emergency electrical functions. Station 12 and the LMT will be connected to the existing national electricity supply grid by overhead 33kV line and will not use crude oil for power generation. Future additional grid connection options are being discussed with KETRACO and provision has been made at Stations 4, 6, 8, 9 and 10 for future connections, should these become available.

4.1.4 Stations

There are 16 Stations along the pipeline. The first pump station (PS1) is located at the Lokichar Export Facility (LEF) within the Upstream Central Facilities Area (CFA) and it is expected that all power, water and other utilities will be provided by the CPF for PS1. Table 4.1-4 below details the station locations and their associated facilities.

Table 4.1-4: Key Station Locations and Features

County	Station	KP	Description	Approximate Size (m)
Turkana	LEF (PS1)	0	Pigging Station, Block Valve Station	95 x 7 0
	S1	38	Power Input Point	35 x 34
	S2	74	Block Valve Station	20 x 16
Samburu	S3	113	Power Input Point, Block Valve Station	35 x 34
	S4 (PS2)	151	Generator Station, Pump Station, Pigging Station	140 x 150
	S5	188	Power Input Point	35 x 34
	S6	268	Generator Station	120 x 140
	S7	302	Pigging Station, Block Valve Station	45 x 35
Isiolo / Meru	S8	339	Generator Station, Block Valve Station	120 x 140
	S9 (PRS)	418	Generator Station, Pressure Reduction Station, Pigging Station	120 x 140
Garissa	S10	491	Generator Station, Block Valve Station	120 x 140
	S11	560	Power Input Point	35 x 34
	S12	588	Generator Station, Pigging Station	140 x 147
	S13	623	Power Input Point	35 x 34
	S14	699	Generator Station, Pigging Station, Block Valve Station	120 x 140
	S15	751	Block Valve Station	20 x 16
Lamu	S16	783	Power Input Point, Block Valve Station	35 x 34
	LMT	824	Marine Terminal, Pressure Reduction Station, Pigging Station	140 x 147

4.1.4.1 Site Selection for Stations

The location of the Stations along the pipeline route has been considered via various design engineering studies. Factors that influence the location of pipeline stations include:

1) The reach-out distance between power input points and generation stations is typically 35-40 km in each direction;

2) Where practicable, 150 km is used as the separation distance between pigging stations; however, the maximum separation distance between pigging facilities can be extended to 200 km;

3) The distance between block valves varies depending on a number of factors including topography, profile, proximity of sensitive areas or waterbodies. A maximum of distance of 80 km between two block valves has been used, although locations such as permanent rivers have been designed with additional block valves to minimise potential impact to the environment in case of leaks or rupture; and

4) Locations of Pump Stations and the Pressure Reduction Station were determined from Flow Assurance studies.

Where possible, facilities have been located to make use of existing infrastructure and to facilitate construction, without any significant increase in overall route length. Some Stations will be in remote areas, which will require the construction of a total of 31.4 km of access tracks where access is not available using existing roads.

Figure 4.1-12and Figure 4.1-13 illustrate the typical layout of large and small Stations along the pipeline route, in relation to the working width (RoW) and the positioning of stations within the footprint of the LAPSSET corridor. For illustration purposes, a 100 m pipeline corridor has been included in these figures to indicate the proximity of the RoW to the boundaries of the LAPSSET corridor. In instances where Stations extend outside the linear LAPSSET Corridor, any such additional areas have also been legally defined and gazetted as part of the LAPSSET Corridor.

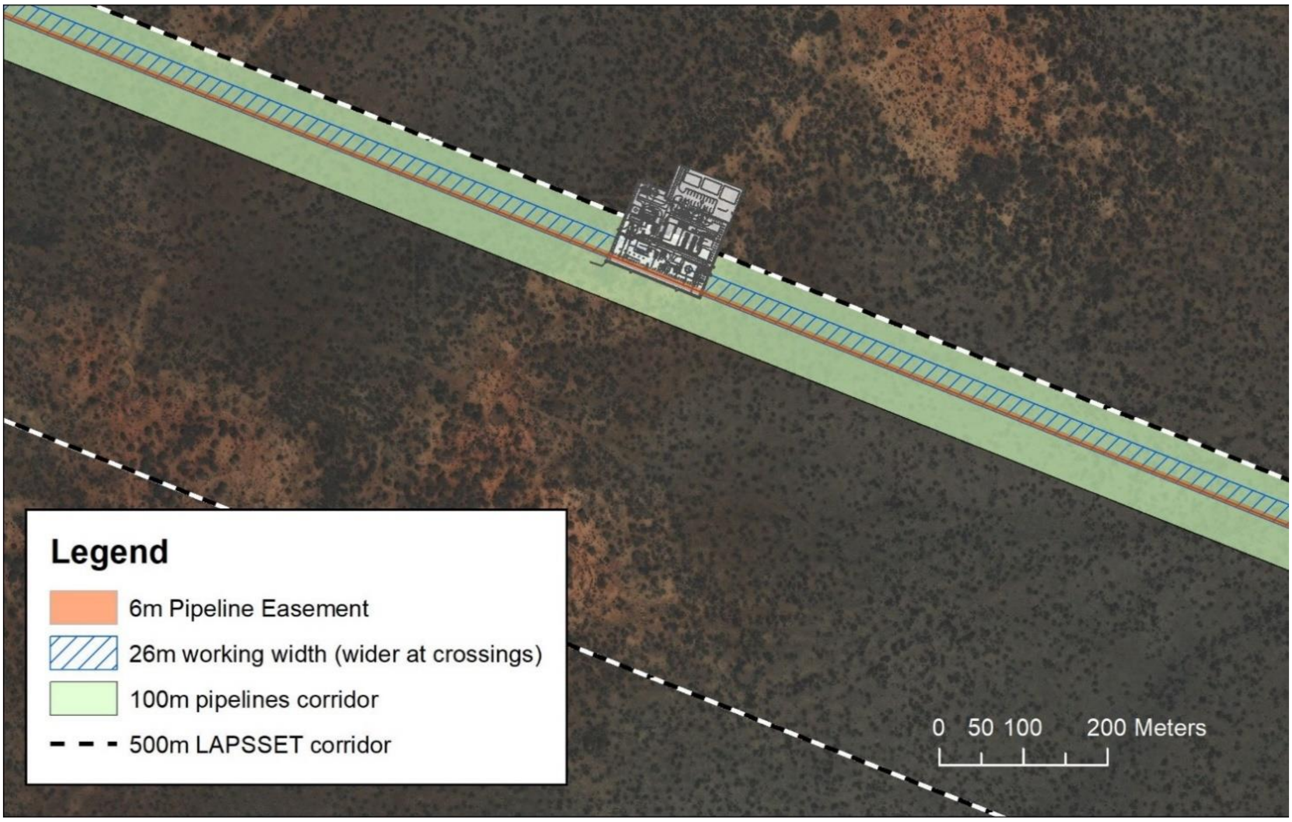


Figure 4.1-12: Example of large (major) Station location position along pipeline route

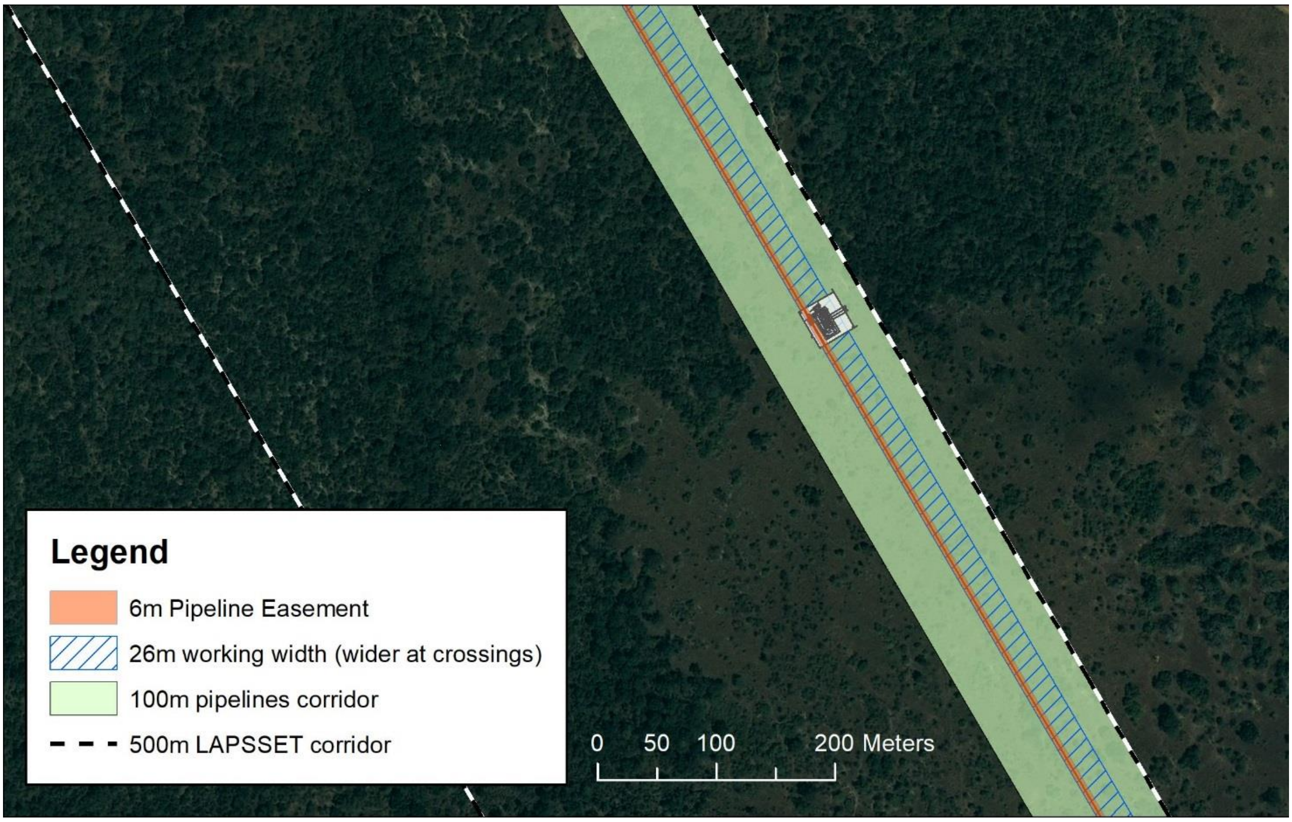


Figure 4.1-13: Example of small (minor) Station location position along pipeline route

Further details of the pipeline route development are discussed in the Analysis of Alternatives (Section 4.2).

4.1.4.2 Lokichar Export Facility (LEF)

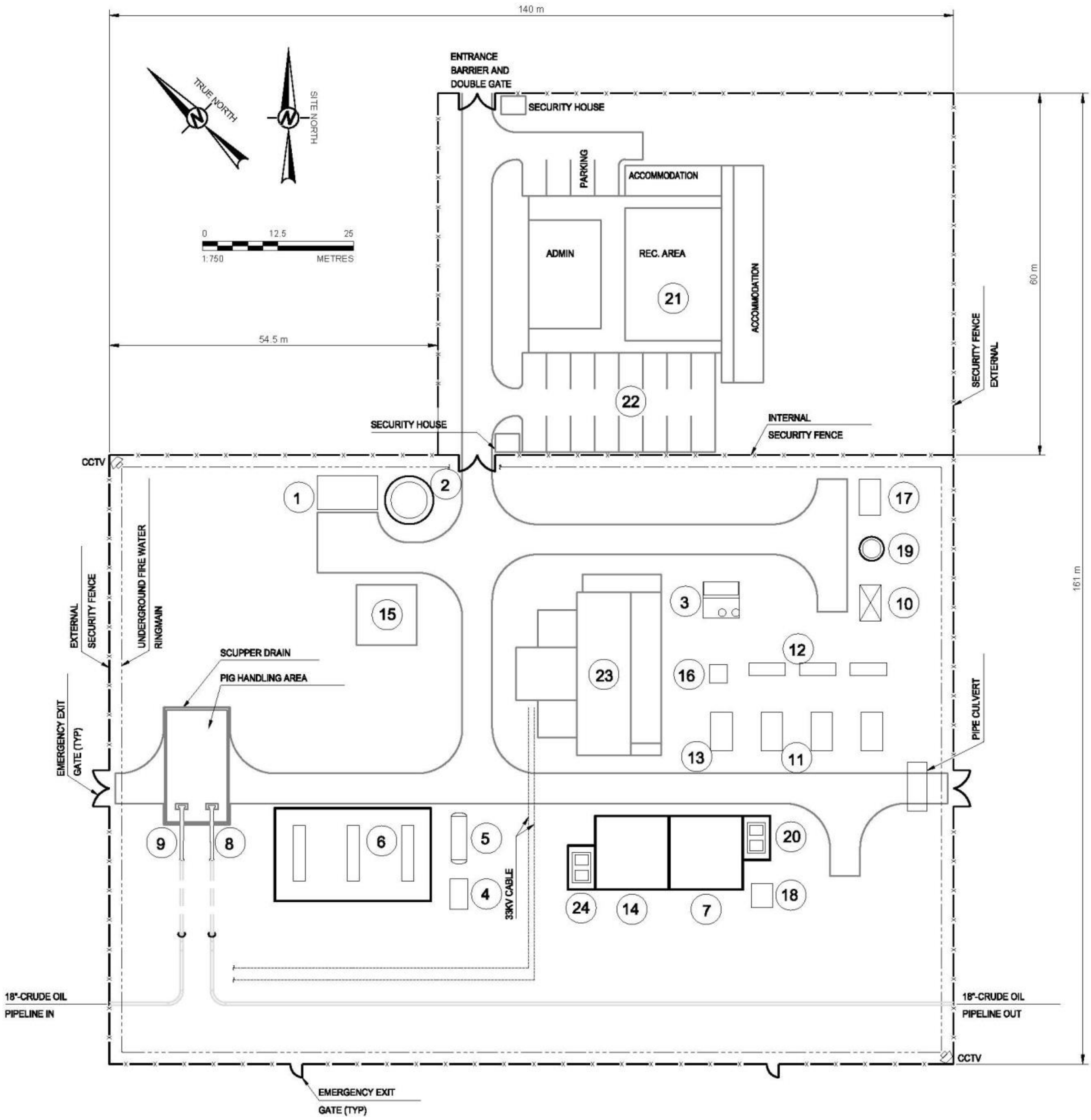
The main Pump Station (PS1) will be established at the LEF to transport annualised flow rates of 65 kbopd up to a maximum of approximately 80 kbopd. PS1 comprises three pumps (two operating and one on standby) in a separate area within the Upstream CPF footprint.

4.1.4.3 Pump Stations

A typical Pump Station system will comprise the following items:

- Oil transportation pumps (to pump oil along the pipeline) and standby facilities at each pump station;
- Fire water tanks and pumps;
- Emergency generators;
- Air and water utility packages;
- Oil pipeline pig launcher/receiver;
- Fuel storage (Crude Oil) for minimum 28 days' supply;
- Electricity generation for the electric trace heating system and pump power;
- Accommodation facilities (at Station 4, 9, 10 and 14); and
- Security and guarding facilities.

An indicative layout for a Pump Station is provided below.



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	FIRE WATER PUMPS (MAIN & JOCKEY)	13	DIESEL EMERGENCY GENERATOR
2	FIRE WATER TANK	14	DIESEL TANK
3	INSTRUMENT/UTILITY AIR COMPRESSOR SKID	15	MAINTENANCE AND STORES
4	OILY WATER INTERCEPTOR	16	DIESEL DAY TANK
5	COLLECTION VESSEL CLOSED DRAIN	17	UTILITY & POTABLE WATER UNIT
6	ELECTRIC PIPELINE PUMPS	18	CATHODIC PROTECTION
7	CRUDE OIL TANK (HEATED)	19	SERVICE WATER TANK
8	PIG LAUNCHER	20	FUEL OIL PUMPS
9	PIG RECEIVER	21	ADMIN & ACCOMMODATION
10	FUEL OIL FILTER PACKAGE	22	PARKING FOR ONSITE VEHICLES
11	CRUDE OIL ENGINE GENERATORS	23	SUB-STATION & CONTROL ROOM
12	AIR-COOLERS FOR GENERATORS	24	DIESEL UN-LOADING/TRANSFER PUMPS

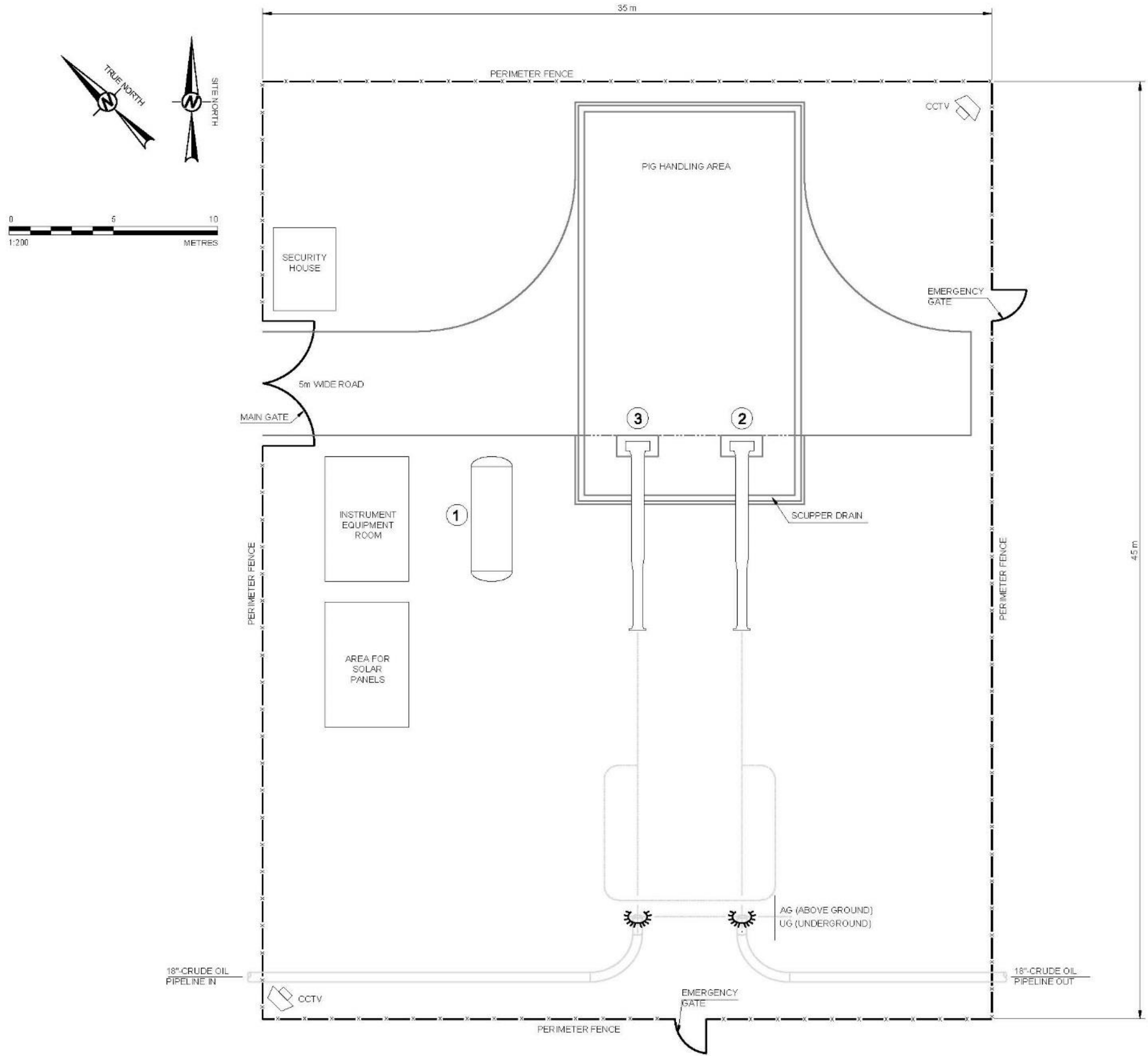
Figure 4.1-14: Indicative Pump Station Layout

4.1.4.4 Pigging Facilities

Pigging refers to a technique of cleaning, wax removal or inspection of pipelines. It is done through inserting a device known as a ‘pig’ into the pipeline via a ‘pig launcher’ (a launching station). The pressure-driven flow of the product in the pipeline is used to push the pig along the pipe until it reaches the receiving trap – ‘pig receiver’ (at a receiving station).

Pipeline pig launchers and receivers are provided at a number of locations to enable intelligent and operational pigging of the entire oil pipeline. Pigging facilities are included at the LEF, the LMT and Station 4, 7, 9, 12 and 14.

An indicative layout for a launching station is provided below.



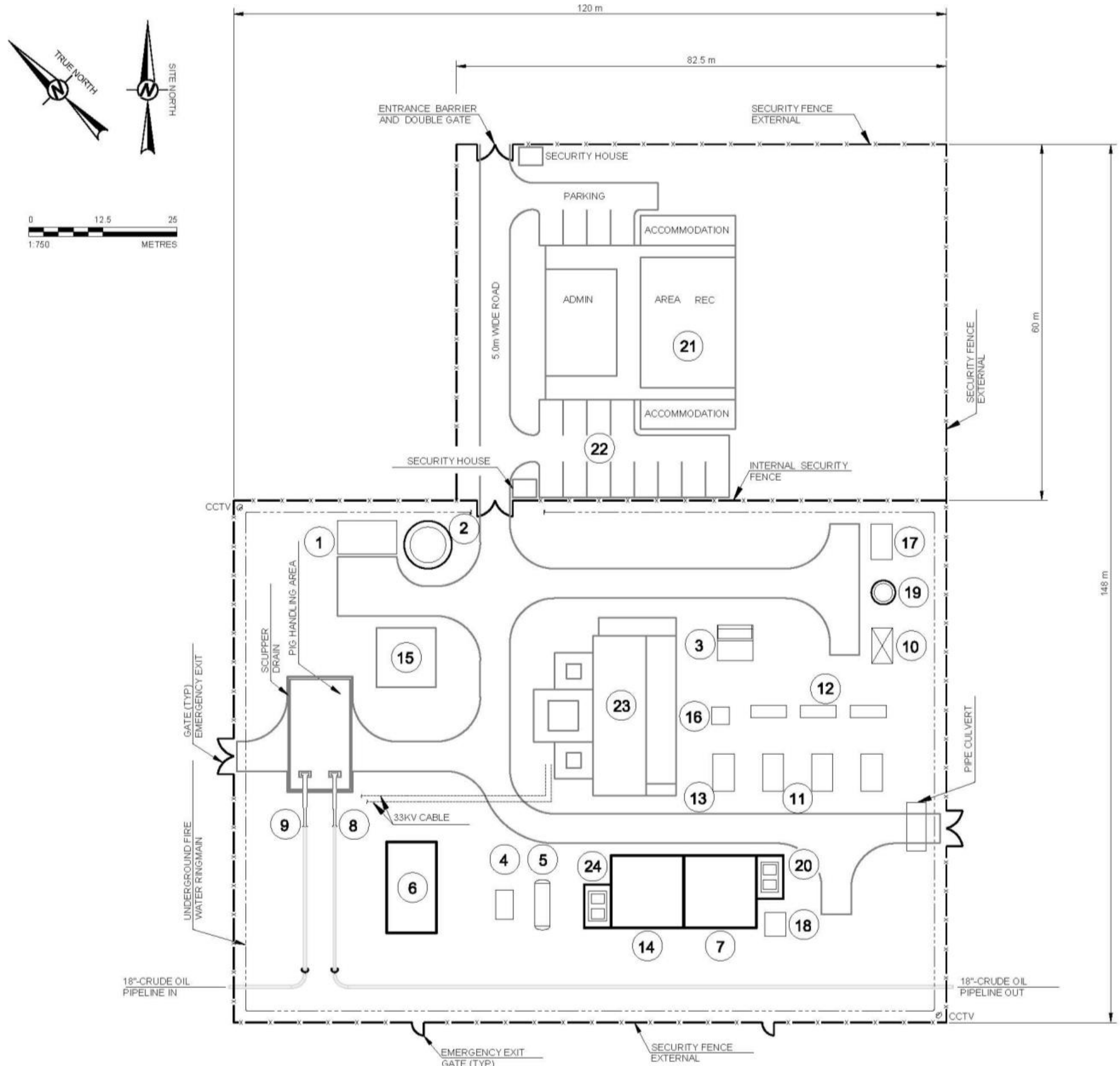
ITEM	DESCRIPTION
1	DRAIN VESSEL (U/G)
2	PIG LAUNCHER
3	PIG RECEIVER

Figure 4.1-15: Indicative Launching Station Layout

4.1.4.5 Pressure Reduction/Regulation Stations

Pressure Reduction Stations (PRS) are located at KP 418 (Station 9) and one at the entry into the LMT. These Stations are included to allow lower design pressures to be used downstream of the regulating Stations as well as to maintain the pipeline contents at a minimum pressure of 5 barg at any location.

An indicative layout for a Pressure Reduction Station is provided below.



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	FIRE WATER PUMPS (MAIN & JOCKEY)	13	DIESEL EMERGENCY GENERATOR
2	FIRE WATER TANK	14	DIESEL TANK
3	INSTRUMENT/UTILITY AIR COMPRESSOR SKID	15	MAINTENANCE AND STORES
4	OILY WATER INTERCEPTOR	16	DIESEL DAY TANK
5	COLLECTION VESSEL CLOSED DRAIN	17	UTILITY & POTABLE WATER UNIT
6	ELECTRIC PIPELINE PUMPS	18	CATHODIC PROTECTION
7	CRUDE OIL TANK (HEATED)	19	SERVICE WATER TANK
8	PIG LAUNCHER	20	FUEL OIL PUMPS
9	PIG RECEIVER	21	ADMIN & ACCOMMODATION
10	FUEL OIL FILTER PACKAGE	22	PARKING FOR ONSITE VEHICLES
11	CRUDE OIL ENGINE GENERATORS	23	SUB-STATION & CONTROL ROOM
12	AIR-COOLERS FOR GENERATORS	24	DIESEL UN-LOADING/TRANSFER PUMPS

Figure 4.1-16: Indicative Pressure Station Layout

4.1.4.6 Block Valves

As part of the design, actuated Block (isolation) Valves are located at Station 1, 2, 3, 5, 6, 8, 10, 11, 13, 15 and 16. Should a leak be detected, these can be operated remotely to isolate sections of the pipeline and reduce the consequence of the release.

An indicative layout for a Block Valve Station is provided below.

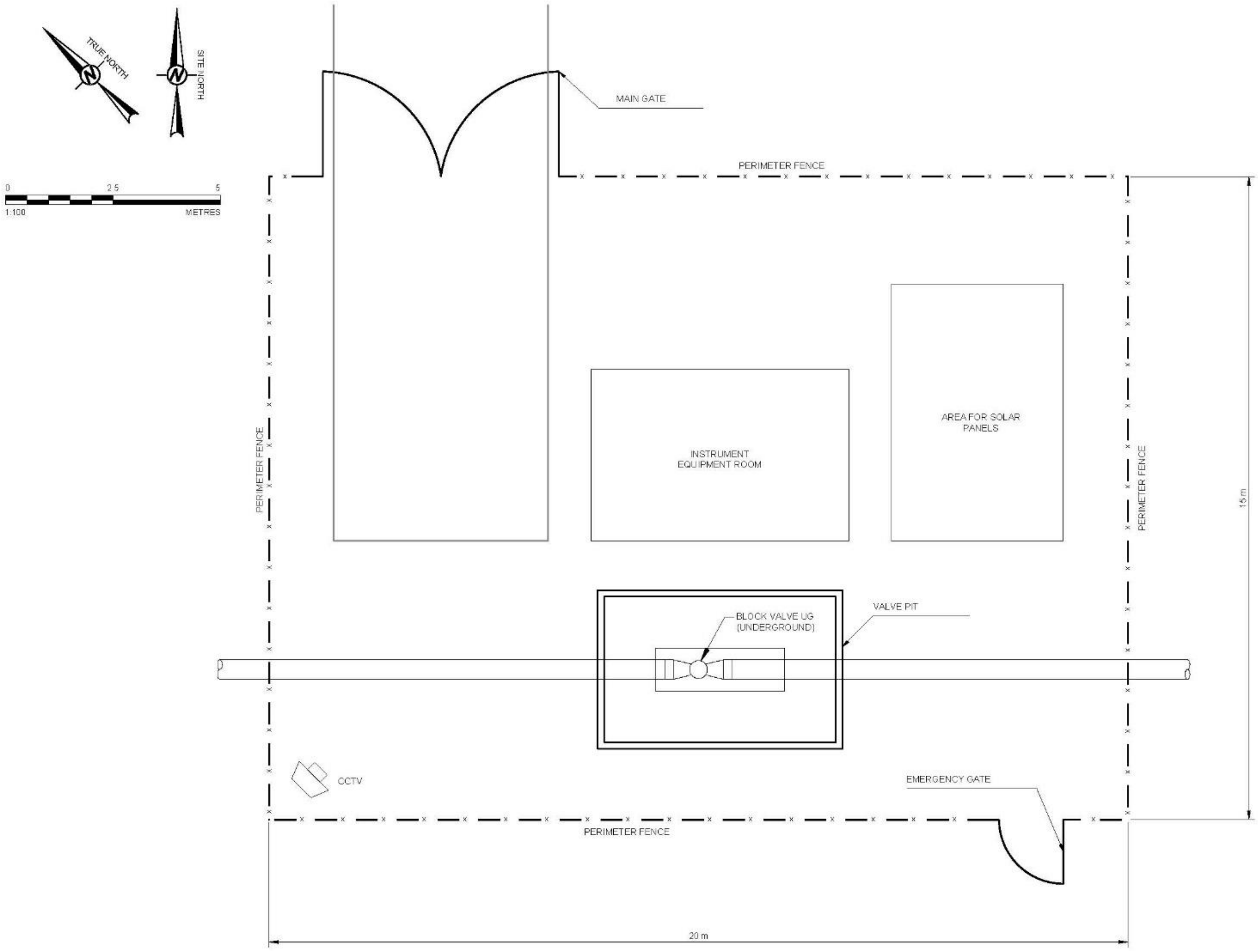


Figure 4.1-17: Indicative Block Valve Station Layout:

At the remaining Stations (4, 7, 9, 12 and 14 and at the LEF and LMT), there are Emergency Shutdown (ESD) Valves on the pipeline inlets and outlets to the Stations. There is also an ESD at the LOF at Berth 3. Again, as well as being used to isolate the facilities, they can be operated remotely to isolate sections of the pipeline. Manual block valves will be located at significant river crossings; the permanent river crossings at Kerio, Suguta and Ewaso Ng'iro, to allow for isolation of the pipeline at river crossings.

4.1.5 Lamu Marine Terminal

The LMT at KP 824 provides metering and pressure reduction facilities and pumping operations for the export of crude oil to the LOF at Berth 3. Pipeline operations will be controlled from the main control room at the LMT. The location of the LMT within Lamu Port is illustrated in Figure 4.1-18.

The LMT facilities will comprise the following:

- Pressure reduction facilities;
- Power supply for the LMT and integral facilities will be via grid connection at Lamu;

- Firewater, fire suppression and associated protection systems for the LMT facilities;
- Firewater supply to the LOF;
- Terminal control room, laboratory, spare parts and emergency stand-by generators;
- 18" pipeline to LOF, including pig launcher;
- Personnel accommodation and messing building;
- Utility systems as required; and
- Export pumping facility for load-out to floating storage and offloading vessel.

4.1.5.1 Load-out Facility

The LOF is the facility at berth 3 is where the 18" pipeline from the LMT terminates. At the LOF there is a pig receiver and vessel loading arms for loading the crude onto the storage vessel, the VLCC. The VLCC will be permanently moored at Berth 3 of Lamu Port and will have a storage capacity of 1.45MM bbl. The port is sheltered by the Kenyan mainland, Manda Island and Pate Island and is only exposed to moderate wind and wave conditions thereby offering appropriate conditions for berthing of tankers.

The VLCC acts as an FSO and will load crude oil for export, via ship to ship loading, in parcels of 1MM bbl which can be loaded within a period of 24 hours. The maximum design vessel for the export of crude oil will be a Suezmax vessel. An export tanker is anticipated to be loaded and leave the facility every 12 days. In addition, the VLCC and mooring arrangements will also be designed to accommodate Aframax and Panamax vessels. The arrangement of the LOF and VLCC can be seen in Figure 4.1-18.

Berth 3 is 400 m long and the dredged water depth of the incoming channel and the area at the front of berths 1-3 at Lamu Port is -17.5 m below Chart Datum (-17.5 m CD).

4.1.5.2 Onshore Storage Option

It should be noted that an Onshore Storage option is being considered as an alternative to the current Floating Storage Option using the VLCC. This comprises a conventional onshore tank farm with three 500,000 bbl floating roof storage tanks (1.5 MM bbl storage) located within the LMT facility. Vessel loading would be via large flow pumps at the LMT, (capable of pumping 1 MM bbl crude oil parcels from the storage tanks in 24 hrs), which would pump the oil through 2x26" pipelines to the LOF and through the loading arms, directly into export tankers (Suezmax) at Berth 3.

While this option is still under discussion with the Government of Kenya, the basis for this ESIA and permitting is the floating storage and offloading vessel, permanently moored at Berth 3[2].
In the event that a decision is made to develop the onshore storage option, an Addendum Report to this ESIA would be prepared for review and approval by NEMA to meet the requirements of the Environmental (Impact Assessment and Audit) Regulations 2003.

[2]The subsea pipeline routing described in the ToR (Annex I) is no longer a consideration for the project and for this ESIA

Figure 4.1-18: Floating storage option and LOF for Lamu Port and proposed VLCC mooring arrangement

4.1.6 Land Access

The LLCOP project is a component of the overarching LAPSSET initiative and will be constructed wholly within the LAPSSET Corridor. The land acquisition for the LAPSSET corridor is managed under a separate Government-led process independent of the LLCOP. As such, all land within the LAPSSET Corridor alignments will be acquired by the Ministry of Land & Physical Planning working with the National Land Commission (NLC) and will then be transferred to the LAPSSET Corridor Development Authority (LCDA) under the process set out in the Land Act (No 6 of 2012). As the registered landowner, LAPSSET will then grant a lease to LLCOP.

On 29 June 2016 the LAPSSET Corridor Development Authority submitted to the National Land Commission a request for issuance of land title deeds to LCDA (as the Trustee of all LAPSSET Corridor Project implementers) for all LAPSSET Corridor Project Component areas and investment areas along the LAPSSET Corridor. The process of acquiring land for the LAPSSET Corridor is underway and is being led by the Ministry of Lands and Physical Planning.

As a result, the PPMT has no formal responsibilities related to statutory land acquisition. Impacts related to land access for the LLCOP project are identified and assessed in this ESIA and appropriate mitigations to maintain the livelihoods of affected households and communities, in addition to statutory compensation by NLC, are set out.

Gazettement of Land

Land within the LAPSSET Corridor from Lamu to Isiolo was initially gazetted in in October 2016[3] and physical land surveys were undertaken by an independent consultant. The entire route, including the Upstream area was gazetted on 15 February 2019[4]. Community sensitization activities have been completed by NLC for all gazetted areas and land surveys are ongoing as of October 2019.

Following revisions to the pipeline route in early 2018, the pipeline route from Isiolo to Lokichar has also been designated as part of the LAPSSET Corridor. At this stage, this section will only comprise the pipeline corridor and the option remains open for the main multi-component LAPSSET Corridor to run on its original route to the south of the pipeline alignment.

Table 4.1-5: Summary of Land Requirements

County	Land Requirements for LAPSSET Corridor (ha)	LLCOP Permanent Land Required for Stations (ha)	Length of Pipeline (kms)
Turkana	4,967	0.8	98
Samburu	10,199	3.8	199
Isiolo	4,651	1.6	93
Meru	1,920	1.6	38
Garissa	17,076	5.3	339
Lamu	2,780	34.2	57
Total	41,593	47.2	824

[3] Kenya Gazette, 21 October 2016, Vol CXVIII – No 129, Gazette Notice 8676.

[4] Kenya Gazette, 15 February 2019, Vol CXXI – No 20, p580.

The majority of the land along the route is currently held in trust on behalf of local communities by the respective County governments. Impacts associated with land access and acquisition related to the LLCOP temporary 26 m working width for construction and the permanent 6 m easement and fenced areas for stations during operations are described and appropriate mitigation measures are set out in this ESIA.

4.1.7 Construction

Construction will be undertaken by an EPC Contractor with international experience of design and construction of major oil pipelines, supported by a range of specialist local and international sub-contractors. The EPC Contractor will take the design and specifications developed as part of the FEED process and will use this to undertake detailed design. This will then be used as the basis for purchasing of materials, equipment and manpower necessary to undertake construction of the Project.

As part of this process, the EPC Contractor will finalise the design and location for a number of construction support facilities, such as worker accommodation camps, laydown areas, arrangements for water abstraction and disposal and waste management. The specifications and locations described in the FEED documentation and as summarised and assessed in this ESIA will provide the basis for these designs. Where additional permitting is required by national and County authorities, this will be based on the location of the facilities described and impacts outlined in this ESIA.

Once the EPC Contractor has identified its preferred locations and designs, these will be subject to an environmental and social impact assessment process and consultation with relevant stakeholders including local residents. Potential impacts will be identified and appropriate mitigation measures developed, which will be set out in facility-specific environmental and social management plans. These impact assessments, together with the supporting environmental and social management plan will be submitted to NEMA and other applicable regulatory agencies for review and approval under the framework of the EIA Licence granted for the Project. Approval for construction and operation of these facilities will be provided through a Variation to the EIA Licence.

4.1.7.1 Route, Engineering and FEED Surveys

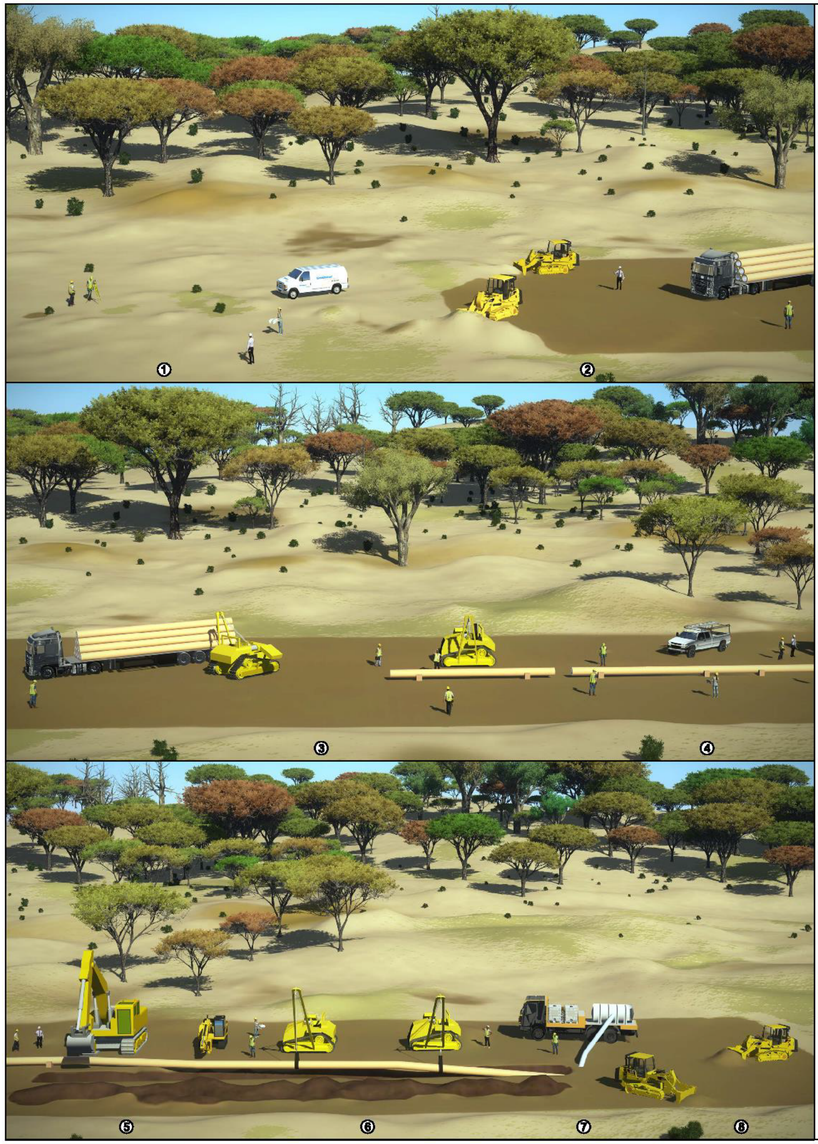
Various field surveys were undertaken to verify desktop studies. A summary of key studies informing the engineering design is provided in Table 4.1-6.

Table 4.1-6: Summary of Surveys Undertaken

Survey	Description
Route Selection	Desktop assessments using geohazard assessment, terrain analysis, detailed satellite data and route evaluations, supplemented with the results of a reconnaissance visit. A site visit in June 2018 complemented previous desk-based research.
Geohazard Fault Assessment	An assessment was completed on faults with a site visit included.
River Crossing Observations and Assessment	Assessment of the Ewaso Ng'iro river crossing.
Geotechnical Surveys	Geotechnical surveys have been carried out at various locations along the pipeline route, including at each major river crossing, with subsequent trial pit and borehole logging and physio-chemical analyses of the soils.

4.1.7.2 Pipeline Construction Sequence

Pipeline construction is a sequential process and comprises a number of distinct operations, beginning with initial survey work and terminating post-implementation with restoration, as shown in Figure 4.1-19



1. PRE-CONSTRUCTION SURVEY
Before construction begins, environmental features are surveyed along the proposed pipeline segments. Utility lines and agricultural drainage's are located and marked to prevent accidental damage during pipeline construction. The pipeline's centreline and the extent of right of way and workspace is staked.

2. CLEARING AND GRADING
The pipeline right of way is cleared of vegetation. Temporary erosion control measure are installed prior to any earth-moving activities. Topsoil is then removed and stockpiled before the ROW is graded and the running track/strip prepared.

3. PIPE STRINGING AND BENDING
Individual joints of pipe are strung along the right of way adjacent to the pipeline centreline and arranged so they are to be accessible for construction personnel. A mechanical pipe-bendng machine bends individual joints of pipe to the desired angle at locations where there are significant changes in the natural ground contours or where the pipeline route changes direction.

4. WELDING, FIELD JOINT COATING AND X-RAY INSPECTION
After the stringing and bending are complete, the pipe sections are aligned, welded together, and placed on temporary supports along the edge of the trench. All welds are then x-rayed. The coating on the line pipe is cut back to allow welding to take place. Once the weld and inspection are complete the field joint coating is applied. The entire pipe coating is then electronically inspected.

5. TRENCHING
Backhoes and trenching machines are then used to excavate the trench.

6. LOWERING PIPE IN AND BACKFILLING
The pipe assembly is lowered into the trench by sidebooms. The trench is backfilled. No foreign materials are allowed in the trench.

7. TESTING
After backfilling, the pipe is filled with water and pressure tested. Tested water is obtained and disposed of in accordance with applicable regulations. The water source may be some distance away, requiring water to be tankered in.

8. RESTORATION
The policy is to clean up and restore the work area as soon as possible. Temporary environmental control measures are maintained until the area is restored, as closely as possible, to its original contour and condition.

Figure 4.1-19: Pipeline Construction Sequence

The Spread

A pipeline construction project looks much like a moving assembly line. A large project typically is broken into manageable lengths called “*spreads*” and utilises highly specialised and qualified workgroups. The LLCOP pipeline will have six main spreads and a specialised mountain spread. Each spread is composed of various crews, each with its own responsibilities. As one crew completes its work, the next crew moves into position to complete its part of the construction process.

Spread Sections

The pipeline route is split into six principal construction spreads. Separate pipeline construction crews will work on different spreads throughout the pipeline route. The spread length will be minimised where possible and crews will work in parallel to reduce the construction schedule.

The location and length of each spread is determined by the following parameters:

- Scheduling;
- Terrain; and
- Road Access.

Whilst the actual number of spreads will be determined by the EPC Contractor when he develops his execution schedule, it is anticipated, due to restrictions on labour crossing county boundaries, there will be one principal spread in Turkana County, one in Samburu County, one in Isiolo/Meru Counties and one in Lamu County. Due to the length of pipeline within the county, it is anticipated that there will be two spreads in Garissa County.

4.1.7.3 Right of Way (RoW)

A pipeline RoW is a type of land use right, allowing for use of private and public property by the pipeline company – for the LLCOP Project this will be a temporary 26 m wide working width for construction.

To delineate the pipeline route, marker posts will be provided at:

- KP posts, every two km;
- changes of direction greater than 12 degrees; and
- road, river, road and third-party service crossings (both sides).

A typical layout of the RoW is presented in Figure 4.1-20.

The technique for installation of the pipeline will be open-cut trenches, which are about 1.5 m wide; the pipeline external diameter is approximately 600 mm. The RoW needed for safe installation using this technique is between 18 and 26 m. The RoW allows sufficient space for digging the trench, laying a pipe alongside the trench before installation, storing topsoil and sub-soil separately during installation and enabling access for construction or emergency vehicles. At times, wider RoWs will need to be used for short distances, for example at road and river crossings.

A permanent 6 m wide easement will be in place once built (an easement is a right to access or otherwise use someone else’s land for a specified purpose). This permanent easement of 6 m will be leased from LCDA within the LAPSSET Corridor for operational access and maintenance for the lifetime of the project.

4.1.7.4 Disturbance Area

Construction related ground disturbance along the route will be limited to the RoW and other approved or designated areas for pipe yards, disposal areas, access roads etc. Any construction or restoration activities outside of these areas will require prior approval from relevant authorities or landowners.

The construction RoW will be allowed to revegetate after completion of construction activities. No permanent structures will be permitted within the permanent easement and deep-rooting trees will be removed.

Working areas which create a potential hazard to the public will be cordoned off to prevent access by the general public during construction. Stations will also be fenced for security purposes.

Pipeline Burial and Separation Distances

The standard onshore pipeline burial depth to top of pipe (ToP) will be 0.9 m (the depth of cover may vary marginally in some areas). This may be reduced to 0.6 m in areas of rock.

For third party crossings, for example other utilities or roads, the minimum separation distances between structures will be as follows:

- For horizontal separation, the greater of the minimum distance stipulated by the pipeline or services owner, or 2.5 m OD to OD.
- For vertical separation, the greater of the minimum distance stipulated by the pipeline or services owner, or 500 mm OD to OD.

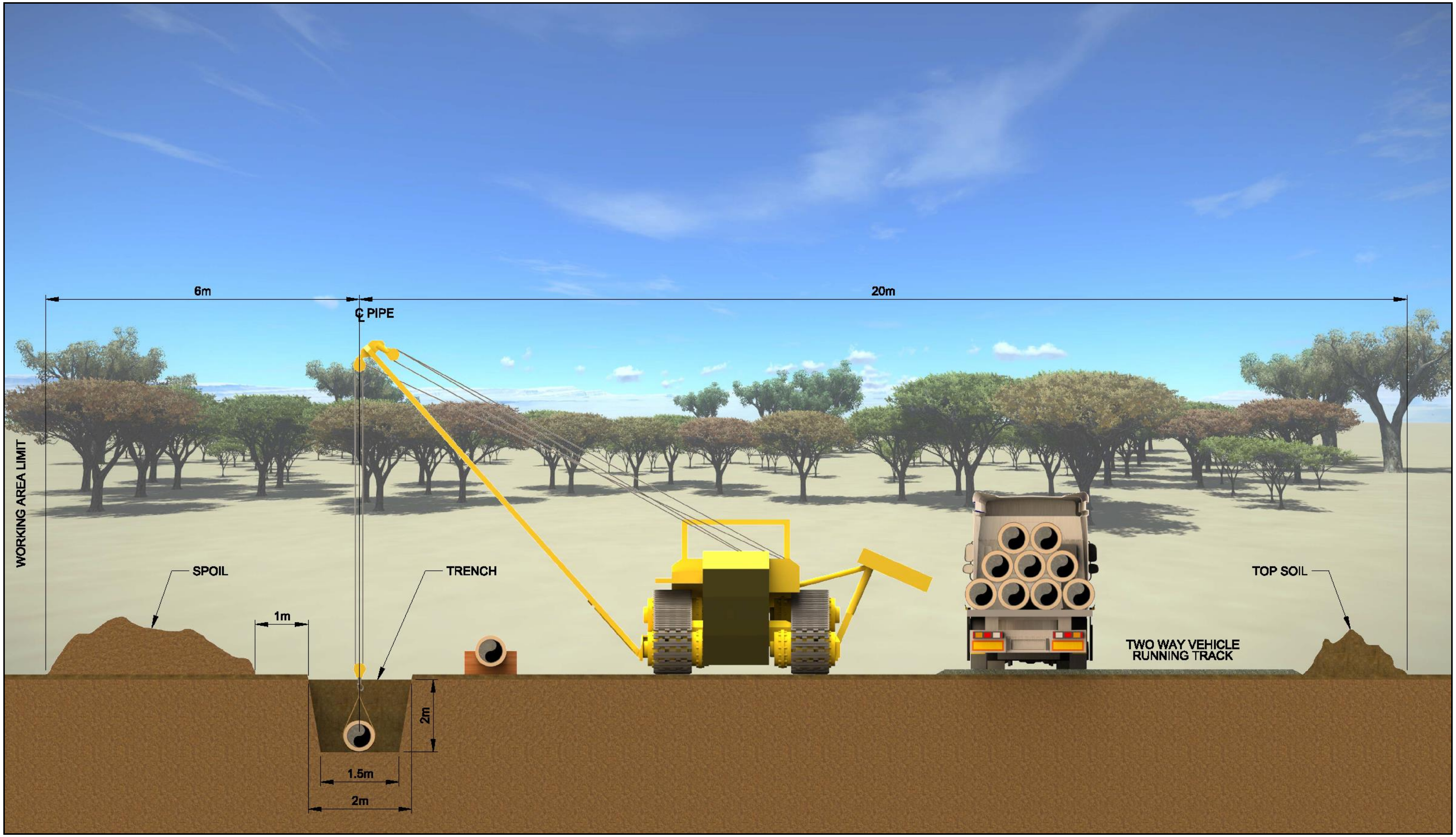


Figure 4.1-20: Typical RoW along the pipeline route during construction

4.1.7.5 Crossings

Table 4.1-7 outlines the crossings types which will be encountered along the pipeline route and the associated planned crossing methodology.

Table 4.1-7: Crossing Types & Methods

Crossing Type	Methodology
Permanent rivers	Open Cut (dry season), with extra protection as applicable
Seasonal rivers (luggas)	Open Cut (dry season), with extra protection as applicable
Environmentally sensitive areas	Wide crossings: Normal construction with extra protection
	Short lengths: Open Cut with extra protection
Major roads	Trenchless (Auger Bore) (alternative option of Open Cut where appropriate)
Minor roads and tracks	Open Cut with suitable diversion plan
Buried Cable	Open Cut
Buried Pipeline	Open Cut
Seismic Fault Lines	Open Cut but designed to withstand earthquakes, if applicable
Scour Areas	Reinforce soil or deeper installation, with extra protection as applicable

Up to 20 potential surface faults have been identified along the route. Special fault crossings are not required for the pipeline as these faults are not associated with earthquake potential.

River Crossings

The three permanent rivers crossed by the pipeline will be crossed with the pipeline installed at depths to prevent erosion or impacts to water and sediment. Permanent and seasonal rivers will be crossed using open cut methods.

River crossings will be constructed during the dry season or other low flow periods. The pipeline will have additional protection via the application of a concrete coating to the pipeline to provide negative buoyancy when installing the pipeline in the trench. For seasonal rivers, the minimum depth of cover will be 2 m below the lowest point of the riverbed, which will offer additional protection to the pipeline at the crossing point.

Manual isolation valves will be placed either side of the permanent river crossings at Kerio and Suguta. At the Ewaso Ng'iro crossing, only one additional block valve will be installed on the downstream side of the crossing, due to the proximity of Station 7 (Archer's Post) to the upstream side. These valves are included in the design to allow isolation of the crossing.

Crossings in Areas Prone to Seasonal Flooding

Sections of the export pipeline cross areas which are prone to seasonal flooding, which could include wetlands.

Construction within these areas will be limited to dry season months. For areas that are prone to flash flooding, temporary buoyancy measures will be used on sections of the pipe that are empty and uncovered. Where required, a working platform will be raised from which to install the pipeline in an adjacent trench.

Post rehabilitation monitoring of vegetation will be undertaken in wetland areas to confirm that hydraulic flows have been maintained in the area of the Project infrastructure.

Road Crossings

Pipeline road crossings will be undertaken by direct burial with the pipeline uncased. Major road crossings will be via a trenchless method (auger bore), as illustrated in Figure 4.1-21. Open cut method will be an option. All minor roads will be crossed by open cut methods but will require a suitable traffic diversion plan during the period of construction and installation[5].

The minimum material cover for roads (blacktop and unmetalled/murram roads) will be 1.2 m.

All road and utility crossings will have a crossing agreement with the corresponding government agency.

Steep Terrain Crossings

The route has been optimised to reduce routings through mountainous or steep areas.

The construction for steep area installation (i.e. gradients of 20% to 50%) will employ methods and equipment specific to the location.

Areas of High Erosion Potential

There is a section from KP 110 to 300 (in Samburu), which is prone to erosion from flash flooding events which could cause potential constructability issues. In these areas, the following methodology will be applied:

- Avoid areas where possible;
- Route via the highest point along an existing scour area;
- Trench through as normal (open cut), filling in scours when reinstating;
- Either reinforce soil where required using cement/sandbags to prevent washout and exposed pipe in the future, or;
- Trench deeper to pass underneath existing scour areas.

4.1.7.6 Station Construction

Station construction will be divided between several teams, with crews working simultaneously at each major Station. The following are defined as 'major Stations':

- Lokichar Export Facility;
- Station 4 (Pump Station 2);
- Station 12;
- Four Stations (Station 6, 8, 10 and 14) which act primarily as electrical power generation stations for the pipeline trace heating system;
- Pressure Reduction Station; and
- Lamu Marine Terminal.

[5] All road crossings and any other infrastructure crossings will be permitted by the appropriate regulator under Kenyan law.

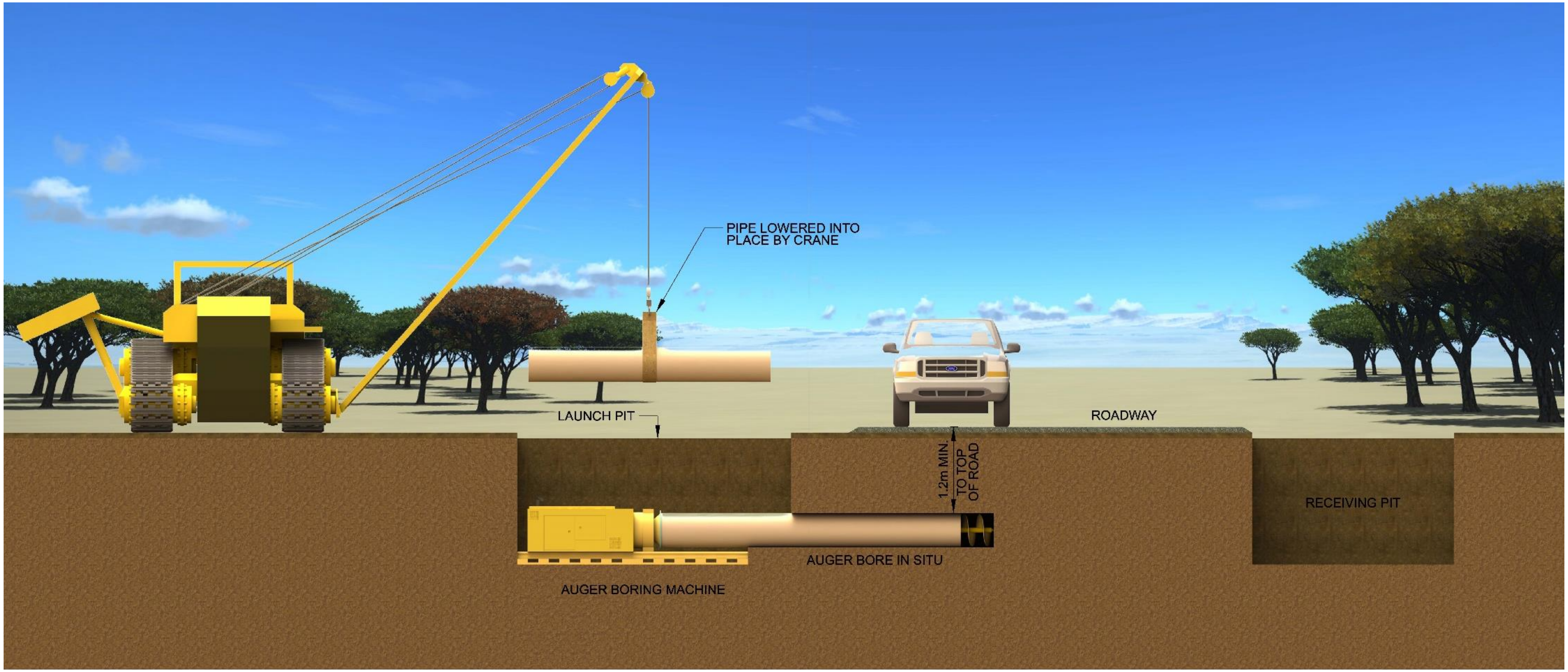


Figure 4.1-21: Method for road crossings

4.1.7.7 LMT Facilities Construction

The LMT will be installed in line with the procedure for a major station. The LMT will be constructed in the Lamu Port development area and construction procedures will be developed to take account of other activities in the vicinity.

4.1.7.8 Waste Management

Waste materials will be generated by the construction and, to a much lesser extent, operation of the Project. This will include both non-hazardous and hazardous wastes. A waste management study was undertaken by the FEED Contractor in 2017 and provides key information on waste management. Based on this information, a preliminary review of existing waste management facilities has been undertaken to determine the ability of exiting waste management facilities to handle waste generated by the Project. This information will be updated and developed in more detail as part of the EPC process.

Construction Waste

Construction waste will be generated from a range of activities including:

- Preparation and transportation of pipe and other equipment and facilities;
- Clearance of vegetation within pipeline RoW;
- Pipeline installation through cut and fill trenching;
- Pipeline welding and finishing;
- Pre-commissioning and commissioning, including hydrotesting;
- Construction camps for pipeline workers; and
- Offices and other facilities.

Initial estimates of waste streams and waste volumes have been prepared as part of the Pre-FEED process. These volumes will be further refined during the detailed design process.

Earthworks Waste

Earthworks waste has been estimated for the installation of the pipeline and construction of stations. No additional earthworks are assumed for the LMT as existing onshore facilities will be used and storage will be via an FSO.

Over most of the length of the pipeline, 100% of the excavated material will be returned to the trench. Padders will be used on the construction spreads which will allow the excavated material to be used as backfill material, around the pipe and cables, by separating out larger stones from the excavated material.

There is only a small amount of residual spoil (per linear metre) when the trench is completely backfilled and this can be spread across the RoW when completing the reinstatement and restoration, without any impact. There is no need to remove spoil from site for disposal elsewhere.

In rocky areas, there may be insufficient fine material for backfill and material will need to be imported. This will result in some wasted excavated material; however, volumes are still likely to be relatively small. In rock, the excavation depth and cover to the top of the pipe will be reduced to as low as 0.6 m and the trench sides will be vertical.

In a trench with vertical sides, the volume of backfill required is minimised. The volume of backfill and hence the volume of residual spoil for a vertical trench is approximately 0.8 m^3 per linear metre of trench, whilst for a battered trench, the volume is more than double. Pipeline trenches with battered sides will be required in some areas, however the overall percentage will be very low, and any additional material will be mixed and spread across the RoW following the same method as above.

As part of FEED, some preliminary cut and fill drawings were produced for three of the stations, Station 4, 6 and 8. On all three drawings, the cut and filling plan shows that the excavation is neutral, in that the levels for the sites are selected so that cut volumes match the required fill volumes. It may be the case that some of the cut material is not suitable for use as fill, but the quantities of spoil generated remain low, but typically there will be no surplus spoil generated by the construction activities.

There will be some surplus material generated when levelling the site, as the topsoil which will be stripped across the whole site before cut and fill commences but all of this will be utilised for landscaping or spread outside the plot area on the pipeline RoW. Spreading of topsoil across the RoW will result in an increase in original ground level of only a few millimetres.

In some areas, particularly within Garissa and Lamu, it may be necessary to import fill material to elevate the sites due to the potential of flooding and to avoid standing water on the sites.

Metal Waste

Metal waste volumes have been estimated by the FEED process for the pipeline but have not been estimated for construction of Stations and the LMT and this will need to be considered as part of the EPC process.

For pipeline waste, it has been assumed that 0.3% - 0.5% of the pipeline will be metal waste (from off-cuts, damaged sections etc.), which will amount to approximately 2,500 m - 4,100 m of scrap line pipe material. Assuming a typical average weight for the project line pipe of 9.5 mm, the weight of scrap line pipe material will be approximately 260 - 425 tonnes of steel.

In addition, there will be welding rod (electrode) waste of approximately 10% - 20% of the weight of each rod. An 18" pipe joint takes approximately 2.5 kg of weld metal per joint, therefore for the (approximate) 67,500 welds, the weight of discarded welding rod stubs would be 17 - 34 tonnes of waste metal.

All metal waste will be stored at the main construction camps, weighed and accounted for prior to disposal. This waste (scrap) will attract a market value and all receipts reconciled at the end of construction.

General Solid Waste

This comprises waste generated by accommodation camps, offices and storage facilities, and includes paper, plastics, non-recyclable materials, food waste and other non-hazardous waste materials, with an estimate of 460 kg/day/camp for construction accommodation camps and compounds and 160 kg/day for offices.

General construction waste volumes will be generated from field joint coating materials and packaging, line pipe end caps/bevel protectors, cable drums and pallets.

Some of the materials generated, such as waste epoxy and waste PUF, will need to be segregated and handled separately. Some of the packaging materials will also be contaminated and need to be managed as hazardous waste. The following is an estimate of the quantities of waste that will be generated:

- Sacks/Plastic bags, 2,500 - 3,000 No.;
- Wooden pallets, approximately 4,000 No.;
- Cable drums (wooden), approximately 800 No.;
- Pipe end caps/bevel protectors, approximately 135,000 No.; and
- Grit (Garnet) from blasting operations, approximately 2,000 tonnes.

It should be noted that items such as the cable drums and pallets could be reused by local communities for firewood or building materials. An assessment of such opportunities will be undertaken during detailed design.

Wastewater

Wastewater volumes can be calculated for sanitary wastewater based on 100 ltr/person/day for sewage and 200 ltr/person/day for grey water.

Hydrotest water will be used to test the integrity of the pipeline for leaks. Sources for hydrotest water will be confirmed during the EPC process; this may include treated seawater for the sections of the pipeline close to the coast. It is assumed that hydrotest water will be re-used where possible from one test section to another but an average wastage rate of 20% per section transition should be assumed as well as 100% wastage between sections in different counties.

Wastewater settlement ponds are planned to be constructed at the downstream end of each hydrotest section. All hydrotest water will be passed through a break tank and filtration system before entering settlement ponds. Precise details on the design and location of these ponds will be developed during the EPC process and water abstraction and discharge will be permitted in line with applicable Kenyan regulations.

Hazardous Waste

Hazardous waste will include waste oils and filters from mobile plant and equipment and generators, oily rags, waste solvents, used chemical drums, used lubricants, paint waste and hot insulation waste (both used for tanks, vessels and piping at stations).

No detailed assessment of the volume of hazardous wastes generated by the construction process has been developed as part of the FEED process. This will be considered as part of the EPC process.

For construction of the pipeline the main process that generates waste, apart from welding, is the field joint coating. A basic assessment has been made providing an estimate of the quantities of hazardous waste that will be generated:

- Waste epoxy (approx. 30 to 40 l/km), approximately 25 to 30 m^3;
- Waste PUF (approx. 45 kg/km), approximately 37 tonnes; and
- Epoxy containers (200 l drums), with residual epoxy, approximately 1000 to 1500 drums.

All hazardous wastes will be stored at the work site in segregated areas with an impermeable base and roofing to prevent contamination of run-off. Hazardous wastes will be collected on a regular basis and taken for disposal to an appropriately licenced waste management facility.

Operational Waste

During operations, small quantities of general solid waste, sanitary wastewater and hazardous waste will be generated. The majority of this will be generated at manned stations and the Lamu Marine Terminal. Detailed information on operational waste streams will be developed during the EPC process.

Waste Management Strategy

The Waste Management Strategy defined by the FEED process is based on the waste management hierarchy as follow:

- Minimise waste produced at the site;
- Reuse or recycle any waste generated at the site, for either on-site use of off-site local communities' use;

- Waste which cannot be reused or recycled will be relocated to Project owned (or controlled) waste handling facilities; and
- Waste which cannot be handled and disposed of using Project owned (or controlled) waste handling facilities, will be removed from the site and transported to appropriately licenced third-party waste handling facilities.

Anticipated waste streams have been evaluated against the requirements of the Environmental Management and Coordination (Waste Management) Regulations 2006 and the disposal methods and options have been identified in this ESIA Report.

Where a waste disposal facility/landfill is not present within close proximity of significant waste generator locations (e.g. main accommodation camps), or of sufficient size to handle to additional quantity, a Project owned (or controlled) and NEMA licenced disposal facility may be set up, where required, along the pipeline route.

Based on the FEED process, this ESIA Report has identified the key waste streams and volumes and has also defined appropriate treatment methods for each waste stream. This information will be used in the EPC process to determine final details related to the use and upgrading of existing waste management facilities and the development of new facilities where existing facilities are not adequate.

Potential impacts associated with waste management are described in this ESIA and appropriate broad mitigation approaches defined. Once final locations for facilities including waste management infrastructure are identified, site-specific environmental and social impact assessments will be undertaken and the broad mitigation approaches of the ESIA will be adopted. Site specific mitigations will be developed as a result and the impact assessment reports presented to NEMA as addenda to the main ESIA.

4.1.8 Construction and Operations Workforce

Indicative workforce projections have been developed as part of the FEED process. The EPC Contractor will prepare more detailed workforce numbers and workforce management plans based on the commitments set out in this ESIA report.

4.1.8.1 Construction Workforce

The construction workforce will peak at approximately 7,000 jobs. Construction jobs have been classified as follows as part of the FEED Process:

- Management – Site Project Engineer, Supervisor, Foreman, Site Planner;
- Skilled – Quantity Surveyor, Welder, Site CAD Operator, Operators;
- Semi-Skilled – Nurses, Electrician, Mechanic, First Aid; and
- Unskilled – General Labourer, Guards, Drivers.

At present there is no assessment of the build-up and demobilisation of workers through the duration of the construction phase. More detailed workforce projections and plans will be developed as part of the EPC process.

4.1.8.2 Operations Workforce

The operations workforce will comprise approximately 280 workers. This comprise both company staff and local contract workers. Contract workers will be engaged to provide services including security support, catering and housekeeping support.

The Lamu Marine Terminal will be the main control hub with the Main Control Centre located there. The facility in Turkana will be a secondary control hub with the Control Room located in shared facilities within the Lokichar CPF.

The majority of the field operations staff will be located at Stations in the CFA (Turkana), Samburu, Isiolo, Garissa and Lamu.

More detailed workforce projections and plans will be developed as part of the EPC process.

4.1.8.3 Recruitment and Local Content

Recruitment and training of workers will be undertaken based on a number of plans which will be prepared as part of the EPC process to implement the requirements of the Local Content Bill, 2018. Specifically:

- Local Content Development Plan; and
- Employment and Skills Development Plan.

The overall approach will be to employ local workers who possess the qualifications and experience required for the performance of the relevant work. To facilitate this process, a job readiness and skills development process will be developed and implemented as part of the EPC process.

4.1.9 Construction Logistics

4.1.9.1 Logistics Concept

The FEED process has estimated the volumes of materials that will be required at different locations along the pipeline route. Proposed locations for camps and storage facilities are subject to further investigation and permitting; and will be determined by the EPC contractor. Potential storage facility (lay-down yard) locations have been identified and confirmed as viable locations for further planning and feasibility assessment. Existing brownfield sites will be used for storage facilities where possible.

The port of entry for all imported materials is Mombasa Port and each county is self-contained in terms of storage, transport and accommodation, with the exception of Isiolo and Meru, which are combine for these purposes.

The logistics plan is based upon receipt of the pipe in a fully insulated state. The movement of all additional materials and equipment will be containerised. Where available and appropriate, materials and equipment will be sourced locally in line with the Project's Local Content Policy.

4.1.9.2 Storage Facilities

Site storage (lay-down) facilities will be located near the RoW within the LAPSSET Corridor where possible or at major facilities along the pipeline route to ensure easy delivery to the construction site.

Storage facilities, where possible and practical, will be:

- Co-located with existing stations;
- Near good access roads;
- Located within close proximity to the RoW, within the LAPSSET Corridor where possible; and
- Located on reasonably level terrain, avoiding areas of flooding and with suitable ground conditions for expected activities.

As part of this process, the EPC Contractor will finalise the design and location for a number of construction support facilities, such as worker accommodation camps, laydown areas, water abstraction and disposal locations and waste management facilities. The specifications and locations described in the FEED documentation and as summarised in this ESIA will provide the basis for these designs. Where additional permitting is required by national and County authorities, this will be based on the location of the facilities described and impacts outlined in this ESIA.

Once the EPC Contractor has identified its preferred locations, these will be subject to an environmental and social impact assessment process and consultation with relevant stakeholders including local residents. Potential impacts will be identified and assessed and appropriate mitigation measures developed, which will be set out in facility-specific environmental and social management plans. These impact assessments, together with the supporting environmental and social management plan will be submitted to NEMA and other applicable regulatory agencies for review and approval under the framework of the EIA Licence granted for the Project. Approval for construction and operation of these facilities will be provided through a Variation to the EIA Licence.

Primary and secondary storage facilities will comprise:

- Each county will have a designated Primary Storage Facility (a combined facility for Isiolo/Meru) to avoid any anticipated county conflicts, and to serve as a hub, through which all goods required for that county will go through. These are considered as the main storage area for that county and will be the first storage areas completed and receiving/storing goods. The possibility of a joint primary storage facility in Isiolo should be considered for the counties of Samburu and Isiolo/Meru, should this border not be cause for concern.
- Secondary Storage Facilities serve to break up the large county journey distances from the primary storage facility. These will be located so that a single journey from the Primary Storage Facilities, including stringing, will not exceed 150 km, which represents the maximum distance to be travelled in one day to avoid or at best restrict night-time driving. They will also be located to ensure that there are no county border crossings required. Direct transit of goods from the port of entry to the Secondary Storage Facilities, i.e. bypassing the Primary Storage Facility, would be possible should the total journey time be reduced.

Storage facilities will provide adequate equipment, buildings, and personnel to unload, receive and store materials, and sufficient space to load and haul pipe and materials from receiving points to storage and on to the RoW, as necessary. The capacity of each primary storage facility accounts for all pipe to be laid within that specific county, whereas the capacity of each secondary storage facility accounts for all pipe to be laid directly from that storage facility.

Construction Camps

Each storage facility will contain a camp within the facility boundaries proportional to the level of activity and quantity of goods that will be stored there. The camp located at each storage facility will equate to 15% of total storage area. Secondary camps are currently fixed within the secondary storage facilities. An indicative camp layout is set out below.

Camps and lay-down facilities will be reinstated to their original condition following completion of pipeline construction.

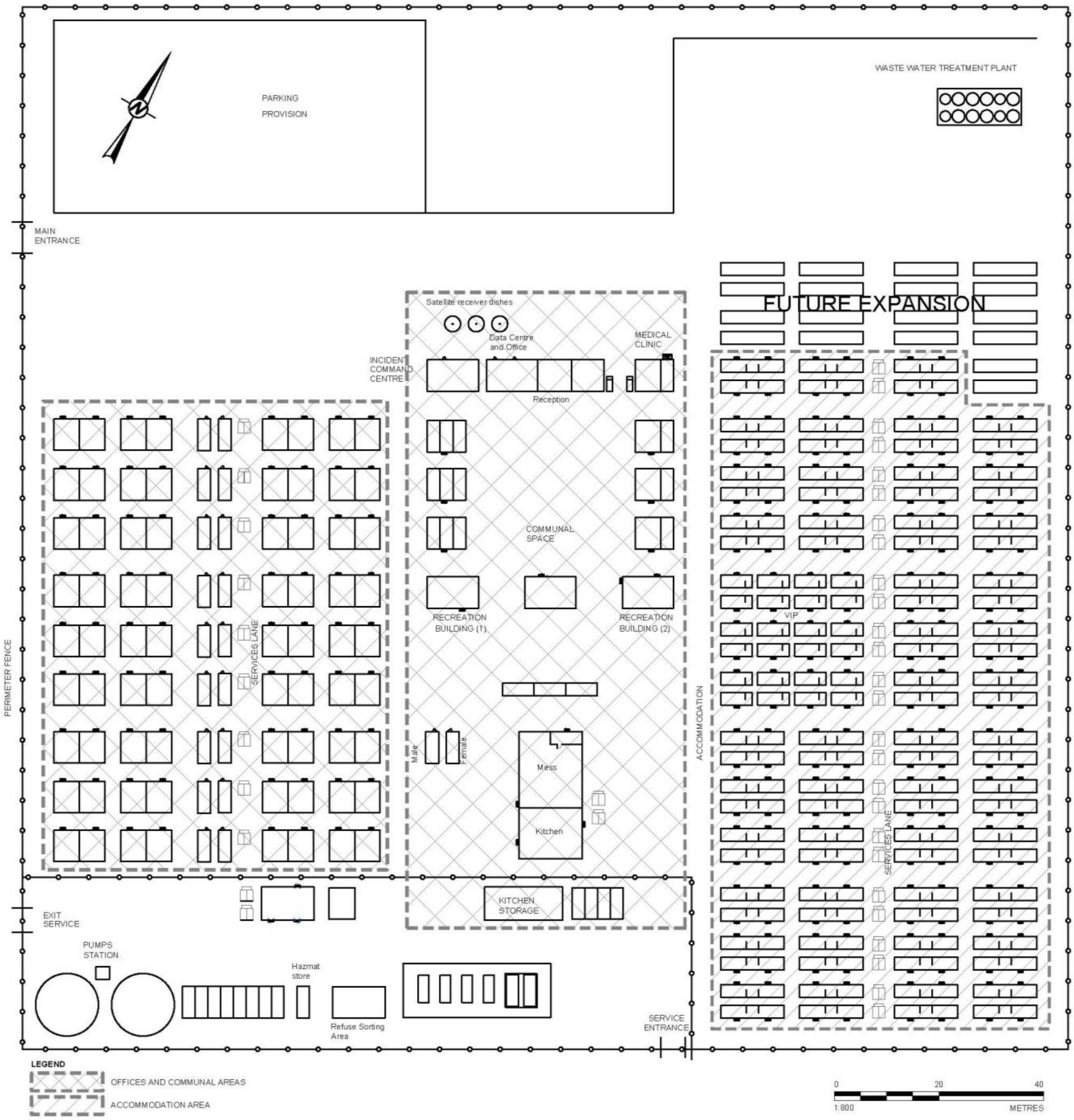


Figure 4.1-22: Indicative Construction Camp Layout

Table 4.1-8 and Figure 4.1-23 identify the Primary and Secondary Camp and Storage Yards located at the RoW.

Table 4.1-8: Storage Yards: Summary Details

Facility	County	KP	Total Size of Facility (m^2)
Import Storage Yard	Kwale/ Mombasa	-	150,000
Primary Camp and Storage Facility 1	Turkana	0.0	15,000
Secondary Camp and Storage Facility 1		48	7,000
Secondary Camp and Storage Facility 2	Samburu	151	15,000
Primary Camp and Storage Facility 2		281	30,000
Primary Camp and Storage Facility 3	Isiolo/Meru	337	20,000
Secondary Camp and Storage Facility 3		413	7,500
Secondary Camp and Storage Facility 4	Garissa	489	7,500
Primary Camp and Storage Facility 4		572	50,000
Secondary Camp and Storage Facility 5		697	10,000
Primary Camp and Storage Facility 5	Lamu	822	9,000

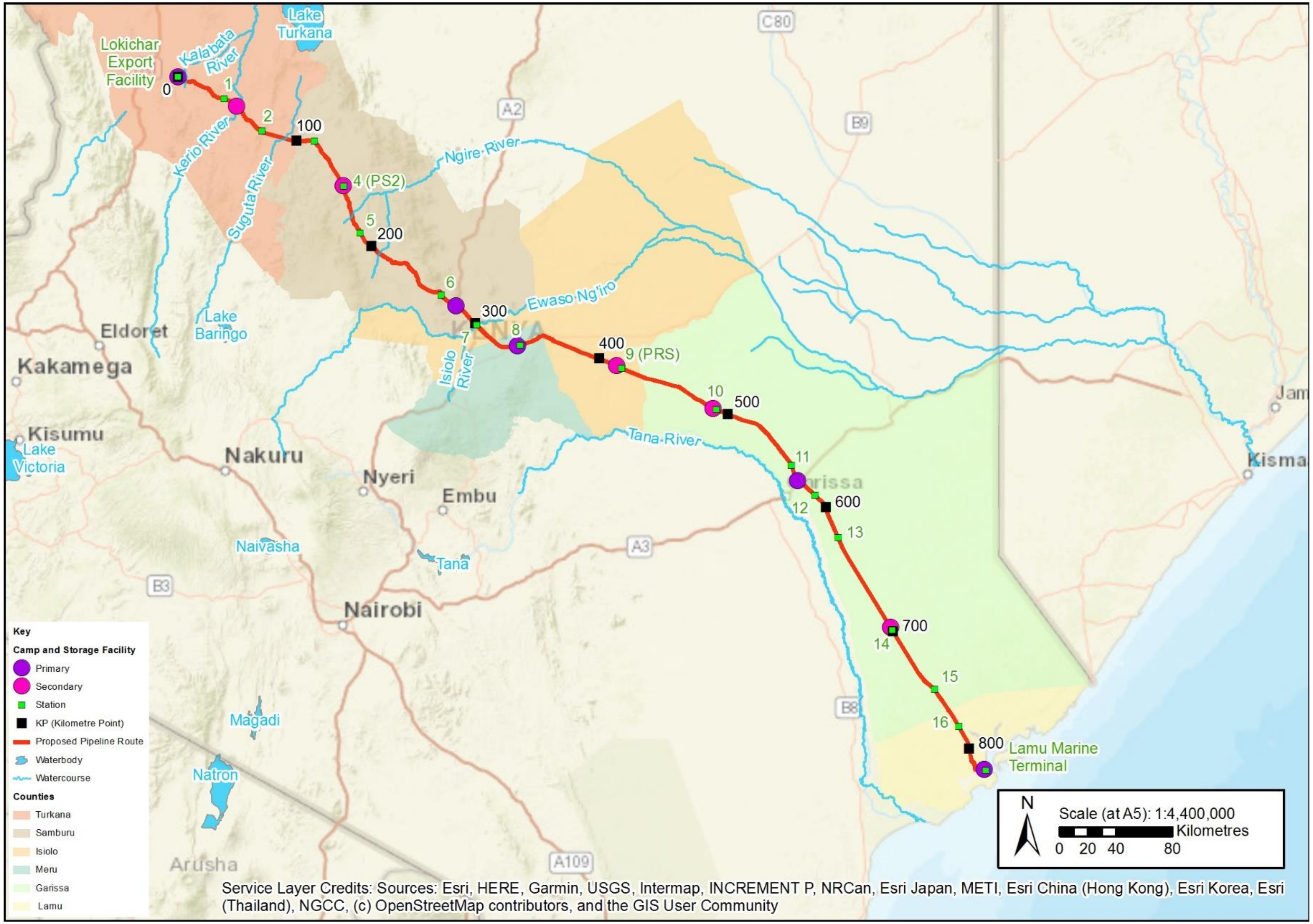


Figure 4.1-23: Proposed camp and storage facility locations

4.1.9.3 National-Level Transportation

The transportation of pipes and materials to the primary storage facilities is detailed below. The map in Figure 4.1-24 details the expected planned road upgrades prior to construction.

In addition to those highlighted in Figure 4.1-24, it was found from the in-country travel that local unsealed roads are likely to require upgrading.

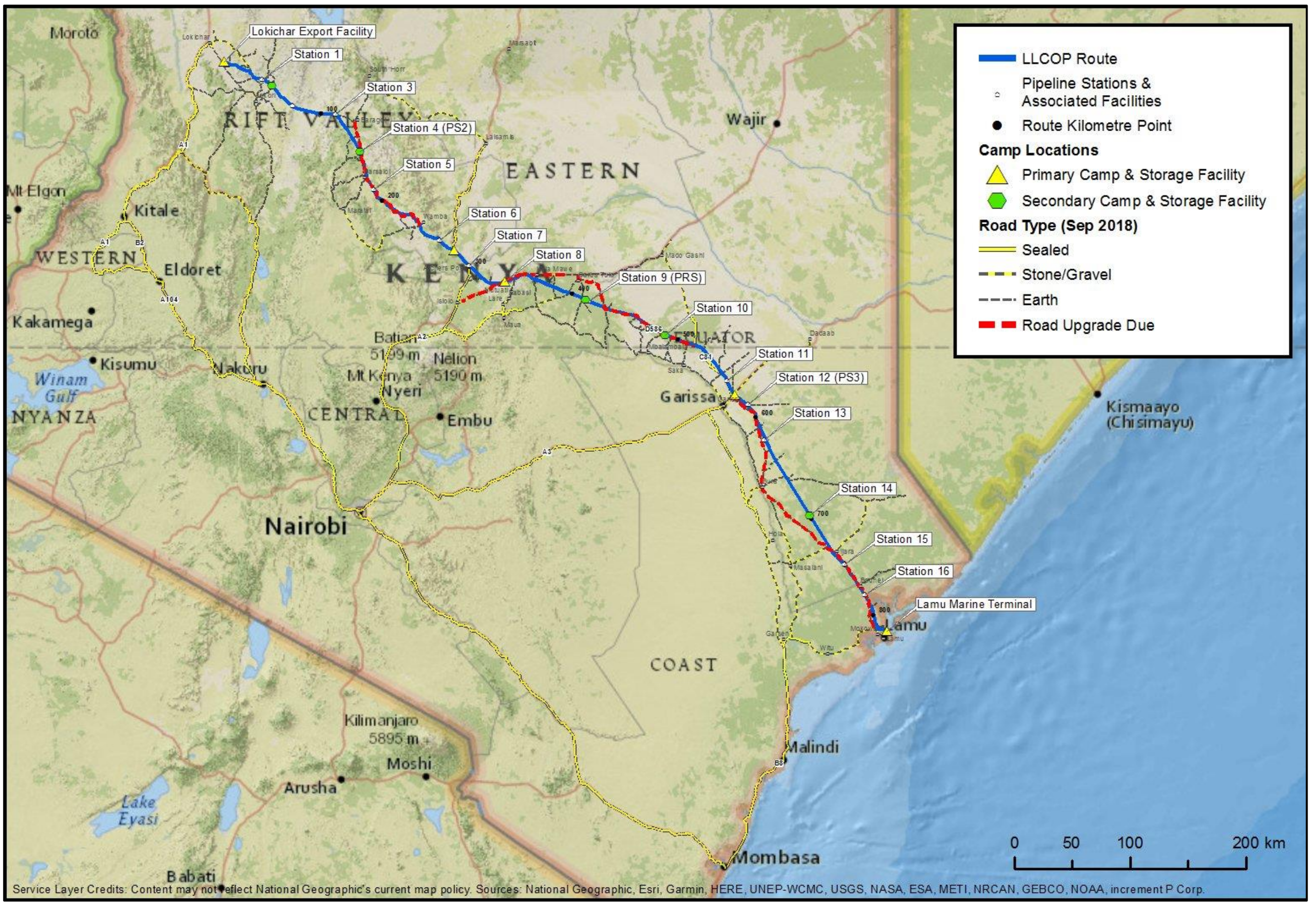


Figure 4.1-24: Expected Road Upgrades Prior to Construction

Mombasa Port to Import Storage Facility

The route will follow the A109 as shown in Figure 4.1-25. The total route length is approximately 14 km, all of which is paved.

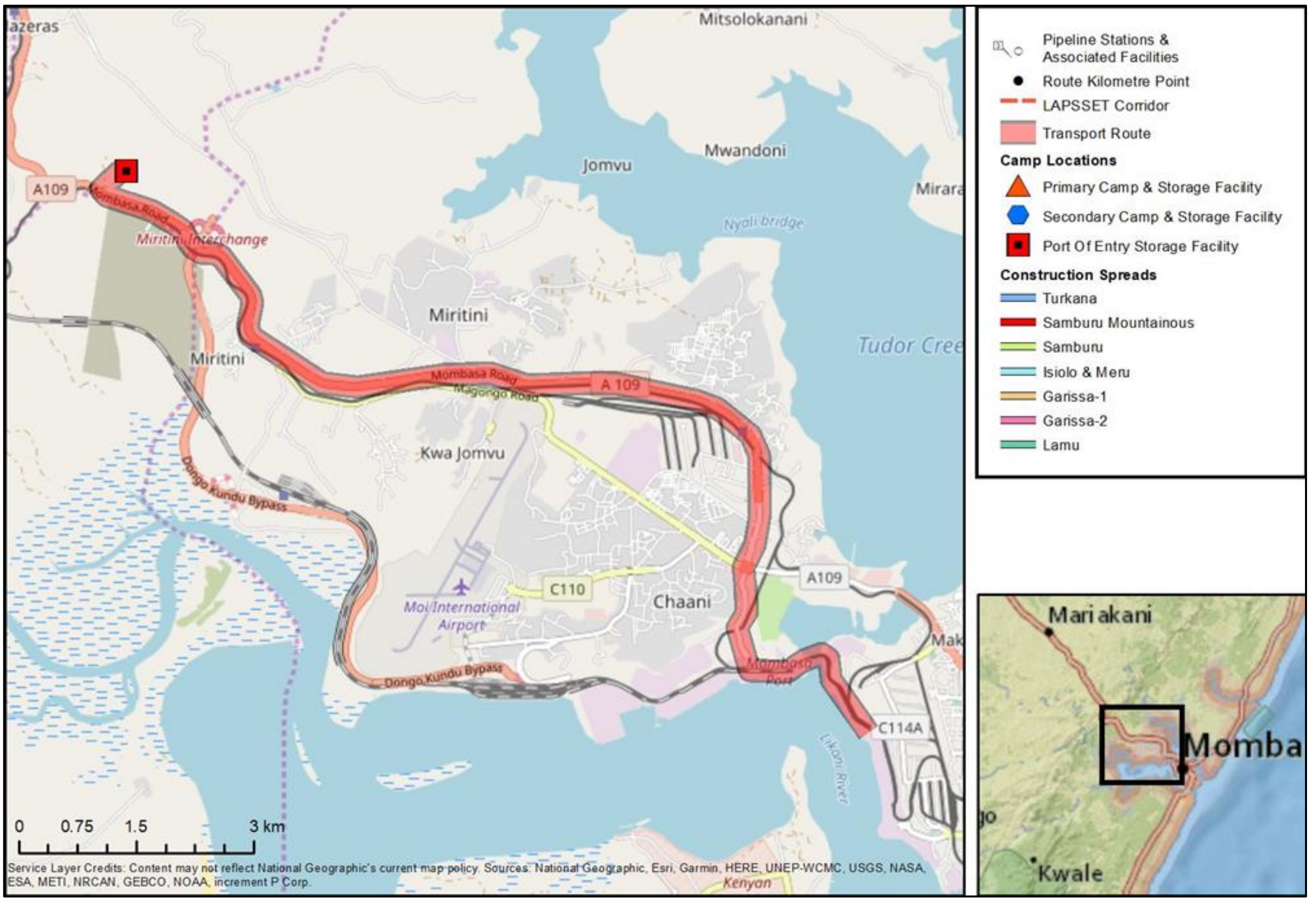


Figure 4.1-25: Transportation Route from Port of Entry to ISF

Import Storage Facility to Primary Storage Facility 1

The route will follow the A109, A104 and A1 as shown in Figure 4.1-26. The total route length is approximately 1145 km of which 100 km is estimated to be unpaved. This is aligned with the route taken by the EOPS transport to Mombasa.

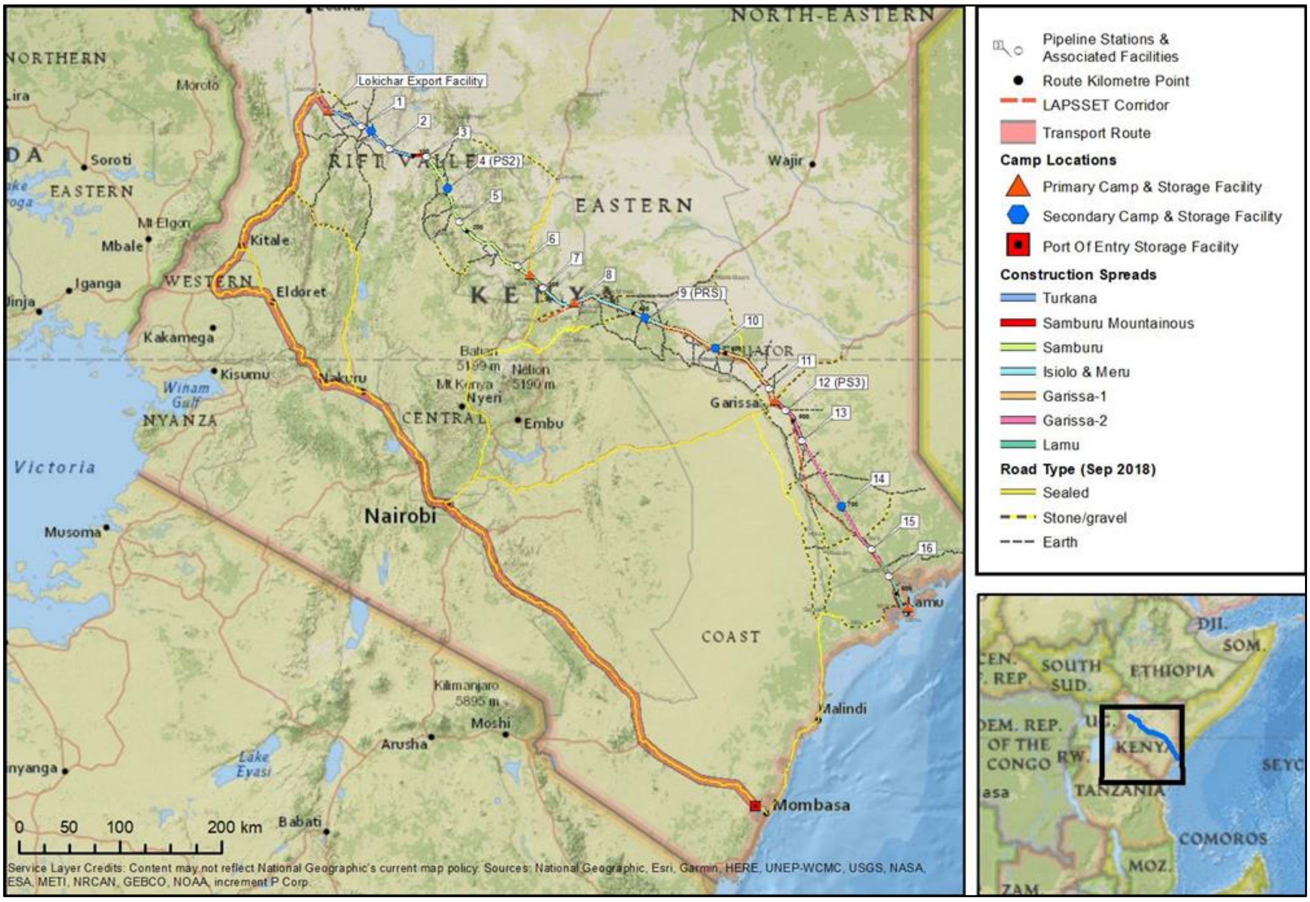


Figure 4.1-26: Transportation Route from ISF to PCS-1

Import Storage Facility to PCS-2

The route will follow the A109, A104 and A2 as shown in Figure 4.1-27. The total route length is 810 km all of which is paved.

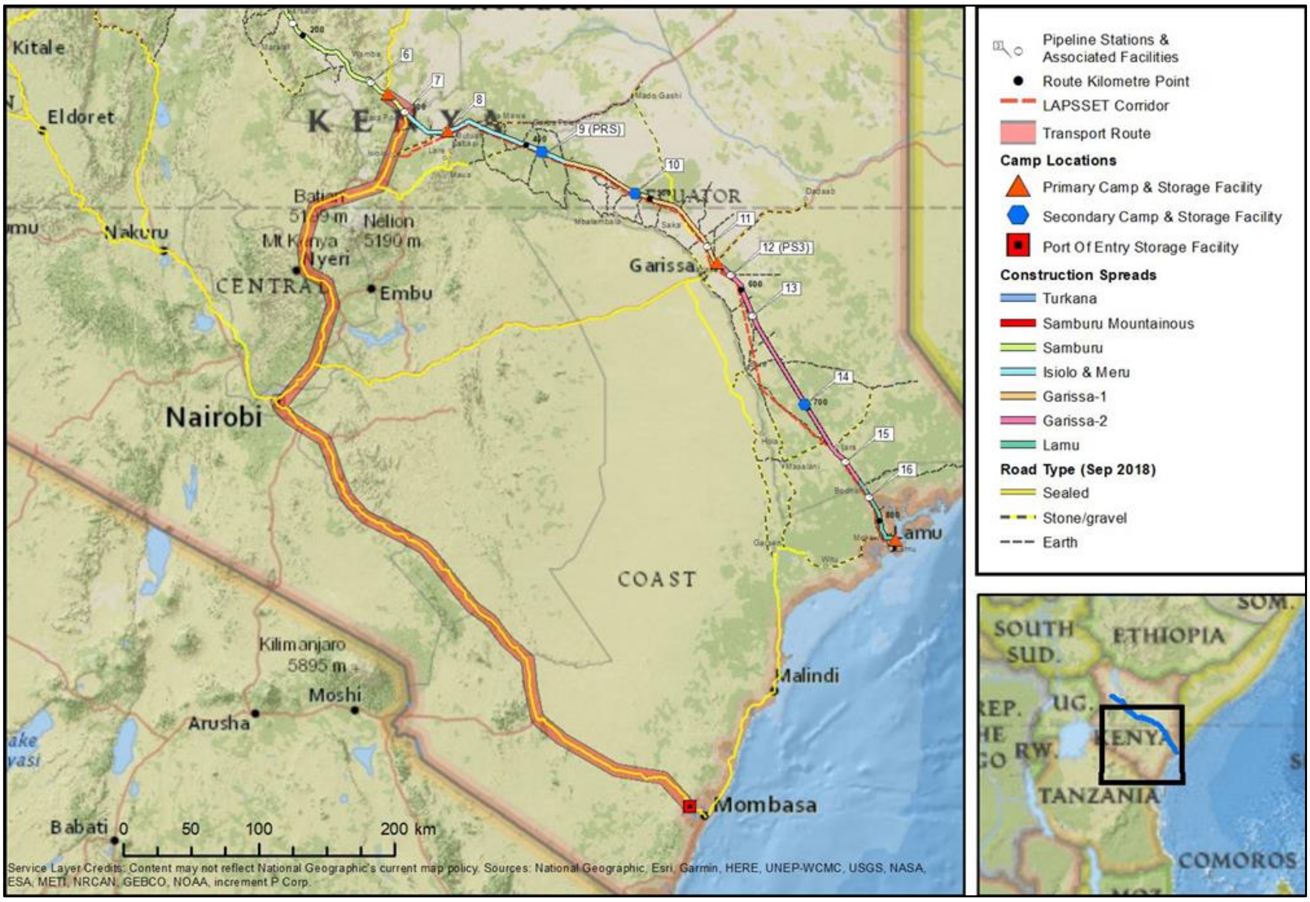


Figure 4.1-27: Transportation Route from ISF to PCS-2

Import Storage Facility to Primary Storage Facility 3

The route will follow the A109, A104, A2 and B9 as shown in Figure 4.1-28. The total route length is 805 km of which 45 km is unpaved.

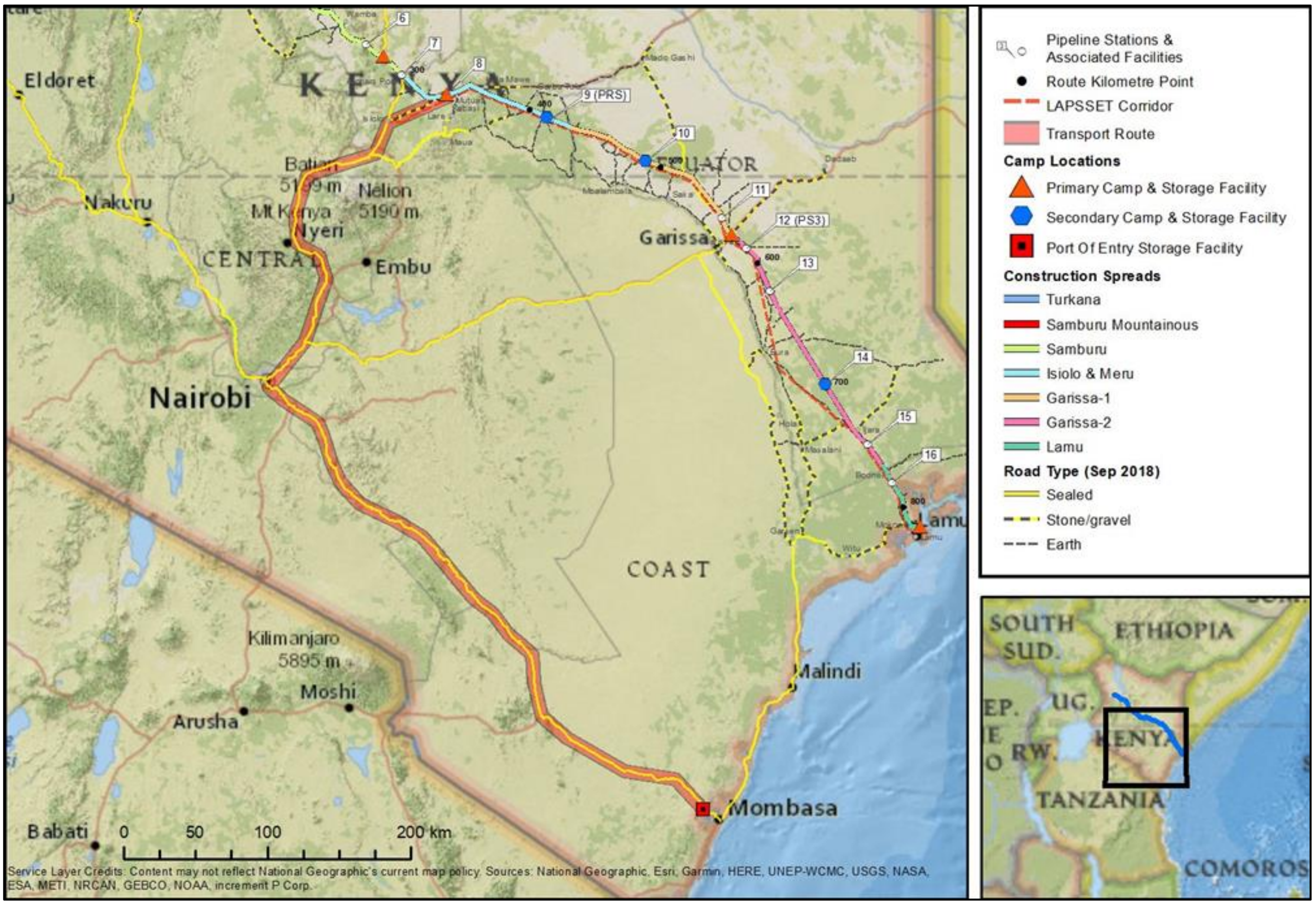


Figure 4.1-28: Transportation Route from ISF to PCS-3

Import Storage Facility to Primary Storage Facility 4

The route will follow the B8 and A3 as shown in Figure 4.1-29. The total route length is 475 km of which 85 km is understood to be unpaved.

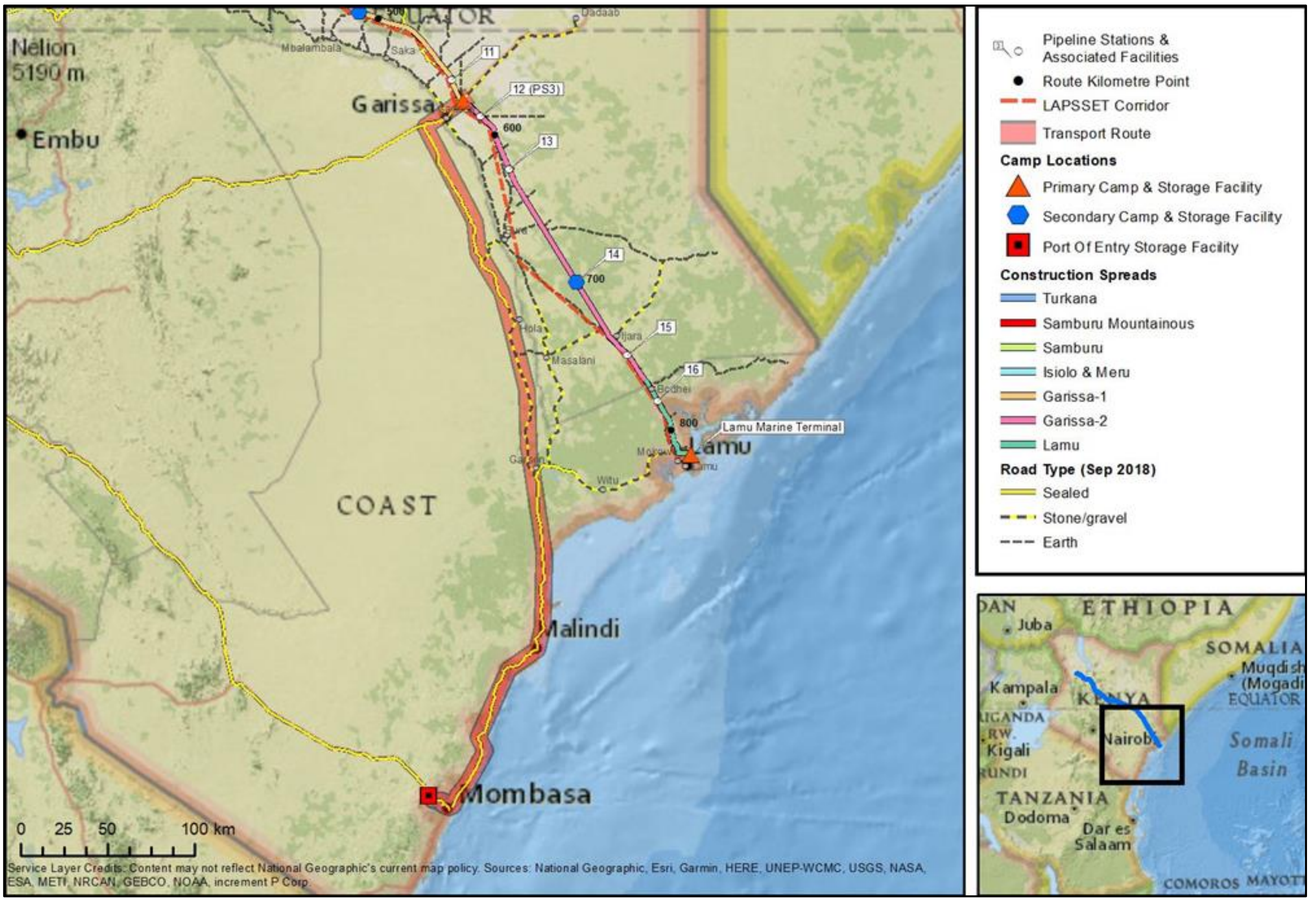


Figure 4.1-29: Transportation Route from ISF to PCS-4

Import Storage Facility to Primary Storage Facility 5

The route will follow the B8 and C112 as shown in Figure 4.1-30. The total route length is 340 km of which 110 km is unpaved.

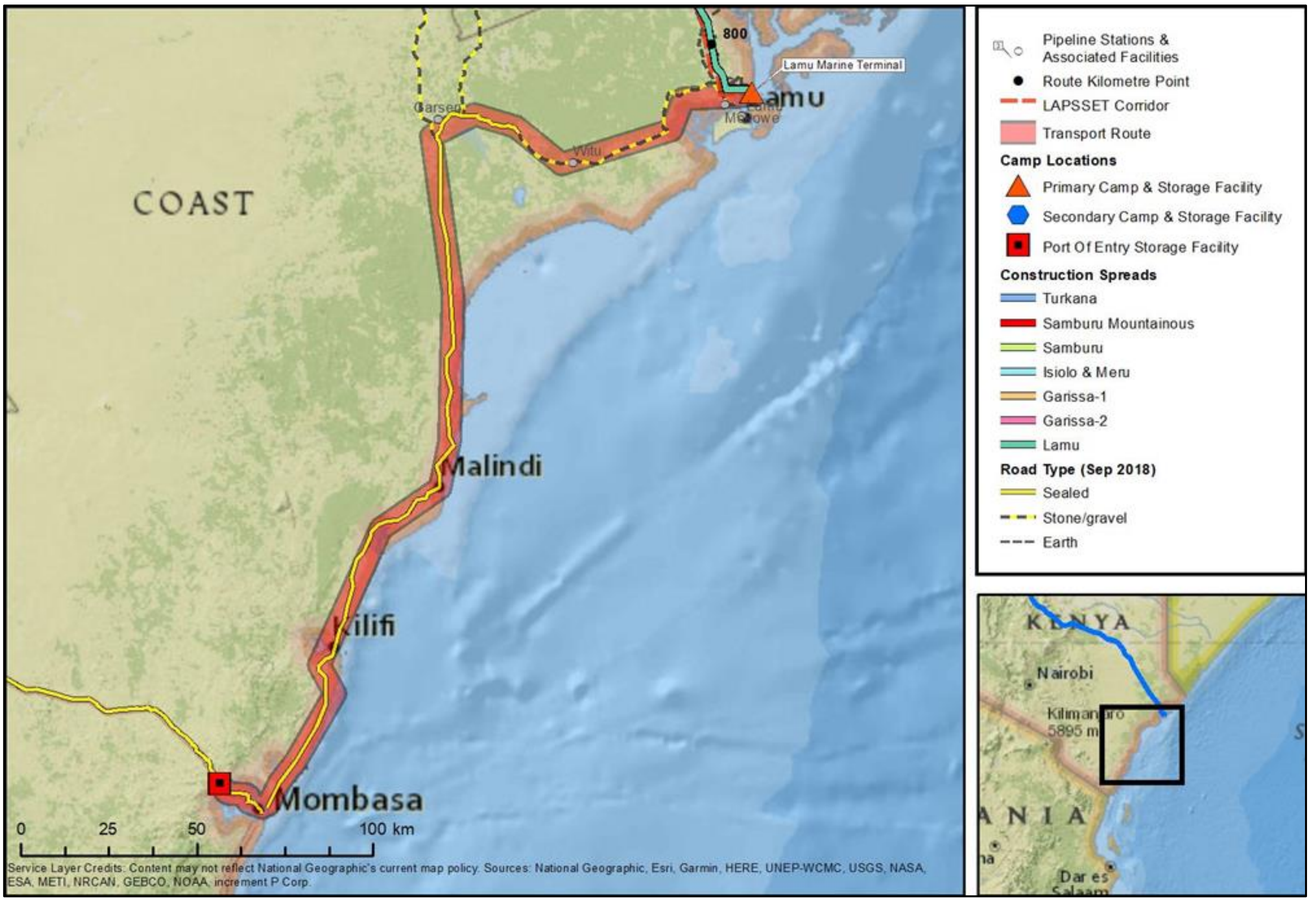


Figure 4.1-30: Transportation Route from ISF to PCS-5

4.1.9.4 In-field Transportation

To reduce interference with public traffic and transportation, the pipeline RoW will be used where practical and safe for the transportation of goods and equipment between storage yards and the site. When transporting goods to storage areas, the local road system will be used, with the option of also utilising the RoW to reduce the requirement for local road upgrades.

From the Import Storage Facility (in Mombasa) to the Primary Storage Facilities (in each County), roads that will allow the fastest route to destination will be selected (see above). From the Primary Storage Facilities to the Secondary Storage Facilities, roads and the RoW area will be utilised wherever possible to minimise the amount of new access roads that are required to be built.

Transportation will be possible to primary storage facilities throughout the year, as routes are not anticipated to be affected by the rainy seasons. Local transport to the secondary storage facilities will stop for the same duration as the construction activities, due to the reduced quality of the local roads and RoW transport during the rainy season

The maximum speed a flatbed truck can travel on a paved road is 40 km per hour, 30 km per hour for unpaved road and 20 km per hour on the RoW.

4.1.9.5 Pipeline Transportation and Supply

The pipe transportation and storage planning has been calculated assuming 12.2 m pipe lengths. As illustrated in Figure 4.1-31 below, these will be transported on standard 40' flatbed trailers.

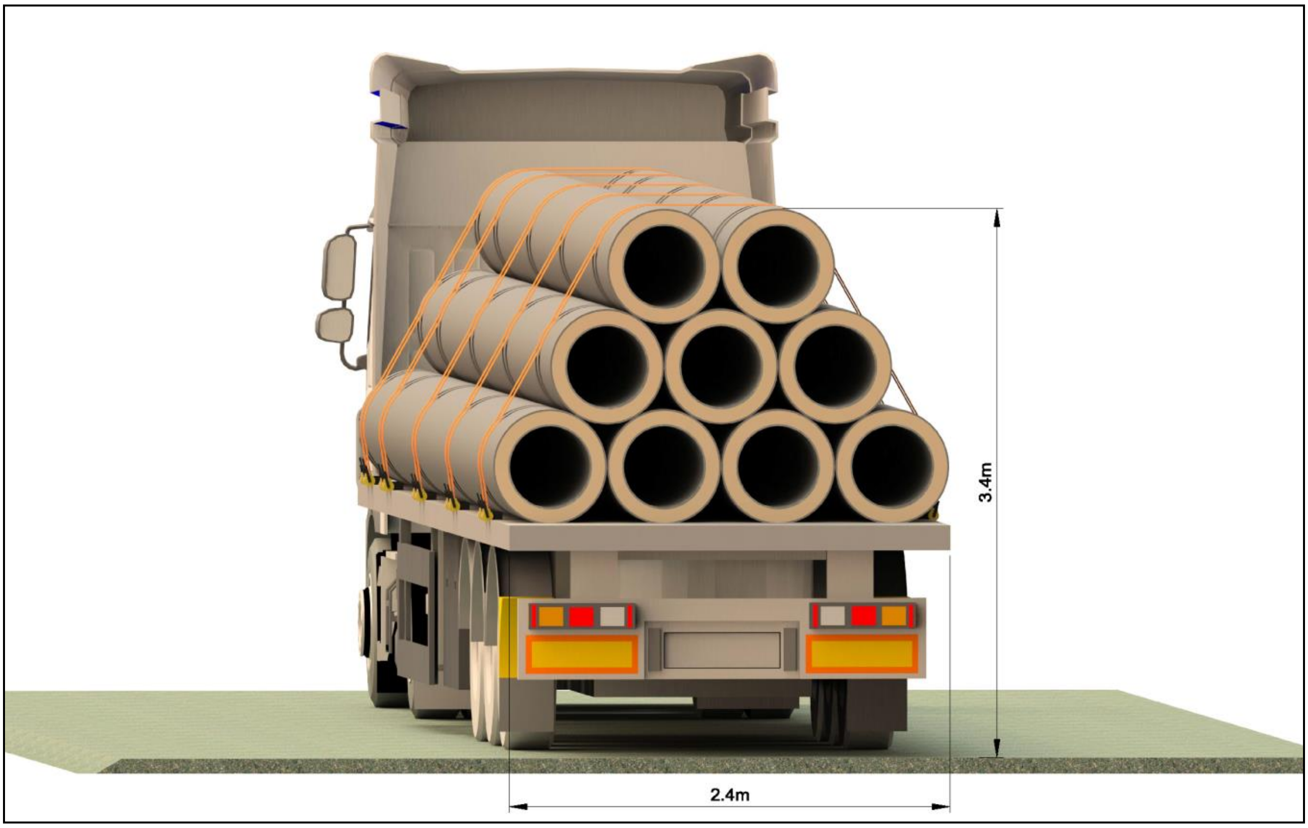


Figure 4.1-31: Pipe configuration for truck transportation

Table 4.1-9 outlines the number of journeys and trucks required to deliver the line pipe and associated fittings to the required storage destination within scheduled construction timeframe.

4.1.9.6 Transport of Other Equipment and Materials

Transportation of equipment and materials to stations will be containerised where possible and carried on articulated trucks with 40 ft trailers, with a maximum load of 25 tonnes, and on the assumption of direct transport to site for installation following import at Mombasa. Once at the pipeline route, trucks will move down the RoW to the installation location.

4.1.10 Pre-Commissioning

Pipeline pre-commissioning activities include cleaning, testing and drying. Similar operations will be undertaken for the project facilities. Activities will be performed by the construction contractor to ensure the pipeline is ready for overall commissioning.

The onshore pipeline pre-commissioning will be carried out separately by the individual spreads responsible for each county, in line with the construction strategy. Pre-commissioning will begin after backfilling and compaction activities have been completed.

Within each spread, the pipeline will need to be tested in several sections, dependent upon design pressures and construction schedule/section, access, elevation terrain, and water availability.

Table 4.1-9: Required trucks and journeys for transportation of line pipe

Route		Route Distance (km)	Total Number of Truck Journeys Required	Minimum Number of Trucks Required
From	To			
Mombasa Port	Import Storage Facility (ISF)	14	7792	12
ISF	PCS-1	1145	942	15
ISF	PCS-2	810	1903	24
ISF	PCS-3	805	1232	16
ISF	PCS-4	475	3193	30
ISF	PCS-5	340	527	4
PCS-1	SCS-1	65	487	2
PCS-2	SCS-2	150	1106	8
PCS-3	SCS-3	94	526	2
PCS-4	SCS-4	88	557	2
PCS-4	SCS-5	190	660	6
		Total	**18,925**	**121**

4.1.10.1 Filling (Flooding), Cleaning and Gauging

Pipeline cleaning will be completed prior to hydrotesting in order to remove any loose rocks, sand, construction debris or any waste left over from the construction phase, which could potentially damage the pipeline or processing equipment.

The onshore pipeline will be filled with filtered fresh water for testing. Where possible, test water will be transferred to the next test section, reducing additional water requirements and the subsequent need for water disposal. Acceptance levels for cleanliness will be defined in the Contractor's pre-commissioning procedures. Where possible the installation of any flanged block valves will only proceed once initial satisfactory cleaning operations have been completed, in order to avoid damage to valves.

4.1.10.2 System Pressure-testing (Hydrotesting)

Hydrotest sections will consider wall thickness, elevation profile and the potential location of water. The number of hydrotest sections will be minimised, with test sections no greater than 40 km. Due to the uncertainty regarding actual recycling of hydrotest water, firm volumes of water to be disposed of cannot be provided; however anticipated fill volumes (based upon pipeline volume is approximately 125,000 m^3.

The potential impacts associated with the abstraction and discharge of hydrotest water are described in this ESIA and appropriate mitigation measures are defined. Once final locations have been identified a detailed environmental risk assessment and stakeholder consultation process will be undertaken to define site-specific mitigations and ensure that local institutional stakeholders have been appropriately consulted. Based on the risk assessment and consultation exercise, approval for the abstraction and subsequent discharge of hydrotest water will be sought from appropriate authorities including the Water Resources Management Authority (under the Water Act, 2006) and NEMA as a variation under the EIA Licence for the project (or if required by WaRMA, as stand-alone ESIAs);

Water containing silt and suspended material with harmful corrosive components will not be used unless treated appropriately by use of filters or chemical additives. Potential primary water supply options for hydrotest, include lakes and rivers, existing water wells, and where available, local municipal water supply. Any abstraction will be undertaken only after the necessary permits have been obtained.

Where water source locations are limited, test water may be transferred between adjacent test sections. Water will be tested to determine chemical properties before pumping into the pipeline. Biocides and corrosion inhibitors will be avoided where possible, based on the water quality. Water will be extracted, filtered and pumped into the settling tanks before filling operations begin.

Items to be pre-tested before installation into the pipeline may include pipe for a major crossing. The pre-testing specification and procedure will be the same as the main strength test.

4.1.10.3 Dewatering – Discharge of Water

Pipeline cleaning and testing will require disposal of used hydrotest water and any solid matter removed from the pipeline. The preferred course of action is to recycle hydrotest water from one section to another.

Post-use, all hydrotest water will be tested, then discharged at a controlled rate to a site pre-agreed with the regulator. Land disposal is expected, incorporating erosion control measures.

4.1.10.4 Drying

In addition to dewatering, drying will be required to the point that a dew point of -40°C is achieved in the drying medium in each test section. The expected drying method will be dry air.

4.1.11 Commissioning

Commissioning is the preparation of a production system for start-up, or the preparation, start-up, and test of a non-production (utility) system to verify its functional and operational performance is in accordance with project design and specification. Commissioning is carried in accordance with System Commissioning Procedures (SCPs).

Commissioning activities will include the following:

- Authentication of safety systems to ensure proper installation;
- Energising of electrical systems and electrically powered equipment;
- Undertake initial visual review of equipment;
- Visual inspection of systems and sub-systems; and
- Emergency Shutdown system checking.

When all system commissioning, start-up activities and tests are complete, a System Completion Notice (SCN) may be issued. When the SCN has been signed off, responsibility and ownership of the system transfers from the Design Team to the Operations Team.

4.1.12 Pipeline Operations

4.1.12.1 Environmental and Social Management System

The Project will develop and implement an Environmental and Social Management System (ESMS) to implement the mitigation requirements set out in the ESIA and other project controls.

4.1.12.2 Pipeline Control System

The pipeline will be monitored, operated and controlled from the Main Control Centre at LMT, which will be continuously manned 24 hours a day, 365 days a year. The pipeline will be controlled and operated through an Integrated Control and Safety System (ICSS) consisting of a process control system, safety systems and overall security systems. A back-up/secondary Control Room for pipeline operations will be provided within CPF Control Room.

Integrated Control and Safety Systems (ICSS)

The ICSS consists of the following sub-systems, as a minimum:

- PCS (Process Control System):
  - The PCS will monitor and control all process equipment associated with pump stations, pressure regulating stations, etc.
- Safety:
  - Emergency Shut Down;
  - Fire and Gas Systems; and
  - Process Shut Down.
- Security System.

Security Systems

At each Station, including PS1 and the LMT site, the 'core' installation will be contained within an inner High Security fence. The fence will be monitored by perimeter CCTVs and fence mounted Perimeter Intrusion Detection System (PIDS). The PIDS, based on DAS technology, will monitor any threat to the pipeline along its entire length. At all manned Stations, a card-based Access Control System to buildings will be installed.

Telecommunications

Telecommunications infrastructure will be based on a fibre-optic cable (FOC), laid with the pipeline, which will provide control/safety data communications, together with telecom/auxiliary services (telephone, security, CCTV, access control, metering, leak detection and other services) along the pipeline. A back-up communication system is provided using satellite links located at selected stations. During FOC failure, satellite communication will provide a continuous link between all sites.

4.1.12.3 Emergency Preparedness and Response

A number of events could potentially lead to leakage from a pipeline. Causes of pipeline releases may include third party interference, corrosion, material failure; as well as events such as flooding or ground movement. Each of the events are considered in turn and the mitigation, within the LLCOP design highlighted. An emergency response facility will be located at the LMT.

Third Party Interference

Third party interference can be either accidental or malicious for example, striking the pipeline during some third-party construction activity, illegal tapping to steal the product, or an act of sabotage. The most prevalent event is accidental damage during third party construction activities.

As described above, the pipeline will be monitored by a DAS detection system which will detect any activity close to the pipeline and allow intervention to prevent damage. Additionally, there will be routine inspection patrols carried out by and on behalf of the pipeline operator.

4.1.12.4 Operations Manning Philosophy

The proposed operations manning is set out below:

- Manned Facilities:
  - LEF (PS1);
  - Station 4 (PS2);
  - Station 6;
  - Station 8;
  - Station 9 (PRS);
  - Station 10;
  - Station 12.
  - Station 14; and
  - LMT.

Accommodation facilities will be provided at various stations and the LMT for manned station operations. Station 4, 9, 10 and 14 will have accommodation provisions. Accommodation at the LEF is provided within the CPF facility. Security guards will be located at all facilities.

4.1.13 Decommissioning

The pipeline has a design life of 25 years. At this stage it is not possible to anticipate the situation at that time. However, in line with good international industry practice, the following Decommissioning Philosophy will be adopted:

- All underground equipment (pipeline) will be emptied of oil product, left in a clean state and left *in situ*;
- All above ground infrastructure (stations) will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with Affected Communities and County Government to identify any facilities than can be safely handed over for community use;
- All marine facilities will be emptied of oil product and removed from the site for safe disposal; and
- Five years prior to the planned End of Project, a Decommissioning Plan will be developed for agreement with the appropriate authorities.

Information relating to the Decommissioning Philosophy is set out in Section 8 of this ESIA.

4.2 Analysis of Alternatives (including ‘No project’ Alternative)

4.2.1 Introduction

The layout and design of the Project as described in the Project Description was developed through an iterative design process, which considered a variety of project alternatives for the transportation, storage and export of waxy crude oil from the oil fields and associated Central Processing Facility (CPF) at Lokichar in Turkana County.

As part of the feasibility assessment process, project alternatives were progressively narrowed down, with the adoption of a crude oil pipeline emerging as the favoured and the most feasible method of transporting the crude oil to the coast for export. As the design process progressed, a range of pipeline route alternatives were considered to achieve the optimal routing. This section presents an analysis of the potential alternatives that were considered and, where relevant, why they were discounted or excluded from the Project Design. This section also presents an analysis of the 'no project' alternative, which considers the situation if the LLCOP Project did not exist.

4.2.2 Need for the Project

Under the Vision 2030 programme of the Government of Kenya, development of the oil and gas sector is identified as an economic imperative. The development of the oil and gas industry in Kenya is considered to be an important strategic goal for achieving sustainable economic growth and the LLCOP project represents a fundamental component of this strategy. Without the project, the capacity of the Government of Kenya to deliver its aspirations for wider economic growth will be reduced.

In addition, the Lamu Port, South Sudan, Ethiopia Transport Corridor (LAPSSET) development is also part of the Vision 2030 process for the economic development of northern Kenya, providing a linear multi-spoke land corridor for strategic infrastructure development. It is a major initiative for Kenya and the East African region and, as part of its initial mandate, it includes a crude oil pipeline from Turkana to the Indian Ocean.

The PSC for Blocks 10BB and 13T provides authority to explore and produce oil in South Lokichar, but a route to market is required for production to be commercially feasible. In 2007, Turkana Drilling Consortium (Kenya) signed a Production Sharing Contract (PSC) for a 100% working interest in newly designated Block 10BB in South Lokichar. In 2011, Africa Oil Kenya B.V and Tullow Kenya B.V (TKBV) each acquired a 50% interest and Operatorship in blocks 10BB and 13T. At the end of 2015, Africa Oil Corporation (AOC) entered into a farm-out agreement with Maersk Oil & Gas A/S, whereby Maersk acquired 50% of Africa Oil's interests in blocks 10BB and 13T. Subsequent to this, Total acquired the Maersk working interest of 25%.

4.2.3 Project Alternatives

4.2.3.1 Strategic Alternatives

The primary strategic alternative that was considered focused on whether it was feasible to refine or partly process the crude oil at Lokichar. This, however, was discounted as the scale of the discovered hydrocarbon resource at South Lokichar is insufficient to justify the investment required to develop a refinery – such an option would not be economically viable.

To be economically viable, refineries typically need to process large volumes of hydrocarbons on a constant basis (i.e. operating 24 hours a day) and, therefore, need to be located where they can process hydrocarbons from a large number of different sources rather than from a single oil field. Also, the local market for refined product (i.e. northern Kenya) would be too small to provide a viable market for refined oil products at the volumes required and so there would still be a requirement for the long-distance transport of large volumes of processed hydrocarbon product to other market destinations, meaning a pipeline would likely still be required.

In order to develop the discovered hydrocarbon resources in the South Lokichar Basin, the only feasible option is to export the resources and, to make this economic, such export would need to be on a large scale. To realise the full potential of the reserves, such export would need to be international.

4.2.3.2 Transportation Alternatives

An initial, high-level assessment of project alternatives was undertaken as part of pre-feasibility studies to determine the most effective method of transporting crude oil from Lokichar to a point of international export on the coast. Alternatives to a pipeline that were considered include transport by road (using Tanktainers loaded onto trucks) and transport by rail, as well a range of non-conventional transport methods (e.g. by air or along watercourses) or a mix thereof.

The study of innovative and non-conventional alternatives did not yield any practicable new ideas that could be safely employed to transport crude oil over the distance and in the volumes required. These non-conventional alternatives were, therefore, discounted at an early stage.

Road Transport Alternatives

Transport by road was not considered a feasible alternative as the volume of crude oil to be produced by upstream operations would necessitate a fleet of trucks so large (approximately 3,000) that the existing road infrastructure could not accommodate such transport, even if such a truck fleet were available. The health and safety implications, in particular, of such a large fleet of trucks, was a key determining factor in discounting road transport as a project alternative. Whilst there is a precedent in other locations around the world for transporting large quantities of crude oil by road, the Early Oil Pilot Scheme (EOPS), where limited volumes of crude oil (c. 2,000 barrels of oil per day) have been transported from Lokichar to Mombasa, has demonstrated the challenges of doing so in Kenya.

Rail Transport Alternatives

Similarly, there is a precedent for transporting large quantities of crude oil by rail transport. This has also been evaluated as a potential project alternative but has been discounted for a number of reasons. Primarily, the prohibitive cost of upgrading the current rail infrastructure makes this alternative unfeasible; the nearest railhead to the oil fields at Lokichar is located at Kitale, and the existing railway from Kitale to Nairobi is a narrow-gauge system, which is not appropriate for transportation of the crude oil.

In September 2016, TKBV commissioned a risk assessment of the potential use of Rift Valley Railways to move the crude oil from Eldoret to Mombasa in the context of EOPS. The key findings were that significant capital expenditure and modifications of rail infrastructure at Eldoret Inland Container Depot (ICD) and Changamwe Refinery were required and such modifications would take a minimum of 6 months. In addition, buildings at Eldoret ICD are currently being used by Moi University students, creating additional encroachment and separation issues, which would require to be managed. In addition to the cost of establishing a rail link to Lokichar and upgrading the existing rail infrastructure between Kitale and Nairobi, the new railway that has been constructed between Nairobi and Mombasa would not be able to accommodate the additional rail traffic that transportation the crude would require.

Multi-Modal Alternatives

A combined approach of transport by road and rail was also considered as an alternative but was discounted because the flaws of both approaches remained (i.e. large fleet of vehicles and inadequate road/rail infrastructure), with the added loading/unloading interface between modes of transport presenting an additional obstacle, both in terms of additional cost and additional risk of spillages.

Pipeline Selected as Most Feasible Alternative

Ultimately, it was determined that a crude oil pipeline was the most feasible method. It is widely accepted, based on extensive experience around the world, that pipelines represent a safer and more efficient mode of transport for crude oil than road or rail. An above ground pipeline was discounted at an early stage due to the potential impacts of such a pipeline on local communities and wildlife, as well as the potential for accidental damage, sabotage and theft.

4.2.4 Export Pipeline – Route Alternatives Considered

4.2.4.1 Regional Route Alternatives

Alternative pipeline routes have been considered at both a regional and local scale. At a regional level, the primary alternative route would be to link with the East African Crude Oil Pipeline (EACOP) that is currently in planning, however this was not considered a viable alternative. The routing of the EACOP, which is outside the influence of the LLCOP project, would require the transportation of crude oil a considerable distance away from the ultimate point of export, which increases both the environmental risks and cost. This alternative would also mean that crude oil would be exported from Tanzania, not Kenya, which does not meet the established need for the Project. As a result, the shortest and most efficient pipeline route identified is entirely within Kenya.

4.2.4.2 National Route Alternatives

At a national level, a number of potential pipeline route alternatives were considered, including the location of the export port. Lamu was favoured over Mombasa as it aligned with objectives of the LAPSSET project. Initially, the pipeline route was aligned to terminate along the coast approximately 30 km south of Lamu, near Ras Tenewi.

It was originally proposed that a Single Point Mooring (SPM) offloading system would be used, located in deep water. An SPM is a floating offshore mooring point, anchored to the seabed, with a pipe that connects to onshore storage tanks, allowing tankers to load up without requiring a purpose-built port. This alternative was discounted, however, as the results of the meteorological survey data indicated that prevailing weather and sea conditions during the rainy season in this area were not conducive to using an SPM, without significant weather-related downtime. Lamu Port was ultimately selected as the most feasible terminus as it represented a safe and sheltered mooring point for tankers to be loaded and accords with the overall objectives for Lamu Port, as defined by Kenya Ports Authority and the LAPSSET Corridor Development Authority

The precise routing of the pipeline between Lokichar and Lamu was rigorously assessed in a number of studies and the evolution of the route between 2014 and 2019 is shown in Figure 4.1-1. The final selected route incorporates a range of engineering design, constructability, accessibility and logistical factors. Further details of this process are provided in the Project Description but, in summary, the final route seeks to avoid settlements, protected or sensitive areas of biodiversity and community importance, agricultural land, and areas of high flood risk. Similarly, as described in the Project Description, the locations of the 16 Stations along the pipeline alignment factored in a range of design engineering, social and environmental considerations.

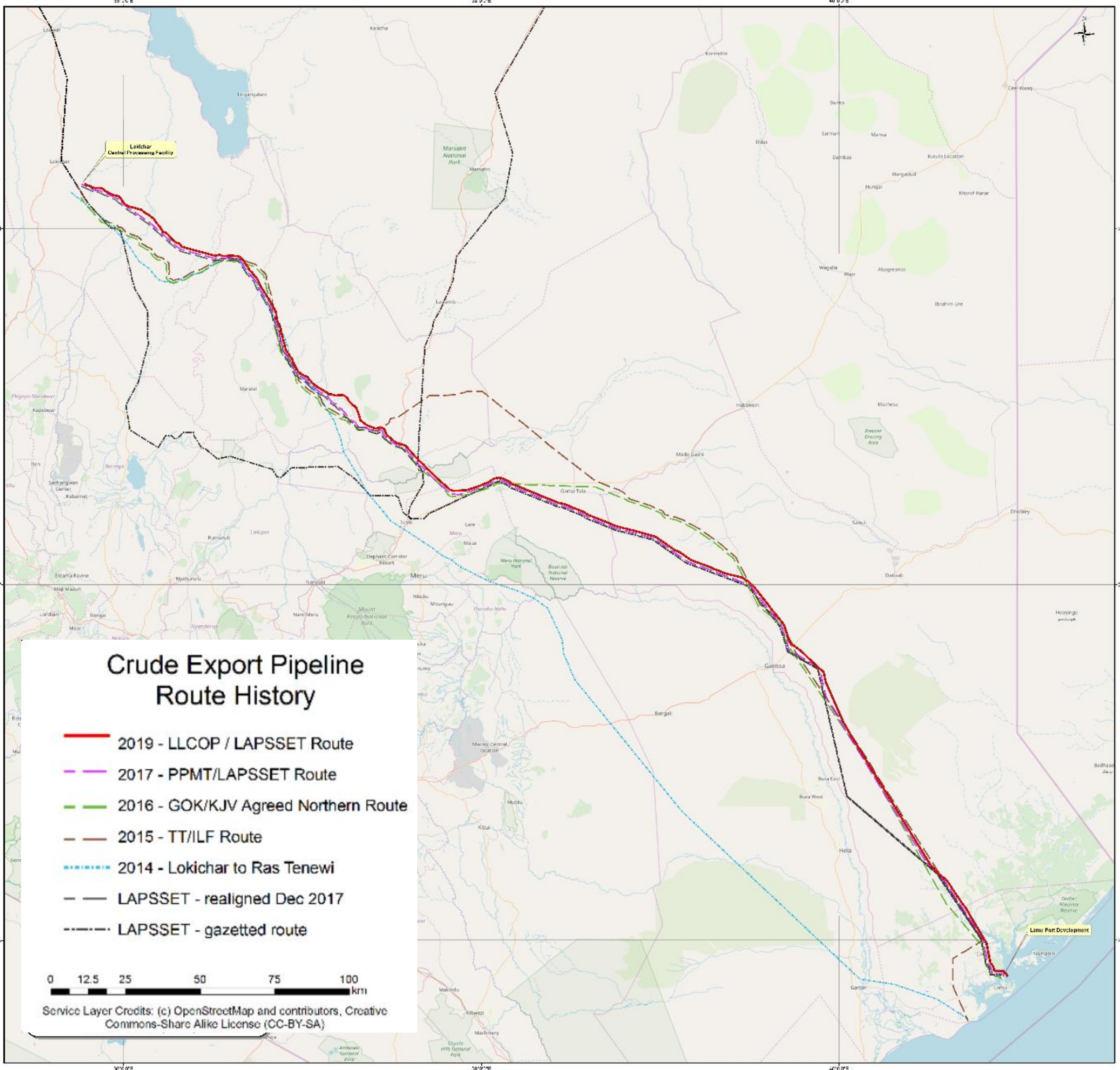


Figure 4.2-1: Pipeline route evolution 2014 - 2019

A number of the detailed route options within the selected route corridor that were considered are presented in Figures Figure 4.2-2 to Figure 4.2-6. Figure 4.2-2 depicts the alternative routes considered between Kilometre Point (KP) 0 and KP 49, with the proposed route selected to avoid ephemeral watercourses and riparian vegetation recognised as exhibiting higher value natural habitat.

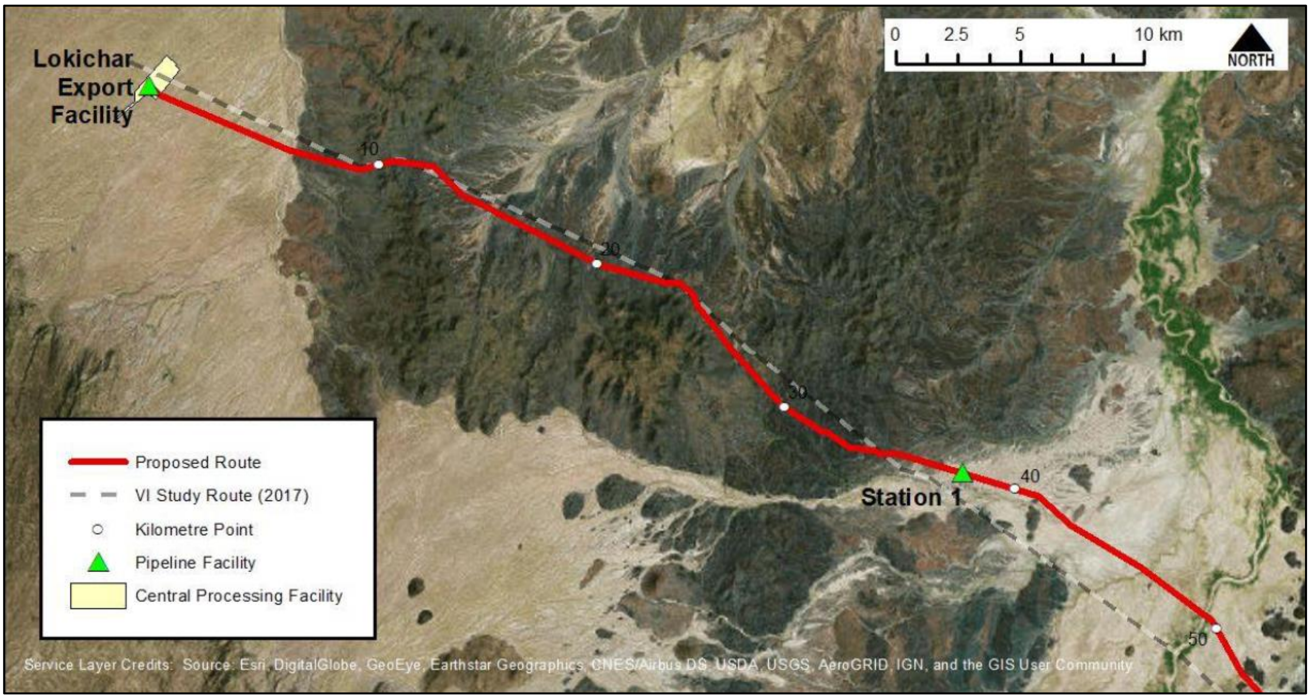


Figure 4.2-2:Alternative routes considered between KP 0 and KP 49

Figure 4.2-3 shows the alternative river crossing at the Kerio River that was considered (KP 49 to KP 50), with the proposed route selected to avoid important habitats. Similarly, Figure 4.2-4 shows the alternative river crossing at Ewaso Ng'iro River, with the proposed route selected to avoid the Shaba and Buffalo Springs National Reserves.

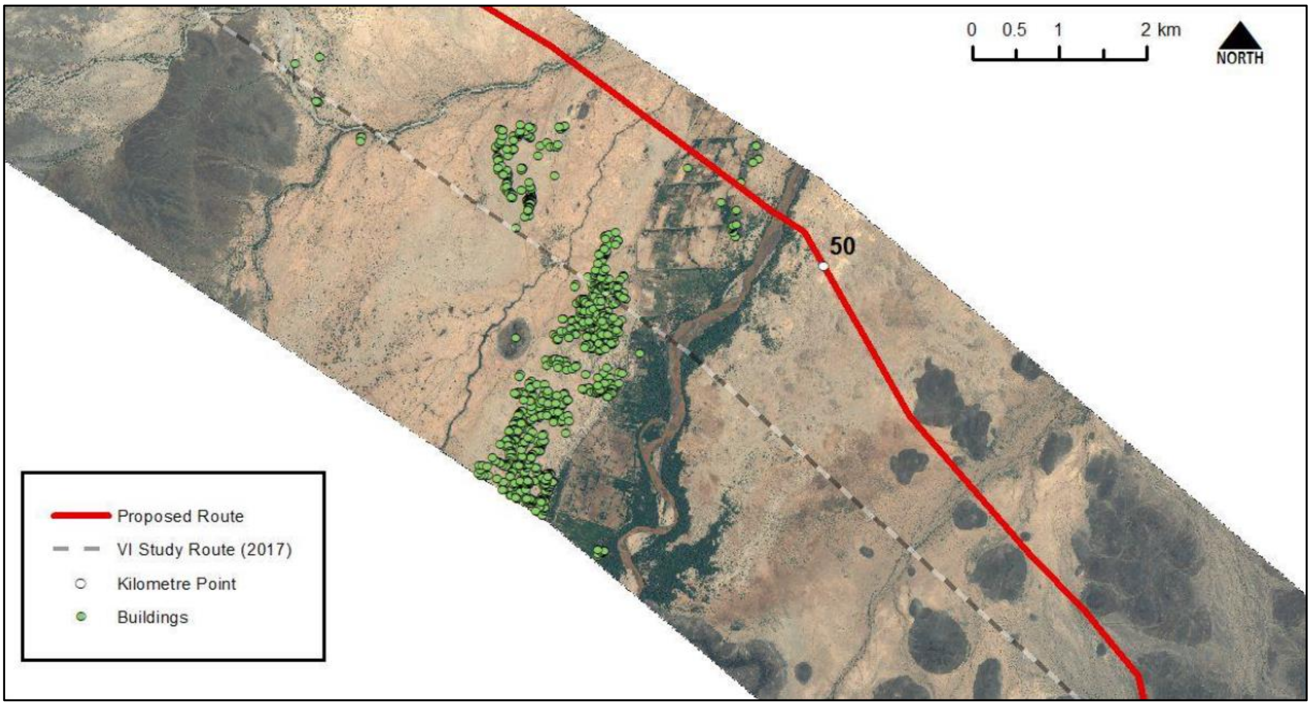


Figure 4.2-3: Alternative river crossing at Kerio River (KP 49 to KP 50)

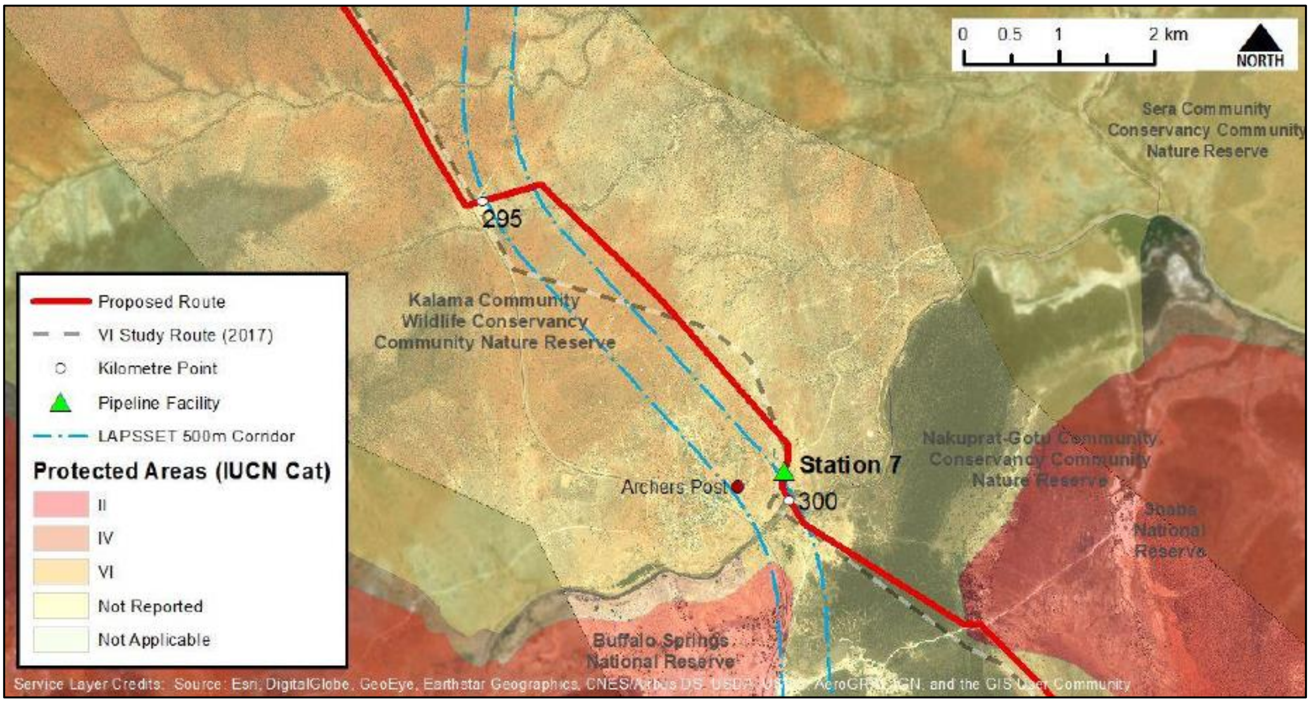


Figure 4.2-4: Alternative route at Ewaso Ng'iro River Crossing (KP 302, near Archer's Post)

Figure 4.2-5shows the alternative routes between KP 220 and KP 225. The proposed route was selected, based on stakeholder consultation, to avoid an area of importance for Grevy's Zebra.

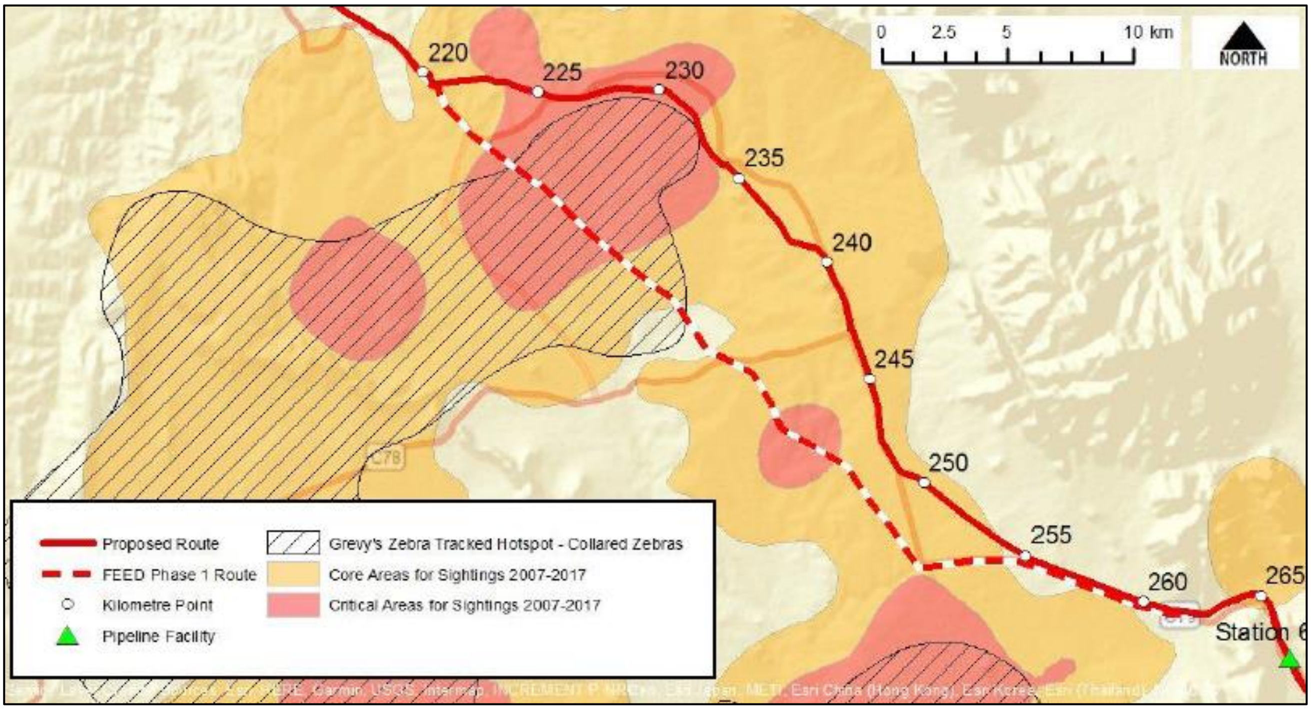


Figure 4.2-5: Alternative routes between KP 220 and KP 255

Figure 4.2-6 presents alternative routes considered between KP 603 and KP 743, with the proposed route selected as it avoids important wetlands recorded north of Ijara and reduces the overall length of the pipeline.

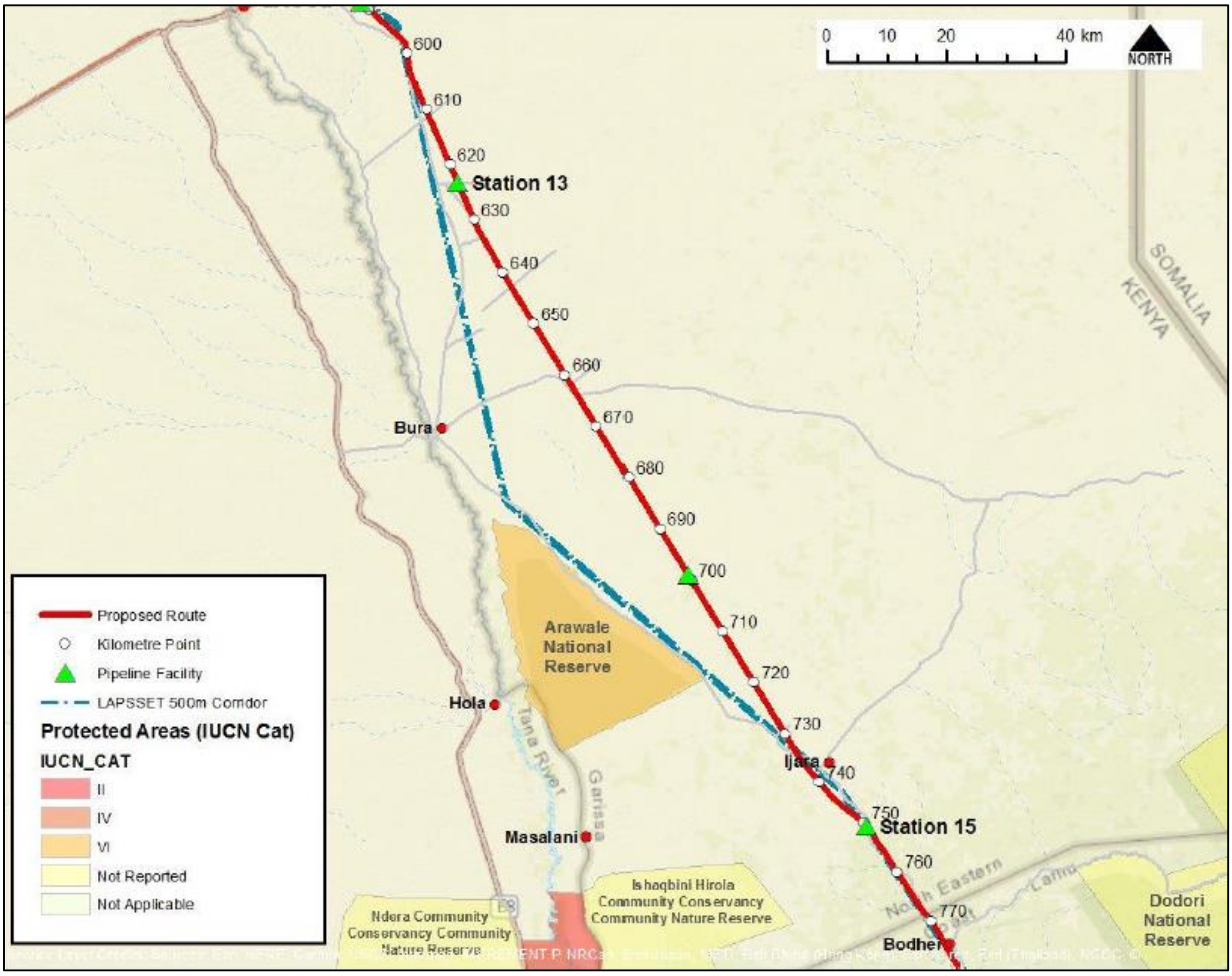


Figure 4.2-6: Route alternatives between KP 603 and KP 743

4.2.5 Export Pipeline – Technology and Design Alternatives Considered

Due to the waxy nature of the crude oil, the need to heat the pipeline along its length is unavoidable. Alternative methods of heating were considered (such as the use of oil-fired heaters at stations), but the LLHT system was considered to be the most appropriate low-impact solution and is a proven technology, having been used on other pipelines internationally.

With regards to power supply, a feasibility study was completed to assess the comparable viability of using standalone crude oil burning electrical generators at Stations along the route and connecting Stations to the existing national grid. This feasibility study indicated that the cost of developing and maintaining the infrastructure that would be required to use the Kenyan national grid to meet all energy supply requirements of the pipeline would be far higher than those for developing standalone electrical generators. Ultimately, a combination of the two approaches was selected, as described in Section 4.1.

Two design alternatives for the crude storage at Lamu have been considered – an onshore and an offshore option.

The base case described in Section 4.1 is the offshore option, which comprises a VLCC, which will act as a FSO vessel. This will be permanently moored at Berth 3 of Lamu Port, where it is sheltered by the Kenyan mainland, Manda Island and Pate Island and is only exposed to moderate wind and wave conditions. Oil tankers will be loaded from the VLCC.

The onshore alternative comprises a conventional onshore tank farm with three floating roof storage tanks. Vessel loading would be via large flow pumps from the storage tanks at the LMT, through the 2x26" pipelines to the LOF and through the loading arms directly into export tankers (Suezmax) at Berth 3. The discussions regarding the preferred option are ongoing with the Government of Kenya, although the offshore option has been used as the base case for the ESIA.

4.2.6 'No Project' Alternative

The 'no project' alternative represents a scenario in which the LLCOP project does not exist. In such a scenario, it is considered that the baseline environmental conditions, as presented in Section 6.0, would prevail and the impacts described in Section 7.0 would not materialise. As such, whilst the adverse environmental effects would not occur, the beneficial socio-economic effects of the LLCOP project would also not be realised and the established need for the project would not be met.

If the 'no project' alternative were pursued, then upstream oil operations at Lokichar would either become unfeasible, with the socio-economic benefits of that project similarly lost, or one of the sub-optimal project alternatives described in this section would have to be pursued, with its own attendant environmental impacts.

4.2.7 Engineering, Procurement and Construction (EPC) Process

The process of defining and detailing project design in ever greater detail will continue as the project design progresses into detailed design. The Project Description presents an indicative FEED-level concept for the construction process, with a number of details to be refined during the engineering, procurement and construction (EPC) process. These include accommodation of construction workers, transport of imported pipe from its import destination at Mombasa and waste management options.

The potential impacts associated with these issues are described in this ESIA and broad mitigation measures proposed. As a result, when final locations have been identified and the impact assessment and consultation processes set out have been implemented, approval for these facilities will be sought from appropriate authorities as a variation under the EIA Licence for the project.

5.0 STAKEHOLDER ENGAGEMENT

Significant engagement activities have been undertaken as part of the ESIA process. This section summarises the LLCOP consultation and engagement process and results under the following headings:

- Overview of consultation/engagement planning;
- Engagement Rounds:
  - Scoping Consultations;
  - Social Baseline Data Collection/Consultations;
  - ESIA Disclosure;
- Overview of Issues Raised by County, by Government and in meetings with NGOs and CSOs;
- Location in ESIA report where issues raised are addressed; and
- Consultation Team Members.

The Project's detailed Stakeholder Engagement Plan (SEP) and attachments are located in Annex III.

5.1 Overview

Participation in engagement activities is an integral part of the ESIA process to ensure that the views, knowledge, and concerns of Project stakeholders are taken into account in the assessment of potential impacts as well as in Project decisions. Stakeholder engagement activities occurred throughout the course of the LLCOP ESIA with strong focus on local communities, government, civil society organisations and non-government organisations (NGOs).

The LLCOP stakeholder engagement program is based on Kenya EIA Regulations:

- The Environmental Management and Coordination Act (1999) and the Environmental (Impact Assessment and Audit) Regulations (2003).
- Regulation 17 of L.N. 101: Environmental (Impact Assessment and Audit) Regulations 2003 stating that an applicant shall take all measures necessary to seek the views of people and communities which are likely to be affected by the project, during the scoping exercise.

In addition, International Finance Corporation (IFC) Performance Standard 7: Indigenous Peoples (2012) and relevant Guidance Documents were reviewed and applied as relevant. The Aweer people in Lamu are considered to be a 'Vulnerable and Marginalised' group and initial consultation meetings were taken with Aweer representatives to determine their potential to be negatively impacted by the LLCOP project (appended to Social Baseline, Annex II. Additional Aweer Social Baseline Data Collection, ref. 1772867.551.7).

Commencement of the ESIA began with "Scoping Consultations", (June 2018) held in each of the six counties that the proposed LLCOP will traverse and Nairobi. The purpose of scoping consultations is to determine the environmental and social issues and potential impacts that the ESIA should address. A detailed Terms of Reference for the ESIA was then produced, based partially on scoping consultation results and also on environmental legislation and regulations.

Approximately four months after the scoping consultation round of meetings, social baseline data collection activities commenced in Area of Influence (AoI) community location in all six counties[1]. Beginning in October 2018 and concluding in January of 2019, social baseline meetings were undertaken at the community level, with forty- nine communities participating in barazas and a series of focus group discussions with Elders, pastoralists, women, youth, farmers and fishers. County level meetings and update meetings with NGOs and Parliamentarians were also held during this social baseline round of consultations.

Upon completion of the draft ESIA, meetings were held with stakeholders in July 2019 prior to the final ESIA submission to NEMA. These 'ESIA disclosure consultations' were again held in all six county centres and with open invitation meetings in selected community locations, with NGOs at the community and national levels and with senior Government Officials and Parliamentarians. The purpose of this round of consultations was to review ESIA findings with stakeholders and obtain feedback on proposed environmental and social mitigation and management strategies. Figure 5.1-1 illustrates the timeline of consultations/engagement and other key dates during the ESIA process.

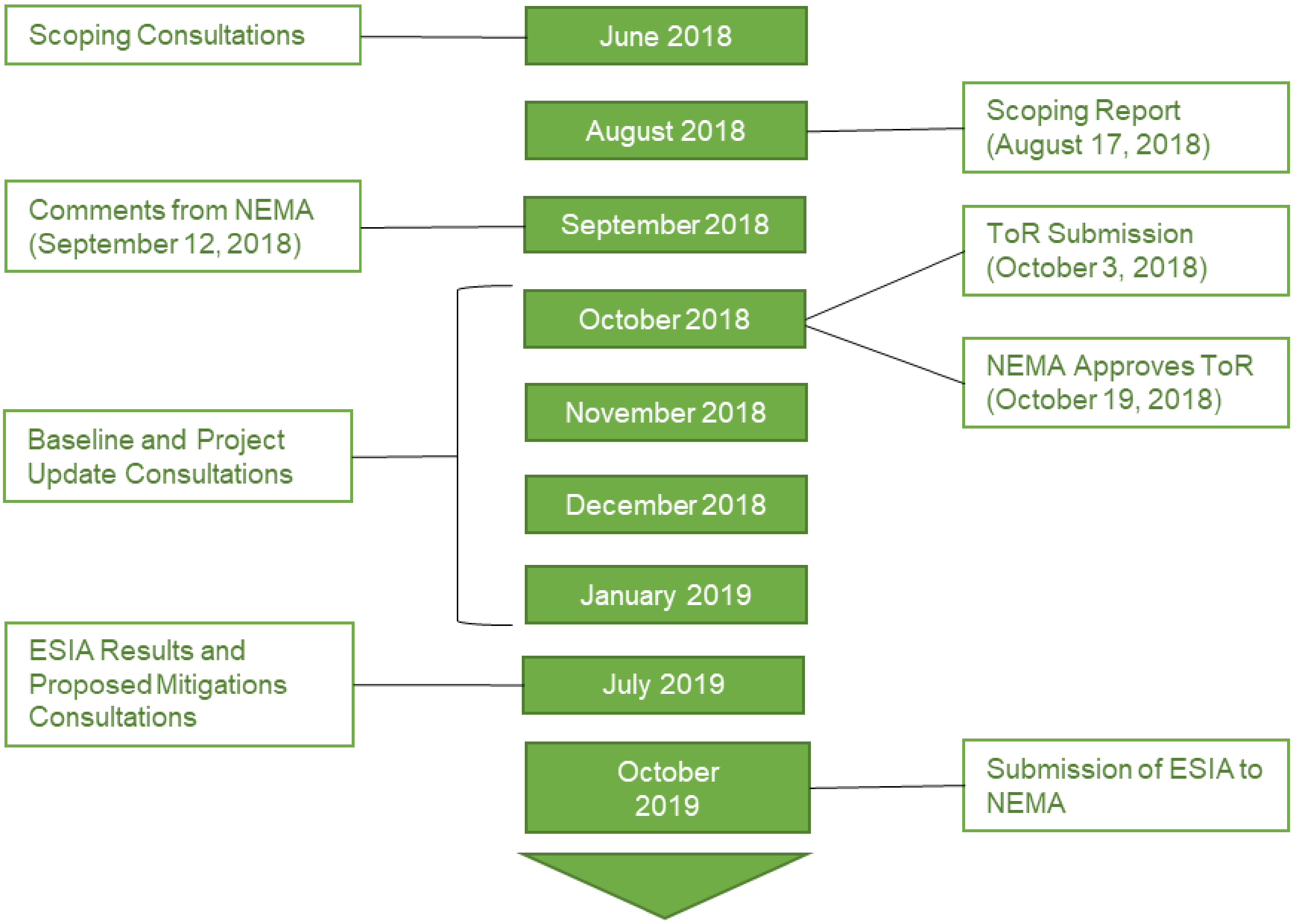


Figure 5.1-1:Stakeholder Engagement Timeline

Meeting schedules and results of the three "rounds" of consultations are described in the sections below. A Stakeholder Engagement Plan (SEP) was developed for the Project and is located in Annex III. The SEP provides detailed description of the planning of consultations and issues raised in all six counties. Attached to the SEP are all meeting minutes, consultation materials used, stakeholder registration lists and example output

[1] The Project's Area of Influence regarding social impacts is defined as communities within approximately 25 kilometers of the pipeline route.

from the project stakeholder database. Annex III, therefore, documents all engagement activities carried out collaboratively between Golder, ESF and the PPMT throughout the ESIA process.

It should be noted that the LAPSSET Authority has already undertaken stakeholder engagement regarding other projects that are part of the LAPSSET Corridor project. As the LLCOP is a component of LAPSSET and entirely within the LAPSSET corridor, representatives from LAPSSET have been present and have participated in LLCOP consultation meetings. A table listing all engagement team members that participated in consultations is provided in Section 5.2 below.

Consultation planning included the following steps:

- stakeholder identification and analysis;
- developing, with county level stakeholders, an approach to consultation activities that is culturally appropriate;
- setting the program for consultation to ensure timely notification of consultation activities and to tie in with key stages in the ESIA process;
- information disclosure, specifically the provision of timely and meaningful information that would be accessible to all stakeholders;
- continuous review of the approach and mechanisms for obtaining stakeholder feedback on the information disclosed; and
- receiving and documenting feedback for inclusion in the ESIA.

5.2 Scoping Consultations

Scoping engagement consisted of a series of eight meetings and included introducing the Project, the overall ESIA process, and gathering valuable information from counties, Parliamentarians, Non-Government Organisations (NGOs) and Civil Society Organisations (CSOs). Meetings were held in each of the six counties that the pipeline will traverse with information presented in English and Swahili. Information, concerns and questions were received from all Project stakeholders and captured in a Project database and included in the Project Terms of Reference (ToR) (Annex I). Scoping phase consultations occurred in June 2018 and the resulting Scoping Report and Project Terms of Reference is included in Annex I.

Following the Scoping meetings, the Project ToR was made available through ESF and can be accessed via the LAPSSET website:

- http://www.lapsset.go.ke/projects/oil-pipelines/

Meeting locations, dates and number of attendees at ESIA Scoping consultations are displayed in Table 5.2-1 below (minutes are attached to the SEP, in Annex III):

Table 5.2-1: Scoping Consultation Meetings

Date	Meeting/ Type	Total Participants
11 June 2018	Parliamentarian Forum - Nairobi	38
12 June 2018	National Gov. and NGO Forum - Nairobi	57
18 June 2018	County Meeting - Isiolo	58
19 June 2018	County Meeting - Meru	45

Date	Meeting/ Type	Total Participants
21 June 2018	County Meeting - Garissa	120
25 June 2018	County Meeting - Lamu	134
27 June 2018	County Meeting - Samburu	93
29 June 2018	County Meeting - Turkana	38
	Total Attendees	**583**

As early as April 2018 and during the Scoping consultations, meetings, telephone calls and email exchanges were held with several organisations to gather issues regarding critical habitat, endangered and species at risk that could be compromised by the LLCOP. Organisations and meeting dates and communications are displayed in Table 5.2-2 below.

Table 5.2-2: Environmental NGOs - Communications

NGO/Agency/Individual	Date
Kenya Wildlife Service (KWS)	27 April 2018
The National Environment Management Authority (NEMA)	2 May 2018
Kenya Wildlife Service (KWS)	8 June 2018
Save the Elephant (informal unscheduled meeting along pipe route)	14 Jun 2018
Kenya Wildlife Service (KWS)	18 (face to face) and 21 (telephone) June 2018
Merwell WildlifeTtrust	21 June 2018
Grevy's Zebra Trust	27 June 2018 in Nairobi
Grevy's Zebra Trust (scouts)	29 June 2018
Grevy's Zebra Trust (Westgate)	27 October 2018
Grevy's Zebra Trust	5, 6, 7 and 8 December 2018
Lamu Marine Conservation Trust (LAMCOT); and Watamu Marine Association (WMA).	Email exchanges and phone calls during 2018. In addition, Duncan Oyaro and Atwaa Salim Mohamed met face to face on the 18 January 2018.
World Wide Fund*	26 March 2019 Conference call with WWF (Kenya and Norway) to discuss scope of LLCOP project and drat Report prepared by WWF "Rapid Risk Assessment of the Lokichar – Lamu Crude Oil Pipeline".
Ewaso Conservation Forum (ECF)*	28 March 2019 at the Great County Inn, Archer's post.

**Note: These additional meetings were held to address specific concerns raised by stakeholders since the original scoping meetings.*

5.3 Social Baseline Data Collection and Project Update Engagement

A second round of consultation meetings were added during the social baseline data collection period between October 2018 – January 2019, in which 49 locations[2] were engaged as part of targeted consultations at the community level. County and community barazas were held to present project information to communities that are within a 25 km corridor of the proposed pipeline and to provide counties with updated information. Parliamentarians and NGOs were also invited to hear updated information about the Project.

In each of the 49 AoI community locations used, focus groups were held with Elders, pastoralists, farmers, fishers (where present), women and youth. Interviews were conducted with local leaderships and planners. Information from the focus groups was incorporated into the LLCOP Social baseline report (Annex II) with focus group discussion guides and write ups attached (Annex II). The objective of the focus group discussions was to collect information deemed important to assessing potential project effects on livelihood and community activities and to provide people at the 'grass roots' level opportunity to share concerns and questions about the Project. Engagement meetings during this round (barazas) are documented in the Project SEP (Annex III).

Dates, locations and number of participants attending the social baseline meetings and the update engagement meetings are presented in Table 5.3-1 below:

Table 5.3-1: Social Baseline and Project Update Meetings

Date	County	Town/Village	Total Number of Participants
17 October 2018	Garissa	Balambala	80
13 October 2018	Garissa	Bouralgy	29
18 October 2018	Garissa	Dagoob	64
15 October 2018	Garissa	Kamuthe	37
14 October 2018	Garissa	Korkora	39
12 October 2018	Garissa	Lantern Resort	45
16 October 2018	Garissa	Mansabubu	47
17 October 2018	Garissa	Masalani	67
13 October 2018	Garissa	Modikae	95
16 October 2018	Garissa	Saka	64
14 October 2018	Garissa	Sankuri	42
15 October 2018	Garissa	Shimbiri	36
13 November 2018	Isiolo	Boji	61
14 November 2018	Isiolo	Garba Tula	142
9 November 2018	Isiolo	Isiolo	124
12 November 2018	Isiolo	Kula Mawe	145

[2] The 49 communities within a 25 km radius of the Pipeline route are considered to be potentially affected and are therefore in the social Area of Influence (AoI).

Date	County	Town/Village	Total Number of Participants
10 November 2018	Isiolo	Ngare Mara	197
11 November 2018	Isiolo	Yaq Barsadi	47
28 October 2018	Lamu	Barigoni	162
27 October 2018	Lamu	Hindi	90
26 October 2018	Lamu	Jipe	170
25 October 2018	Lamu	Kiliana	120
24 October 2018	Lamu	Mokowe	75
23 October 2018	Lamu	Mwanarafa Hall (County mtg)	44
11 November 2018	Lamu	Mwanarafa Hall (Community mtg)	53
30 October 2018	Lamu	Pate	76
31 October 2018	Meru	Kaichuru Village	181
3 November 2018	Meru	Kandebene	157
2 November 2018	Meru	Laare Town	360
30 October, 2018	Meru	Meru Town	39
1 November 2018	Meru	Mutuati	224
19 October 2018	Samburu	Archers Post	93
23 October 2018	Samburu	Baragoi	94
25 October 2018	Samburu	Barsaloi	141
29 October 2018	Samburu	Lerata	199
23 October 2018	Samburu	Maralal	44
22 October 2018	Samburu	Nachola	566
27 October 2018	Samburu	Nkaroni	272
24 October 2018	Samburu	Suyian	135
26 October 2018	Samburu	Swari	118
28 October 2018	Samburu	Wamba	152
17 January 2019	Turkana	Kalapata	265
15 January 2019	Turkana	Katilia	361
20 December 2018	Turkana	Lodwar	20
18 January 2019	Turkana	Lokichar	313
14 January 2019	Turkana	Lokori	68

Date	County	Town/Village	Total Number of Participants
15 November 2018	Nairobi	Nairobi	20
16 November 2018	Nairobi	Nairobi	17
		Total	**5,970**

5.4 ESIA Disclosure

After a draft ESIA (this document) was completed, and prior its submission to NEMA, engagement meetings were arranged in all counties, and with Parliamentarians, NGOs and CSOs. This engagement round was held to discuss baseline findings, Impact Assessment outcomes and proposed mitigation measures and obtain input from stakeholders. These consultations were held in July 2019, as presented in Table 5.4-1 below.

Table 5.4-1: ESIA Disclosure Meetings

Date	County	Town/Village	Total Number of Participants
Monday 01 July	Isiolo	Isiolo town	207
Tuesday 02 July	Isiolo	Ngare Mara	108
Wednesday 03 July	Isiolo	Garba Tula	228
Wednesday 03 July	Garissa	Garissa town	66
Thursday 04 July	Garissa	Balambala	33
Friday 05 July	Garissa	Mansabubu	32
Friday 05 July	Meru	Meru Town	78
Saturday 06 July	Meru	Mutuati	186
Sunday 07 July	Meru	Laare	65
Monday 08 July	Samburu	Maralal	91
Tuesday 09 July	Samburu	Baragoi	145
Wednesday 10 July	Samburu	Wamba	104
Thursday 11 July	Turkana	Lodwar	55
Friday 12 July	Turkana	Lodwar – Mtg with NGOs	34
Saturday 13 July	Turkana	Lokori	75
Thursday, 01 August	Turkana	Lokichar	110
Monday 15 July	Lamu	Mokowe	33
Tuesday 16 July	Lamu	Mokowe – Mtg with NGOs	18
Wednesday 17 July	Lamu	Hindi	100

Date	County	Town/Village	Total Number of Participants
Thursday 18 July	Lamu	Mokowe	72
Thursday 18 July	Nairobi	Nairobi - Mtg with MPs	17
Friday 19 July	Nairobi	Nairobi – Mtg with NGOs	48
		Total	**1905**

5.5 Engagement Issues by County

Several common themes were evident throughout consultation rounds. Land acquisition processes and issues of land titling and compensation dominated much of the discussion about the pipeline project. In addition, all county level engagement meetings received questions about project benefits, climate change assessment and the project's plans for handling accidents and malfunctions (i.e. oil leakage or pipeline rupture).

The following discussion is a review and analysis of issues, comments and questions by county and/or group, focusing on the ESIA Disclosure meetings. Detailed discussion of issues raised in each county is included in the SEP (Annex III). Table 5.5-1 shows where specific topics and issues are addressed in the ESIA report.

Overall, 520 issues were raised during the ESIA Disclosure meetings. In addition to six county level meetings, twelve community meetings and three NGO meetings were held, as indicated in the table above. Communities were selected for meeting locations based on recommendations made by County Officials. Transportation was provided for up to ten selected representatives from nearby AoI communities. County Officials nominated the individuals to represent their communities. NGO meetings were held in counties where there is a concentration of NGOs, specifically Lamu and Turkana. A national level NGO meeting was held in Nairobi, preceded by a meeting with Parliamentarians and senior government officials.

Based on the analysis of the total number of issues raised and comments contributed, the following key themes and areas of interest are evident:

- 14 per cent of the total issues contributed during this phase were focussed on the benefits the LLCOP project would bring to recipients and communities that may be impacted by the pipeline. Expectations of employment targeted to counties that would be receiving the Project are high and employment of foreigners was frequently raised as a concern and discouraged;
- There is almost an equal distribution between issues regarding environmental impacts and land-related impacts, 11.0 and 11.2 per cent, respectively. Environmental issues (water, loss of vegetation, impacts on soils and revegetation) and questions about loss of land are related to changes in livelihoods, which are based on land and natural resources.
- 9 per cent of the total issues raised revolve around expectations of the LLCOP project to demonstrate its commitment to local people by investing in CSR initiatives in the AoI or communities most local to the pipeline route;
- 8.8 per cent of the issues centred around the ESIA process itself, especially regarding consultation; and
- 8.3 per cent of issues were raised about the LAPSSET project overall and plans.

Figure 5.5-1 and Figure 5.5-2 show total number of issues raised by percentage and numerical value.

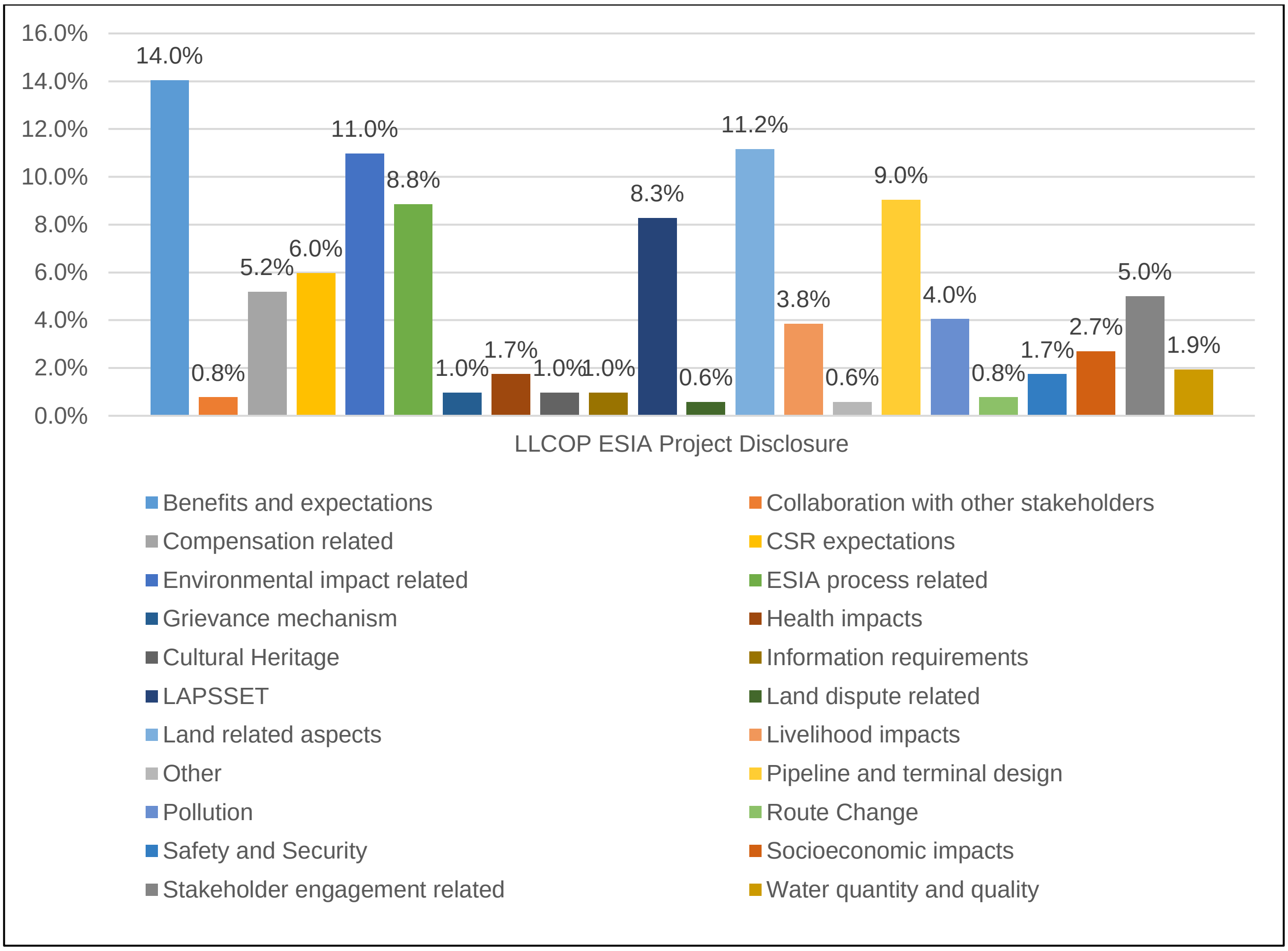


Figure 5.5-1: Issues Raised by Percentage

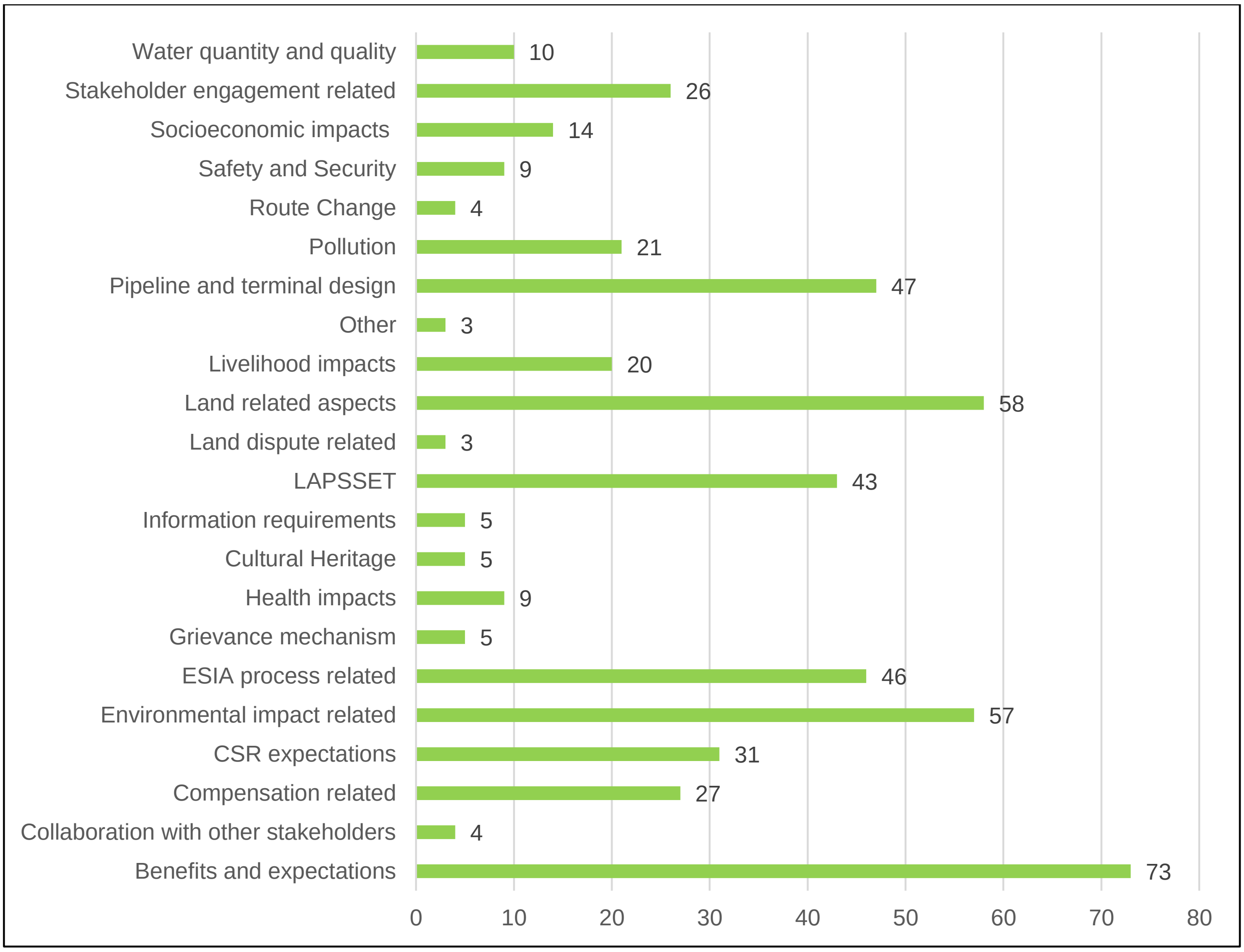


Figure 5.5-2: Issues Raised by Numerical Value

Issues by County are presented in Figure 5.5-3 to Figure 5.5-8 below. Figure 5.5-9 to Figure 5.5-11 present issues from NGO meetings held in Nairobi, Lamu and Turkana, and meetings with MPs.

The LLCOP SEP (Annex III) describes issues by county and group in detail. The pie graphs below intend to show key areas of interest and are briefly summarized as follows.

As expected, the NGO meetings held in Lamu, Turkana and Nairobi focused mainly on pipeline and project design, including interest in the nature of the waxy oil, the pipeline security system and oil spill prevention, hydrostatic testing of the pipeline and the decommissioning process. NGOs in Nairobi, having been engaged throughout the ESIA process, were appreciative of having their ideas and proposed mitigations being considered in routing the pipeline.

Parliamentarians and senior government officials asked a number of questions related to pipeline design and security and showed great interest in project employment including how the relatively small number of employment positions would be filled and how to arrive at a fair recruitment process to avoid conflict in and between communities. There was interest in community development opportunities and Community Social Responsibility (CSR) programming.

County issues varied, with Lamu and Turkana meetings heavily focused on LAPSSET and land compensation. All counties raised concerns that communities had not registered land and that they would not be compensated fairly. In Isiolo and Samburu, concerns related to effects on wildlife were raised due to their dependency on nature conservation and tourism revenues. The topic of benefits dominated discussions in Garissa, Lamu, Isiolo and Samburu. County residents expressed interest in having camps and above ground facilities in their counties for the main purpose of being included in the hiring pool for construction jobs and camp service positions. Meru representatives asked about environmental impacts. In all meetings, concerns were raised about project oversight of EPC Contractors and the approach to monitoring and ensuring that mitigations will be carried out as per the ESIA and Management Plans.

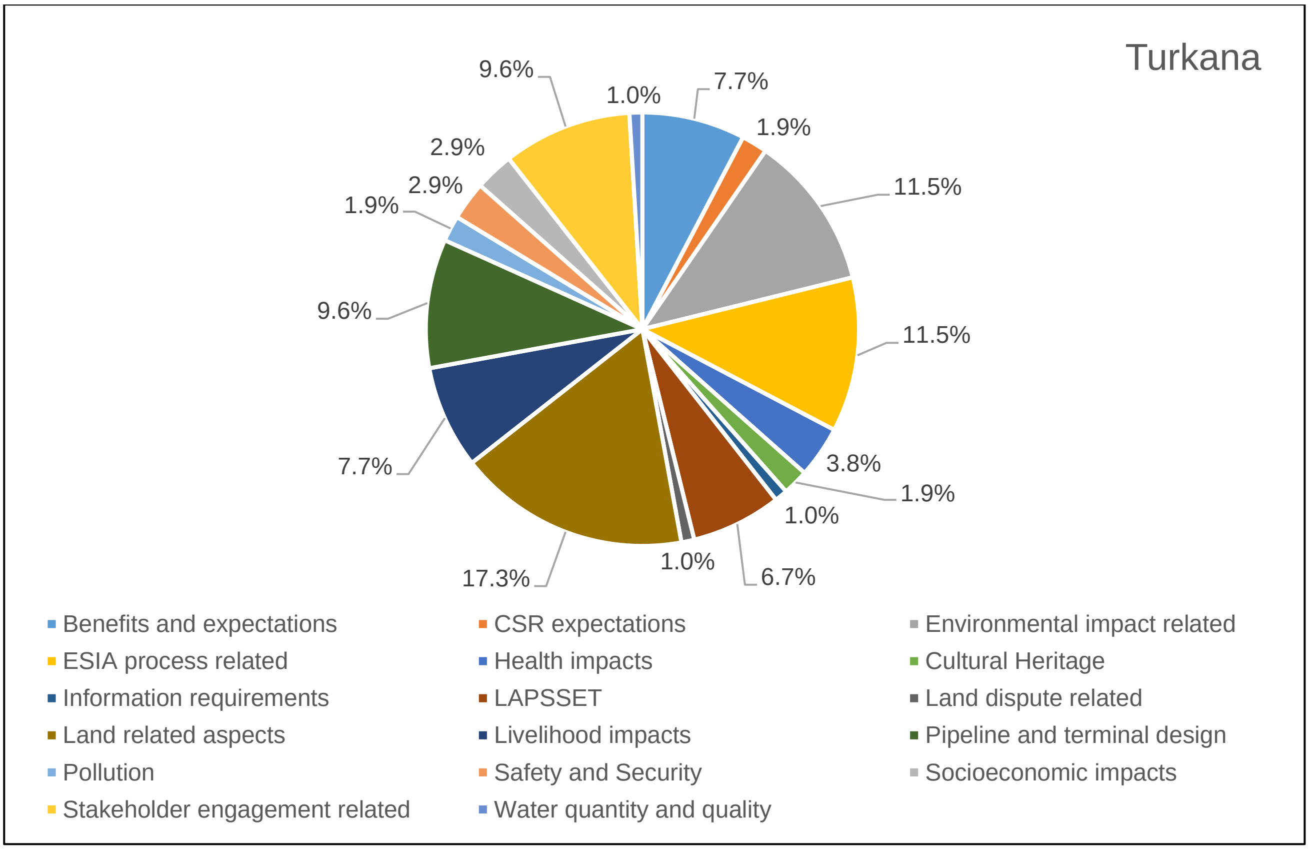


Figure 5.5-3: Turkana (includes NGO and community meetings)

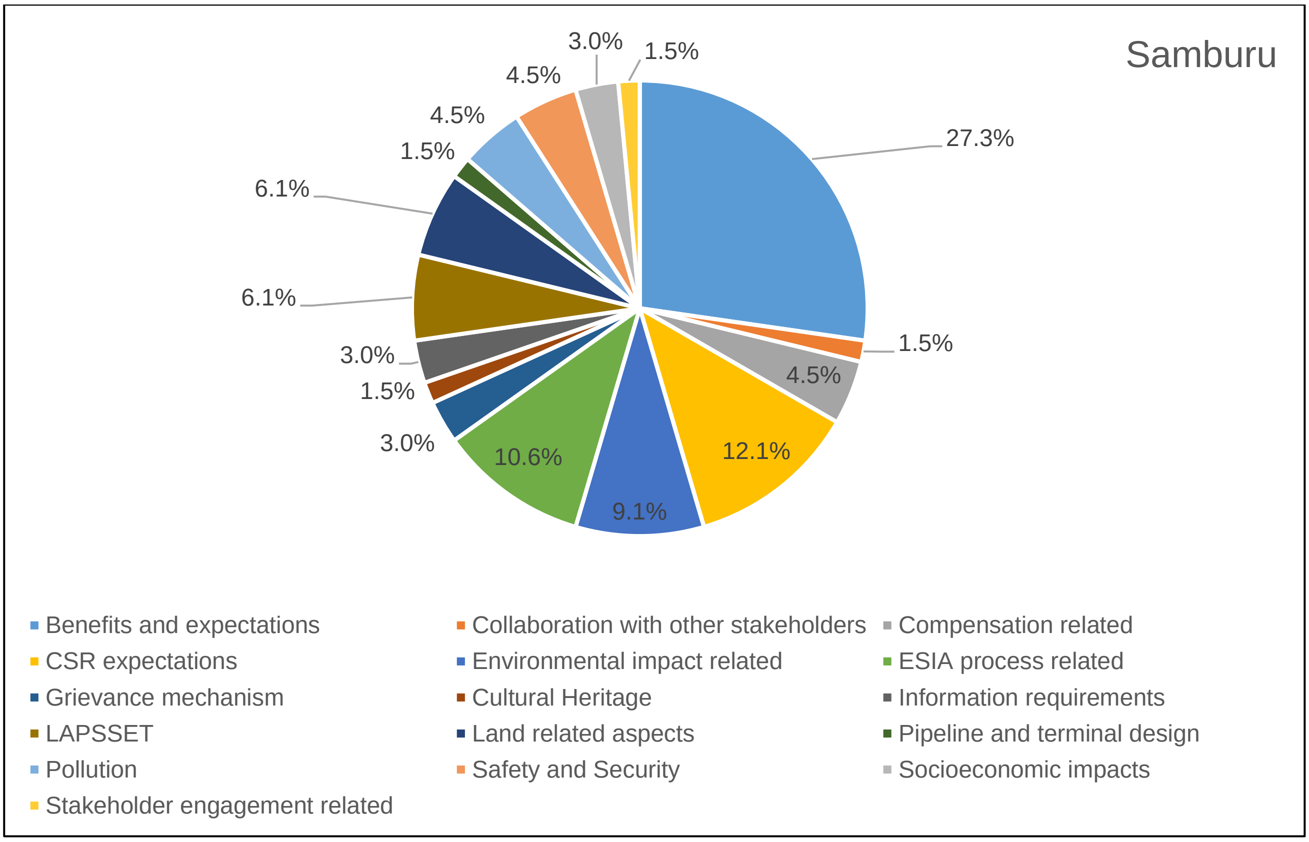


Figure 5.5-4: Samburu (includes community meetings)

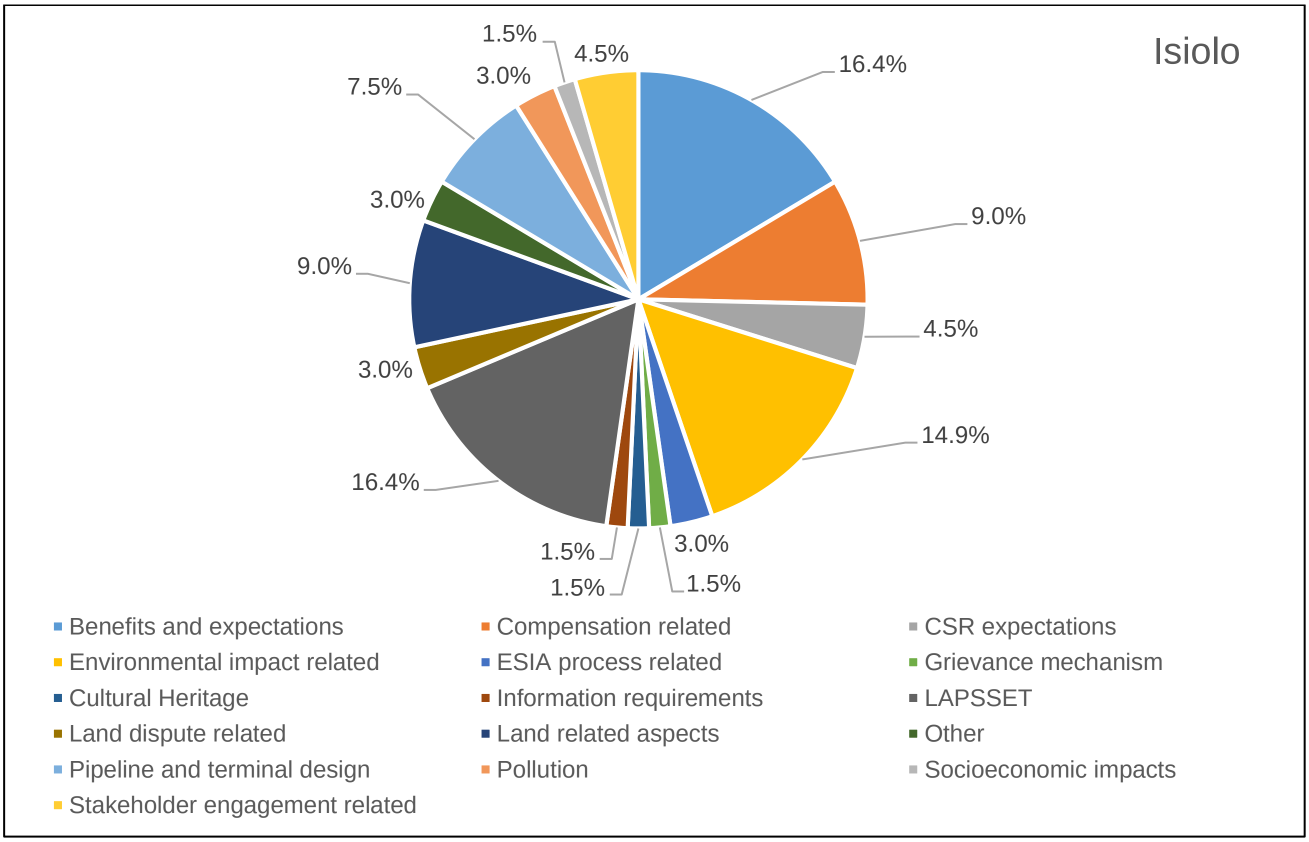


Figure 5.5-5: Isiolo (includes community meetings)

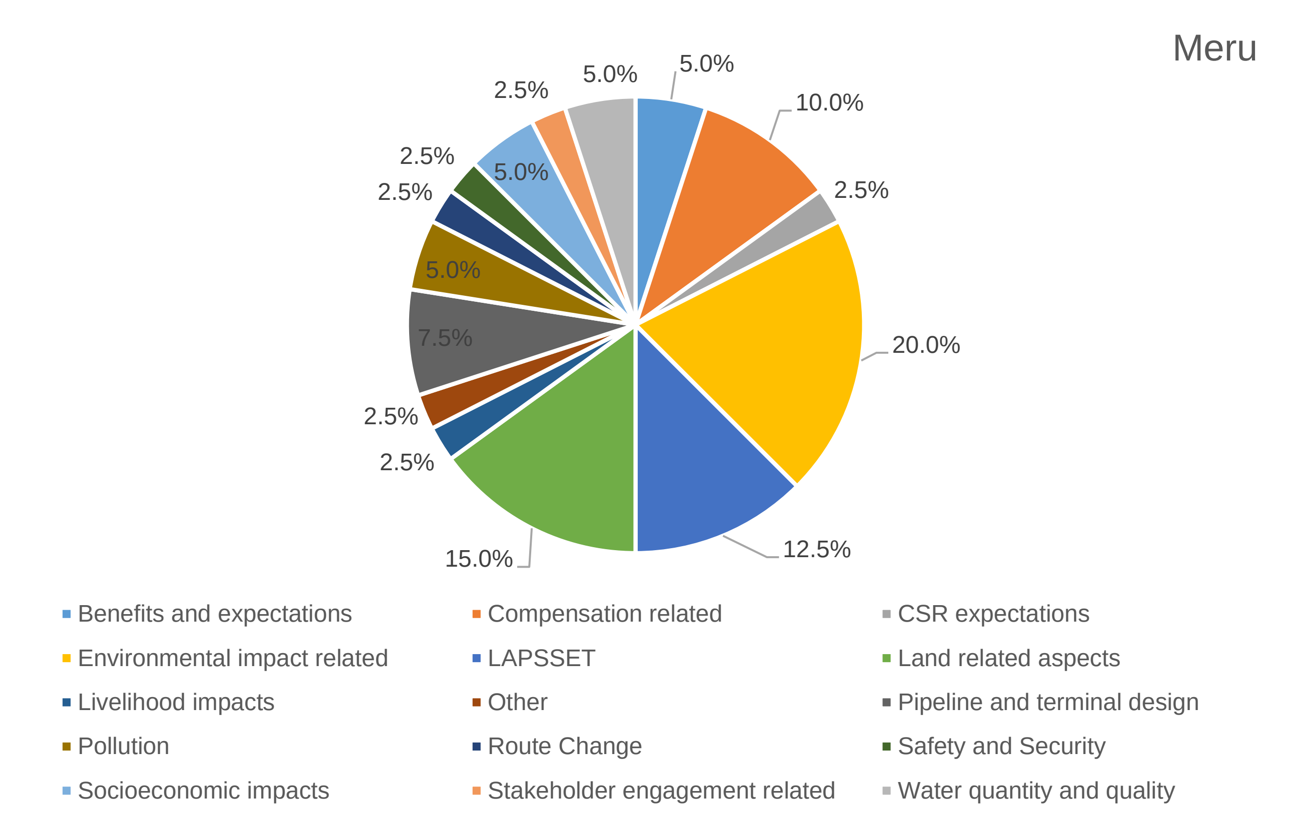


Figure 5.5-6: Meru (includes community meetings)

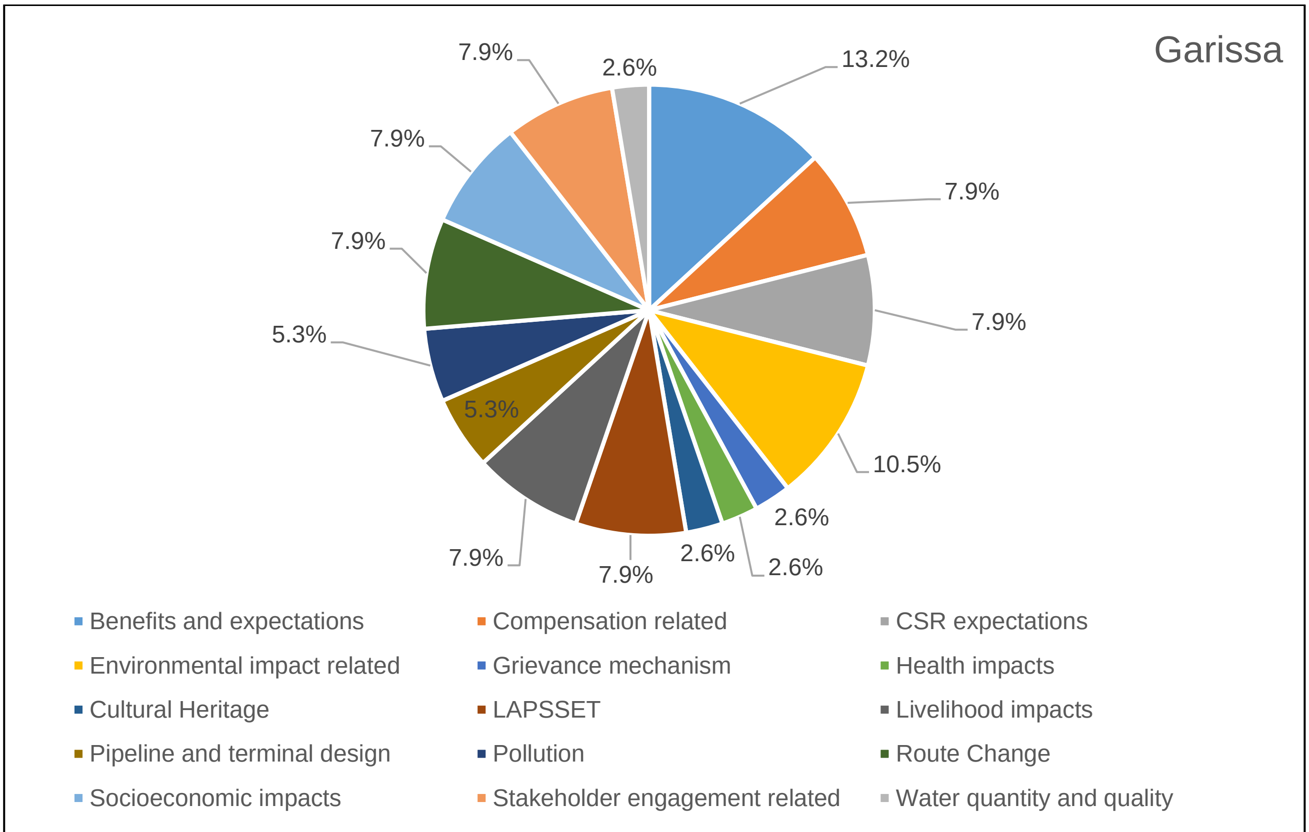


Figure 5.5-7: Garissa (includes community meetings)

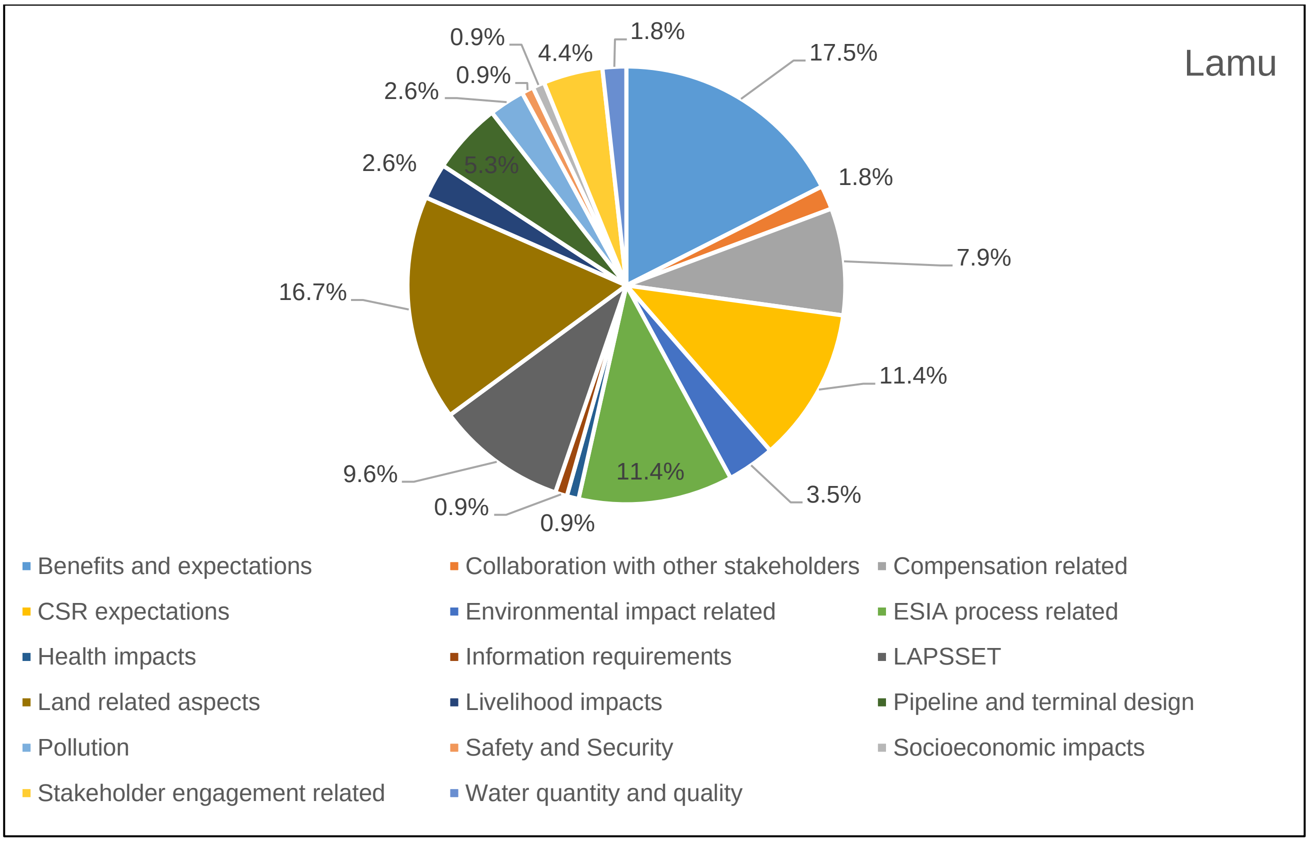


Figure 5.5-8: Lamu (includes NGO and community meetings)

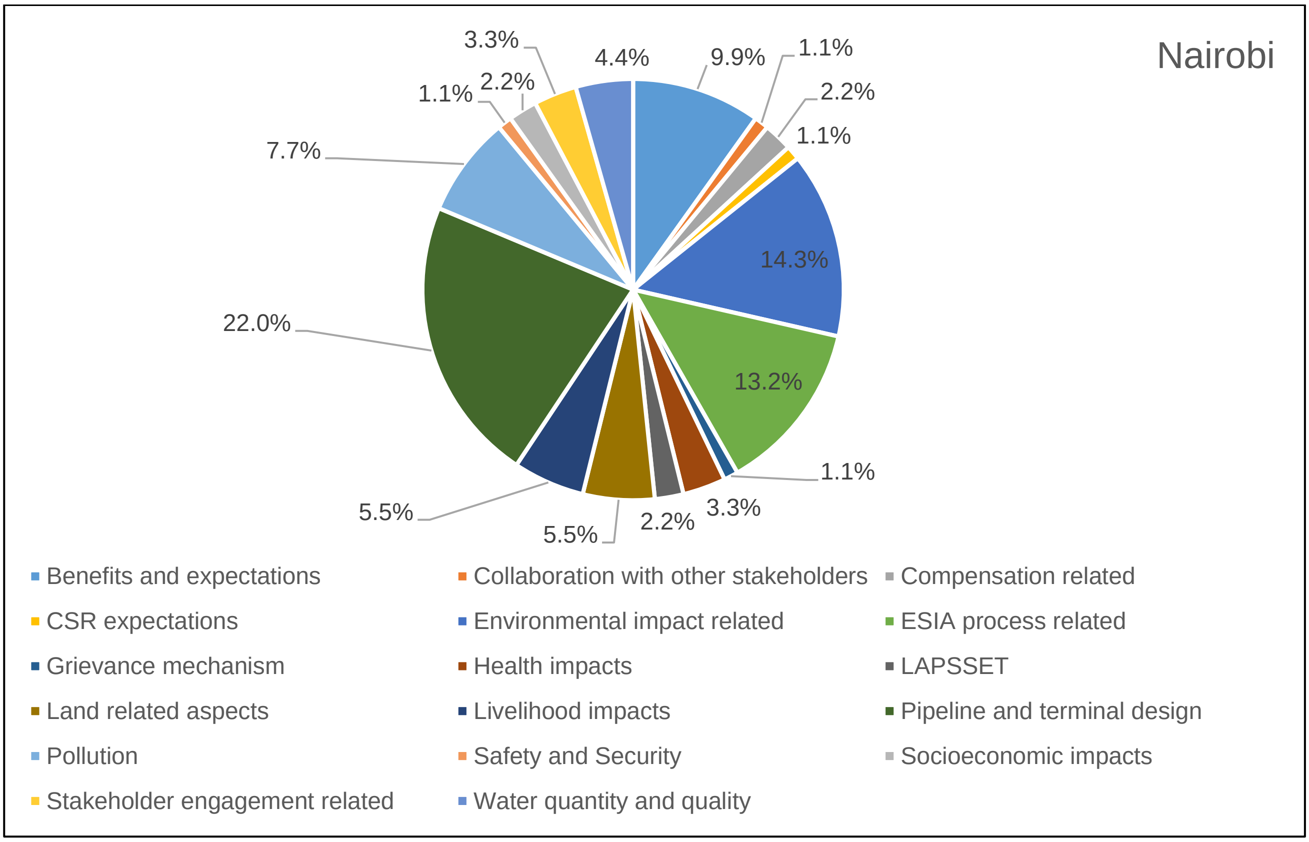


Figure 5.5-9: Nairobi (graph consolidates MPs and NGO meeting in Nairobi)

Results below includes data related to the NGO meetings in Lamu, Turkana and Nairobi.

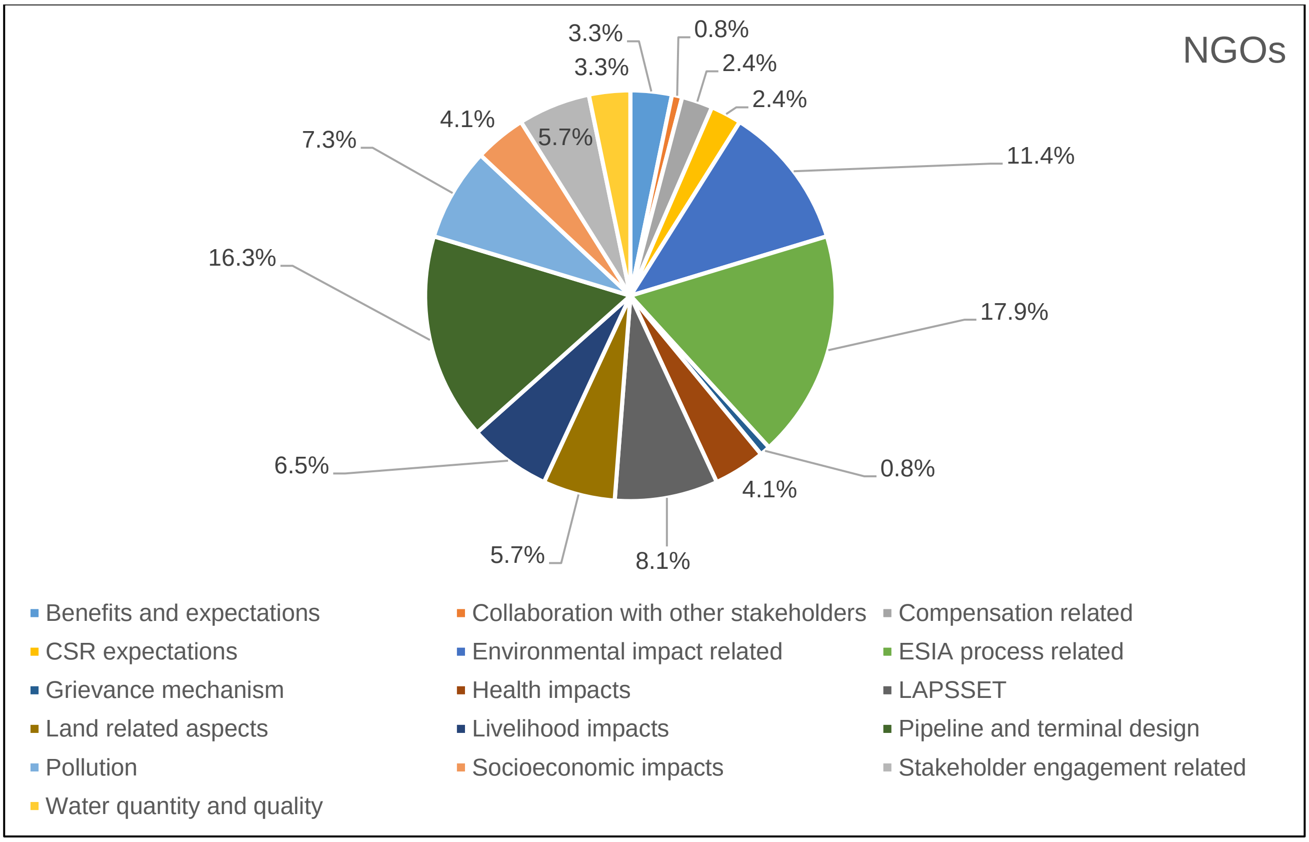


Figure 5.5-10: NGO meetings in Lamu, Turkana, and Nairobi

Results below includes data only related to the MP's meeting in Nairobi.

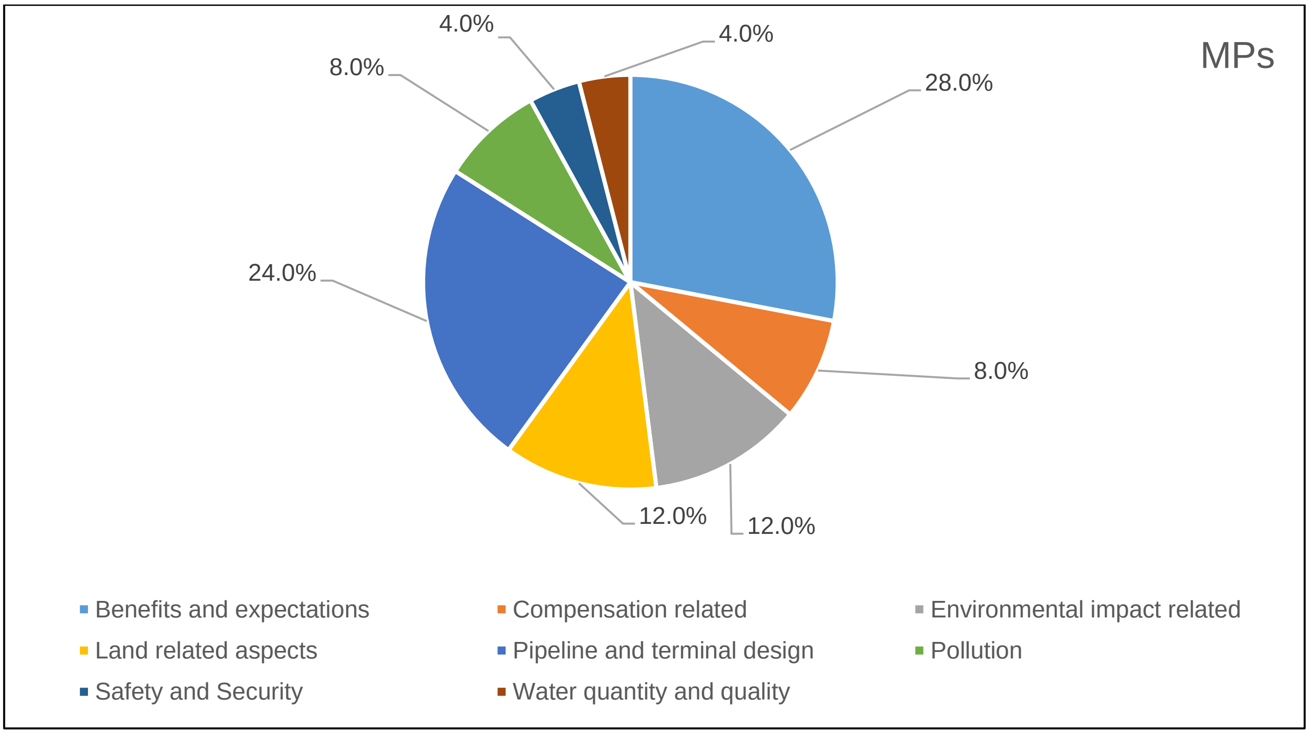


Figure 5.5-11: MPs Meeting in Nairobi

All issues raised during all rounds of consultations were inputted into the Stakeholder database and also provided to scientists carrying out discipline-specific impact assessments for inclusion in their assessments and reports. Table 5.5-1 below categorises issues and indicates where the issue is addressed in the ESIA Reports. Detailed definitions of issues are included in the SEP (Annex III).

Table 5.5-1: Issues and Where Addressed in ESIA Report

Category	Sub-category	Impact Assessment	Baseline
Air Quality	Dust	7.1.9.1.1	6.2.3.6
	Air emissions	7.1.9.1.2	6.2.3
Project Noise	Noise	7.2.9.1; 7.2.9.2	6.3.3
	Pipeline blasting	7.2.9.1	-
Water Resources	Surface water quantity	7.3.8.1; 7.3.8.2	6.4.4.1
	Surface water quality	7.3.8.1; 7.3.8.2	6.4.4.1
	Groundwater (aquifers)	7.3.8.1; 7.3.8.2	6.4.4.2
	Flood risk	7.3.8.1; 7.3.8.2	6.4.4.1
Soils, geology and geohazards	Soil erosion	7.4.8.1	6.5.4.2
	Geohazards	7.14.2.1	6.5.4.4
Terrestrial and Aquatic biodiversity	Terrestrial Flora - revegetation	7.5.8.1; 7.5.8.2	6.6.7.1
	Terrestrial Flora - invasive species	7.5.8.1; 7.5.8.2	6.6.7.1
	Terrestrial Fauna - habitats/protected areas	7.5.8.1; 7.5.8.2	6.6.8.3
	Terrestrial Fauna - wildlife movement (e.g. migration)	7.5.8.1; 7.5.8.2	6.6.7.3
	Terrestrial Fauna - species of concern	7.5.8.1; 7.5.8.2	6.6.5
Marine Environment	Marine Flora	7.6.8.1; 7.6.8.2	6.7.5.2
	Marine Fauna- habitats/protected areas	7.6.8.1; 7.6.8.2	6.7.5.5
	Marine Fauna - species of concern	7.6.8.1; 7.6.8.2	6.7.6
Cultural Heritage	Archaeological/palaeontological finds	7.8.8.1	6.9.3
	Tangible cultural heritage	7.8.8.1	6.9.3
	Intangible/living cultural heritage	7.8.8.1	6.9.3
Landscape and Visual		7.7.7	6.8
Physical and Social Infrastructure	Influx	7.9.4.2	6.11.2.1
	Health infrastructure	7.10.2.5	6.11.2

Category	Sub-category	Impact Assessment	Baseline
	Water demand	7.9.4.2	6.10.4
	Waste management	7.9.4.2	6.10.5
	Energy access/supply	7.9.4.3	6.10.7
Community Health, Safety and Security	Road traffic accidents	7.10.4.2	6.11.2.3
	Project hazards/health	7.10.4.3	6.11.2.5
	Diseases (e.g. HIV)	7.10.4.6	6.11.2.2
	Security and conflict	7.10.4.2	6.11.3
Economics and Employment	Employment	7.12.4.2	6.12.7
	Local business	7.12.4.3	6.12.8
	Wildlife Tourism	7.12.4.4	6.12.8
Livelihoods	Pastoralism	7.11.4.1	6.13.4
	Marine Fishing	7.11.4.2	6.13.6
	Agriculture and Forest-based livelihoods	7.11.4.3	6.13.5
Ecosystem services	Provisioning services (e.g. medicinal plants)	7.13.9.1	6.14.3.1.1
Land take	Land acquisition process (related to NLC and LAPSSET)	7.11.4.3	6.13.8
	Land Compensation	See ESMP (Section 8)	-
Project Infrastructure and Design	Pipeline design, corridor and re-routing	4.2	-
	Stations and camps	4.4	-
	Marine infrastructure	4.5	-
	Project lifetime	4.12	-
Emergency, Accidental and Non-Routine Events (QRA, OSM results etc.)	Security/emergency response (e.g. threats)	7.14	-
	Oil leaks/spills into river environment	7.14.4.1	-
	Oil leaks/spills into marine environment	7.14.5.1	-
	Fires	7.14.4.2	-
	Third-party intrusion	4.11.2.3	-
Decommissioning	Decommissioning Philosophy	4.12	-
Cumulative Impacts	LAPSSET corridor	7.16.4	-

Category	Sub-category	Impact Assessment	Baseline
	Other projects (e.g. Lamu Port, powerline)	7.16.4.1	-
Climate Change		7.3.6.4	6.1.8; 6.1.10
Stakeholder Engagement		5	-
Grievance Mechanism		See ESMP (Section 8)	-
CSR and Community Development		See ESMP (Section 8)	-
Benefits and Expectations		See ESMP (Section 8)	-

Note: Full baseline reports are available in Annex II.

5.6 LLCOP Engagement/Consultation Team

This ESIA has been planned and completed by a consulting team external to the PPMT. Consultations were led jointly by Golder Associates and ESF. ESF recruited Regional Coordinators to plan consultations and facilitate barazas in specific communities. Note takers were provided by ESF. The ESIA team has extensive mining, natural resources assessment, and international ESIA experience combined with strong local experience provided by several well-qualified local experts who were present at meetings to answer questions.

LAPSSET representatives were present during the ESIA Results round of consultations and presented a brief update on LAPSSET projects completed and schedule of next steps. The PPMT had representation at all consultations. Table 5.6-1 identifies the key team members of the Consultation team.

Table 5.6-1: LLCOP ESIA Consultation Team

Name	Role
Environmental, Social, Health and Safety Consultants (ESF)	
James Kambo	In-Country Coordinator
Fidelis Katima	Minutes taker
Mohamed Hajir	Regional Coordinator – Isiolo, Meru, Samburu
Halkano Dida	Assistant Regional Coordinator- Isiolo
Duncan Oyaro	Regional Coordinator – Lamu
Nathir Mohamed Gabo	Assistant Regional Coordinator – Garissa
Bernard Murithi	Assistant Regional Coordinator - Meru
Alex Nadome	Assistant Regional Coordinator - Samburu
Muthoni Koinange	Regional Coordinator - Turkana

Name	Role
Maurice Ikaal	Assistant Regional Coordinator - Turkana
Duncan Oyaro	Regional Coordinator - Lamu
Mohamed Kitete	Assistant Regional Coordinator - Lamu
Golder Associates	
Linda Havers	Senior Social Specialist
Eamon Barrett	Senior Project Advisor (E&S)
Kevin Arbizu	Project Coordinator
Pipeline Project Management Team (PPMT)	
Alex Mayhook Walker	Africa Oil Corp.
Ken Kamal	Tullow Kenya BV
Oli McCredie	Tullow Kenya BV
David Kombe	Tullow Kenya BV
Paul Mowatt	Tullow Kenya BV
Allen Prayle	Tullow Kenya BV
Priscilla Kjizi	Tullow Kenya BV
Fila Elema	Tullow Kenya BV
LAPSSET	
Abdilatif Hussein	LAPSSET Representative
Raymond Ogola	LAPSSET Representative
Benson Thuita	LAPSSET Representative
Victor Nyakachunga	LAPSSET Representative
Bernard Oluoch	LAPSSET Representative

All consultation analysis and reporting has been prepared by Golder and reviewed by ESF. Consultation materials were prepared by Golder and ESF jointly.

6.0 BASELINE

6.1 Meteorology and Climate

6.1.1 Introduction

Kenya is an equatorial country in East Africa with a very diverse relief including a short, low coastal plain on the Indian Ocean shore, extensive inland plateaux regions with altitudes between 1000 m and 1500 m, and several mountain ranges and peaks such as Mount Kenya. The reduction of temperature with altitude produces temperatures over much of Kenya which are subtropical or temperate. Its equatorial situation means that Kenya experiences very limited annual variation in temperature across the country. The constant high temperatures and humidity typically associated with equatorial latitudes only occur in the Kenya's coastal lowlands although daytime sea breezes have a cooling effect. The northern part of Kenya is hot throughout the year, however experiences lower humidity than coastal areas (UK Met Office 2011).

Kenya's National Drought Management Authority (NDMA) classifies the seasons in Kenya as follows:

- January to March – Dry Season;
- April to June – Long Rains;
- July to September – Dry Cool Season; and
- October to December – Short Rains.

Inter-annual variability of rainfall is significant in Kenya. Heavy rains can cause flooding in the rainy season. Severe droughts can result from the failure of rains to arrive, especially in the arid and semi-arid regions of northern and eastern Kenya (UK Met Office 2011).

The proposed 824 km long LLCOP runs from the proposed oil fields near Lokichar in Turkana in south-easterly direction to the new port in Lamu at the coast of the Indian Ocean. Along the route, the pipeline traverses mainly areas of hot semi-arid climate, however it also passes through areas of hot desert climate and tropical savanna climate which also dominates the coastal plains and the coastal area of Lamu.

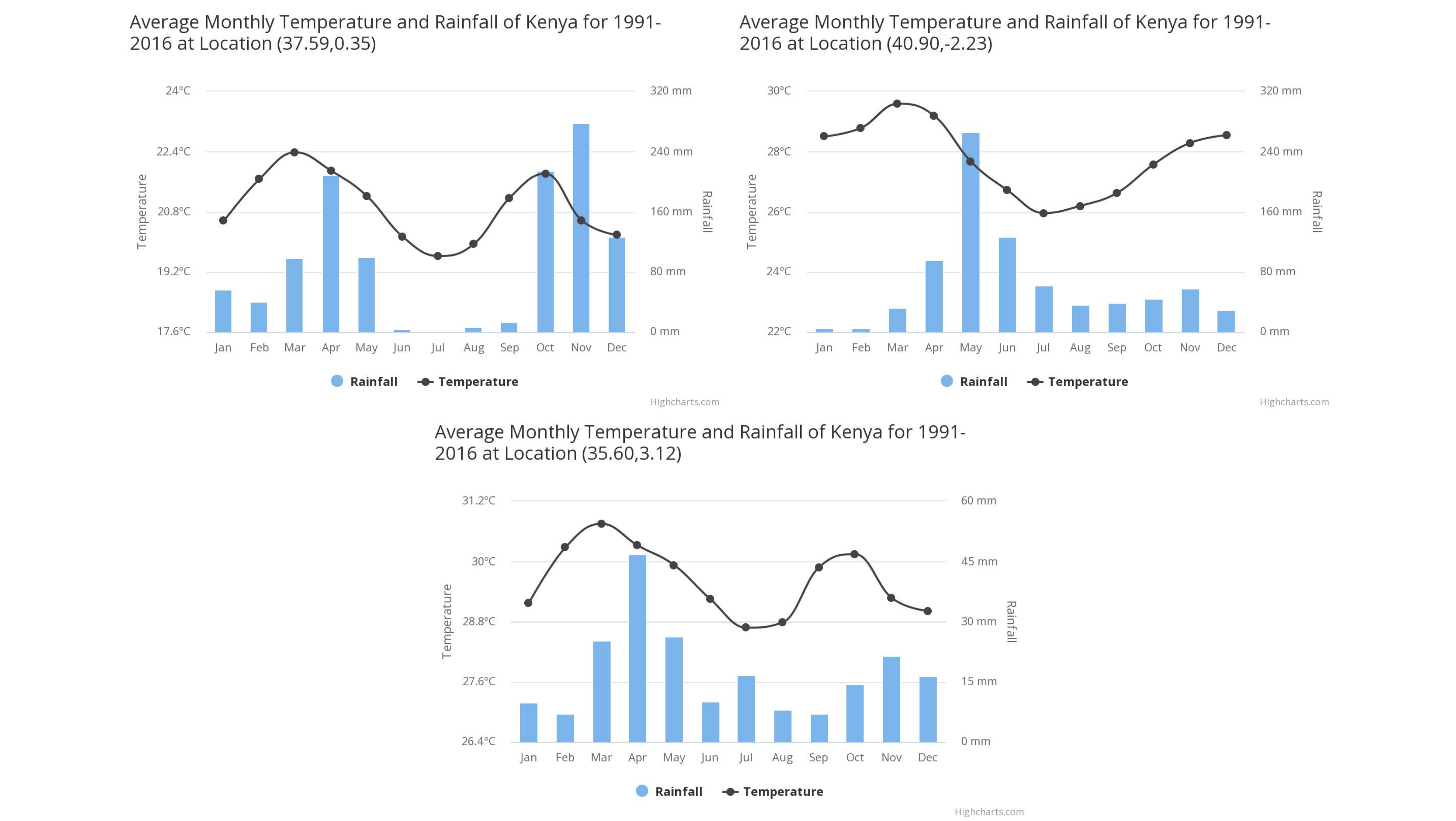


Figure 6.1-1: Average monthly temperature and rainfall data from World Bank Climate Change Knowledge Portal. Top left Lodwar (1991–2016), top right Isiolo (1991 – 2016), bottom Lamu (1991–2016) (World Bank Group, 2019)

Figure 6.1-1 presents summarised rainfall and temperature data captured from the World Bank Climate Change Knowledge Portal and as indicated by Wood Group Kenny (2014), which provides some context for the variations across the proposed LLCOP route. To build on the data presented in Figure 6.1-1, Golder acquired meteorological data from five meteorological stations close to the LLCOP to further characterise the different meteorological conditions and parameters along the pipeline (Figure 6.1-2). Two of these stations, Kapese and Ngamia in Turkana, have been installed on behalf of Tullow Kenya B.V to support the characterisation of meteorological conditions in the proposed oil fields near Lokichar. The meteorological stations at Meru, Garissa and Lamu are stations operated by the Kenya Meteorological Department. Locations and elevations of these meteorological stations are described as follows:

- Meteorological stations at Kapese and Ngamia are located at an elevation of approximately 700 masl in Turkana, in an area of hot semi-arid climate. Selected data from between 2015 and 2018 (with appropriate integrity and completeness) was used to inform this baseline;
- The meteorological station at Meru is located approximately 310 km to the south-east of Kapese and Ngamia at an altitude of 1554 masl, in an area with tropical savanna climate. Data for the years 2011, 2012, 2014, 2017 and 2018 were used to inform this baseline;
- The meteorological station at Garissa is located a further 225 km south-east of Meru at an elevation of 147 masl, in an area with hot desert climate. Data for the years 2009, 2011, 2012, 2013 and 2014 were used to inform this baseline; and
- The meteorological station at Lamu, approximately 250 km south-east of Garissa. Lamu is located at the coast of the Indian Ocean at an elevation of only 6 masl, in an area of tropical savanna climate. Data for the years 2009, 2011, 2012, 2013 and 2014 were used to inform this baseline.

While the primary (Kapese and Ngamia) and secondary (Meru, Garissa and Lamu) data are not concurrent data sets (i.e. data are recorded during different periods), the monthly average data can provide a defendable comparison between the local and regional characterisation of meteorology. The following key meteorological parameters have been used to describe meteorological baseline conditions:

- Ambient air temperature (°C);
- Relative humidity (%);
- Total precipitation (mm);
- Wind speed (m/s); and
- Wind direction (°).

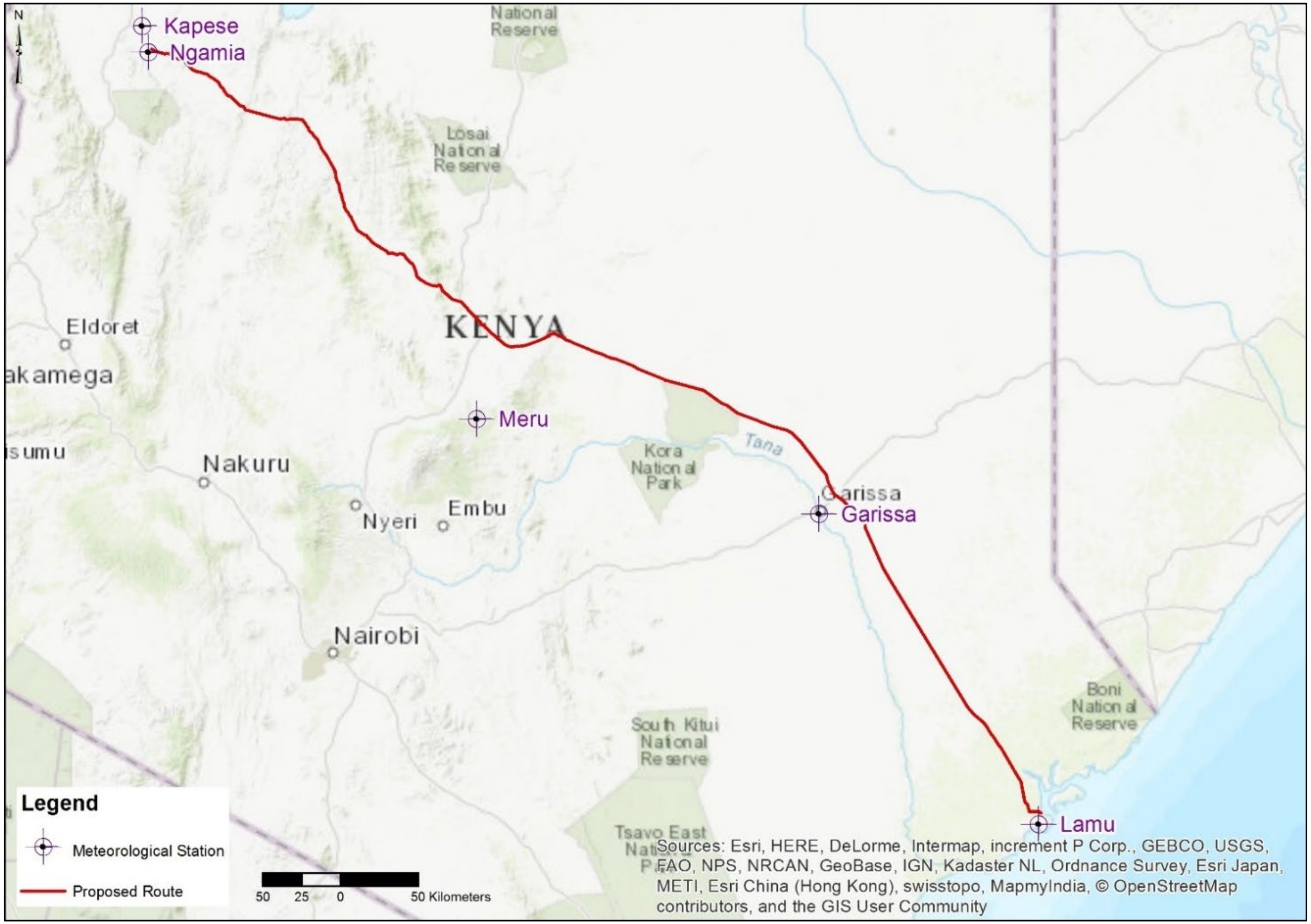


Figure 6.1-2: Locations of meteorological stations used for baseline characterisation

6.1.2 Ambient Air Temperature

Figure 6.1-3 shows the average monthly temperatures at each meteorological station. Clearly portrayed is the lack of seasonal variation in temperature across all stations due to the equatorial situation of Kenya. Average monthly temperatures at Kapese, Ngamia, Garissa and Lamu are similarly high in line with their equatorial situation. Average monthly temperatures at Meru are distinctively cooler than at the remaining meteorological stations because of the reduction in temperature with altitude.

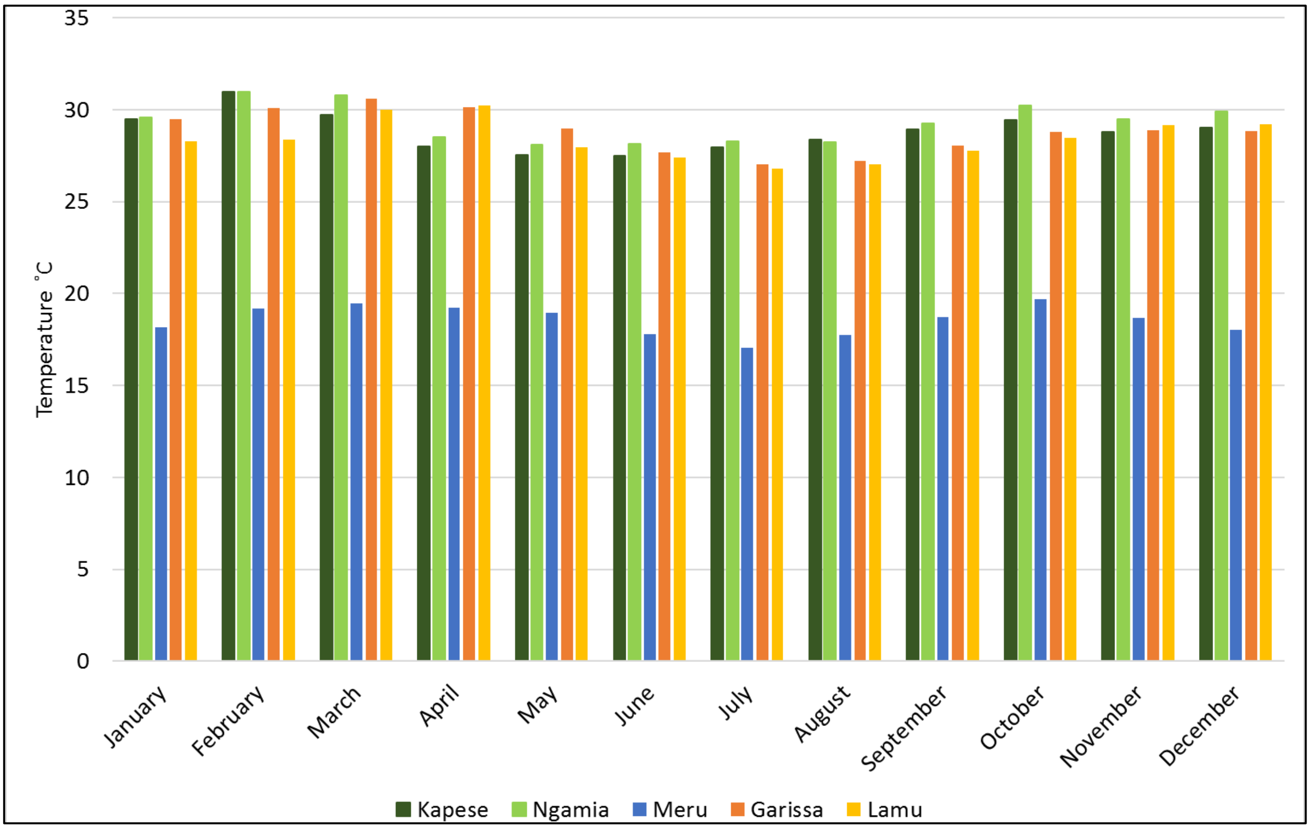


Figure 6.1-3: Average monthly temperatures in comparison

6.1.3 Relative Humidity

Figure 6.1-4 shows the average monthly relative humidity at each meteorological station. Relative humidity is lowest at Kapese and Ngamia, the stations that are located furthest from the Indian Ocean and in a semi-arid climate. Relative humidity is highest at Meru and Lamu, which are in areas of tropical savanna climate. Higher average monthly humidity measurements correlate with the wet seasons described in Section 6.1.4.

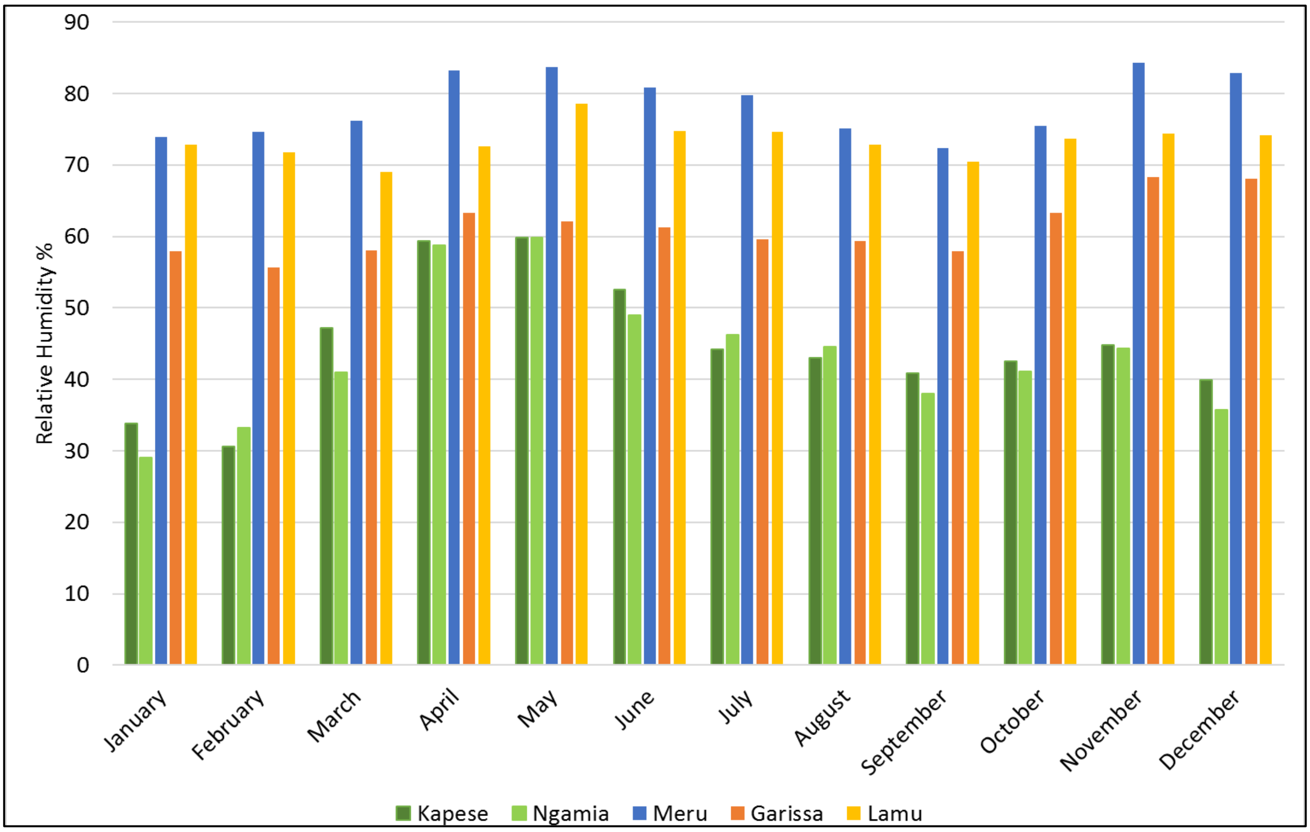


Figure 6.1-4: Average monthly relative humidity in comparison

6.1.4 Total Precipitation

Figure 6.1-5 shows the average monthly total rainfall at each meteorological station except from Lamu, which is only operated on a part-time basis with a high percentage of missing data[1].

Figure 6.1-5 clearly portrays the annual monsoon patterns across Kenya with a dry season at the beginning of the year, the 'long rains' from April to June, another dry season from July and September followed by the 'short rains' in October to December. In Kapese and Ngamia most of the total precipitation appears to occur during the 'long rains', the first rainy season at the beginning of the year, while in Meru average monthly total rainfall is highest during the 'short rains' at the end of the calendar year. Garissa, located in an area of hot desert climate receives little rainfall during either the 'long rains' or 'short rains' period, and no rainfall at all in some months of the dry seasons (February, July, September).

[1] Average values have been presented for temperature, humidity and wind from Lamu. As total precipitation is calculated as a sum rather than an average the monthly sum could strongly underestimate the actual total precipitation occurring in Lamu. Therefore total precipitation is not presented here.

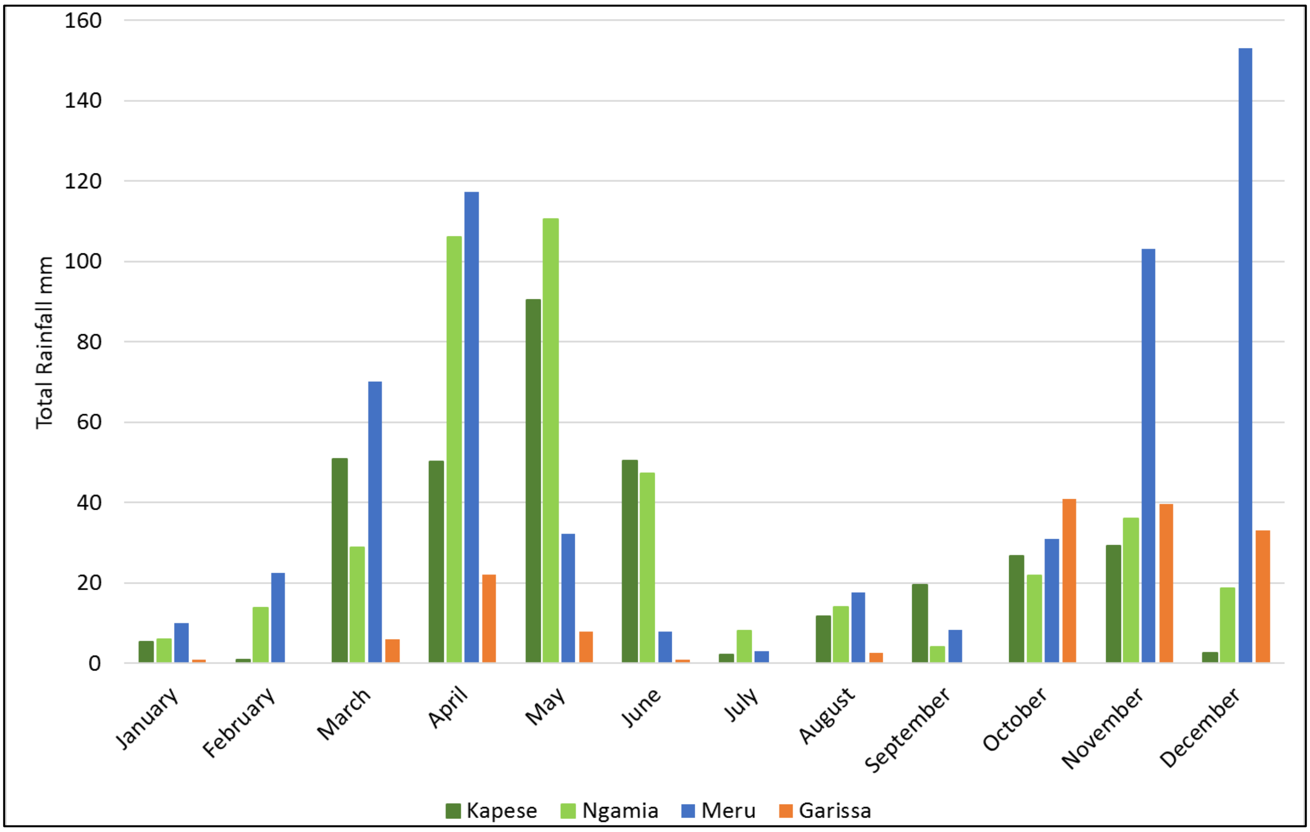


Figure 6.1-5: Average monthly total Precipitation in comparison

6.1.5 Wind Speed

Figure 6.1-6 shows the average monthly wind speed at each meteorological station. Average wind speeds are generally low. This is particularly the case for the meteorological stations located inland, Kapese, Ngamia and Meru. Wind speeds are slightly higher at Garissa and Lamu which are located further south and closer to the coast and the Indian Ocean. The differences in wind speed between the stations may also be related to local topography near individual meteorological stations.

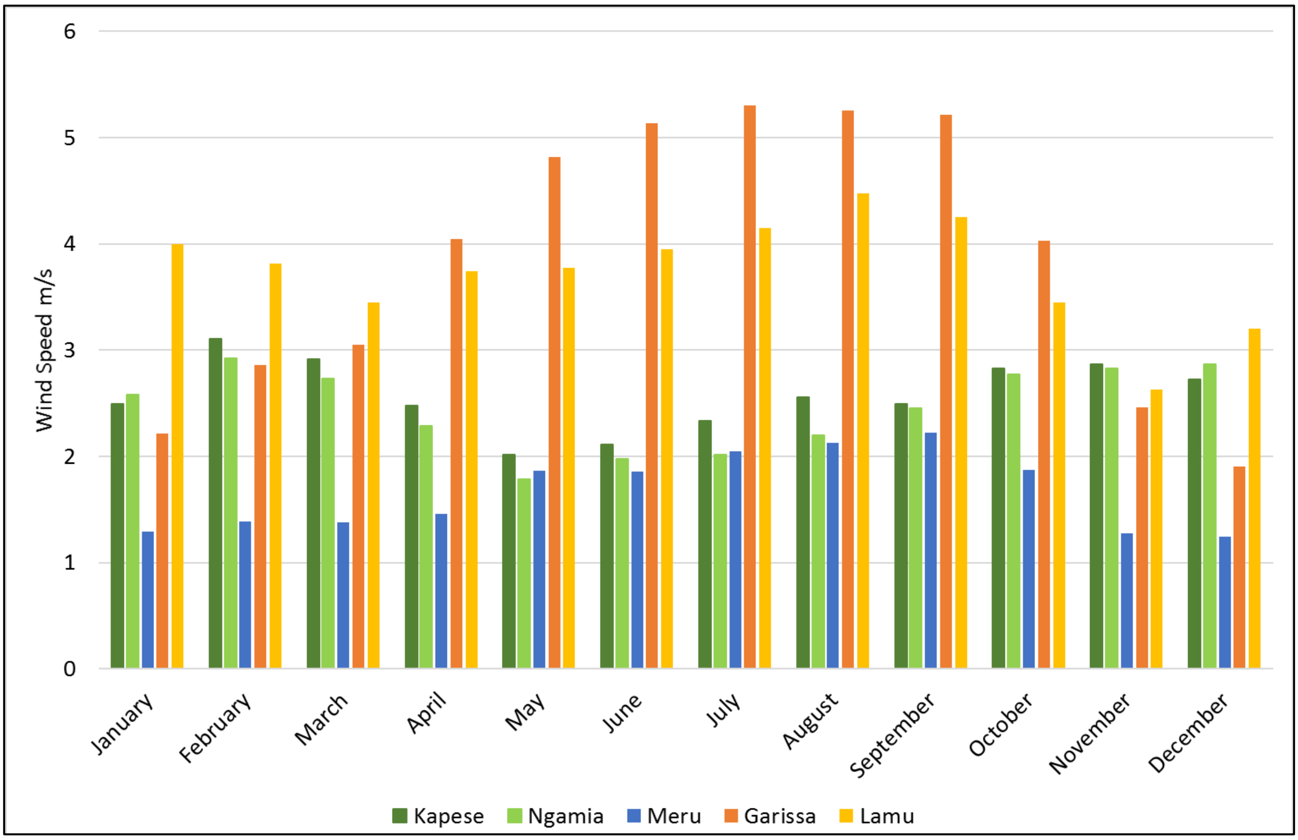


Figure 6.1-6: Average monthly wind speed in comparison

6.1.6 Wind Direction

Figure 6.1-7 shows the annual windroses for each meteorological station. Portrayed is the prevalence of easterly wind directions linked to the northeast and southeast monsoons over equatorial Eastern Africa (Okoola 1999, UK Met Office 2011). In Kapese and Ngamia, which are located north of the equator, winds from north-easterly directions dominate, however south-easterly winds are also present. At the meteorological station located further south-east and at the geographic equator (Meru) or below the geographic equator (Garissa and Lamu) the wind patterns change. Here, winds from south to south-easterly directions prevail and dominate the annual windroses. As for wind speeds, prevailing wind directions and hence windroses at individual meteorological stations may also be influenced by local topography near the stations.

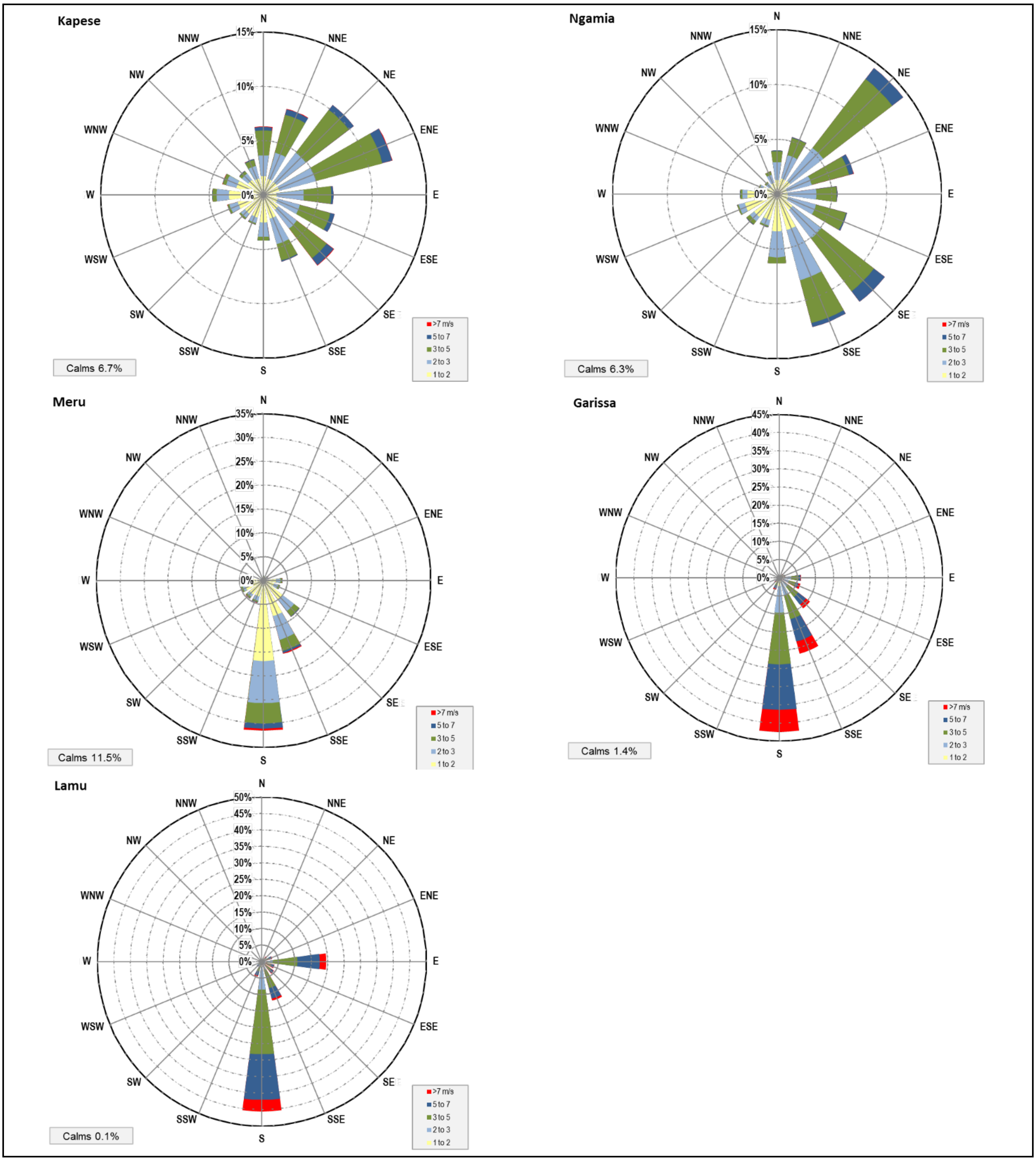


Figure 6.1-7: Annual windroses in comparison

6.1.7 Meteorology - Summary

Meteorological data from five stations situated along the route of the pipeline has been used to present the different meteorological conditions along the pipeline. While meteorological parameters show variation between different stations, the following general meteorological characteristics have emerged:

- Temperatures are generally high and show very little seasonal variations;
- Relative humidity increases from inland stations towards the coastal areas;

- Total precipitation follows annual monsoon patterns over Kenya with a dry season at the beginning of the year, the ‘long rains’ from April to June, another dry season from July and September followed by the ‘short rains’ in October to December;
- Wind speeds are generally low; and
- Prevailing wind directions are from the north-east at the northern most part of the pipeline however shift to south/south-eastern directions further south. The prevalence of easterly wind directions is linked to the northeast and southeast monsoons over equatorial Eastern Africa.

6.1.8 Climate Change - Current Trends

6.1.8.1 Ambient Air Temperature

In Kenya, the mean annual temperature has increased by 1.0˚C since 1960 with an average rate of 0.21˚C per decade (McSweeney et al., 2010a). The decline of the Lewis Glacier on Mount Kenya which lost 40% of its mass since 1963 (MENR, 2002) is a visible indicator of the warming trend. Daily temperature observations indicate increasing trends in the frequency of hot days and hot nights with hot days or nights defined by the temperature exceeded on 10% of days or nights in current climate of that region. Between 1960 and 2003, the number of hot days has increased in Kenya by 57 i.e. an additional 15.6% of days. Over the same time period, the number of hot nights increased by 113, i.e. an additional 31% of nights. Meanwhile the frequency of cold days and cold nights has significantly decreased by 16 (4.4%) and 42 (11.5%), respectively. Cold days or nights are defined as the temperature below which 10% of days or nights are recorded in current climate of that region or season (McSweeney et al., 2010a).

6.1.8.2 Precipitation

Parry et al. (2012) report changes in rainfall patterns being noticed in Kenya since the 1960 however, observations of rainfall across Kenya since 1960 do not show statistically significant trends (McSweeney et al., 2010a). Recent trends in precipitation patterns however indicate an increase in proportion of rainfall occurring in heavy events (McSweeney et al., 2010a). Further observations indicate a potential shift in monsoon patterns with a decline of rainfall during the spring ‘long rains’ and an increase of rainfall during the autumn ‘short rains’ (MENR, 2002).

6.1.9 Future Climate Projections

Future climate projections figures presented in this section are based on the United Nations Development Programme (UNDP) Climate Change Country Profile for Kenya (McSweeney et al., 2010b). Existing climate data has been used to generate a series of country-level studies of climate observations and the multi-model projections made available through the WCRP CMIP3 (World Climate Research Programme Coupled Model Intercomparison Experiment, Phase 3). The methodology underlying the analysis for each country profile is detailed in McSweeney et al. (2010b). The climate model projections are based on the IPCC (Intergovernmental Panel on Climate Change) Special Report on Emissions Scenarios (SRES). All projections detailed below represent anomalies relative to the mean climate of 1970 – 1990 (McSweeney et al., 2010a).[2]

6.1.9.1 Ambient Air Temperature

The current trend in increasing annual mean temperatures is predicted to continue with a projected increase in Kenya of 1.0 ˚C to 2.8˚C by the 2060s and 1.3 ˚C to 4.5˚C by the 2090s.

All projections indicate further increase in the frequency of days and nights considered hot in the current climate coupled with a decrease in the frequency of days and nights considered cold in the current climate. Cold days

[2] WCRP is constantly advancing climate projections. Updated versions of climate models and are driven by different assessment scenarios (https://www.wcrp-climate.org/wgcm-cmip, accessed 24/02/2019).

and nights are expected to become exceedingly rare and do not occur at all under the highest emissions scenarios by the 2090s (McSweeney et al., 2010a).

By the 2060s, projections indicate that 'hot' days will occur on 17-45% of days annually, and 23-75% of days by the 2090s. Nights that are considered 'hot' for the annual climate of 1970 – 1999 are projected to increase more quickly than hot days. By the 2060s, projections indicate that hot nights will be occurring on 32-75% of nights, and on 40-95% of nights by the 2090s (McSweeney et al., 2010a).

6.1.9.2 Precipitation

East Africa's seasonal rainfall can be strongly influenced by the El Niño-Southern Oscillation (ENSO), however model simulations show wide disagreements in projected changed in the amplitude of future El Niño events (Christensen et al., 2007). This contributes to the uncertainty in climate projections for Kenya, in particularly in the future inter-annual variability in the region (McSweeney et al., 2010a).

Projections reported by the UNDP Climate Change Country Profile for Kenya are consistent in indicating increases in annual rainfall in Kenya. The projected increase varies from -4 mm to +20 mm by the 2060s and from -1 mm to +27 mm by the 2090s.

In line with trends already observed in Kenya today, models also consistently project increases in the proportion of annual rainfall that falls in heavy rainfall events. The increases range from 1% to 13% in annual rainfall by the 2090s. In addition, 1-day and 5-day rainfall annual maxima increases by the 2090s of up to 25 mm in one-day events, and 32 mm in five-day events are projected by the models for Kenya (McSweeney et al., 2010a).

However, contrary to the results of the WCRP CMIP3 presented in the UNDP study, other studies indicate a decrease in future rainfall in Kenya. Funk et al. (2010) for example predict that large parts of Kenya will experience more than a 100 mm decline in long rains by 2025, linking the reduction in precipitation to changes in circulation patterns over the warming Indian Ocean.

6.1.10 Climate Change - Summary

Current climate trends in Kenya show that average ambient air temperatures are increasing together with the number of hot days and nights occurring each year. The number of cold days and cold nights on the other hand are showing a declining trend. Based on the analysis presented in the UNDP Climate Change Country Profile for Kenya, climate model projections predict that these trends will continue and likely intensify over the coming decades in Kenya and in the potential AoI (McSweeney et al., 2010a).

Current climate trends in Kenya also indicate an increase in the proportion of rainfall occurring in heavy events (McSweeney et al., 2010a; Parry et al., 2012). Further observations indicate a potential shift in monsoon patterns with a decline of rainfall during the spring 'long rains' and an increase of rainfall during the autumn 'short rains' (MENR, 2002).

Uncertainty in precipitation projections for Kenya arises from the wide disagreement of different climate models in the projected change in amplitude of future El Niño events. The latter strongly influence the seasonal rainfall in East Africa (McSweeney et al., 2010a). Projections presented in the UNPD Climate Change Country Profile for Kenya consistently indicate an increase in total annual rainfall both over Kenya and the potential AoI. In addition, the proportion of rain falling in heavy rainfall events is predicted to increase (McSweeney et al., 2010a). However, other studies predict a potential decrease in future rainfall in Kenya. Funk et al. (2010) for example predict that large parts of Kenya will experience more than a 100 mm decline in long rains by 2025, linking the reduction in precipitation to changes in circulation patterns over the warming Indian Ocean.

In summary, temperature change predictions due to climate change across different analyses are considered consistent, but changes to rainfall patterns and total rainfall are more complex to predict. Nevertheless, climate change allowances should be made in design criteria for operational infrastructure.

6.2 Air Quality

6.2.1 Introduction

The proposed 824 km long LLCOP runs from the proposed oil fields near Lokichar in Turkana in south-easterly direction to the new port in Lamu at the coast of the Indian Ocean. Along the route, the pipeline traverses mainly areas of hot semi-arid climate, however it also passes through areas of hot desert climate and tropical savanna climate which also dominates the coastal plains and the coastal area of Lamu. This gives rise to a number of pollutant concentrations, combined with the contributions from human settlements and activities which may be nearby. The pollutants accounted for in monitoring activities are justified as below:

- Key pollutants Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Fine Particulates (PM_{10} and $PM_{2.5}$) will be emitted from the power generators which will be located at some of the AGI locations;
- Volatile Organic Compounds (VOCs) are gases emitted from a wide range of solids or liquid materials including crude oil;
- Vehicle emissions reacting with other chemicals such as VOCs could lead to the creation of ozone (O_3); and
- Deposited dust can be generated during groundworks, maintenance and from traffic on unsealed roads.

The full air quality baseline is provided in Annex II.

6.2.2 Area of Influence

The AoI for the air quality assessment (Figure 6.2-1), within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes an area 1 km surrounding each station along the LLCOP route and a 250 m buffer along the entire pipeline.

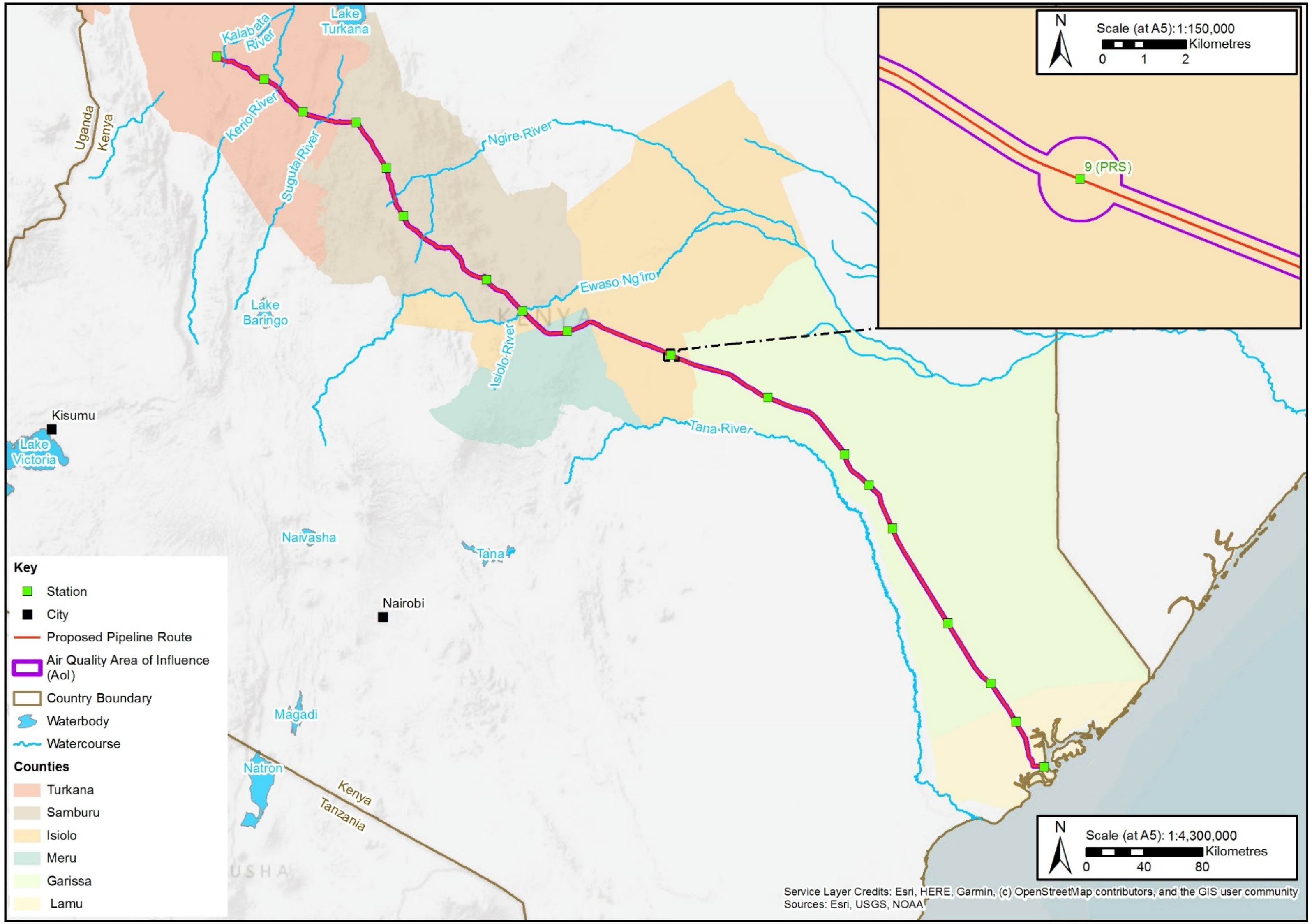


Figure 6.2-1: Air quality AoI

6.2.3 Methods

Air quality data was obtained at seven representative locations for the station locations along the LLCOP to characterise existing air quality along the pipeline Figure 6.2-2. The monitoring sites are in village locations and therefore not fully representative of the more remote and less disturbed station locations. Therefore, the baseline data should be used as indicative of the conservative local background in the AoI which may also include the contributions from local village sources.

The monitoring location for Station 4 is Barsaloi Chief's Office, which lies at an elevation of 467 m and is a settlement with some commercial shops. Station 6 uses Wamba as a monitoring proxy location, which lies at an elevation of 512 m and is a residential area with a small business centre and a road passing next to it. Station 7 uses Archer's Post in Isiolo as a proxy for monitoring, it is located at an elevation of 839 m and is next to the Ewaso Ng'iro river and the Isiolo Marsabit road, with a shopping centre and a police post nearby. Garba Tula is the monitoring proxy for Station 9, which lies at an elevation of 466 m and is a village settlement. Station 10 uses Rahole National Reserve in Garissa as a monitoring proxy, with sampling elevations of both 337 m and 335 m. There is a village settlement, water pan, small kiosk and a school near the sampling location. Lamu uses a proxy monitoring location in a village across the road from the entrance to Lamu Port. Ngamia has been monitored as part of the Upstream ESIA.

Data was gathered from December 2018 to February 2019 using substance specific diffusion tubes for NO_2, SO_2, O_3, Benzene, Toluene, Ethylbenzene and Xylene (BTEX), and frisbee type dust gauges for deposited dust. The two sampling methods were deployed together and placed at approximately 1.5 m above ground level to sample within the average breathing zone of humans. Passive diffusion tubes and dust gauges were exposed for approximately one-month intervals, before analysis by SGS Kenya Limited. Particulate matter (PM_{10} and $PM_{2.5}$) monitoring was undertaken at each location using an Airmetrics minivol TAS, for the period from December 2018 to January 2019. At Ngamia, monitoring has been undertaken since November 2015 for sixteen non-consecutive months up to March 2019 for NO_2, SO_2, O_3, BTEX and deposited dust, and for March 2019 for PM_{10} and $PM_{2.5}$ only.

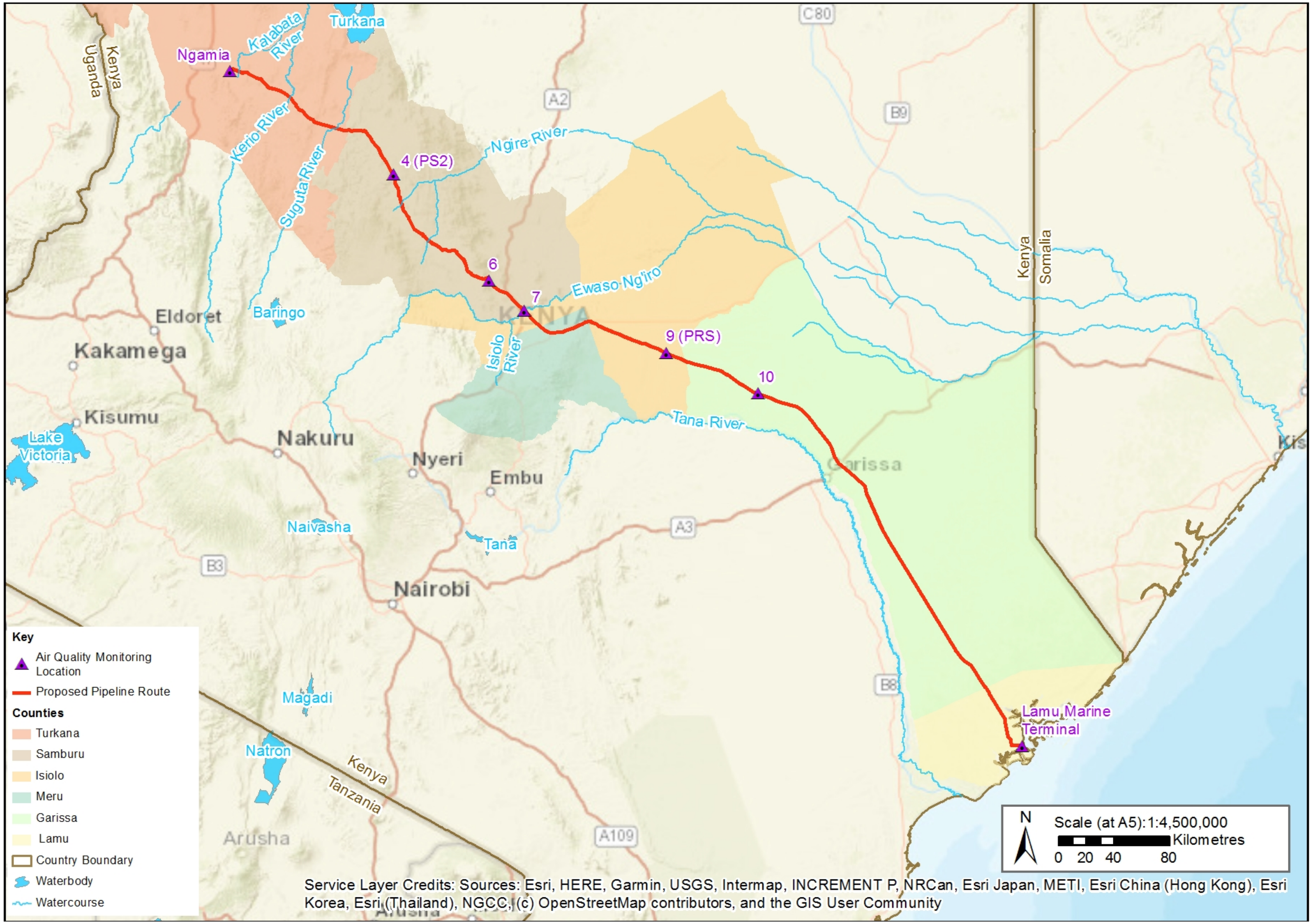


Figure 6.2-2:Location of air quality monitoring stations used for baseline characterisation

6.2.4 Results

The baseline air quality has been compared to the Air quality standards (AQS) selected for the Project, i.e. the project standards, which are defined in Annex I. Where Kenyan standards are absent or international guidelines are more stringent, the international guideline values are considered most appropriate as the Project AQS. In the following sections, where the Project AQS does not equal the Kenyan Standard, the Kenyan standard is also shown in the figures.

6.2.4.1 NO_2

Figure 6.2-3 shows annual average concentrations of NO_2 at monitored stations compared to the relevant Project AQS, taken from the more stringent international standard (40 µg/m^3) and the Kenyan AQS (0.05 ppm, which equates to approximately 94 µg/m^3). Measured values are very similar at each measured location and are low compared to the AQS values. The annual average of the seven monitoring locations is 0.6 µg/m^3.

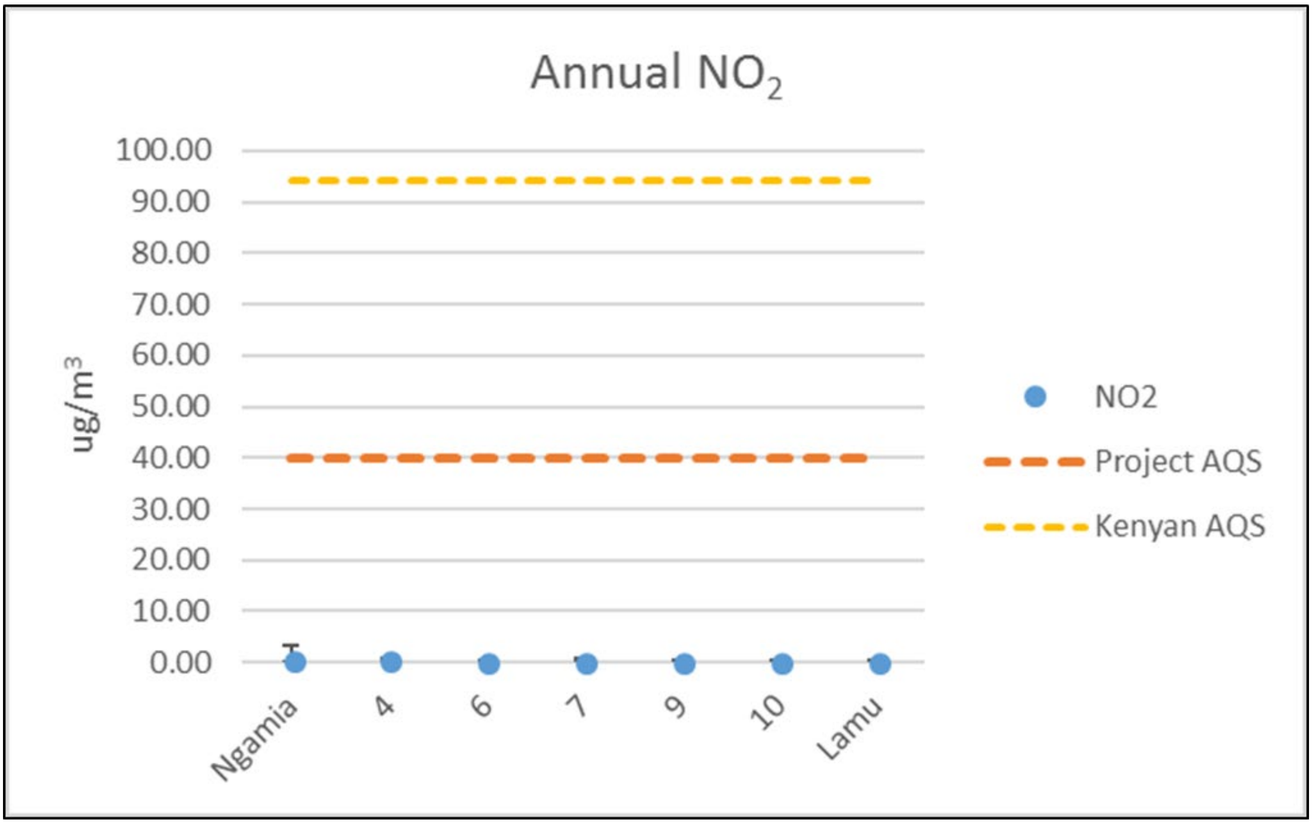


Figure 6.2-3: NO_2 annual average concentrations at monitored stations

6.2.4.2 SO_2

Figure 6.2-4 shows annual average concentrations of SO_2 at monitored stations compared to the relevant Project AQS, which is the Kenyan AQS of 50 µg/m^3. There is no international AQS for annual SO_2. Measured values are very similar at each measured location and are low compared to the AQS values. The annual average of the seven monitoring locations is 0.6 µg/m^3.

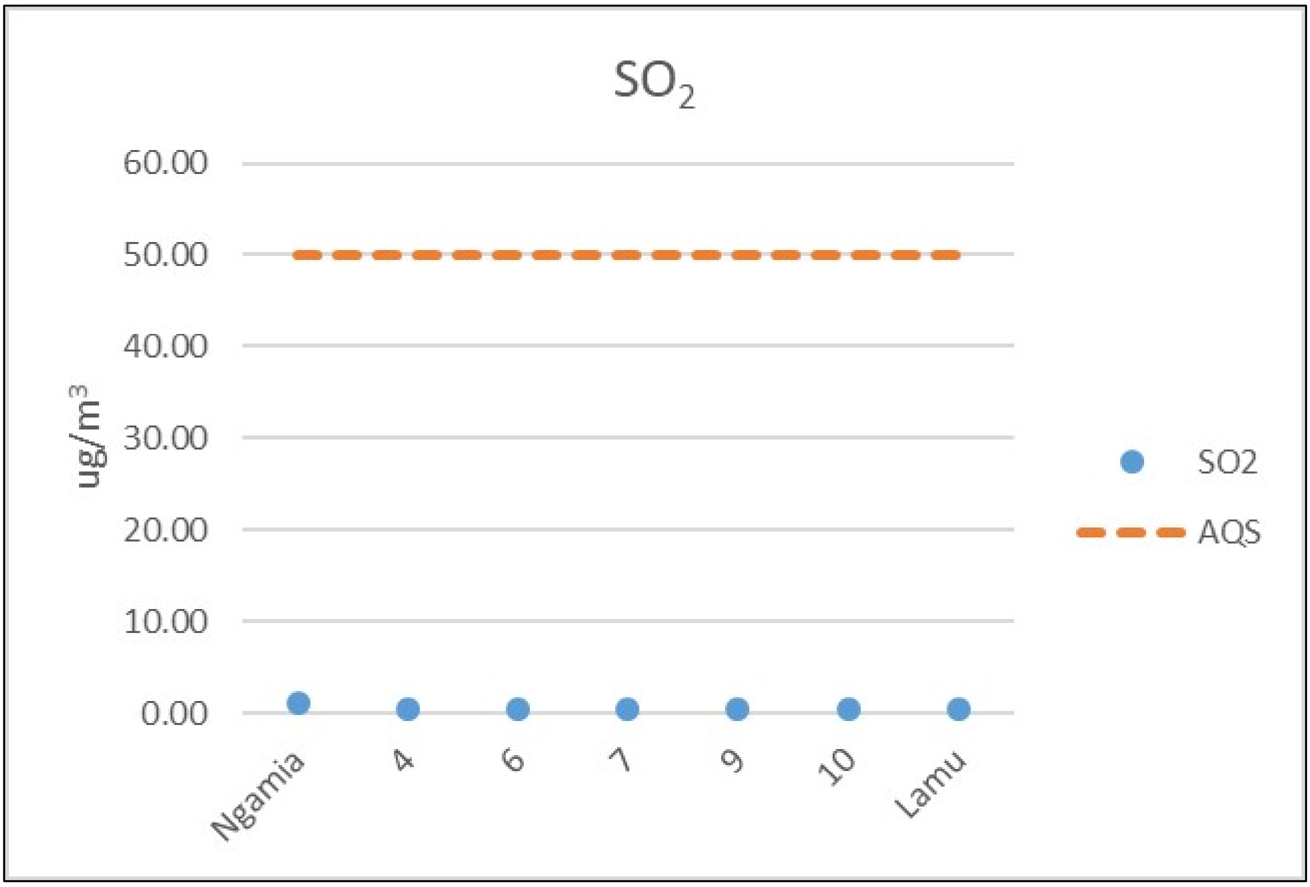


Figure 6.2-4: SO_2 annual average concentrations at monitored stations

6.2.4.3 O_3

Figure 6.2-5 shows annual average concentrations of O_3 at monitored stations. There is no International or Kenyan standard for annual O_3 to compare the baseline concentrations against. No data was collected at Station 6 due to access issues and a broken sample tube. The measured values are similar at locations 4, 9, 10 and Lamu and Ngamia has the maximum value monitored.

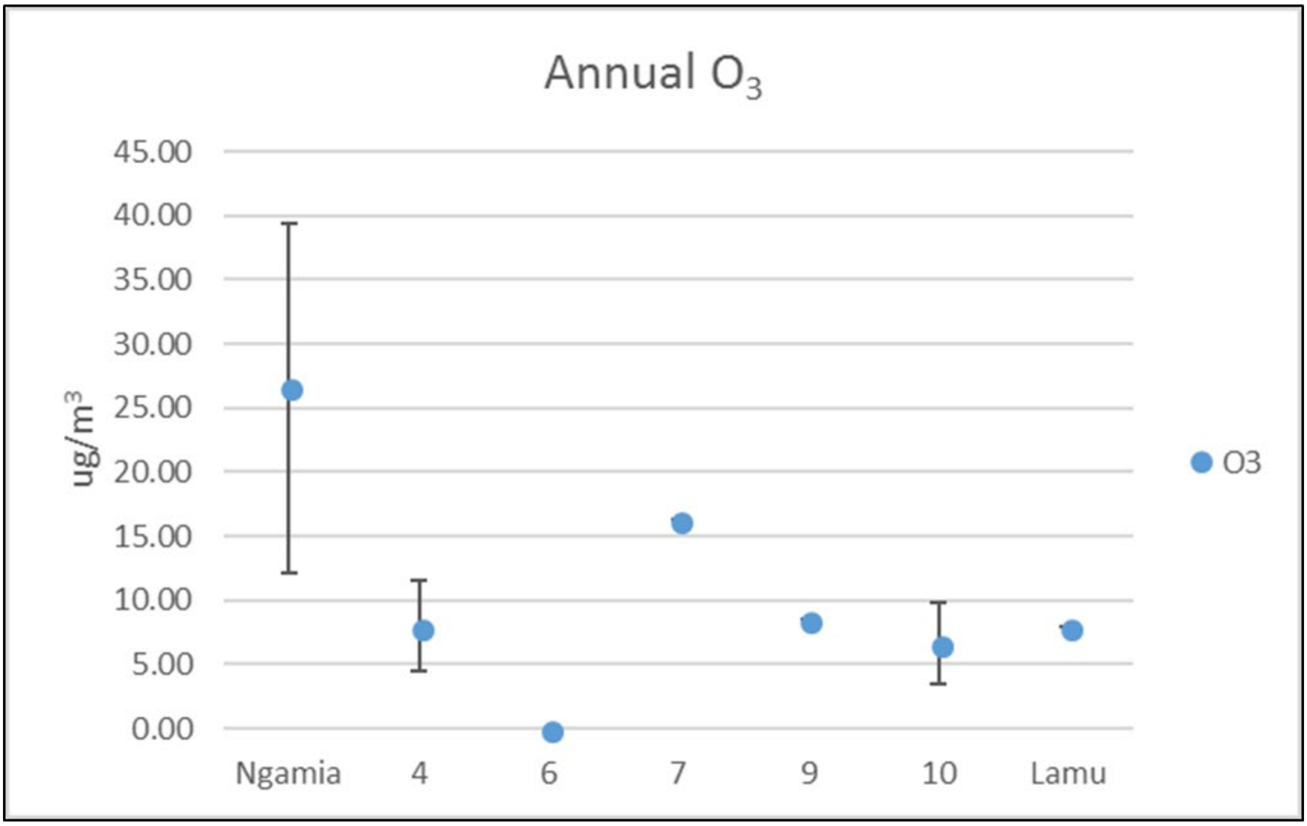


Figure 6.2-5: O_3 annual average concentrations at monitored stations

6.2.4.4 BTEX

There are no Kenyan or International AQS values for annual concentrations of either Benzene, Toluene, Ethylbenzene or Xylene. There is a 24-hour Kenyan AQS for 24-hour Total VOCs of 600 µg/m^3 which is the closest applicable standard, however this would include all VOC species cumulatively and is applicable for a different averaging period than presented for the baseline. Although there is no relevant annual AQS for BTEX, the baseline data allows for a comparison to be made with the operational phase of the project.

Figure 6.2-6 shows annual average concentrations of Benzene at monitored stations. Concentrations are similar at all monitored locations, with slightly higher concentrations at stations 4, 9 and Ngamia, and slightly lower concentrations at Stations 7 and 10. All values are between 1.6 µg/m^3 and 2.1 µg/m^3.

Figure 6.2-7 shows annual average concentrations of Toluene at monitored stations. There is no relevant AQS value for annual concentrations, so this has not been included. Concentrations are similar at all monitored locations, with slightly higher concentrations at stations 4, 9 and Ngamia, and slightly lower concentrations at station 7. All values are between 1.7 µg/m^3 and 2.3 µg/m^3.

Figure 6.2-8 shows annual average concentrations of Ethylbenzene at monitored stations. There is no relevant AQS value for annual concentrations, so this has not been included. Concentrations are similar at all monitored locations, with slightly higher concentrations at stations 4, 9 and Ngamia. All values are between 1.8 µg/m^3 and 2.6 µg/m^3, showing the greatest variability of the monitored BTEX species

Figure 6.2-9 shows annual average concentrations of Xylene at monitored stations. There is no relevant AQS value for annual concentrations, so this has not been included. Concentrations are similar at all monitored locations, with slightly higher concentrations at Station 4, and slightly lower concentrations at Stations 4, 10, Ngamia and Lamu. All values are between 2.6 µg/m^3 and 2.9 µg/m^3.

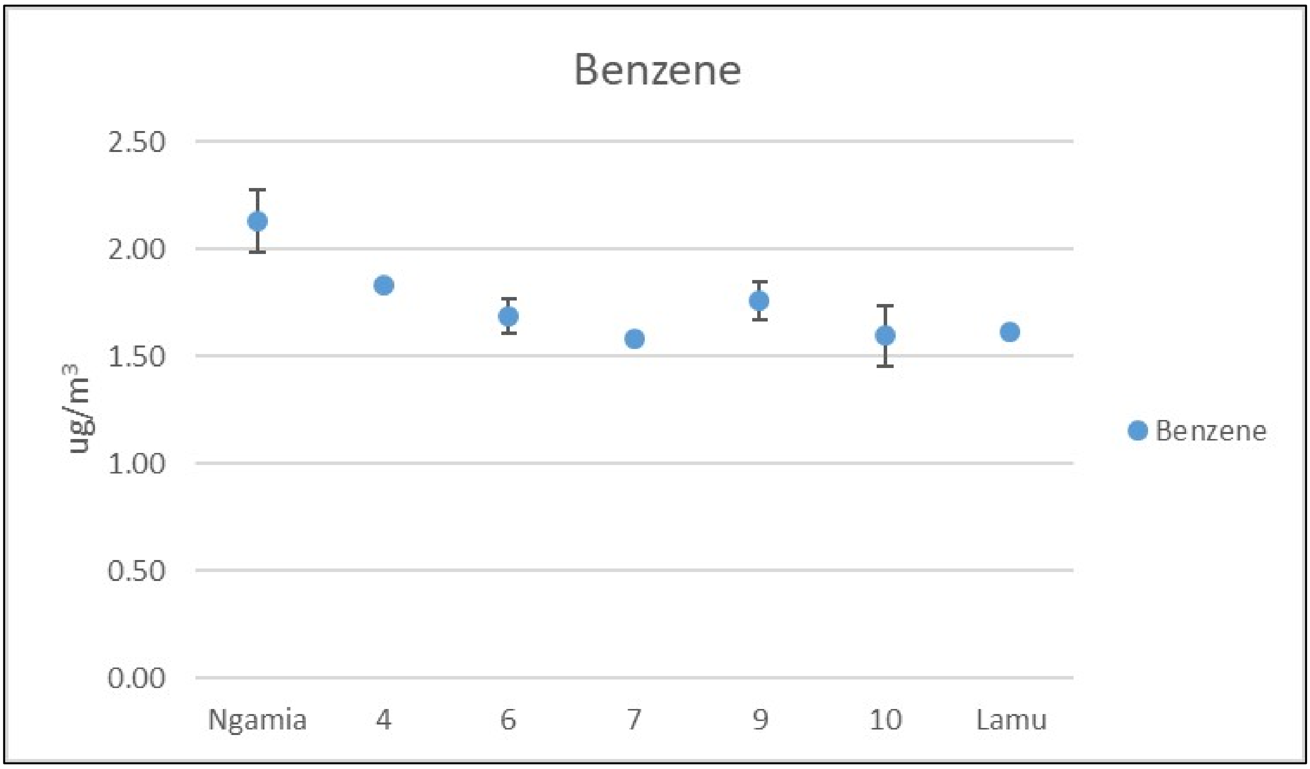


Figure 6.2-6: Benzene annual average concentrations at monitored stations

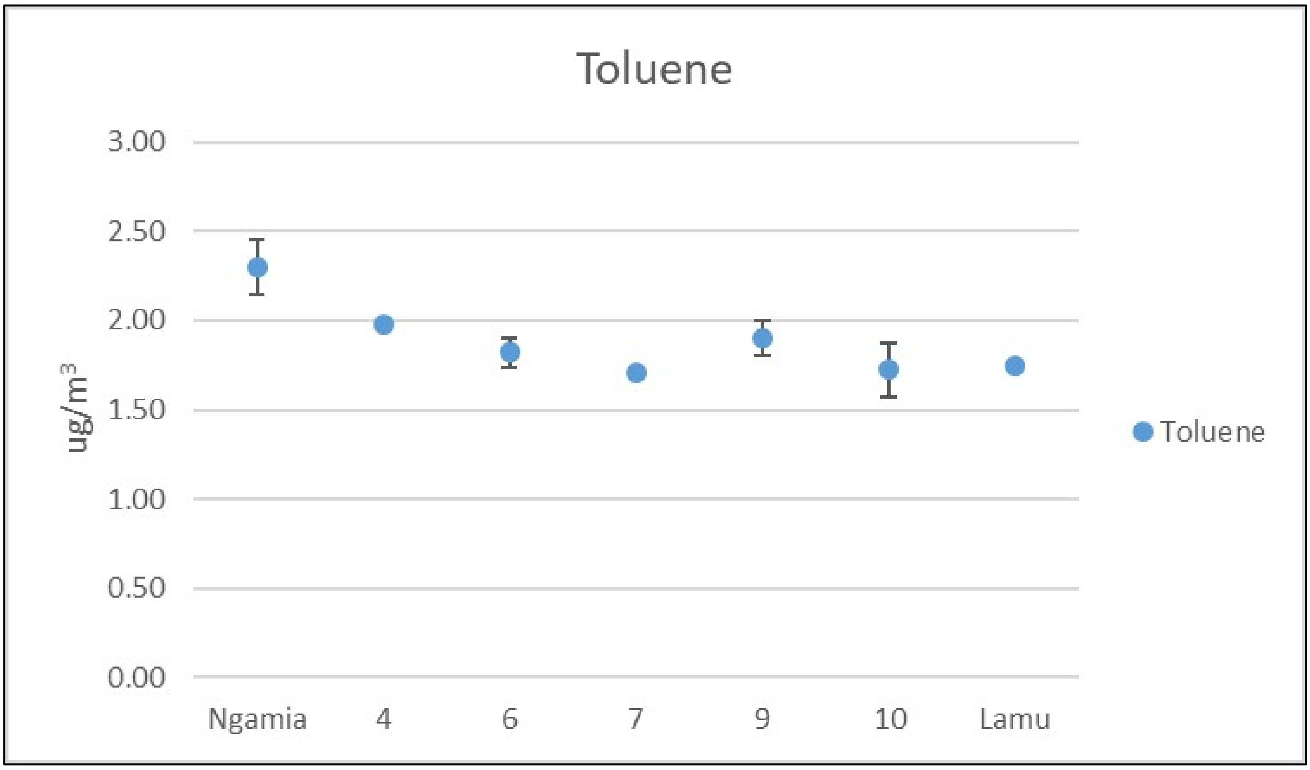


Figure 6.2-7: Toluene annual average concentrations at monitored stations

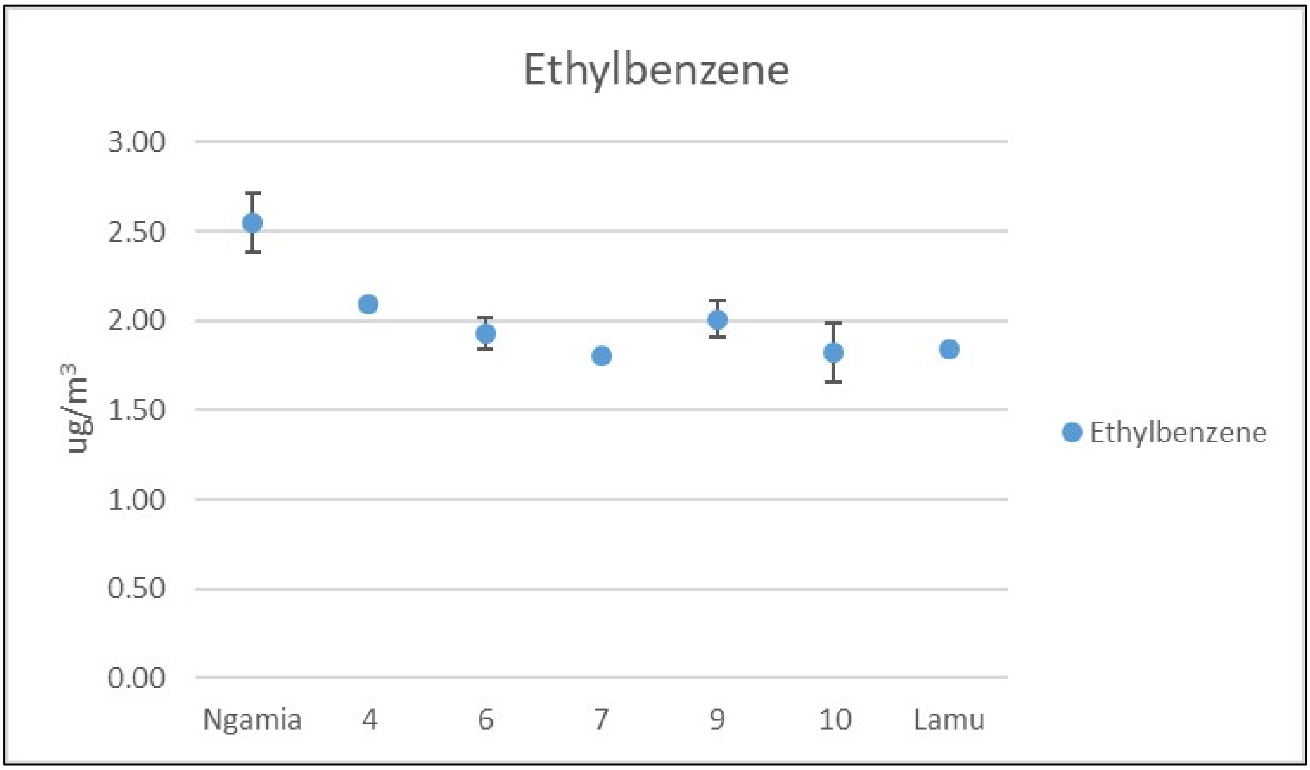


Figure 6.2-8: Ethylbenzene annual average concentrations at monitored stations

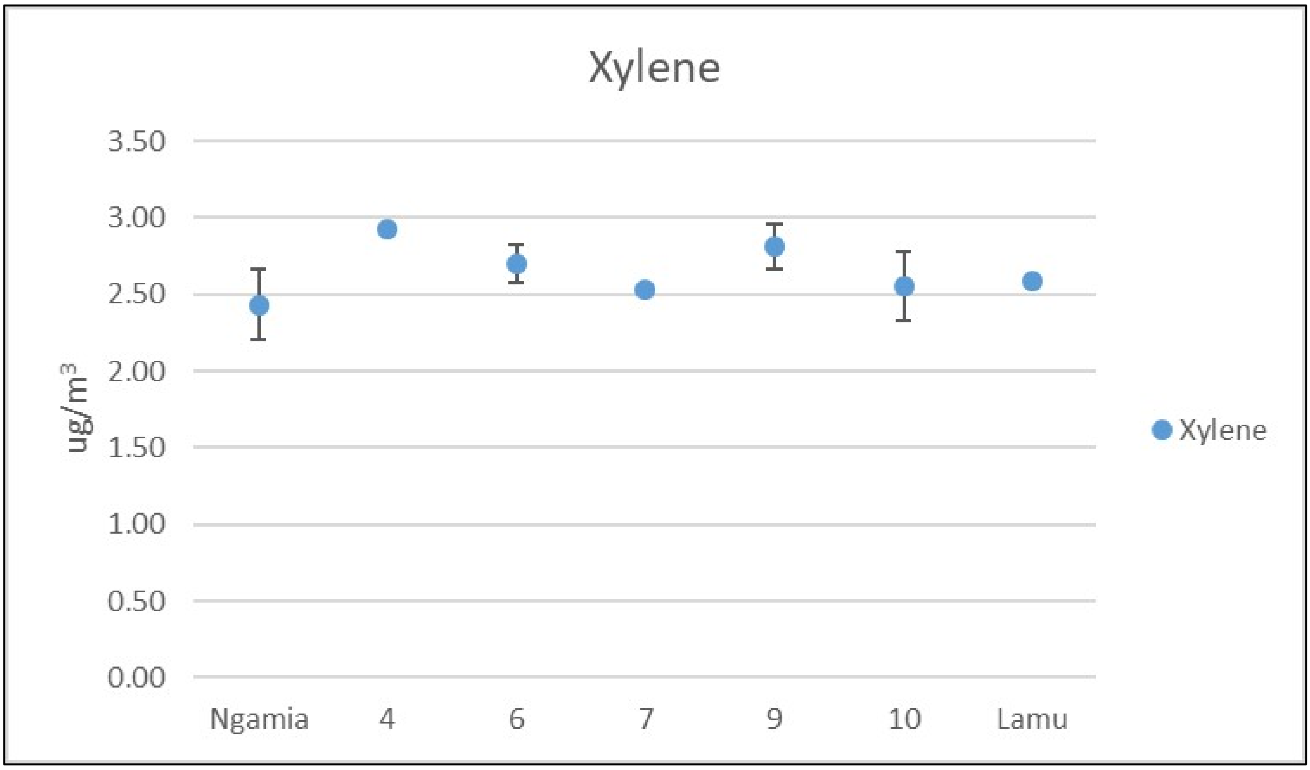


Figure 6.2-9: Xylene annual average concentrations at monitored stations

6.2.4.5 PM_{10} and $PM_{2.5}$

Figure 6.2-10 shows annual average concentrations of PM_{10} at monitored stations compared to the relevant Project International AQS and Kenyan AQS values. The annual project AQS is the international standard of 20 µg/m^3 which is more stringent that than Kenyan annual PM_{10} standard of 50 µg/m^3. Concentrations are similar at all stations except Ngamia and Station 4, which are significantly greater. All monitored values exceed the AQS values, however it should be considered that the AQS value used is the IFC Guideline value – which is the most stringent. There are interim targets set by the IFC for areas where pollution is high which could be applicable to this project (WHO, 2005).

Figure 6.2-11 shows annual average concentrations of $PM_{2.5}$ at monitored stations compared to the relevant Project International AQS and Kenyan AQS values. The annual project AQS is the international standard of 50 µg/m^3 which is more stringent that than Kenyan annual $PM_{2.5}$ standard of 70 µg/m^3. Measurements at Stations 4, 6, 9 and Lamu were 0.0 µg/m^3, and measurements at Ngamia and Stations 7 and 10 exceed the AQS values.

The AQS exceedances of PM_{10} and $PM_{2.5}$ may relate to the dusty environment, meteorological events such as periods of high wind speeds or dry periods. They could also be related to elevated source conditions at the monitoring locations including burning and exhaust emissions. The locations are well established and have multiple potential emissions sources.

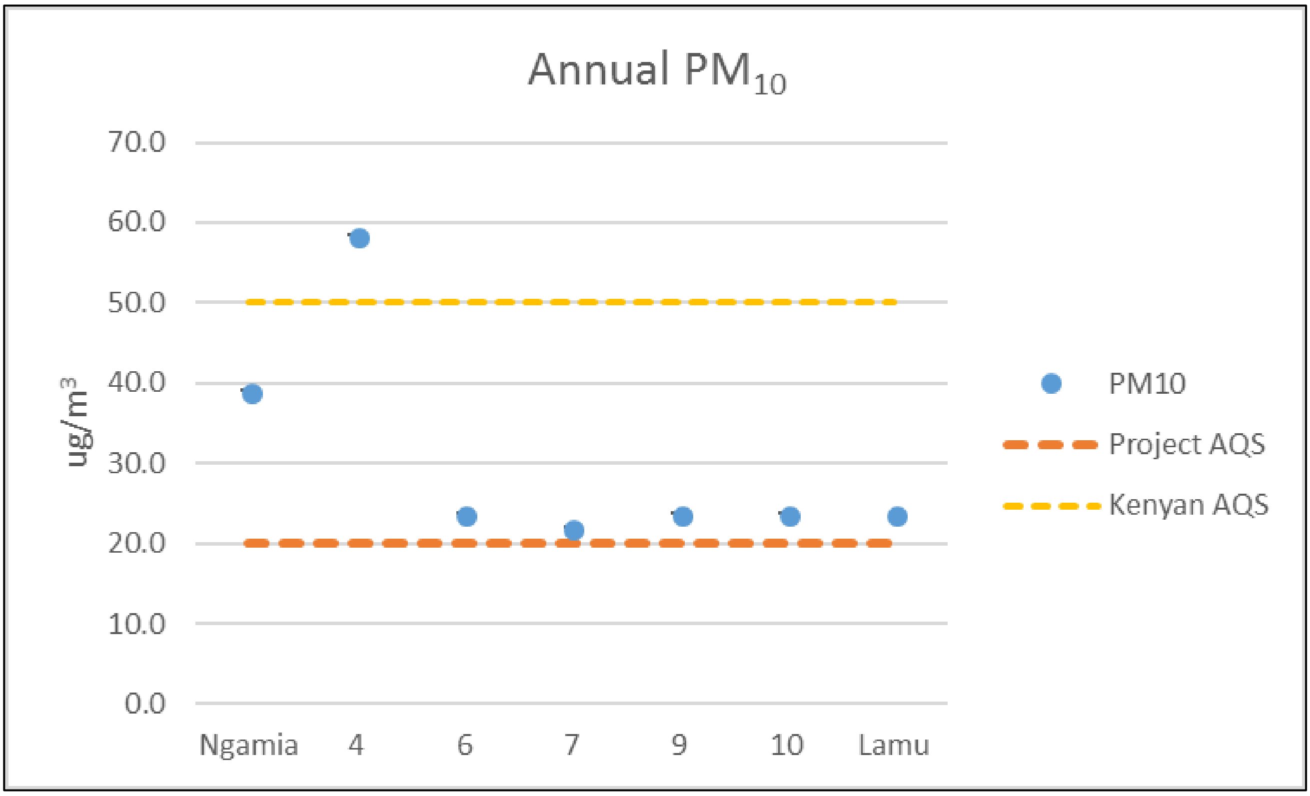


Figure 6.2-10: PM_{10} Annual average concentrations at monitored stations

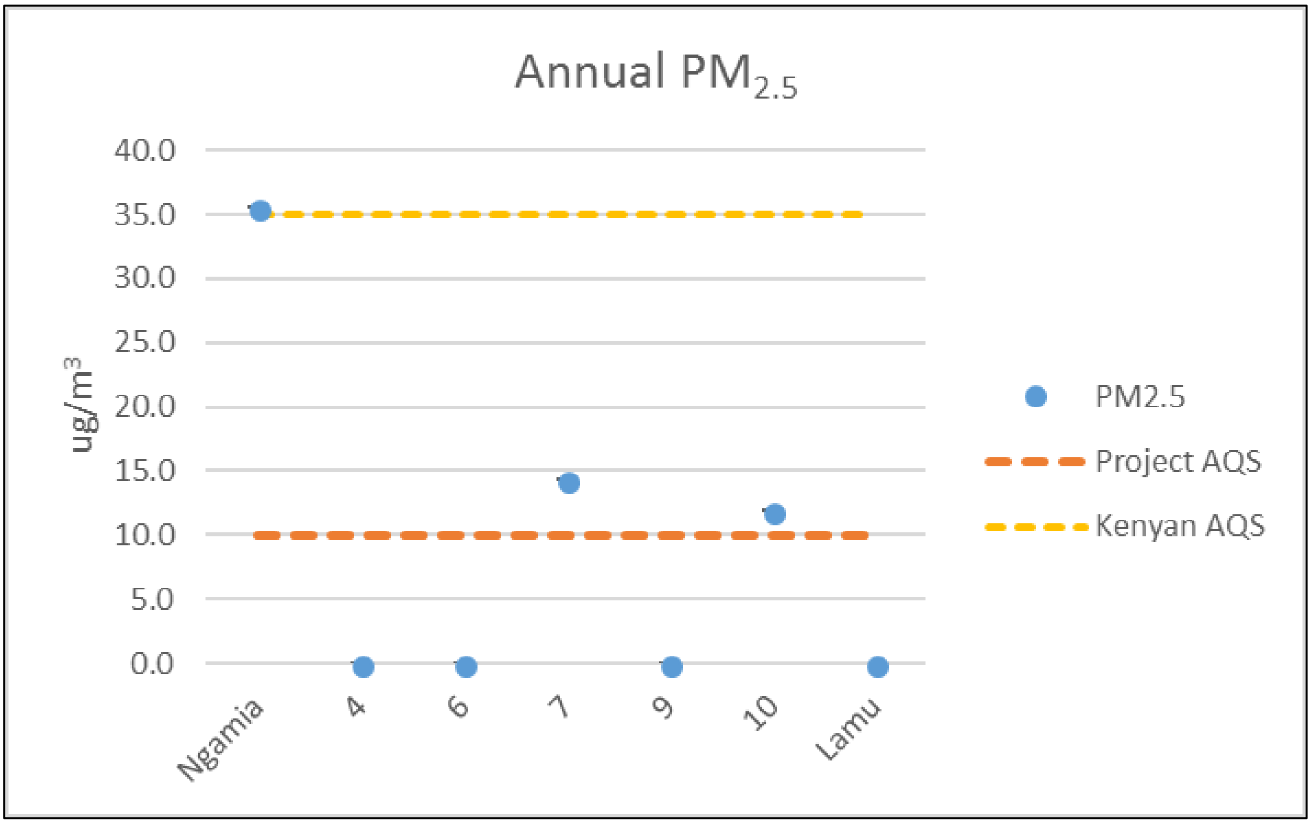


Figure 6.2-11: $PM_{2.5}$ Annual average concentrations at monitored locations

6.2.4.6 Deposited Dust

Figure 6.2 12 shows annual average concentrations of deposited dust in mg/m^2/day, compared to the relevant Project AQS values, which in the absence of any Kenyan Standard, is based on International standard. This standard is derived from the UK Institute of Air Quality Management (IAQM) 'Guidance on Air Quality Monitoring in the Vicinity of Demolition and Construction Sites' (IAQM, 2012). In relation to perceived loss of amenity caused by dust, international guidelines advise that dust deposition levels should not exceed 130-350 mg/m^2/day to prevent amenity impacts due to dust soiling. Therefore the 200 mg/m^2/day standard is considered applicable.

Measured concentrations are all below the Project AQS value. Concentrations are highest at Stations 4 and 6, and lowest at Lamu.

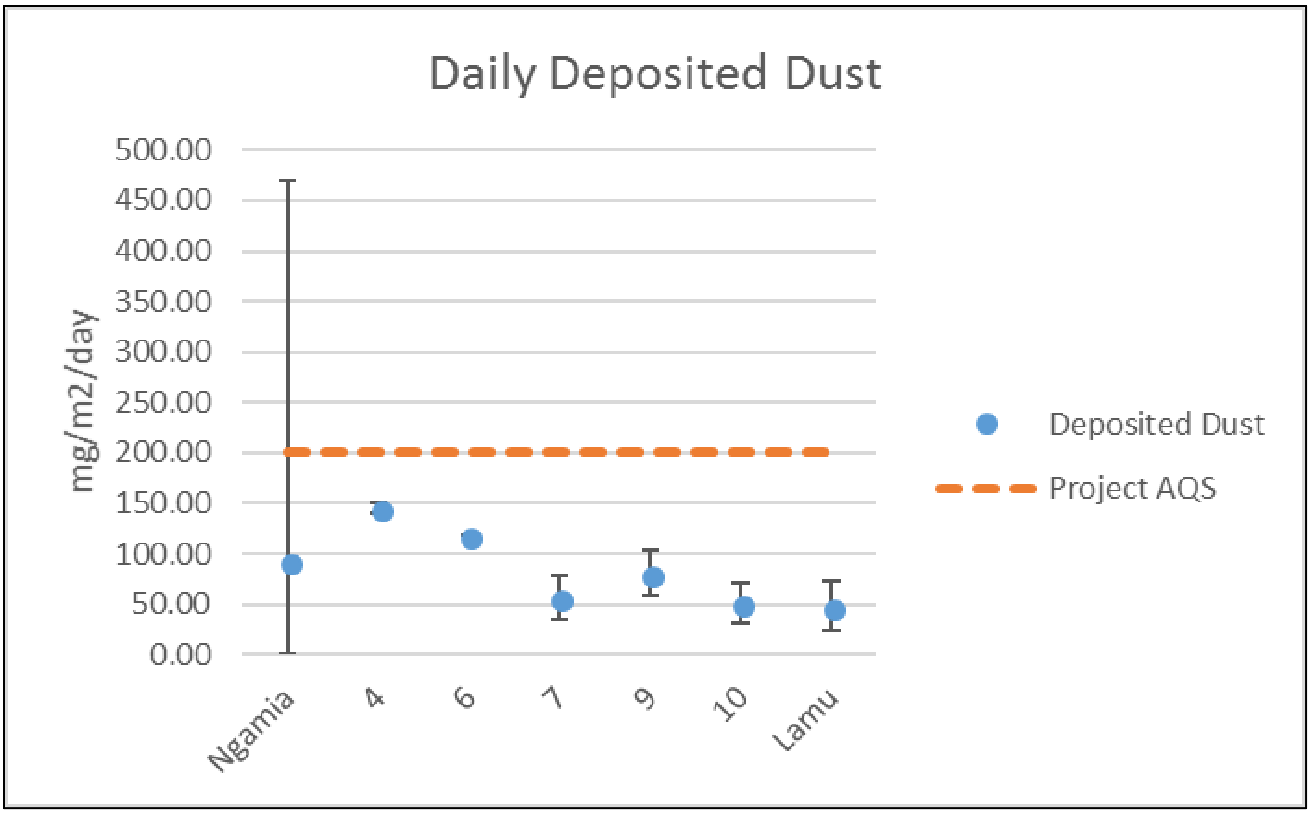


Figure 6.2-12: Deposited dust annual average concentrations at monitored locations

6.2.5 Discussion

Air quality data from seven stations situated along the route of the pipeline has been used to showcase the different pollutant concentrations along the pipeline. While some pollutants show variation between different stations, generally concentrations are similar at each station for each respective pollutant. All baseline concentrations (excluding PM_{10} and $PM_{2.5}$ at isolated locations) are below the Kenyan annual standard.

- Concentrations of NO_2, SO_2, O_3 and BTEX species are similar at each station respectively, and either fall well below the Project AQS and Kenyan standard, or do not have a relevant AQS value for comparison;
- PM_{10} and $PM_{2.5}$ values exceed the Project AQS and Kenyan standard at one location for each, however the village locations of the monitoring stations may account for this. Actual station locations are more remote and so the monitoring values are considered conservative and the IFC interim standards may be applicable to this project; and
- Deposited dust concentrations fall below the Project AQS and Kenyan standard.

6.3 Noise and Vibration

6.3.1 Introduction

Noise baseline data gathering was completed during three separate field visits (December 2018, March 2019, and April 2019) and included six monitoring locations. Additional data has been considered from the Upstream baseline data gathering program collected during a field visit in March 2019. Data from these locations characterise the baseline noise environment within the potential noise and vibration Area of Influence where permanent human activity is expected to occur near the Project. This section is an overall summary of the full noise baseline provided in Annex II.

No vibration data was gathered as part of the ESIA baseline. Due to the lack of development along the pipeline route, the baseline vibration is assumed to be negligible. The effects assessment of changes in vibration will be completed as a comparative change based on predicted changes in activity associated to the Project.

6.3.2 Area of Influence

The AoI for the noise assessment (Figure 6.3-1), within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes an area comprising 5 km surrounding each station along the LLCOP route and a 1.5 km buffer along the entire pipeline.

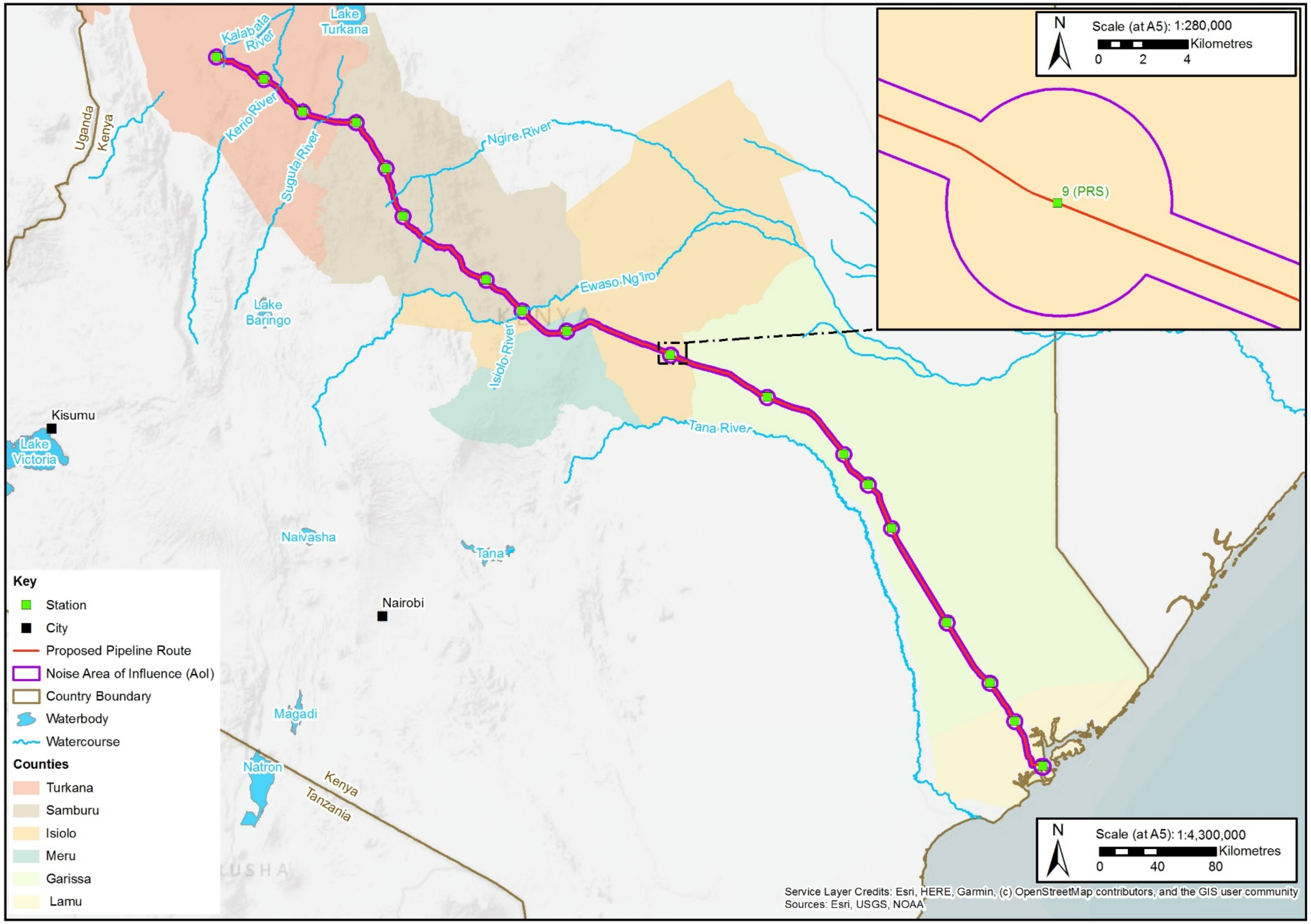


Figure 6.3-1: Noise AoI

6.3.3 Methods

6.3.3.1 Secondary Data

There is no known baseline data for noise or vibration in the potential Area of Influence other than the primary data gathered as part of the ESIA baseline data gathering associated with the Project.

6.3.3.2 Primary Data

Baseline noise levels were measured in communities across the potential Area of Influence which correspond to representative areas with permanent human receptors that have the potential to be impacted by Project noise. The baseline noise data gathering was designed in general accordance with the requirements of International Organisation for Standardisation (ISO) 1996 Parts 1 and 2 (ISO, 2003; ISO, 2007), which provides guidance on the equipment to be used, conditions under which noise measurements should be undertaken, measurement parameters and appropriate siting of monitoring equipment. Data was collected at seven locations within communities located near Project station locations along the LLCOP to characterise the sound levels along the pipeline (Figure 6.3-2).

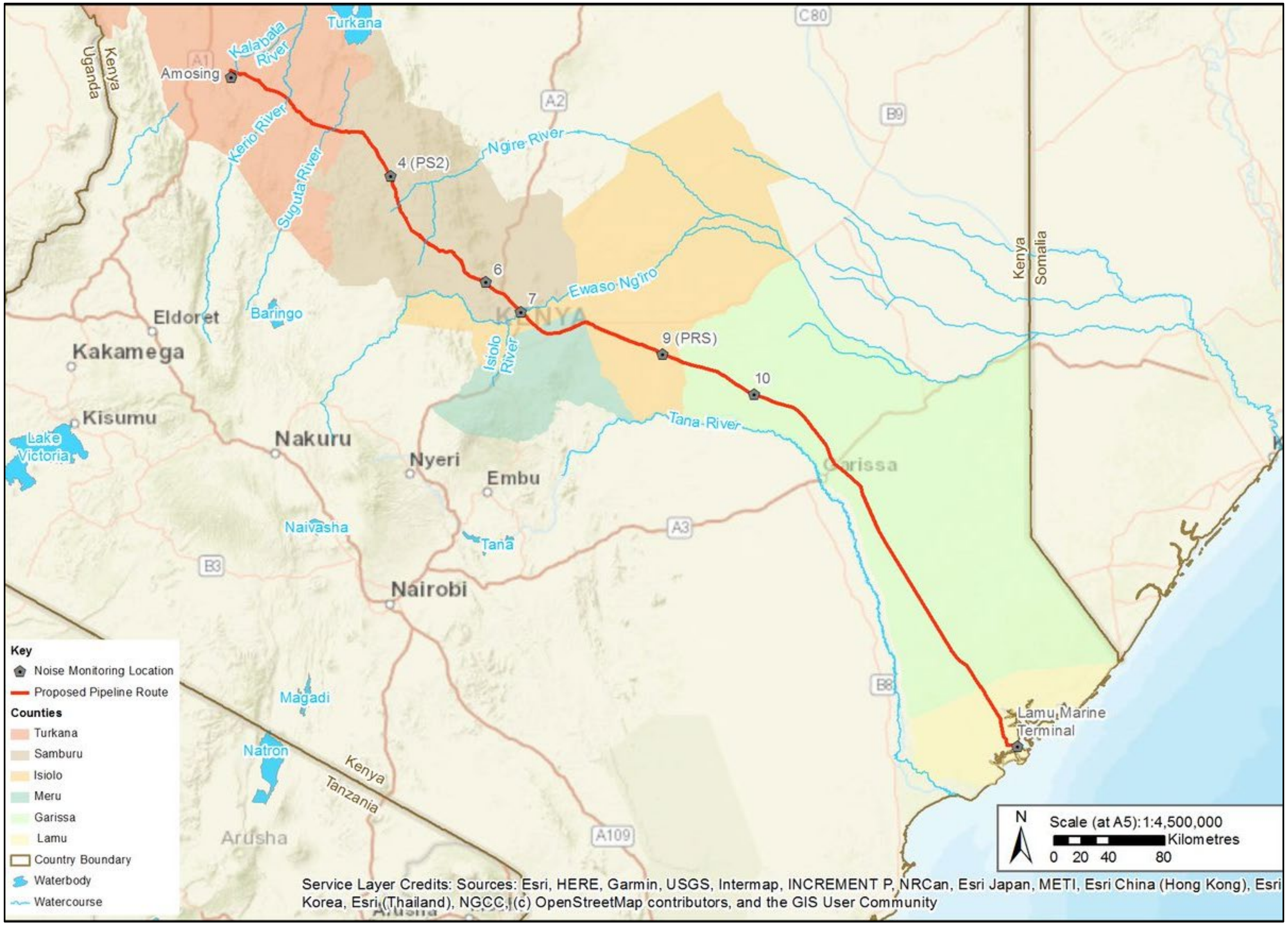


Figure 6.3-2: Baseline noise monitoring locations

The noise monitoring location for station 4 was Barsaloi Chief's Office, which lies at an elevation of 467 m and is a settlement with some commercial shops. The station 6 monitoring location was in Lengusaka, which lies at an elevation of 512 m and is a residential area with a small business centre and a road passing next to it. The station 7 monitoring location was in Archer's Post in Isiolo, which is located at an elevation of 839 m and is next to the Ewaso Ng'iro river and the Isiolo-Marsabit road, with a shopping centre, and police post nearby. Station 9 monitoring was conducted in Garba Tula, which lies at an elevation of 466 m and is a village settlement. Station 10 monitoring was conducted in Ohio Village in Rahole National Reserve in Garissa, with sampling elevations of both 337 m and 335 m. There is a village settlement, water pan, small kiosk and a school near the sampling location. The Load Out Facility monitoring location was located in a village adjacent to the entrance to Lamu Port.

Monitoring conducted at Amosing-5 as part of the Upstream ESIA is considered to be representative of baseline noise levels near LEF/PS1.

The sound level meters (SLMs) were deployed at each monitoring location and collected baseline noise data unattended and continuously for approximately 24 hours. The data collected at each monitoring location included 10-minute equivalent sound levels (L_{Aeq}). The L_{Aeq} is the equivalent continuous sound level, which in a stated time and at a stated location has the same energy as the time varying noise level. The gathered 10-minute L_{Aeq} noise data were aggregated to give daytime (07:00 to 22:00) and nighttime (22:00 to 07:00) period averages. The exact location of the noise monitoring set up, provided in Table 6.3-1, considered security and accessibility.

6.3.4 Results

The *International Finance Corporation Environmental, Health and Safety (EHS) Guidelines - Noise Management* dated 2007 (IFC Noise Guideline) and *Kenya Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations* dated 2009 (Kenya Noise Regulations) have been considered in defining the Project Standards.

Kenyan noise regulations for Zone C – Residential Outdoor are 50 dBA L_{eq} for daytime (06:01 to 20:00) and 35 dBA L_{eq} during night-time (20:01 to 06:00). However, in comparing standards to baseline data, it was observed that baseline values exceed Kenyan standards. Therefore, in line with the ESIA team justification on other projects in Kenya (Golder, 2016[1]) the IFC noise level limit for residential, institutional and educational receptors is considered more appropriate to the LLCOP Project and to this ESIA.

The specified IFC noise level limit for residential, institutional and educational receptors during daytime (07:00 to 22:00) is set at 55 dBA L_{eq}, and during night-time (22:00 to 07:00) at 45 dBA L_{eq}. These limits are adopted as the Project Standards for operational noise and presented on Figure 6.3-3 to Figure 6.3-9.[2]

The weather during most of the noise monitoring periods was dry with light winds. There was a short period of light rain (i.e. less than an hour) at the beginning of the noise monitoring period at Archer's Post on 10 December 2018; the noise monitoring data measured during this time were removed from the analysis. Meteorological conditions were not expected to have a significant effect on the remaining measured noise levels. The following figures show the time series of the 10-minute L_{Aeq}, L_{Apeak}, L_{AFmax}, and L_{AFmin} measured at a selection of the noise monitoring locations[3]. The Project noise limits are shown for comparison.

[1] Golder 2016 - Review of IFC noise Guideline and Kenya noise regulation sound level limits – South Lokichar Basin Project, 165017.511

[2] Note that the definition of daytime and nighttime for the construction limits in the Kenya Noise Regulations differs from the daytime and nighttime definition in the IFC Noise Guideline.

[3] Amosing–5 summary data is presented in Table 6.3-1

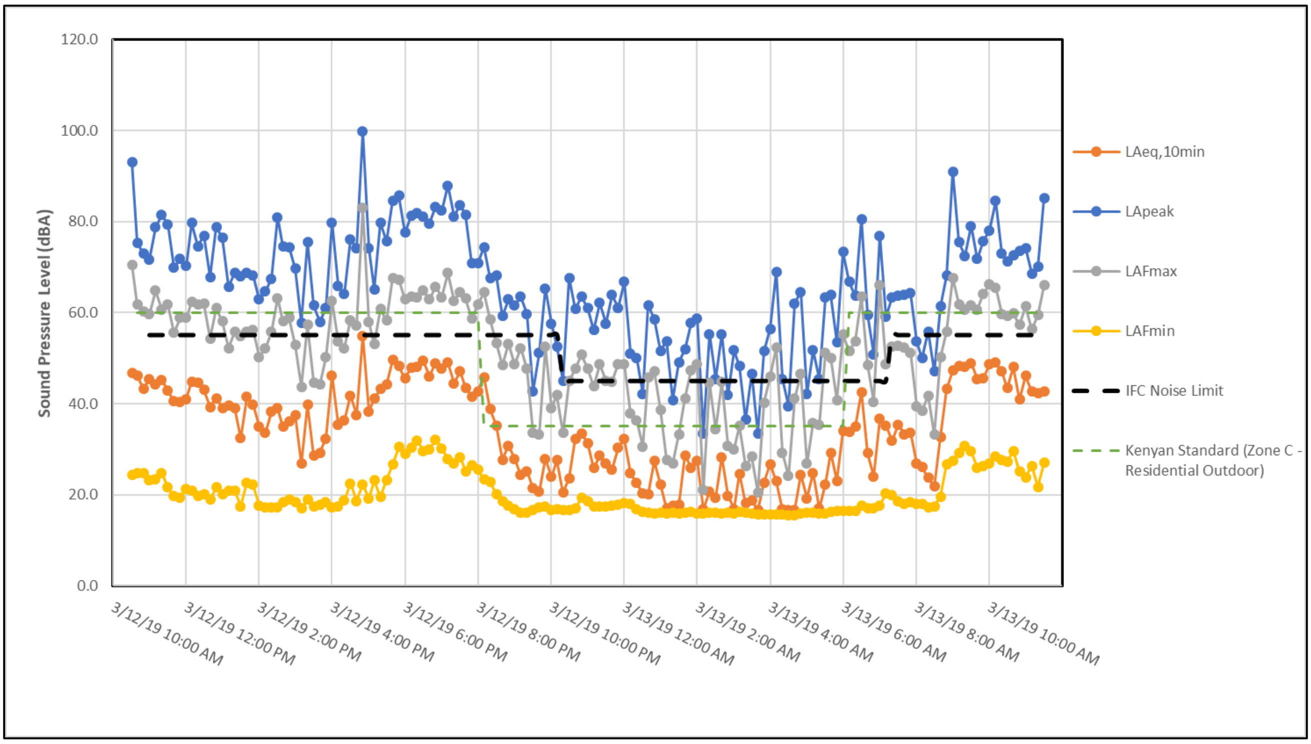


Figure 6.3-3: Time history graph of measured baseline noise levels at Amosing-5 (12 to 13 March 2019)

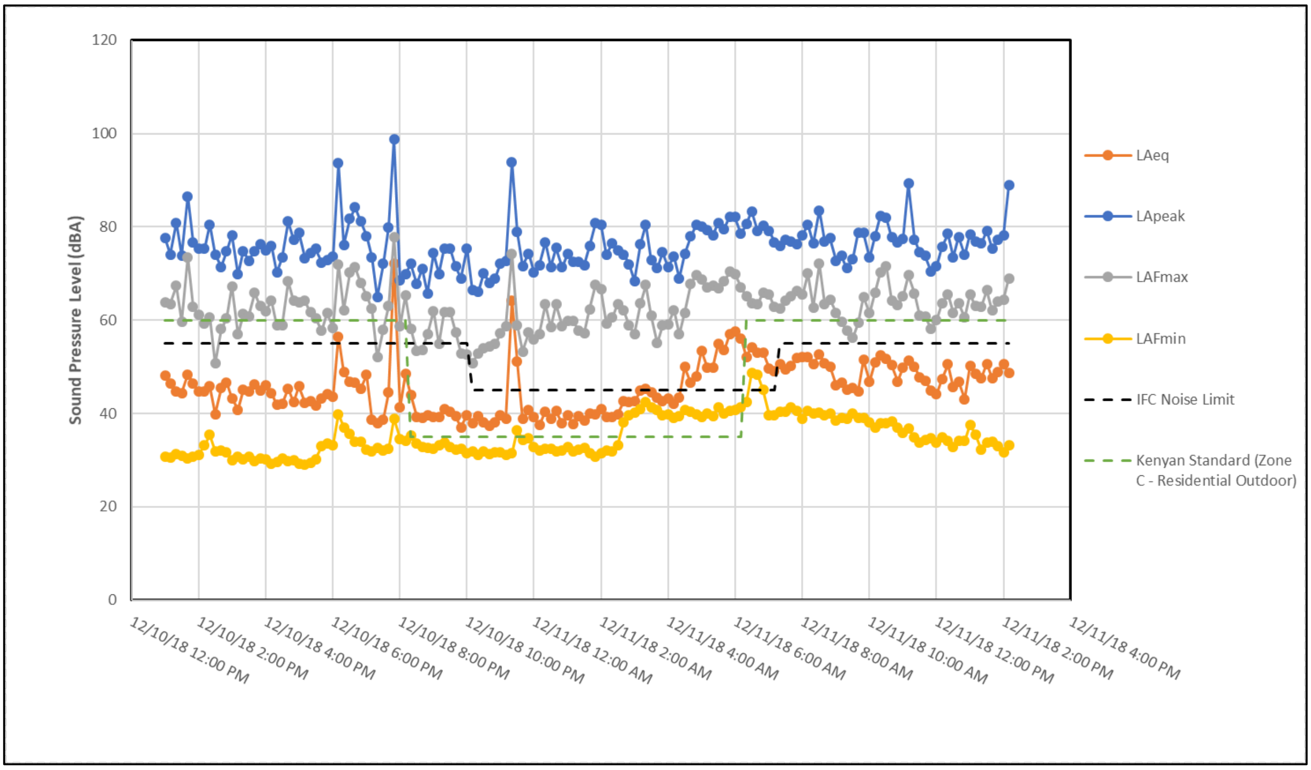


Figure 6.3-4: Time history graph of measured baseline noise levels at Archer's Post (10 to 11 December 2018)

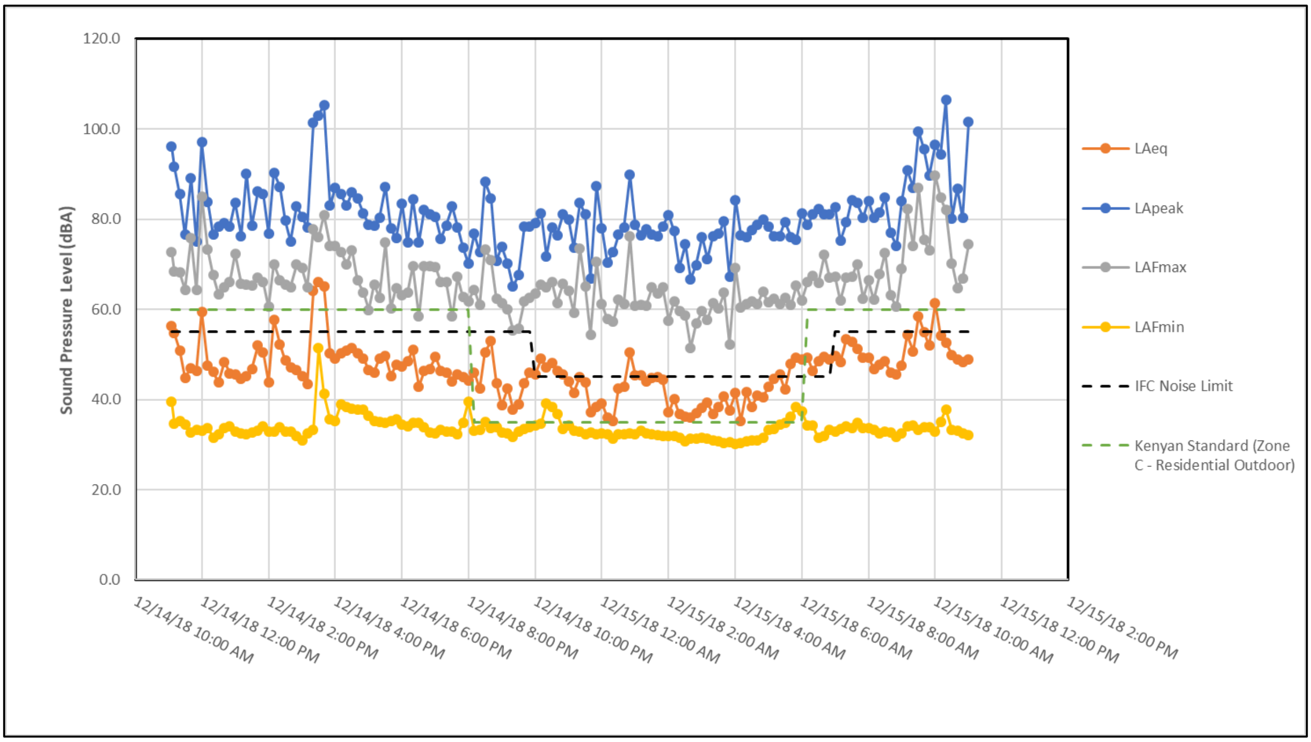


Figure 6.3-5: Time history graph of measured baseline noise levels at Ohio Village (14 to 15 December 2018)

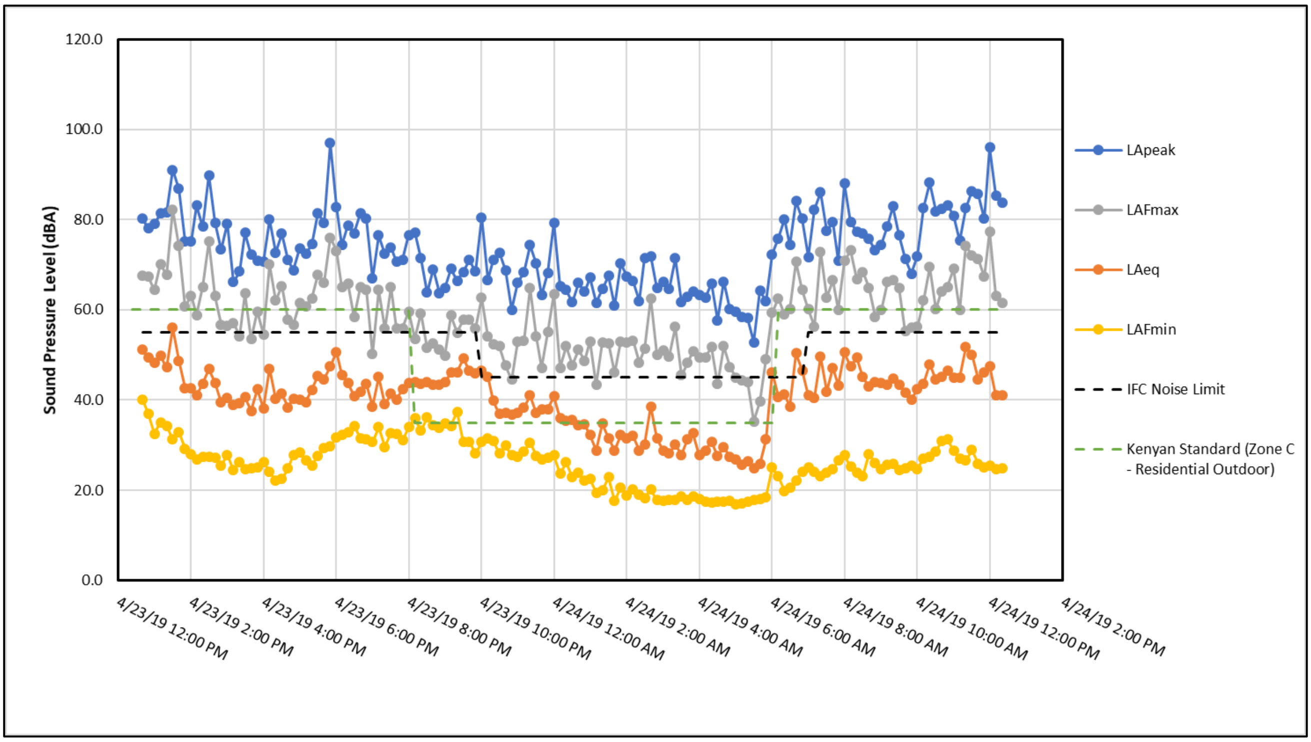


Figure 6.3-6: Time history graph of measured baseline noise levels at Barsaloi (23 to 24 April 2019)

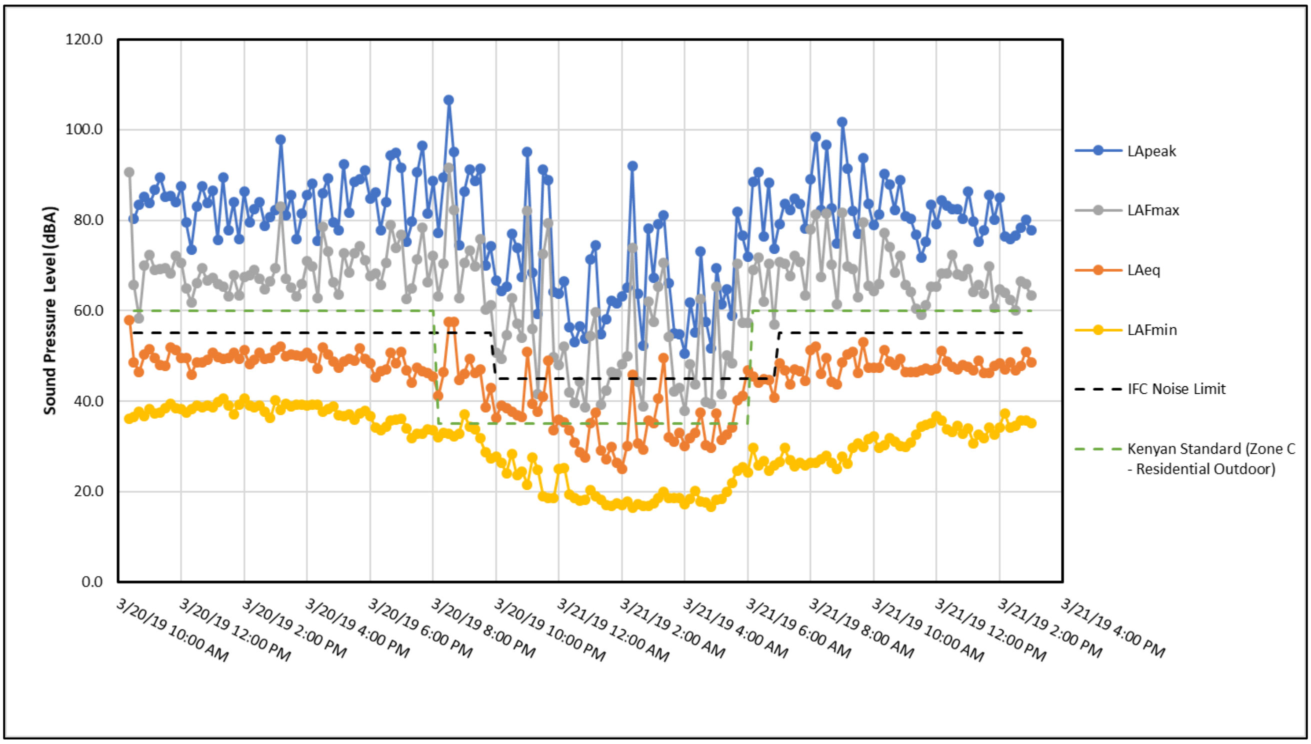


Figure 6.3-7: Time history graph of measured baseline noise levels at Lengusaka (20 to 21 March 2019)

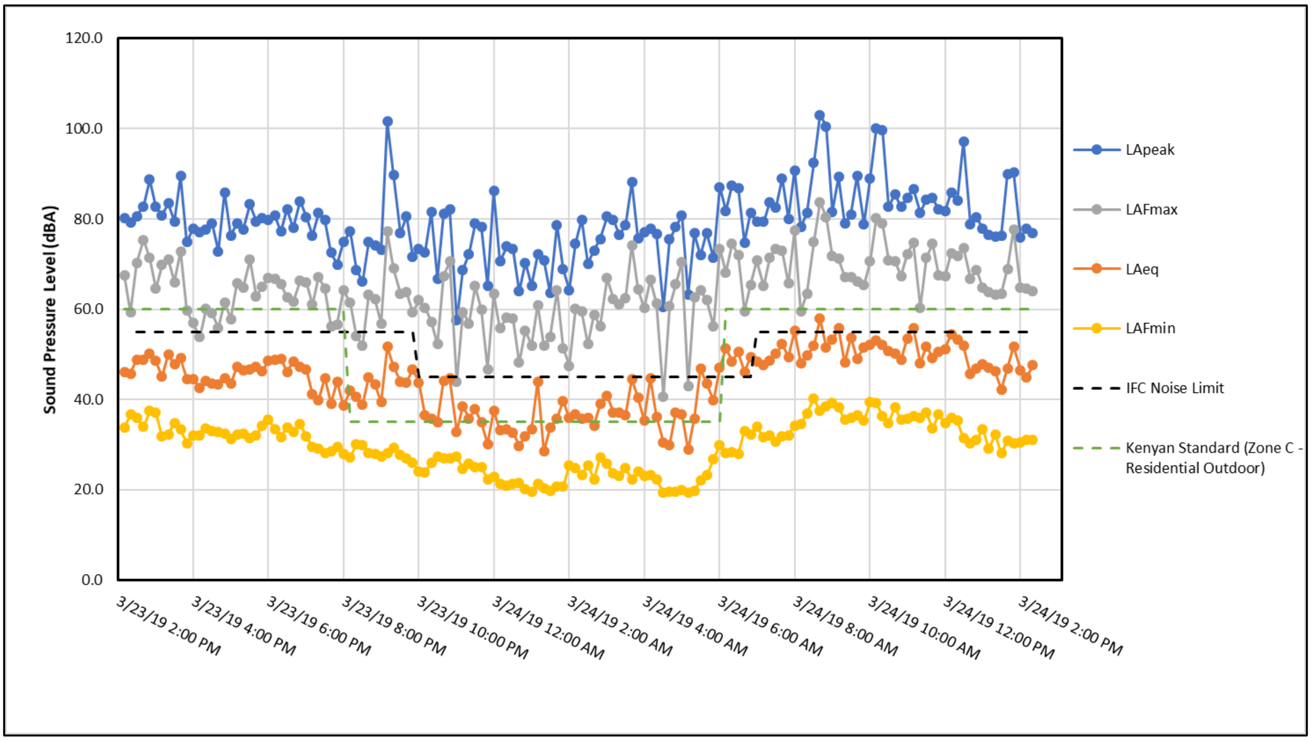


Figure 6.3-8: Time history graph of measured baseline noise levels at Garba Tula (23 to 24 March 2019)

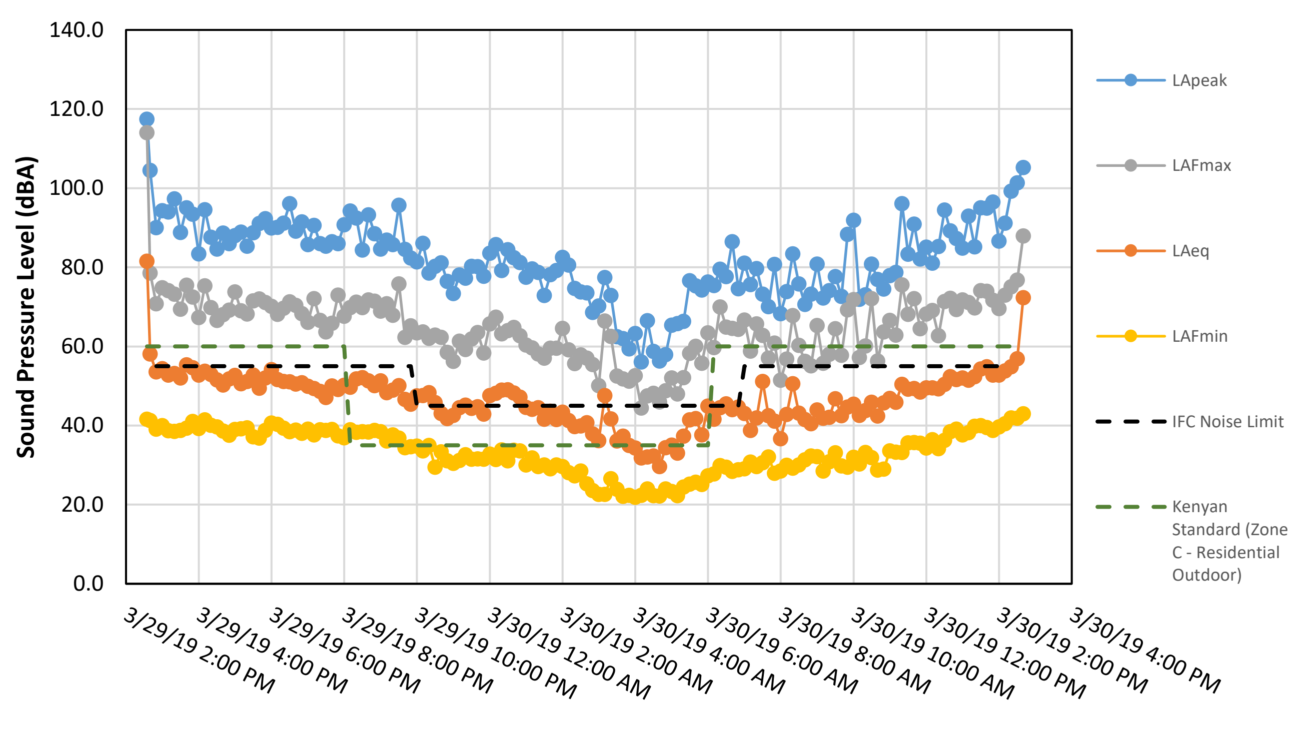


Figure 6.3-9: Time history graph of measured baseline noise levels at Lamu Port (29 to 30 March 2019)

A summary of the minimum hourly and period average measured baseline noise levels is provided in Table 6.3-1.

Table 6.3-1:Summary of Measured Baseline Noise Levels

Noise Monitoring Location (Nearest Representative Station)	Latitude/ Longitude	Monitoring Period	Minimum One Hour L_{Aeq} (dBA)		Average One Hour L_{Aeq} (dBA)	
			Daytime [a]	Night-time [b]	Daytime [a]	Night-time [b]
Amosing-5 (LEF/PS1) [c]	**N:** 02°10'53.7" **E:** 35°47'01.9"	March 2019	25.4	20.7	44.1	29.3
Archer's Post (Station 7)	**N:** 00°38'24.6" **E:** 37°40'12.6"	December 2018	39.5	38.5	53.7	50.9
Barsaloi (Station 4)	**N:** 01°20'07.2" **E:** 36°51'48.2"	April 2019	40.2	27.4	45.9	39.1
Lengusaka (Station 6)	**N:** 00°52'38.0" **E:** 37°19'01.3"	March 2019	46.1	32.9	49.2	40.9
Garba Tula (Station 9)	**N:** 00°31'46.2" **E:** 38°31'06.8"	March 2019	42.0	33.7	49.6	42.2
Ohio Village (Station 10)	**N:** 00°05'42.9" **E:** 39°12'57.3"	December 2018	42.3	37.4	53.5	44.7
Lamu Port (Load Out Facility)	**N:** 02°11'56.6" **E:** 40°54'32.2"	March 2019	44.0	32.7	50.6	43.9

***Note:** Daytime – 07:00 to 22:00; Nighttime – 22:00 to 07:00*
[a] Project Standard daytime noise level limit, 55 dBA and Kenyan daytime noise level limit 50 dBA
[b] Project Standard nighttime noise level limit, 45 dBA and Kenyan nighttime noise level limit 35 dBA
[c] Baseline noise levels at Amosing-5 were measured as part of the Upstream baseline noise gathering and is further discussed in the Upstream ESIA

6.3.5 Discussion

The measured hourly minimum and average L_{Aeq}s are summarised in Table 6.3-1 for all noise monitoring locations. Measured baseline noise levels are below the Project Standards (IFC) excluding Archers Post (Station 7) during the night-time period. Table 6.3-1 Archers Post, Ohio Village and Lamu Port have daytime average one-hour noise values above the Kenyan daytime limit and for the night-time period all locations excluding Amosing 5 exceed the Kenyan standard for Zone C outdoors.

The Amosing-5 noise monitoring location was located adjacent to the Amosing exploration well pad in South Lokichar. Measured noise levels were influenced by occasional truck movements.

The Archer's Post noise monitoring location was in a school compound, 280 m north of Forest Road, near several other schools and a shopping centre; the schools were closed for holidays during the noise monitoring period. Measured noise levels were influenced by local residents and traffic on Forest Road. There were several religious buildings in the area, and the calls to prayer could have influenced the noise environment.

The Ohio Village noise monitoring location was next to the Rahole National Reserve, located within 30 m of Garissa-Bonane Road, which is used as a transport route during the night-time period. West of the noise monitoring location was a water pan used by the community, and livestock was herded past the area by nomadic communities. Measured noise levels were influenced by local residents, wildlife, and traffic on the Garissa-Bonane Road.

The Lengusaka noise monitoring occurred at the Chief's residence, in a residential area with a small business centre. The location was within 200 m of the Archer's Post-Barsaloi Road. Measured noise levels were influenced by human activity within the community, vehicle traffic, and wildlife.

The Garba Tula noise monitoring was conducted at a police station, located near a residential area. Measured noise levels were influenced by wildlife, human activity and vehicle traffic.

The Lamu Port noise monitoring location was a homestead located approximately 400 m from the Lamu Port's main entrance. Measured noise levels were influenced by truck traffic associated with the Port, as well as human activity in the village and wildlife.

The Barsaloi noise monitoring was conducted at the Chief's office. It was located near a settlement with commercial shops, approximately 30 m from the Wamba-Suiyan Road. Measured noise levels were influenced by human activity within Barsaloi.

6.4 Water Resources (Surface Water and Groundwater)

6.4.1 Introduction

The objective of the water resources impact assessment baseline is to characterise the surface water and groundwater regimes along the Project corridor, so that it is possible to then assess the potential impacts and effects that the Project could feasibly present to the key water resource receptors identified through the baseline studies. To do this, the baseline conditions have been established for the following:

- Shallow groundwater and surface water quality;
- Groundwater regime, including aquifers and levels;
- Surface water flows and flooding; and
- Local water use.

This section of the ESIA presents a summary of those baseline water resources conditions within the Project AoI. The focus of this summary is on the water features that have been carried through as receptors for the impact assessment. The full baseline is provided in Annex II. Water features that are ecologically important are considered within the biodiversity baseline.

6.4.2 Area of Influence

The AoI for the water resources assessment (Figure 6.4-1), within which data has been gathered for the baseline, comprises the area of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes an area 5 km buffer along the entire pipeline to ensure that any potential effects downstream of any watercourse, crossed by the route crossing are within the AoI.

This same AoI has been carried forward into the impact assessment (Section 7.3).

6.4.3 Method

A combination of secondary and primary data sources have been used to collate the baseline environmental setting information about the surface water and groundwater environments. These sources have been used in combination to present summary baseline information relating to the topics covered in the results section (6.4.4).

6.4.3.1 Primary Data Sources

Primary data sources used to compile the water environment baseline include site specific investigation and monitoring data gathered as part the Project. Additional relevant primary data collected as part of the Upstream project has also been incorporated. The primary data includes surface water and groundwater quality sampling results, surface water flow data, ground investigation observations and measurements, groundwater level monitoring and the results of infiltration tests.

Other baseline studies that include primary data have also been drawn upon to add relevant information to the surface water and groundwater baseline. The climate baseline (Annex II) has been drawn upon for Project specific rainfall and temperature data. The social baseline (Annex II) includes water use surveys/census data, and this water baselined has been drawn upon that for Project specific information on water users and the sources of water supplies. Ecology baseline (Annex II) included the collection of surface water quality field parameters (such as pH, temperature, electrical conductivity and total dissolved solids). This data has been used in the hydrology (surface water quality) section of this baseline.

Additional studies that have been undertaken by the Project team provide further sources of primary information, such as information on flood risk and erosion studies[1]

6.4.3.2 Secondary Information Sources

Publicly available information sources have been used as secondary data sources for the baseline. Such sources typically provide high-level regional or country-wide background information on the surface water and groundwater environments. These sources include literature (e.g. papers, websites and reports), maps and available national or regional data sets. Organisations that publish the secondary sources used to compile this baseline include, the World Bank, the Food and Agriculture Organisation of the United Nations (FAO), the United Nations, the British Geological Survey (BGS,) and the Kenyan Water Resources Authority (WRA).

[1] Wood Group, 2019: Lokichar to Lamu Crude Oil Pipeline – FEED Phase 2, Flooding and Fluvial Erosion Study. Report reference 803122. Wood Group, 2018a: Lokichar to Lamu Crude Oil Pipeline – FEED Phase 1, Geohazard Desktop Study. Report reference LLCOP-WOD-PL-REP-0002.

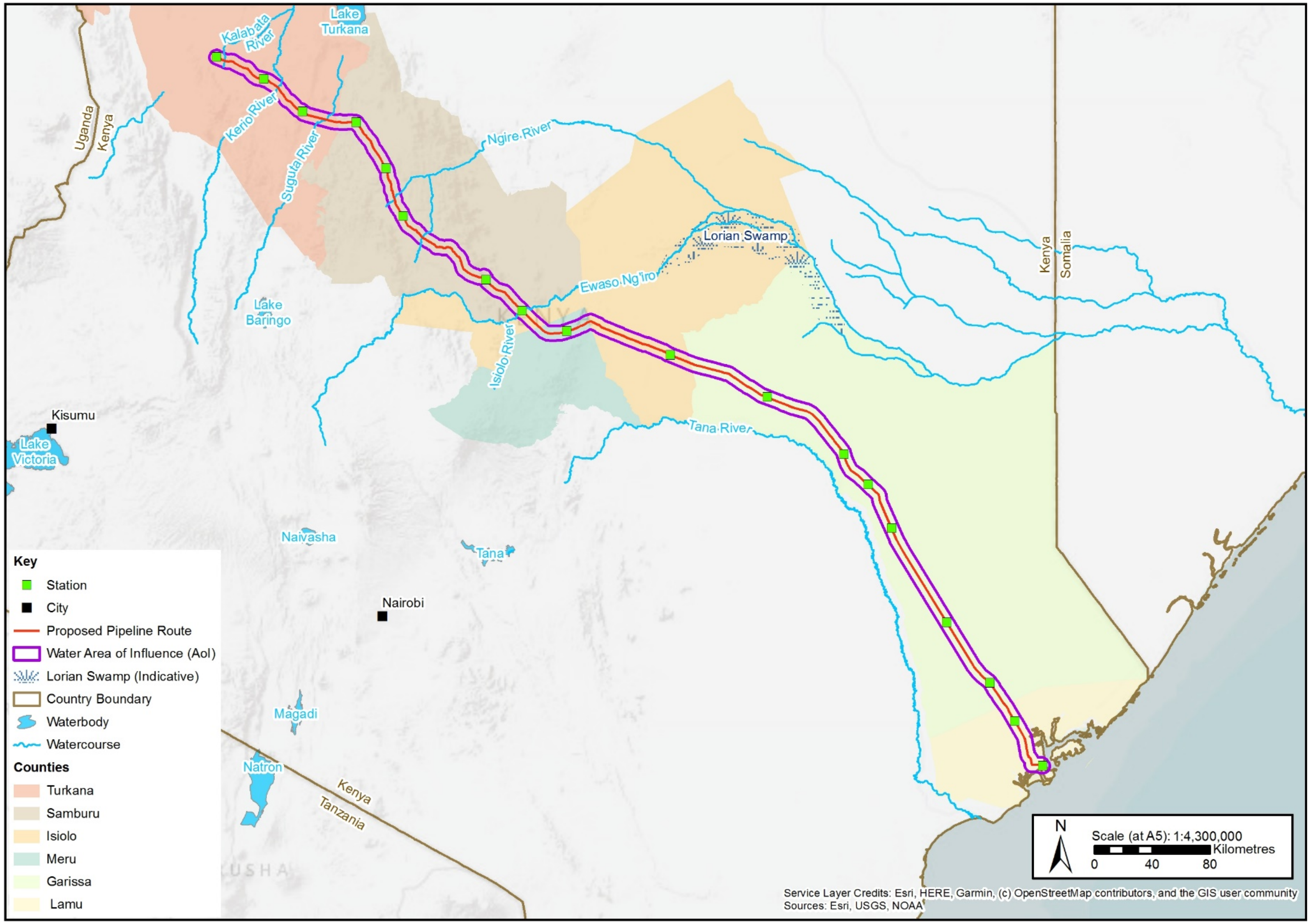


Figure 6.4-1: Key surface watercourses and AoI

6.4.4 Results

6.4.4.1 Hydrology (Surface Water)

The water features crossed along the Project route include rivers and streams that are either perennial (flow all year around) or are ephemeral (flow seasonally or are short-lived/temporary, for example during periods of heavy rainfall). The pipeline route crosses three largely perennial rivers, the Kerio River, the Suguta River and the Ewaso Ng'iro River, as illustrated in Figure 6.4-1. This summary of baseline hydrological conditions focuses on the three main rivers identified in the full baseline, but also includes general information on the more minor, typically ephemeral (seasonal) watercourses, Lake Turkana, the coastal water environment, flooding and surface water quality.

Kerio River

The Kerio River originates from the Metkei and Timboroa forests and flows approximately 500 kilometres (km) towards the northeast, passing through the Kerio Valley before draining to Lake Turkana.

Flow data are generally scare (Wood Group, 2018). There is a gauging station (Station 2C8) at Lokori. Based on measurements between 1970 and 1973 at this station, the mean inter-annual flow was estimated to be 10.5 cubic metres per second (m^3/sec).

The ESIA aquatic ecosystems baseline work (Annex II) included dry season estimations of watercourse width and height, and flow velocities. The estimated dry season discharge was 3.64 m^3/s. The predicted extreme event 1 in 100-year return period peak flow for the Kerio River (Wood Group, 2019) is 1,040 m^3/s.

Figure 6.4-2: Kerio River near the proposed pipeline crossing

Suguta River

The Sugatu River originates in the Suguta Valley. The low rainfall and high evaporation rates in the valley means that the flow regime is irregular and major discharge only occurs following the rainy season.

The river has a large flood valley that includes several abandoned channels. The current channel is approximately 100 m wide at the proposed pipeline crossing, but the floodplain (with the possibility of channel migration) means the distance between ‘banks’ could be much greater (up to 6.2 km) (Wood Group, 2018). A photograph of the Suguta River near the crossing location is included as Figure 6.4-3 (Golder, 2019a).

The ESIA aquatic ecosystems baseline work (Annex II) included the estimation of dry season discharge at 2.85 m^3/s. The predicted 1 in 100-year return period peak flow for the Suguta River (Wood Group, 2019) is 1,450 m^3/s.

Figure 6.4-3: Suguta River near the proposed pipeline crossing (6 December 2018)

Ewaso Ng’iro River

The pipeline route crosses the Ewaso Ng’iro River near Archer’s Post. The river originates from the wetter Nyandarua Mountains and Mount Kenya over 200 km in the west and flows for about 700 km to the Somalian desert. Its drainage basin covers an area of 210,000 kilometres squared (km^2) (Wood Group, 2018).

The Ewaso Ng’iro River at the proposed pipeline crossing at Archer’s Post is typically perennial. In most years the river becomes ephemeral near the town of Merti, which is located approximately 120 km downstream and northeast of the pipeline crossing, but when the rains are poor flows can cease further upstream (Acacia Water, 2014).

At the pipeline crossing, the river is approximately 150 m wide (Wood, 2018). The southern bank mainly comprises fine sand, with local fluvial conglomerates underneath. A photograph of the Ewaso Ng'iro River near the pipeline crossing location is included as Figure 6.4-4 (Golder, 2019a).

The river flows into the Lorian swamp (see Figure 6.4-1) where it is an important source of water for recharging groundwater and maintenance of vegetation cover (Kinconsult Associates Ltd, 2016). The Lorian Swamp is located approximately 100 km downstream of the Project Ewaso Ng'iro crossing. It is not a wetland area with any conservation designations.

Figure 6.4-4: Ewaso Ng'iro River near the proposed pipeline crossing (9 December 2018)

Field data from a flow gauge in the Ewaso Ng'iro River (Wood Group, 2019) shows that the maximum annual flow discharge during the period 1960 to 1978 ranged between 220 m^3/s in 1960 and 1,752 m^3/s in 1961, but that the maximum annual flow discharge for most years fell between 400 m^3/s and 700 m^3/s. The predicted extreme flow is 1,131 m^3/s for the 1 in 20-year return period and 1,540 m^3/s for the 1 in 100-year return period according to Wood Group (2019).

The ESIA aquatic ecosystems baseline work (Annex II) included the estimated discharge rates of 16 m^3/s in the dry season and 41.6 m^3/s in the wet season.

The Ewaso Ng'iro River flows through Isiolo County and then close to the boundary between Garissa and Wajir Counties until it reaches the border (approximately 360 km east of Archers Post).

Seasonal Rivers and Luggas

The proposed pipeline crosses numerous seasonal/ephemeral watercourses (including drainage luggas) that have surface flow either seasonally or after individual intense rainfall events. The desk study and predictive flood assessment work (Wood Group, 2018 and 2019) identifies these watercourses and divides them into 14 seasonal rivers and around 100 ephemeral streams. Some watercourses can be dry for prolonged periods and the presence of water can be flashy and unpredictable. Water may still be present beneath the bed of the watercourses during the dry seasons despite no visible surface flows.

The minor ephemeral streams all along the proposed pipeline route are formed from merging of eroded gullies (or luggas) and are active only during flash flood events (Wood Group, 2018). Wood Group (2018) notes that the small eroded gullies could grow, merge and form new streams in the Project lifetime.

The predicted extreme event 1 in 100-year return period peak flows for the seasonal rivers are 190 m^3/s in the Nakwakal River and 540 m^3/s in the Seya River (Wood Group, 2019). The predicted 1 in 100-year return period peak flows for the other smaller watercourses/luggas are typically below 30 m^3/s.

Lake Turkana

Lake Turkana receives approximately 90% of its input from the River Omo, which originates in the Ethiopian Highlands (The Overseas Development Administration London, 1982). About 10% of water input is from the Kerio river, which is crossed by the proposed pipeline, and the Turkwel river. Farming takes place along the lake shore and the lake is a source of water supply.

Coastal Hydrology

Along the coast there is a system of tidal creeks, flood plains, coastal lakes and mangrove swamps (the Tana Delta) that are located behind a sand dune system (United Nations Development Programme et al., 2016). The hydrology along the coast is influenced by river discharge and the tide (United Nations Development Programme et al., 2006). Discharge to the coastal region from rivers can transport 80% of the available sediment load in a matter of days due to heavy rainfall. The tides are semi-diurnal most of the time (i.e. two tides every 24 hours). Spring tidal variations in East Africa can be up to 4 m (average 2.5 m to 3 m).

There are tidal creeks in the coastal section in Lamu and the Project design includes one crossing location (Figure 6.4-5). Water near the coast in these tidal creeks will be saline.

Seasonal rivers crossed by the pipeline in southern Garissa County and in Lamu are likely to discharge to the coast. Of the main rivers that are crossed by the pipeline, only the Ewaso Ng’iro discharges to the coast after it has converged with the Juba River in Ethiopia and discharges to the sea about 290 km northeast of Lamu.

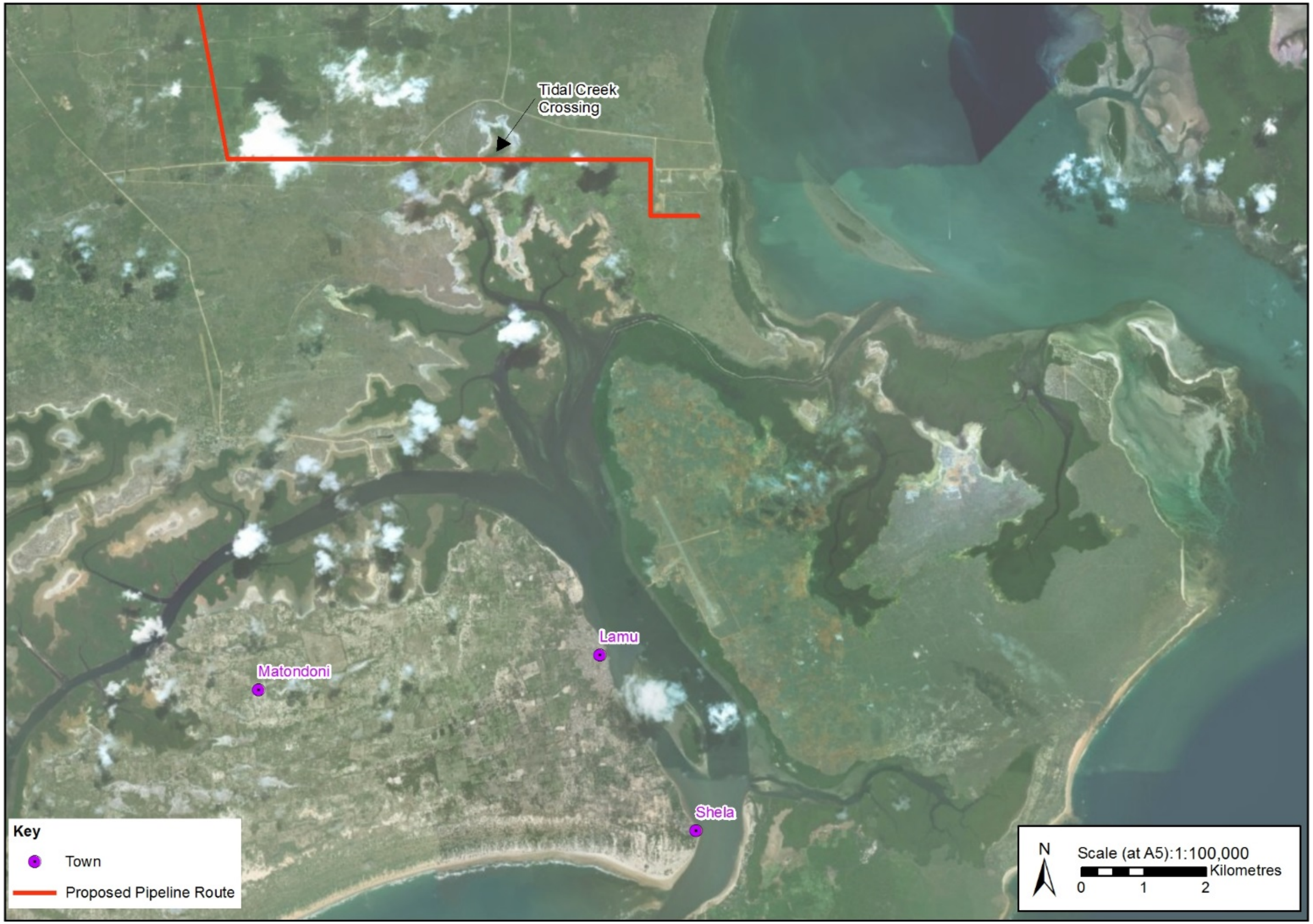


Figure 6.4-5: Pipeline Creek crossing location

Flooding

It is stated in the Wood Group study (2018) that the LLCOP route is subject to river flood hazards, largely associated with seasonal flash flood events following periods of significant rainfall. There is also a risk of coastal flooding. It is stated in the report that the tidal creeks do not pose an erosion risk. The study did not recommend further studies on the tidal creeks to inform the Project design.

Additional work was undertaken to understand flood risks and erosion potential (Wood Group, 2019) to inform the pipeline design, including predictions of the size of the floodplain and changes in river bed and floodplain depths to determine over what distances the pipeline should be buried deeper to limit risks from erosion. The study focussed on the three main river crossings (Kerio, Suguta and Ewaso Ng'iro), but also considered nine seasonal rivers and 113 streams. Two model scenarios were developed for the three main rivers 1) to consider flooding during a 1 in 100-year event, and 2) to model the general erosion behaviour under long-term low discharge/flows. For all other watercourse crossings, the erosion depths were predicted using an empirical equation.

The modelled 1 in 100-year return period flooding extents and flood water depths for the three main rivers (after Wood Group, 2019) are included in the full water resources baseline. The predictions are summarised as follows:

- Kerio River – Along the proposed crossing route, the flood plain is predicted to extend to approximately 1.3 km on the north-west side of the river and approximately 4.4 km on the south-east side. The depth of flood water is predicted to exceed 3 m in the main river channel. In the flood plain, the depth of flood water is not predicated to exceed 2 m. Along the proposed crossing route, the flood depths are predicted to be typically less than 0.5 m, with localised areas predicted to be up to 1 m deep.
- Suguta River – Along the crossing route, the flood plain is predicted to extend to approximately 3.2 km on the west side of the river and approximately 3.5 km on the east side. The depth of flood water is predicted to exceed 3 m in the main river channel. In the flood plain, the depth of flood water is predicated to be less than 2 m along the proposed crossing alignment.
- Ewaso Ng'iro River – The model predicts flooding will particularly occur upstream of the road and bridge to the village of Archers Post. The flood modelling for the Ewaso Ng'iro River predicts a narrower flood plain extent at the proposed pipeline crossing location when compared to the Kerio and the Suguta rivers. Along the crossing route, flood plain is predicted to extend to approximately 0.4 km on the north side of the river and approximately 0.5 km on the south-east side. The depth of flood water is predicted to exceed 3 m in the main river channel. In the flood plain, the depth of flood water is also predicated to exceed 3 m in areas up to 0.25 km from the main river channel.

The modelled changes in river-bed and floodplain elevations as a result of a 1 in 100-year return period flooding event has predicted some change in surface elevation across almost the full extent of the flood plain at all three proposed pipeline crossing locations of the main rivers. The Wood Group study was undertaken to give a preliminary understanding of the likely erosion and souring risks. Since there was no detailed topographic/bathymetric data available for the crossing locations and the geotechnical work hadn't been undertaken, the results are preliminary and a more detailed hydrological study is required for the major crossings, the results of which will ensure that the pipeline will be buried with sufficient cover to adequately protect the pipeline.

Setbacks for the other seasonal/ephemeral rivers and streams range from <0.5 m to 4 m. The full summary table is presented in full baseline report. These predictions have been used to inform the design of the pipeline (namely burial depth at watercourse crossings) and how far laterally from the main river channel the deeper burial needs to start.

The Ewaso Ng'iro experiences long periods of drought separated by short, but often major flooding periods (Wood Group, 2018). Floods near Archer's Post have been recorded in March 2010, November 2011, April 2013 and October 2014. Moderate floods are experienced once every seven months and severe flooding once every 18 months.

Coastal flooding results from surges (tidal, storm, tsunami) and wave action. The coastal area close to Lamu port is densely vegetated and characterised by the presence of wetland areas and tidal creeks prone to flooding.

The National Drought Management Authority (NDMA, 2019) produce monthly drought early warning bulletins. The summaries include information on flood events that have taken place. Flood event details included in the monthly drought reports for the last year (February 2018 to January 2019 indicate that flooding typically occurs in April, May and June.

Surface Water Quality

Surface water quality data has been collected through a combination of field measurements (i.e. pH, electrical conductivity (EC), temperature, total suspended solids (TSS) and total dissolved solids (TDS)) and sampling for laboratory analysis. Data has been collated from that collected as part of the Project baseline and data collected previously for the EOPS project (Golder, 2017). The monitoring locations are shown on Figure 6.4-6 to Figure 6.4-10 and include seasonal watercourses/luggas and the main three river crossings. Details are in the full baseline, and the general findings can be summarised as follows:

- The surface water temperature is reflective of air temperature for the seasons, so dry season surface water temperatures are higher than wet season temperatures. Surface waters have a typical temperature of around 30°C to 35°C.
- The pH measurements for the three main rivers taken during both sets of field data collection are consistent for each river location (i.e. all three measurements taken in the Ewaso Ng'iro River are around pH 8 and all three measurements taken in the Suguta River are around pH 9). The pH in other watercourses is typically between 7.5 and 8. Theses pH values (>7) are likely to be a reflection of contact with soils/sediments.
- With respect to the main rivers, the EC and TDS measurements in the Suguta River (4 milli-siemens per centimetre (mS/cm) to 5.49 mS/cm and 2,000 parts per million (ppm)) are higher than in either the Kerio River or the Ewaso Ng'iro River (0.174 mS/cm to 0.46 mS/cm and 121.5 ppm to 217 ppm). These concentrations represent a range from both the dry and wet seasons.
- During the wet season, the highest EC and TDS were observed in water pools in luggas (up to 0.933 mS/cm and over 600 ppm).
- EC and TDS measurements were taken at most of the sampling locations included in the June 2018 (wet season) and October 2018 (dry season) monitoring. Where measurements were made at a location during both seasons, the dry season measurements of EC and TDS are higher than those in the wet season.
- The laboratory data show that no TPH, PAH or BTEX have been detected at concentrations above the laboratory limit of detection (LOD) in any of the samples.
- The metals cadmium, chromium, copper nickel, lead, mercury and zinc were also not detected in surface water at concentrations above the laboratory above the LOD.

- The laboratory data that were above the LOD have been screened against the project standards, which have been derived from National Kenyan standards, where available, or from internationally recognised guidelines; whichever is lowest.
  - Water quality across the study area can be described as good with no inexplicable exceedances of water quality standards. The concentrations of major ions were generally below the Project water quality standards.
  - Concentrations of sodium, chloride, nitrate, phosphate and fluoride in the Suguta River water were all higher than in the Kerio and Ewaso Ng'iro rivers and exceed the Project water quality standards. These concentrations are likely to be natural and reflect the volcanic geology in the Suguta Valley where the river originates.
  - The water in the Ewaso Ng'iro River has the highest suspended solids concentrations and they exceed the Project water quality standards. The high concentrations of suspended solids compared to the other rivers reflects the findings of the aquatic baseline field measurements.
  - Ewaso Ng'iro River TSS concentrations are four times more than in Kerio River and eight times more than in Suguta River.
  - There is some evidence of human or animal waste in the Kalabata River and surrounding luggas, as indicated by the coliform count (total and faecal).

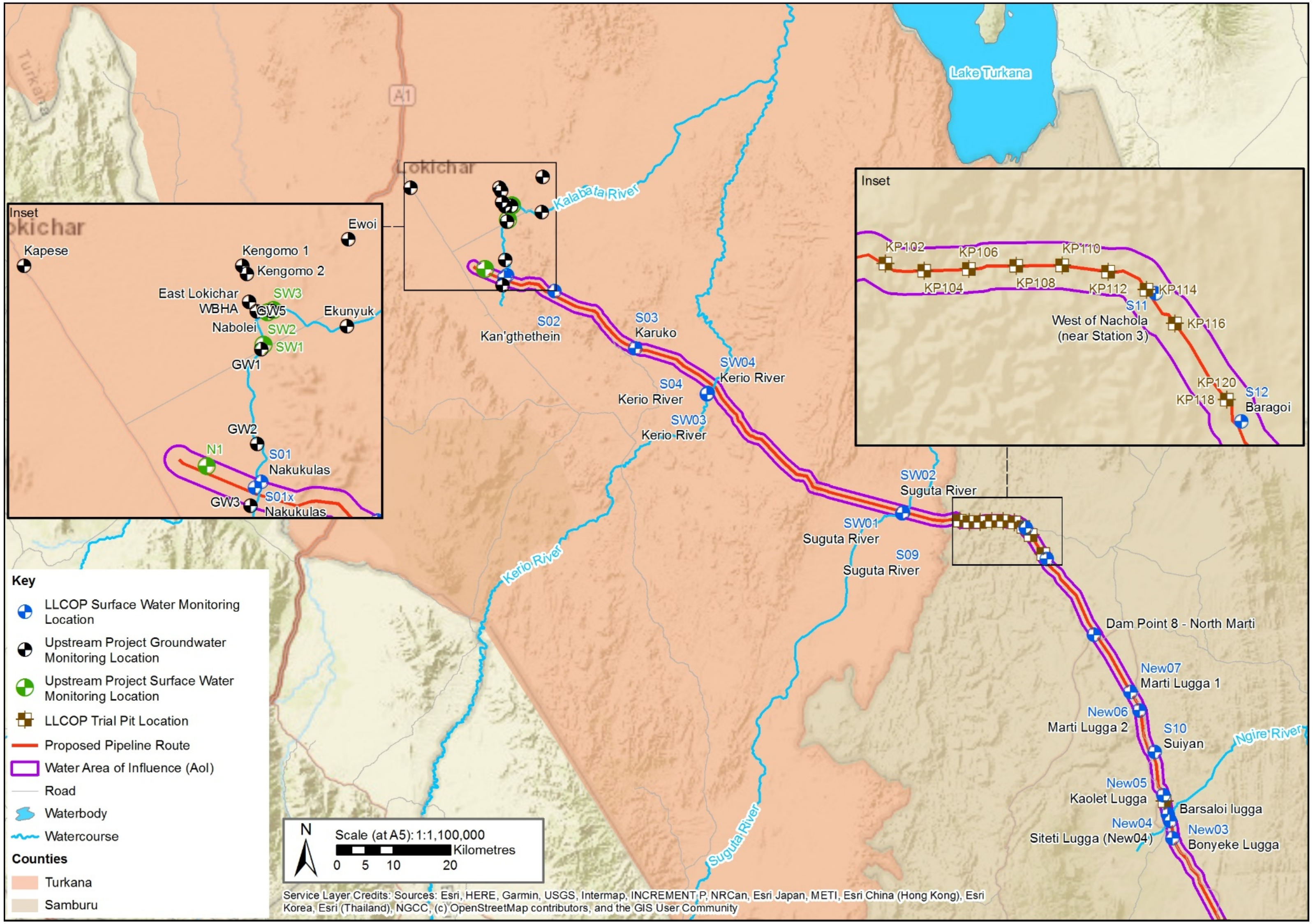


Figure 6.4-6: Ground investigation, groundwater and surface water monitoring locations (Turkana)

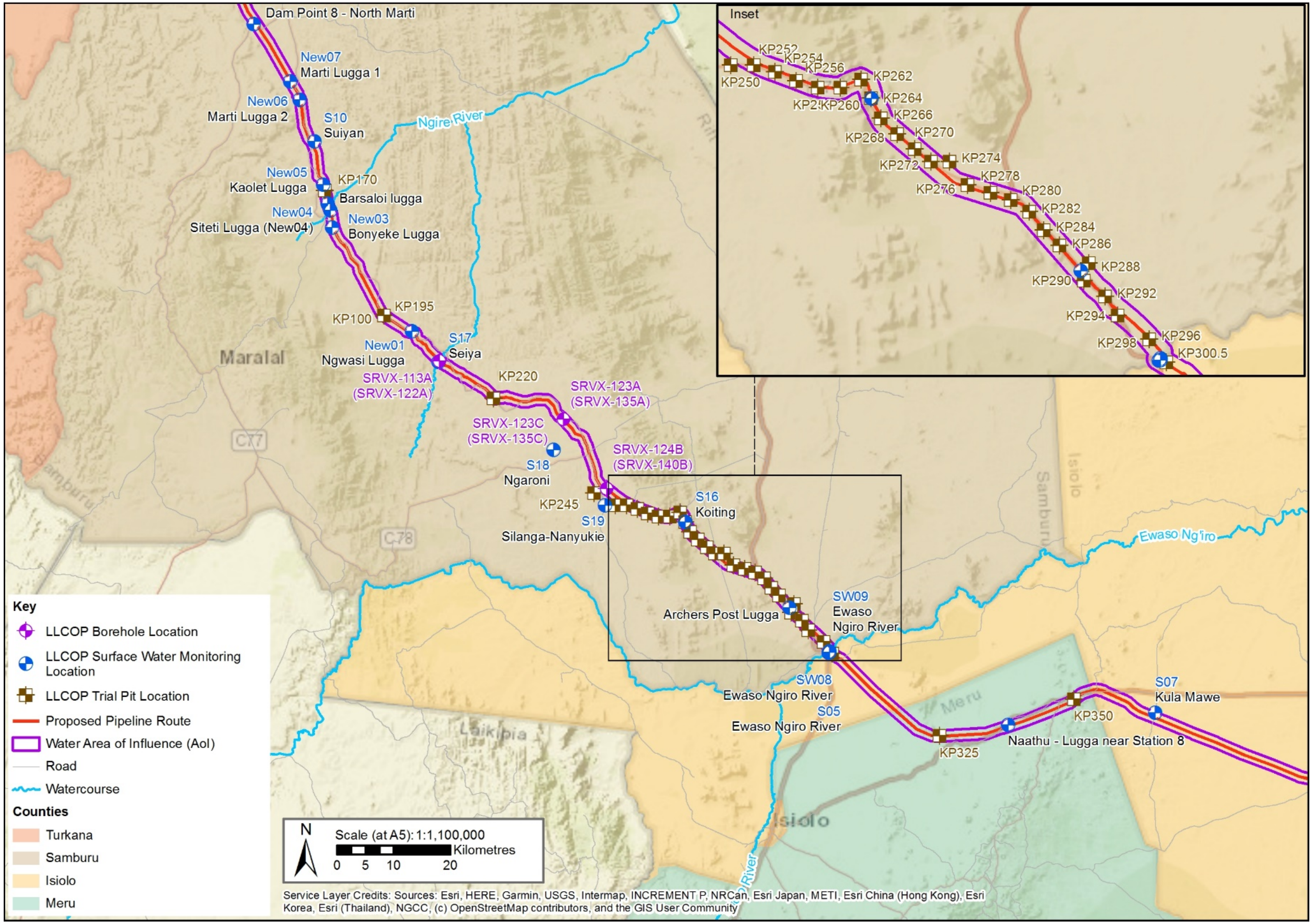


Figure 6.4-7: Ground investigation, groundwater and surface water monitoring locations (Samburu)

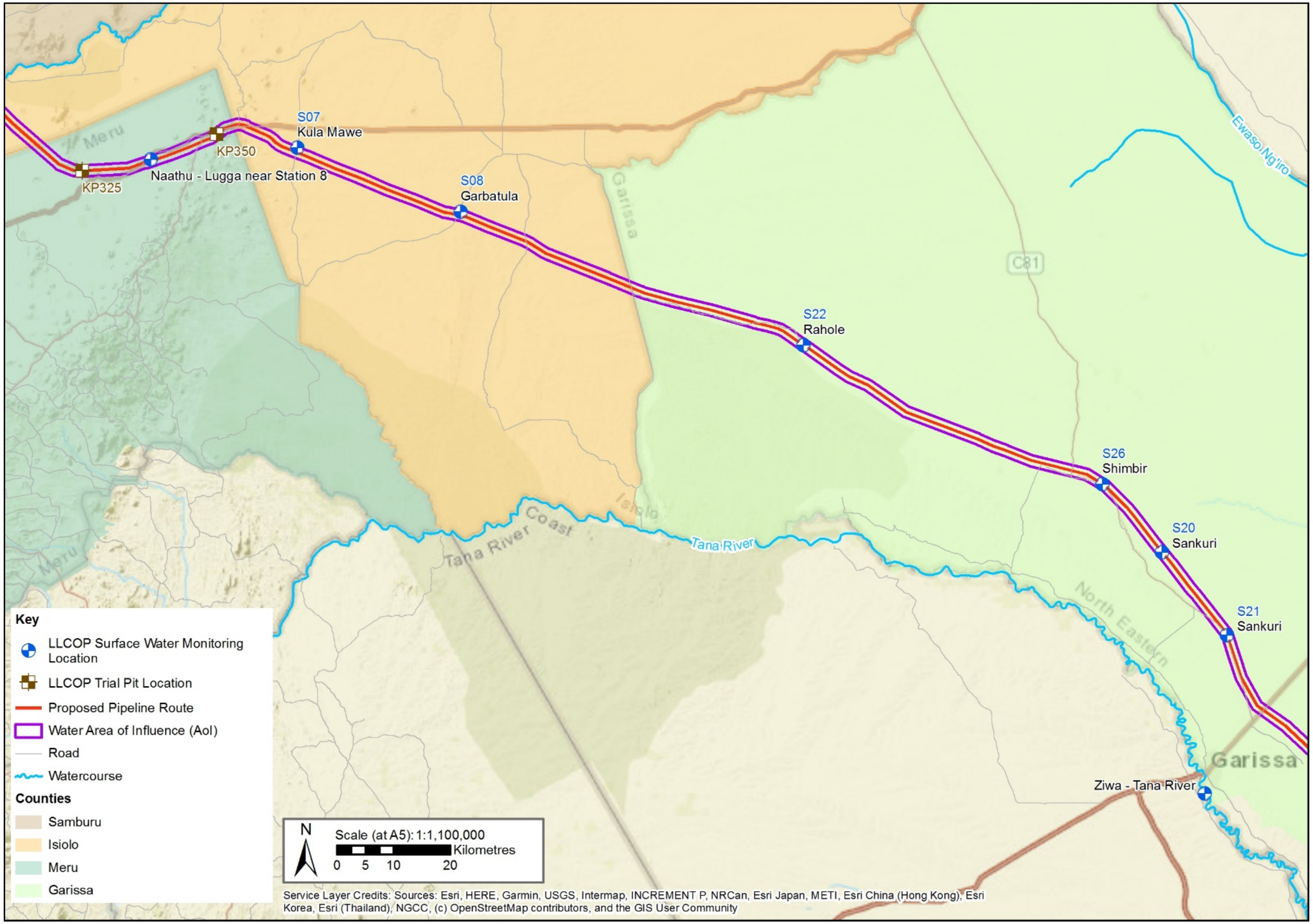


Figure 6.4-8: Ground investigation, groundwater and surface water monitoring locations (Isiolo/Garissa)

Figure 6.4-9: Ground investigation, groundwater and surface water monitoring locations (Garissa)

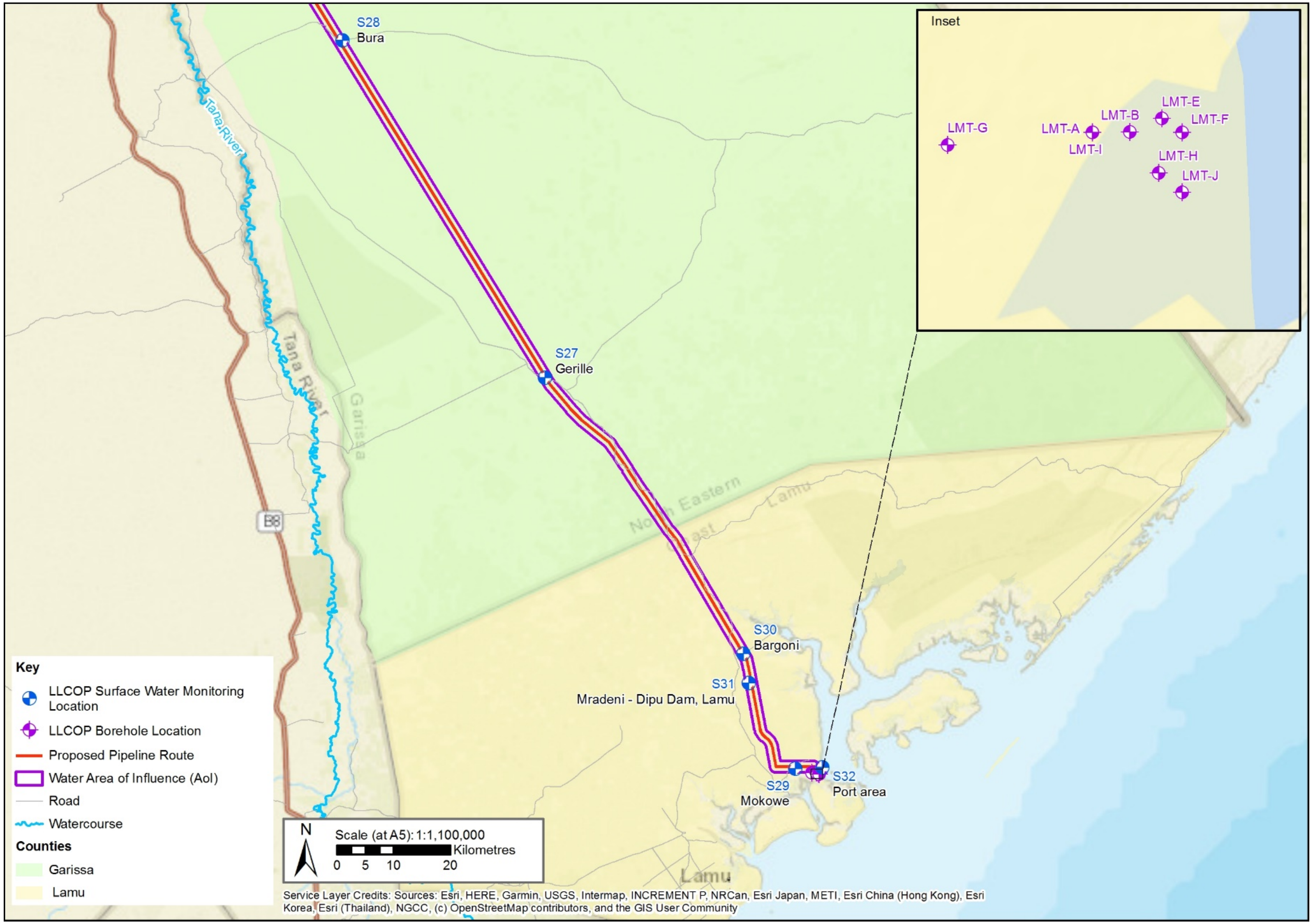


Figure 6.4-10: Ground investigation, groundwater and surface water monitoring locations (Garissa/Lamu)

6.4.4.2 Hydrogeology (Groundwater)

This section describes known Aquifers and their properties, groundwater level and quality.

Main Aquifers

In the Rift Valley Basin area the proposed pipeline route passes over the Kerio Volcanics, which are classified as a poor aquifer[2]. The basement rocks throughout Kenya are also classified as a poor aquifer. These poor aquifers are not considered further in this baseline because they either contain little groundwater or groundwater is poor quality. These poor aquifers will also be of limited importance from a resource perspective.

In the Rift Valley Basin, the Lodwar Alluvial Aquifer is classified as a special aquifer[3], as is the Lodwar Aquifer (WRA, 2018a). The Lotikipi Valley Aquifer is classified as a minor aquifer[4]. Information on these sedimentary aquifers (British Geological Survey (BGS), 2018) is presented in Table 6.4-1. Other deposits in this area, such as sand and gravel deposits and the Miocene Volcanics, can provide local sources of water.

Through the Ewaso Ng'iro North Basin Area the pipeline passes over the Mt. Kenya and Aberdares Volcanics, Colluvial Deposits and the Merti Aquifer. The Mt. Kenya and Aberdares Volcanics aquifer is classified as a major aquifer[5]. No information is available on the classification of the Colluvial Deposits (WRA, 2018a), but shallow aquifers do occur along the riverbeds.

The Merti Aquifer is the largest aquifer in Kenya and underlies part of the Ewaso Ng'iro North and Tana Basin Areas. Parts of the aquifer also extend into Somalia. Figure 6.4-11 shows the extent of the Merti Aquifer relative to the proposed pipeline route. It is a layered aquifer comprising clays, sands, sandstones and limestones and is classified as a both a strategic[6] and a special aquifer. Information on the Merti Aquifer (BGS, 2018; and World Bank, 2011) is presented in Table 6.4-1. It is a strategic resource that provides water for rural centres (Habaswein and Dadaab being the largest) and for the refugee camps in the Dadaab area (World Bank, 2011).

A Lamu Sand Dunes Aquifer has been proposed as a Groundwater Conservation Area because saline intrusion into the previously freshwater zone has been taking place and some wells have dried up. This sand aquifer has a high vulnerability and is threatened by anthropogenic influences. The WRA has put in measures under Water Act 2016 to manage aquifer to ensure protection, conservation and sustainable use (WRA, 2018a).

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[2] The Water Resource Authority defines a 'poor aquifer' as being a low- to negligible-yield aquifer system with moderate to poor water quality.

[3] The Water Resource Authority defines 'special aquifers' because of their importance as aquifers.

[4] The Water Resource Authority defines a 'minor aquifer' as a moderate-yield aquifer systems with variable water quality.

[5] The Water Resource Authority defines a 'major aquifer' as being a high-yield aquifer system with good quality water.

[6] The Water Resource Authority defines a 'strategic aquifer' as one that is used to supply significant amounts/proportions of water in a given area and for which there are no available alternative resources, or where such resources would take time and money to develop; as well as significant transboundary aquifers.

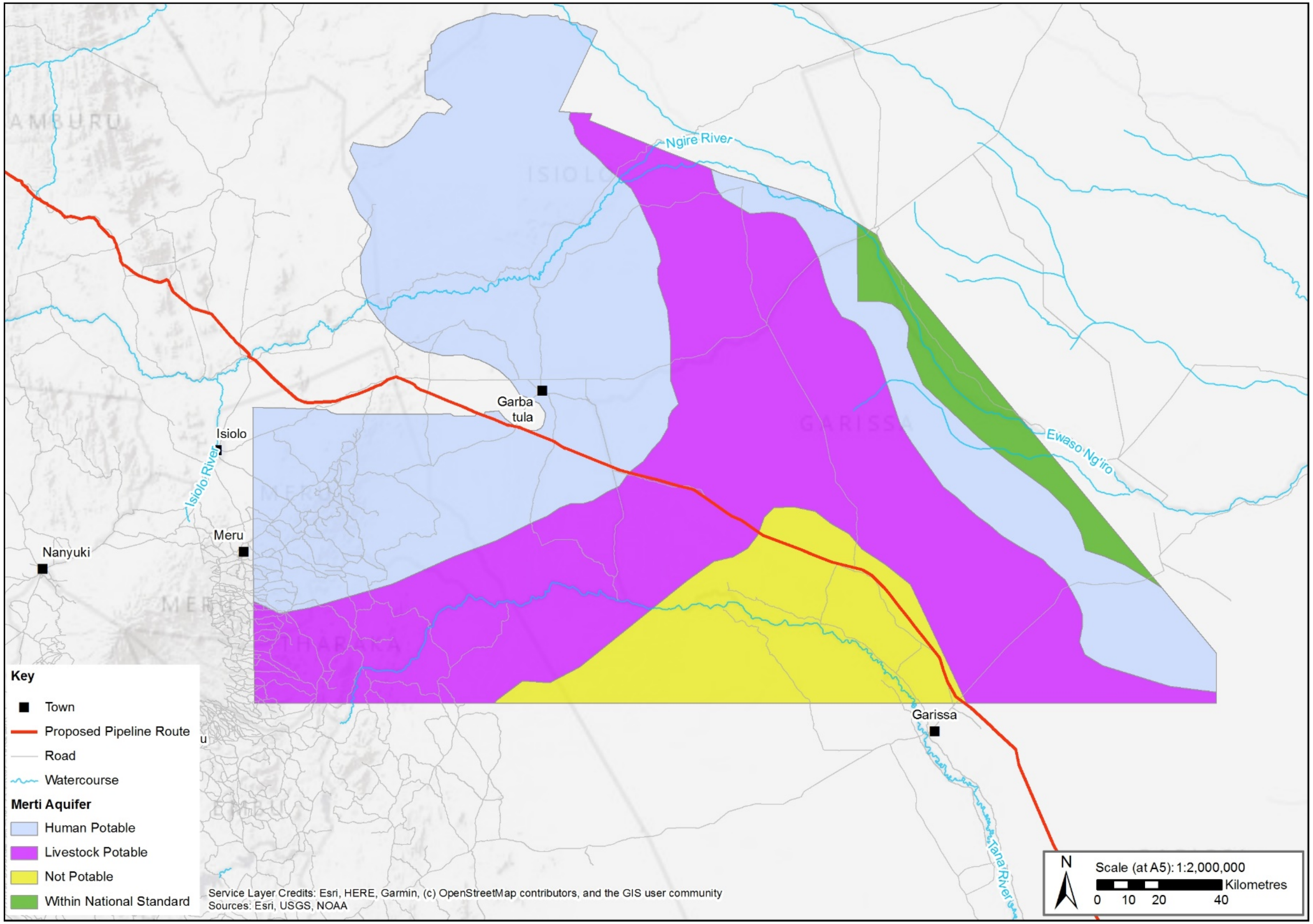


Figure 6.4-11: Merti Aquifer Extent and Potability

Table 6.4-1: Lodwar and merti aquifer information

Named Aquifers	General Description	Water Quantity Issues	Water Quality Issues	Recharge
Lotikipi and Lodwar aquifers	Alluvial sands and sediments, which can be up to 80 m deep. They can have high groundwater potential where dominated by coarse grained sediments (sand and gravel), but elsewhere, groundwater potential is typically limited.		Groundwater in the Lotikipi aquifer is very saline, with conductivity values exceeding 8 mS/cm.	Recharge occurs both by direct rainfall infiltration and, to the Lodwar aquifer, by leakage from the River Turkwel.
Merti Aquifer	The Merti Aquifer comprises semi-consolidated clays, sands, sandstones and limestones. Groundwater is usually confined, flow is intergranular, and water is found at fairly uniform depths of between 110 m and 180 m below ground level. The aquifer is thought to be between 80 m and 280 m thick. Transmissivity ranges from 0.2 metres squared per day (m^2/d) to 840 m^2/d (median 275 m^2/d, n=20) depending on the facies; higher transmissivities in coarse grained materials. Storage coefficients range from 4.3×10^{-5} to 6.7×10^{-4} (n=6). The hydraulic gradient ranges from 0.001 in the western part of the aquifer, falling to 0.0001 to 0.005 toward the border with Somalia.	Locally subject to over-exploitation	Highly variable. Freshest in the centre of the aquifer, becoming more mineralised to north and south. Saline water has been noted in the Merti Aquifer and is also believed to underlie the fresh water layer. Water quality in the Dadaab refugee camps has deteriorated over time, mainly due to increasing salinity. In Habaswein there is evidence of some salinisation as a result of long term abstraction.	Modern recharge is periodic and limited. Most abstraction is of fossil water. No, or extremely limited, surface water interaction with the Ewaso Ng'iro River

Aquifer Recharge and Properties

Information on recharge to the Lotikipi and Lodwar aquifers, and the Merti Aquifer, is presented in Table 6.4-1. The Merti Aquifer is confined by Pliocene lava flows and Pleistocene and Holocene fluvial sediments over much of its areal extent (Acacia Water, 2014); therefore, there is little or no modern recharge. There is some recharge that takes place along the Ewaso Ng'iro River where the aquifer is not confined. Recharge can also occur through the volcanic rock plateau. Due to limited recharge from the surface the Merti Aquifer has low vulnerability to pollution. It is fairly resistant to climate change because little modern recharge occurs. Changes in storage will reflect natural and anthropogenic discharge and not changes in climate (World Bank, 2011). Yields from boreholes located near Habaswein (approximately 200 km east of the pipeline crossing at Archer's Post) range from 75 m^3/d to 350 m^3/d (Acacia Water, 2014).

Aquifer property data in the region of Turkana has been collated by Golder (Golder, 2017) and indicates that the productivity, and, therefore, resource potential from the volcanic and colluvial aquifers in that area is highly variable. Miocene volcanics transmissivity values range from <1 m^2/d to >750 m^2/d. Alluvial deposits transmissivity values range from >600 m^2/d to >5,000 m^2/d. Wells drilled in the Auwerwer Volcanics have typical production rates of approximately 8 m^3/hr to 12 m^3/hr (maximum of 23 m^3/hr). The most productive wells are those that encounter the sandy sedimentary interflow deposits (Price, 2016). River gravel wells in the Kerio Valley indicate the presence of fresh water and had production rates up to 50 m^3/hr.

Permeability (hydraulic conductivity) tests have been undertaken on soil samples taken from the top 2 m of ground in trail pits located in Samburu and Garissa Counties (Treavic Geosystem and Engineering Ltd., 2018/2019). The average permeability from these tests ranged from 0.027 m/d to 64 m/d.

The soils overlying the volcanic aquifers are typically thin and permeable, so it is possible that more than 50% of rainfall in the wet season can contribute to direct recharge. However, due to the arid climate, high evaporation potential, soil moisture deficits recharge to aquifers is generally much less (Samoka, 2010). The estimate of average annual recharge in the Upper Ewaso Ng'iro is presented in that report as 168 mm. Confined aquifers in the basin are recharged by rainfall in the highlands of Mt. Kenya and Aberdare, and some infiltration through sandy riverbeds.

It is stated in the study by Samoka (2010) that the volcanic deposits of the Ewaso Ng'iro Basin (including parts of Meru Country) have the following properties:

- Drainable porosity ranges from <1% to 8%;
- Hydraulic conductivity ranges from 0.01 to 10,000 m/day; and
- Transmissivity values range from 0.1 to 100,000 m^2/d.

The lowest values presented were for rhyolites, phonolites and pyroclastic, and the highest values were for recent basaltic formations and alluvial materials derived from the volcanics.

Groundwater Levels

Groundwater is typically encountered at depths of 5 m to 20 m below ground level (bgl) in the wells located in Turkana in the east of the basin in which the oil wells are located (Golder, 2017). The depth to groundwater is typically greatest where the topographic elevation is highest. The groundwater flow direction in this area is towards the northeast, which corresponds with drainage towards the Kalabata River.

There is little reliable long-term groundwater monitoring data available along most of the rest of the pipeline route. Within the Ewaso Ng'iro North Catchment Area, the groundwater level between July 2017 and June 2018 was consistently taken from four monitoring stations: Aikman, Nanyuki Children's Home, Lolmalick and Kibwi Farm (WRA, 2018b). Groundwater levels were measured around 25 m bgl to 35 m bgl. The exception to this was at the Aikman borehole where groundwater levels were measured as over 50 m bgl.

No groundwater was encountered in the LLCOP trail pit locations that were excavated to investigate the top 1.5 m to 2.0 m of ground (Treavic Geosystem and Engineering Ltd., 2018/2019). The locations of these trial pits are shown on Figure 6.4-6 to Figure 6.4-10. Groundwater strikes recorded in eight ground investigation boreholes in the Lamu marine terminal area (LMT-A, LMT-B, LMT-E, LMT-F, LMT-G, LMT-H, LMT-I and LMT-J) ranged from 1 m bgl to 4 m bgl (Treavic Geosystem and Engineering Ltd., 2018/2019). Piezometers were installed in five of these locations to enable the monitoring of resting groundwater levels to take place (LMT-B, LMT-E, LMT-G, LMT-H and LMT-J). Daily groundwater monitoring in both the morning and the afternoon was undertaken at these five locations for between 68 and 173 days. The resting groundwater level data in this coastal region typically show that after installation the resting groundwater levels were lower than the initial strikes and ranged from around 2.3 m bgl at location LMT-B to nearly 5 m bgl at LMT-J.

Piezometer data is also available for boreholes located at some river crossing locations in Samburu County (Treavic Geosystem and Engineering Ltd., 2018/2019). Boreholes SRVX135A (also called SRVX-123A), SRVX123C and SRVX124B are located at watercourse crossing points on a tributary of the Ewaso Ng'iro, west of the town of Wamba and between approximately 45 km and 60 km north west of Archer's Post. This tributary joins the Ewaso Ng'iro upstream of Archer's post. Borehole SRVX-122A (also called SRVX-113A) is located at the crossing of the Nigire River approximately 85 km north west of Archer's Post. This watercourse does not flow into any of the three largely perennial/permanent watercourses along the Project route. Daily groundwater monitoring in both the morning and the afternoon was undertaken at these locations for between 20 and 71 days. The data indicates that after stabilising the resting groundwater levels in these locations are typically between 1 m and 3 m bgl.

Groundwater levels in the Merti Aquifer in the area of Habaswein (over 200 km east of Archer's Post and the proposed pipeline crossing) were struck at around 130 m bgl. Overall, groundwater levels in the Merti Aquifer are encountered at between 110 m bgl and 180 m bgl. Most successful boreholes that exploit the more permeable zone of the Merti Formation are commonly installed between 105 m to 150 m bgl and water levels (Acacia Water, 2014).

The available information indicates that groundwater in sandy deposits close to watercourses or the sea is likely to be encountered in the top 2 m to 5 m bgl. Further away from watercourses, the depth to groundwater could be more variable and groundwater could be encountered between 5 m and over 100 m bgl.

Groundwater Quality

Baseline groundwater quality data was collected in Turkana (Golder, 2017) in the area of the oil fields. The sample locations are typically located within volcanic or colluvial materials. The data showed the following:

- Groundwater typically has temperatures around 30°C to 35°C.
- The pH of groundwater is close to neutral (from 7.34 to 8.92). These are mainly within the range of the Project quality standard (>6.5 and <8.5). As the pH of rainwater is typically slightly acidic, the pH is likely to be due to contact with soils/sediments.

- Electrical conductivity values ranged between 0.6 mS/cm and 3.5 mS/cm. Values showed no apparent temporal/seasonal trends. The highest of the electrical conductivity measurements in groundwater were mainly, but not exclusively, from deeper boreholes.
- Total Dissolved Solids (TDS) field measurements ranged from 263 milligrams per litre (mg/l) to 625 mg/l, which is within the range expected for fresh water. TDS in groundwater samples measured in the laboratory ranged from 255 mg/l to 4,150 mg/l. TDS concentrations are higher than the quality standard in groundwater samples taken from Nakukulas 9, Kengomo 1, Kengomo 2, Ewoi, Ekunyuk and Nabolei.
- Dissolved oxygen concentrations ranged from 0.7 mg/l to 5.51 mg/l, which indicate that the water is not completely saturated or depleted in oxygen. The dissolved oxygen concentrations were higher during the wet season.
- Water quality in general good with no inexplicable exceedances of water quality standards.
- The concentrations of major ions are generally below the Project water quality standards. Sodium, fluoride and chloride concentrations regularly exceed the Project standards, and are likely to result from natural interactions between water and the geology.
- Most metal concentrations were below the laboratory limit of detection (LOD). Boron, vanadium, zinc and strontium were most commonly detected at concentrations greater than the LOD. Aluminium, barium, copper, manganese and iron were also detected at concentrations greater than the LOD, but in a smaller proportion of samples taken.
- Poly-aromatic hydrocarbons (PAHs) and total petroleum hydrocarbon (TPH) concentrations were occasionally detected in groundwater at concentrations equal to or just above the LOD of 0.01 mg/l.
- There is some evidence of human or animal waste in groundwater from the nitrate (as NO_3) and total coliform counts, but concentrations were usually lower than in surface water samples.

Information on water quality issues in the Lotikipi and Lodwar aquifers, and the Merti Aquifer (Table 6.4-1) indicates that parts of the Merti Aquifer have high electrical conductivity values (greater than 8,000 µS/cm) or are less productive, so the effective extent of the useable aquifer is estimated to be 61,000 km^2 (World Bank, 2011). Figure 6.4-11 includes information on the resource potential of the water, which was collated as part of a study undertaken on the aquifer in 2004[7]. The proposed pipeline does not cross the extent of the aquifer as mapped during the 2004 study, but the Ewaso Ng'iro River downstream of the proposed crossing could provide recharge to the aquifer.

TDS concentrations have also been analysed in samples taken from five of the Lamu Marine Terminal area (LMT-B, LMT-E, LMT-F, LMT-G and LMT-J) (Treavic Geosystem and Engineering Ltd., 2018/2019). The results indicate that TDS concentrations in this area are mainly within the range expected of fresh water (these results ranged from 293 mg/l to 421 mg/l). However, two additional samples were taken from locations LMT-E and LMT-G. Whilst one set of samples from these locations returned results within the fresh water range, the second samples returned concentrations between 28,860 mg/l and 35,165 mg/l, which is above the Project water quality standard of 1000 mg/l.

[7] GIBB Africa Ltd., 2004. UNICEF Kenya Country Office - Study of the Merti Aquifer - Technical Report ISsue 2.0.

Two further water samples have also been taken from locations SRVX122A (also called SRVX-113A) and SRVX135A (also called SRVX-123A), which are at watercourse crossing locations in Samburu County. The TDS results for these locations range from 395 mg/l to 1,479 mg/l (Treavic Geosystem and Engineering Ltd., 2018/2019). The concentration of 1,479 mg/l from the sample taken at location SRVX135A is above the Project water quality standard of 1000 mg/l.

6.4.4.3 Water Resources and Use

Kenya relies on both surface water resources and on groundwater. Water is commonly taken from rivers, ephemeral watercourses, dams, pans, hand dug shallow wells (usually in or near seasonally dry watercourses), boreholes and springs.

The NDMA reports for February 2018 to January 2019 (NDMA, 2019) indicate that drought alerts or alarms were issued in the Counties that the proposed pipeline passes through in the months of February and March. Alerts were also issued in Garissa and Samburu in December and January, and in Isiolo in January.

The NDMA reports also provide information on the main sources of water supply in each county throughout the year. From the information presented for February 2018 to January 2019 (NDMA, 2019), the following key points can be made:

- In Turkana County a range of water sources are used for domestic supply and for livestock, including rivers, springs, lakes, pans and dams, river wells, shallow wells and boreholes. Surface water sources are the main source of supply during the rainy season and boreholes are used more when surface supply availability declines.
- A wide range of types of water supply are used in Samburu County. Rivers provide between 5% and 10% of the supply in most months; as do springs. Although exact proportions vary through the year, the rest of the water supply is sourced from a mixture of shallow wells, dams and pans, river wells and boreholes.
- In Isiolo County boreholes provide over a third of the supply between June and January, which indicates groundwater is an important resource in this county. In the other months, rivers, dams and pans, and shallow wells have increased importance. Rivers provide over a third of the water supply in March and April.
- In Meru County water from boreholes and rivers make up the majority of the water supply. The proportion of water from each varies throughout the year. River sources dominate in April to June and in December after the rains, and borehole sources dominate in September, October, November and February when river flows are less. Springs, and pans and dams are occasional used.
- In Garissa County the dominant water supplies throughout the year are dams and pans, boreholes and river. The proportion from each of these varies through the year. River water is particularly important, and the percentage of supply rivers provide can range from about 15% to nearly 60% deepening on availability of river water and other sources. Little information is provided about which rivers provide this supply, but the River Tana is the main river in this county. More minor sources in this county include natural ponds, shallow wells and piped water.

- In Lamu County the main sources of water throughout the year are shallow wells, dams and pans, boreholes and rivers. The proportion of water that comes from each source varies throughout the year, with an increase in the proportion taken from rivers in May and June after the rains and associated flooding that typically takes place in April and May. As river water use declines, traditional river wells become a more important water source. Additional sources that form small and occasion sources of water during the year include lakes, springs and piped water supplies.

Information on the sources of water in each County along the proposed pipeline route and when they are typically used has been collated as part of the health baseline. The information collected on the types of water sources used by communities along the pipeline route can be summarised as follows:

- Turkana County – water points, traditional wells, water pans, the Kerio River, oases, boreholes and springs.
- Samburu County – dams, rivers (Nacholan, Suyian, Barsaloi, Seyia) and water points.
- Isiolo County – pans dug into river-beds and boreholes.
- Meru County –springs, boreholes, water trucks, dams, the Lanyiru stream and the Rikindu and Wasinara rivers.
- Garissa County – pans, water trucks, traditional wells, piped water (from Tana River), river water (including the Tana River), boreholes and dams.
- Lamu County –boreholes, seasonal dams, ponds, boreholes and wells.

Water users are typically not able to locate the exact position of the sources used. The sources may also change seasonally or between years if new hand dug river wells are created each season or new sources need to be found during extended dry periods. The baseline data show that both surface water and groundwater are important sources of water supply along the proposed pipeline route.

6.5 Soils, Geology and Geohazards

6.5.1 Introduction

The objective of the soils, geology and geohazards baseline summary is to present the pertinent information about the conditions present along the Project corridor with respect to these topics. This information is then used to inform the assessment of the potential impacts that the Project could feasibly present to the key soils and/or geological receptors identified through these baseline studies. In the case of geohazards, the baseline information summarises the potential sources by which geohazards could affect the Project. The full soils, geology and geohazards baseline on which this summary is based, and reference details, is presented in Annex II.

6.5.2 Area of Influence

The AoI for the soils and geohazard assessment (Figure 6.5-1), comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes a 1 km buffer along the entire pipeline. All soils baseline data was gathered within the AoI, but due to the nature of geohazards, baseline information (and for geology associated with the geohazards) are presented for a wider region than the AoI.

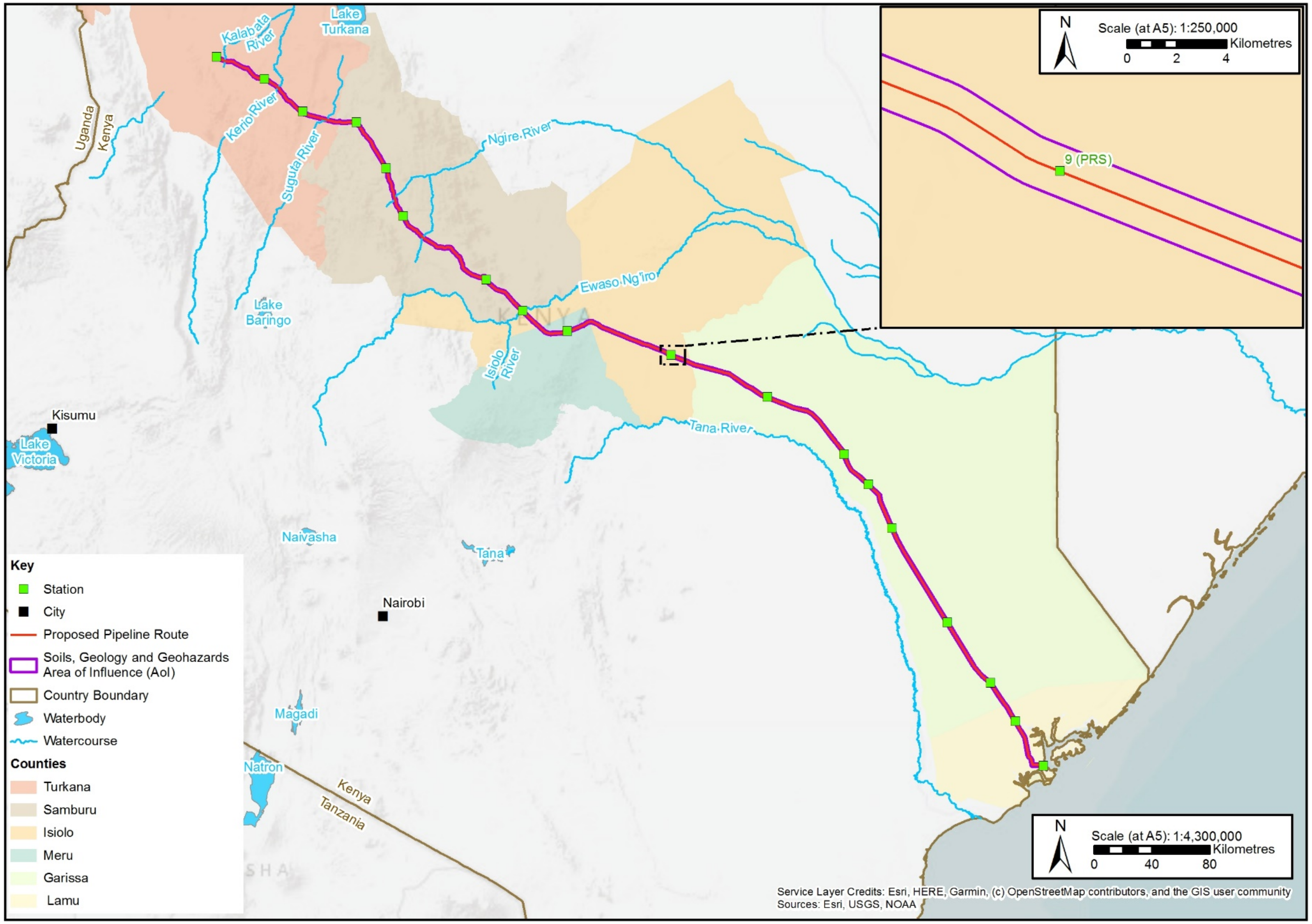


Figure 6.5-1: Soils, geology and geohazards AoI

6.5.3 Methods

A combination of primary and secondary data sources have been used to collate the baseline environmental setting information regarding the soils, geology and geohazards. These sources have been used in combination to present summary baseline information relating to the topics covered in the results section (6.5.4).

6.5.3.1 Primary Data Sources

Primary data sources used to compile the baseline include site specific investigation gathered as part the Project and studies undertaken as part of the Project development.

An investigation into ground conditions along the LLCOP route is ongoing. This baseline summary includes information obtained from 46 trail pit locations (35 with draft trial pit log sheets, 8 with draft log sheets and final logs, and 3 with final logs) and 13 boreholes[1]. The trial pits were excavated to depths between 1.5 m and 2 m below ground level (bgl) and were mainly located in Samburu County, but some were also in Meru County or Garissa County. The presence of soils was noted when encountered. Boreholes were installed to depths of between 10 m and 15 m bgl in the Lamu Marine Terminal area and at selected watercourse crossing in Samburu County. They were drilled using a rotary auguring method and the ground conditions encountered were logged and cores taken were photographed. The locations of the LLCOP trial pits and boreholes where data has been made available for the baseline are shown in the Drawings 6.4-1 to 6.4-8.

In addition to this, information and data presented in the Geohazard Desktop Study[2] has been used to determine the regional tectonic setting in the AoI. In order to establish the location of faults along the LLCOP and their activity, Wood Group (2018) first identified structural lineaments and considered evidence of activity. The focus of the work was on the first 250 km of the LLCOP because this is where the Lokichar Fault and the faults bounding the Suguta Valley are located. A review was then undertaken of earthquake distribution to determine if seismic events could be directly attributed to these features. This first stage was then ground truthed to find evidence of recent sediment deformation and fracturing that could be associated with active tectonics and was considered in conjunction with geological mapping.

6.5.3.2 Secondary Information Sources

Publicly available information sources have been used as secondary data sources for the baseline. Such sources typically provide high-level regional or country-wide information relating to soils, geology, volcanoes and earthquakes. These sources include literature (e.g. papers, websites and reports), maps and available national or regional digital data sets. Organisations that publish the secondary sources used to compile this baseline include the Mines and Geology Department of Kenya, the Commission for the Geological Map of the World, the Kenya Soil Survey, the Food and Agriculture Organization on the United Nations, the United Nations Development Programme, the Kenya Marine and Fisheries Research Institute, the Geological Survey of Denmark and Greenland, and Infonet Biodivision.

[1] Treavic Geosystem and Engineering Ltd., Geotechnical Survey Data. 2018/2019

[2] Wood Group, 2018a: Lokichar to Lamu Crude Oil Pipeline – FEED Phase 1 Geohazard Desktop Study. Ref LLCOP-WOD-PL-REP-002, dated August 2018.

6.5.4 Results

6.5.4.1 Geology

Mapped Geology

Mapped rock formations in Kenya can be grouped into five major geological successions: the Archean (Nyanzian and Kavirondian), the Proterozoic (Mozambique Belt and Bukoban), Palaeozoic/Mesozoic sediments, Tertiary/Quaternary volcanics and Tertiary/Quaternary sediments (Wood Group, 2018a).

The 1:10,000,000-scale geological map of Kenya with an overlay of the LLCOP route is presented in Figure 6.5-2 (background mapping from CGMW, 2016). This scale geological mapping provides an overview of the age and type of geological formation along the LLCOP and indicates that from the LEF to Station 9 the surface geology comprises a complex sequence of Neoproterozoic metamorphic basement rocks, Quaternary sediments and volcanic deposits of various ages. From Station 9 near the Garissa County boundary to the LMT (about half the length of the LLCOP) the surface geology comprises Quaternary sedimentary deposits.

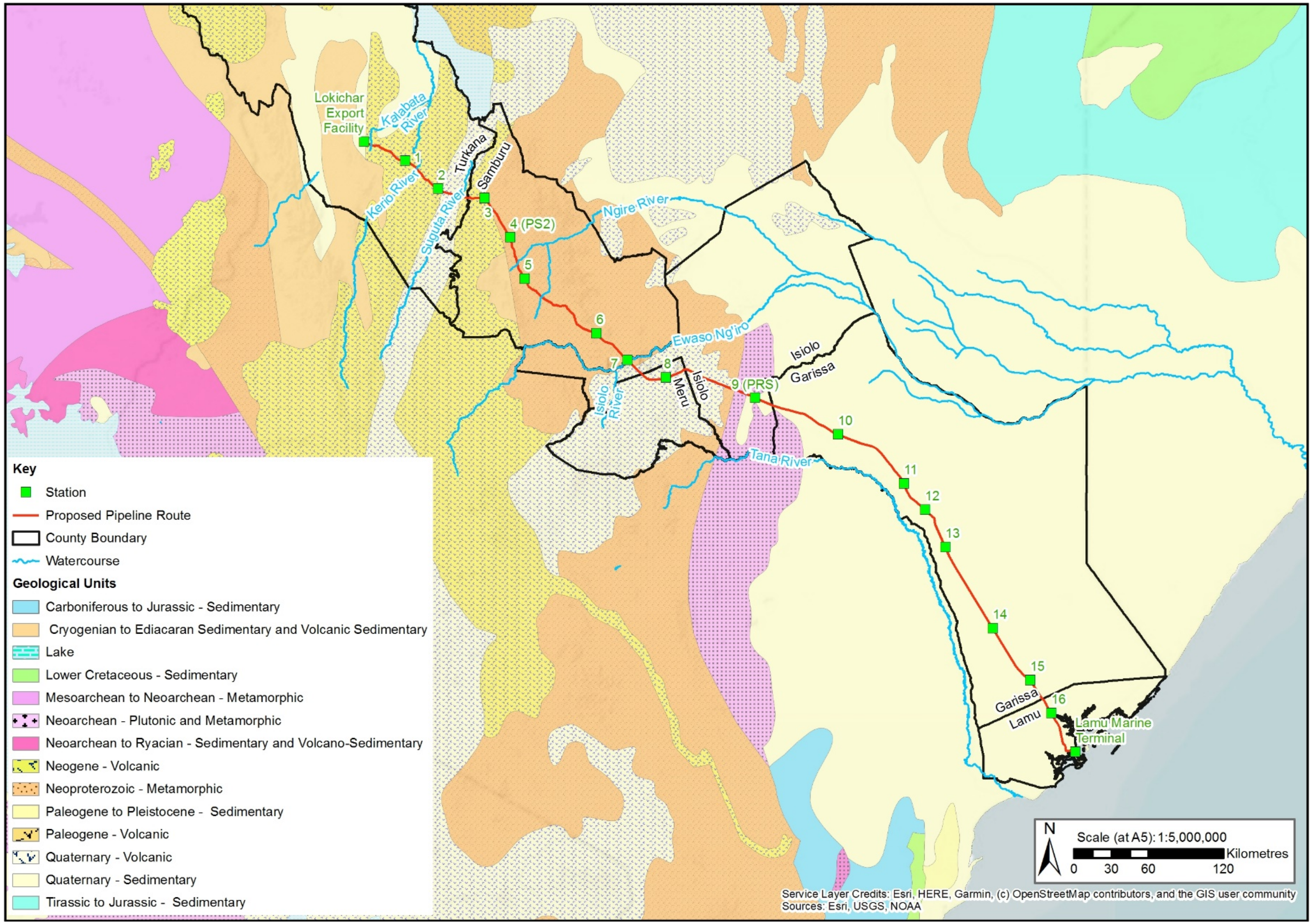


Figure 6.5-2: General geology of Kenya (1:10,000,000 Scale)

The proposed pipeline crosses Tertiary and Quaternary sediments and volcanic rocks in Turkana County and Suguta valley, Palaeozoic/Mesozoic basement rocks of the Mozambique belt (locally overlain by more recent Quaternary volcanic lavas) in the Samburu and Isiolo regions, and recent Quaternary sediments in the Garissa, Tana and Lamu regions. A summary description of each general geology type is presented below.

Tertiary and Quaternary – These deposits are characterised by faulting and short-lived basins resulting in complex successions of volcanics, lacustrine (lake) and fluvial (river) sediments. Quaternary sediments found along the LLCOP route include alluvial (i.e. deposited by running water) and lacustrine sediments of the rift valley, and recent and paleo soils, alluvial beach sands, evaporites, fossil coral reefs and sandstones towards the coast. There are also young volcanic deposits of the Rift Valley. Older, tertiary sediments include coastal sediments, late Miocene and Pliocene volcanics, terrestrial and lacustrine inland sediments.

Mozambique Belt – This is a structural unit within which a variety of metasedimentary and meta-igneous rocks are found. In most of these rocks, the degree of deformation is intense and is of high metamorphic grades. Within the Mozambique Belt basic igneous complexes are found and range in size from bosses to small dykes. Some of the older basic intrusions have undergone deformation and metamorphism to give orthoamphibolites and charnockitic gneisses. The most characteristic feature of the Mozambique Belt is its structural trend, which is near north-south along the entire belt (Wood Group, 2018a). The rocks of the Mozambique Belt are likely to underly the more recent volcanic deposits in Isiolo and Meru Counties.

Quaternary sediments - The coastal geology is sedimentary in origin and deposits range in age from Triassic to recent. The Duruma Sandstone series is the oldest and was deposited under deltaic, lacustrine or neritic (shallow sea – low water down to 200 m depth) conditions. There are also upper Mesozoic sediments that comprise marine limestones and shales, with occasional sandstones. The Cenozoic to recent rocks mostly comprise marls and limestones. Also present are Quaternary wind-blown sands, limestones, cemented sands and coral sands. An extensive fossil reef is located a few metres above the current sea level along much of the Kenyan coast (United Nations Development Programme *et al.*, 2006).

1:2,000,000 mapping of the geology of Kenya[3] with an overlay of the LLCOP route is presented in the Soils, Geology and Geohazards baseline report (Annex II). This scale of mapping highlights the complexity of the geology particularly in the northern half of the LLCOP. A summary of the geology that the LLCOP route passes through, along with the associated soils, is presented in Section 6.5.4.3.

Geology Encountered during Ground Investigations

The preliminary results from geotechnical investigation (Treavic Geosystem and Engineering Ltd., 2018/2019) include descriptions of the geology encountered in the trial pits and boreholes. The locations of the LLCOP trial pits and boreholes are shown in Figures 6.4-6 to 6.4-11 (Section 6.4).

The geology encountered in the boreholes drilled in Lamu Marine Terminal area did not encounter consolidated bedrock. All the recorded deposits comprise a combination of clayey sands and silty clayey sands. The mapped soils and geology in this area includes sandy montmorillonitic (clayey) planosols underlain by unconsolidated (colluvial) Quaternary sedimentary materials, which corresponds well with that encountered in the boreholes.

[3] Mines and Geology Department of Kenya, 2004: 1:2,000,000-scape geological map of Kenya

The trial pit logs indicate that the near surface ground conditions in Samburu County includes sands, silty sands, silty clay, gravelly silt, gravelly sand and silty gravels. Bedrock was encountered in some trail pits and was described mica schist, gneiss, basaltic, or limestone. A selection of trial pit photographs along the LLCOP through Samburu County is presented in Figure 6.5-3. The material encountered could represent the Quaternary alluvium or colluvium overlying NeoProterozoic crystalline basement rock that is shown by the geological mapping.

The two trail pits excavated in Meru County are at KP 325 and KP350. The ground conditions encountered comprised reddish brown sandy silt material with cobbles or boulders overlying metamorphosed basalt and trachytic basalt at KP325 and laterite at KP350. These descriptions are similar to the mapped soils and geology that indicated clayey or loamy soils over volcanics (extrusive igneous rocks).

The three trail pits located in Garissa County are KP450, KP500 and KP525. The ground conditions encountered were dry and comprised brown, orange-brown or red-brown silty sand and grey-brown sandy silt. These correlate well with the mapped red sandy and clayey soils. No bedrock was encountered.

KP100 - Dark brown cobbles with finer material to 0.6 m. Dark brown laterite to 1.2 m. Grey to white highly weathered mica schist to 1.8 m.

KP120 - Light grey silty clay with highly weathered limestone to 0.6 m. White to grey clayey silt with highly weathered limestone to 1.2 m. White to grey clayey silt with highly weathered limestone to 1.8 m with weathered schist in base.

KP170 - Columnar jointed basalt at surface. Brown sandy silt with thin layer of quartzite rocks to 0.6 m. Green slightly weathered mica schist to 1.2 m. Rock refusal below.

KP195 - Dark brown cobbles with finer material. Dark brown laterite to 1.2 m. Grey to white highly weathered mica schist to 1.8 m.

KP250 - Light brown silty sand to 0.6 m. Brown silty sand to 0.9 m. Grey brown cobbles and boulders, slightly gravelly with silt to 1.2 m. Whitish grey to black slightly weathered biotite schist to 1.8 m.

KP270 - Topsoil to 0.1 m. Light brown silty clay to 0.7 m. Dark brown silty clay with limestone to 1.9 m.

Figure 6.5-3: Selected Examples of Trial Pit Photographs from Samburu County

6.5.4.2 Soils

Mapped Soils

Soils in Kenya are dependent on geology, relief and climate and most soils have limitations to agricultural productivity due to salinity/sodicity, acidity, fertility, soil moisture and drainage (Infornet Biodivision, 2019). The

The LLCOP route passes through six counties. Figures 6.5-4 to 6.5-9 show the spatial distribution of each soil type along the proposed route (KENSOTER v2, Kenya Soil Survey, 1996). The route passes through areas of sandy soils in arid and semi-arid environments, and changes as the pipeline route approaches the coast. The mapping shown on these drawings highlights the variability of soils along the route. Drawings that show the soils mapping within AoI and more widely in the region are included within the full soils baseline (Annex II, Baseline Soils, Geology and Geohazards Report).

The soil types present in the AoI include Arenosols, Calcisols, Cambisols, Fluvisols, Lixisols, Luvisols, Phaeozems, Planosols, Regosols, Solonchaks and Solonetz. The soil types observed in the AoI are described below based off the soil descriptions in Soil Fertility and Land Productivity – A guide for extension workers in the Eastern Africa Region (Gachene and Kimaru 2003) and from the Soil and Terrain KENSOTER v2 Kenya Soil Survey. Table 6.5-1 summarises the available baseline information and provides soil descriptions for all soil reference groups and their corresponding principal qualifiers, agricultural limitations and extents along the AoI.

Table 6.5-1: Concerns and limitations of soil types encountered along the proposed route

Reference Soil Group		Parent Material	Principal Soil Qualifiers		Agricultural Limitation		Extent of Soil on Centreline	
Name	Description		Name	Description	Rating	Reason	km	%
Fluvisols	Poorly developed young soils developed from fluviatile, marine and lacustrine sediments	Fluvial, lacustrine, marine	Calcaric	Containing calcaric material between 20 cm to 100 cm of soil surface	Low	Potential for flooding	6.5	0.8
			Eutric	Effective base saturation ≥ 50%	Low	Potential for flooding	6.5	0.8
Planosols	Stagnating water due to abrupt textural difference, water fluctuations leading to reducing/oxidizing conditions	Alluvial, colluvial	Eutric	Effective base saturation ≥ 50%	Moderate – High	Saturated soils, poor rooting	129.7	15.7
Regosols	Soils with no soil development	Range of unconcolidated materials	Calcaric	Containing calcaric material between 20 cm to 100 cm of soil surface	Moderate	Low organic matter, low water holding capacity	67.7	8.2
			Eutric	Effective base saturation ≥ 50%	Moderate	Low organic matter, low water holding capacity	14.1	1.7
Solonchaks	High concentration of soluble salts, not affected by tidal water, salt concentration fluctuates throughout year	Range of unconsolidated sediments	Calcic	Secondary calcium carbonate accumulation within 1 m of surface	Moderate - high	Drought stress, salt stress	8.4	1.0
Solonetz	High exchangeable Sodium, natric horizon within 1 m of surface, strongly structured clay subsoil	Range of unconsolidated fine textured sediments	Calcic	Secondary calcium carbonate accumulation within 1 m of surface	Moderate - high	Drought stress, salt stress, thin topsoil	40.2	4.9
			Gleyic	A horizon ≥ 25 cm thick that has periodic or prolonged saturation resulting in reducing conditions, prominent mottles	High	Salt stress, thin topsoil, saturated soils	67.7	8.2

Reference Soil Group		Parent Material	Principal Soil Qualifiers		Agricultural Limitation		Extent of Soil on Centreline	
Name	Description		Name	Description	Rating	Reason	km	%
			Haplic	Undifferentiated horizon only has the features of the reference soil group,	High	Salt stress, thin topsoil	68.8	8.4
Calcisols	Accumulation of secondary carbonates	Alluvial, colluvial, aeolian	Haplic	Undifferentiated horizon only has the features of the reference soil group,	Low	Fertilizer requirements	9.6	1.2
			Petric	Has a cemented horizon within 1 m of surface	Moderate	Rooting, infiltration, fertilizer requirements	6.2	0.8
Cambisols	Soils with moderate soil development, beginnings of horizon differentiation in the subsoil, evident from changes in structure, colour, clay content or carbonate content	Medium and fine textured material from various origins	Calcaric	Containing calcaric material between 20 cm to 100 cm of soil surface	Low	Organic matter,	55.9	6.8
			Chromic	Surface horizon with hue refer than 7.5YR and chroma >4	Low	Organic matter	65.5	7.9
Luvisols	Clay enriched subsoil from clay migration from upper horizons, high activity clay, high base status	Range of unconsolidated material including glacial till, aeolian, alluvial, colluvial	Haplic	Undifferentiated horizon only has the features of the reference soil group,	Low	Potential for water logging	82.6	10.0
			Calcic	Secondary calcium carbonate accumulation within 1 m of surface	Low	Potential for water logging	22.6	2.7
Lixisols	Clay enriched subsoil from migration from upper horizons, low activity clay, high base status	Range of materials, including unconsolidated chemically weathered soils, fine textured	Haplic	Undifferentiated horizon only has the features of the reference soil group,	Low – moderate	Degraded topsoil	42.5	5.2
			Ferric	Horizon within 1 m of surface in which segregation of iron has taken place resulting in large mottles, poor soil aggregation	Moderate	Degraded topsoil, poor soil drainage	110.2	13.4

Reference Soil Group		Parent Material	Principal Soil Qualifiers		Agricultural Limitation		Extent of Soil on Centreline	
Name	Description		Name	Description	Rating	Reason	km	%
Chernozems	Accumulation of organic matter in topsoil, rich in organic matter, secondary carbonates	Aeolian sediments (loess)	Calcic	Secondary calcium carbonate accumulation within 1 m of surface	None	-	2.1	0.3
Gleysols	Underwater or saturated for long enough periods of time to have reducing conditions, significant presence of mottles	Range of unconsolidated materials, fluvial, marine, lacustrine	Eutric	Effective base saturation ≥ 50%	Moderate	Saturated soil conditions	0.6	0.1
			Calcic	Secondary calcium carbonate accumulation within 1 m of surface	Moderate	Saturated soil conditions	4.2	0.5
Phaeozems	Accumulation of organic matter in topsoil, no secondary carbonates, high base status	Aeolian, glacial till, and other unconsolidated materials	Gleyic	A horizon ≥ 25 cm thick that has periodic or prolonged saturation resulting in reducing conditions, prominent mottles	Low	Potential for saturated soil	6.4	0.8
Vertisols	Alternating wetting and drying of soil, shrink-swell clays, vertic horizon within 1 m of surface	Sediments containing high proportions of shrink swell clays	Eutric	Effective base saturation ≥ 50%	Moderate	Soil moisture stress, root restriction	5.5	0.7

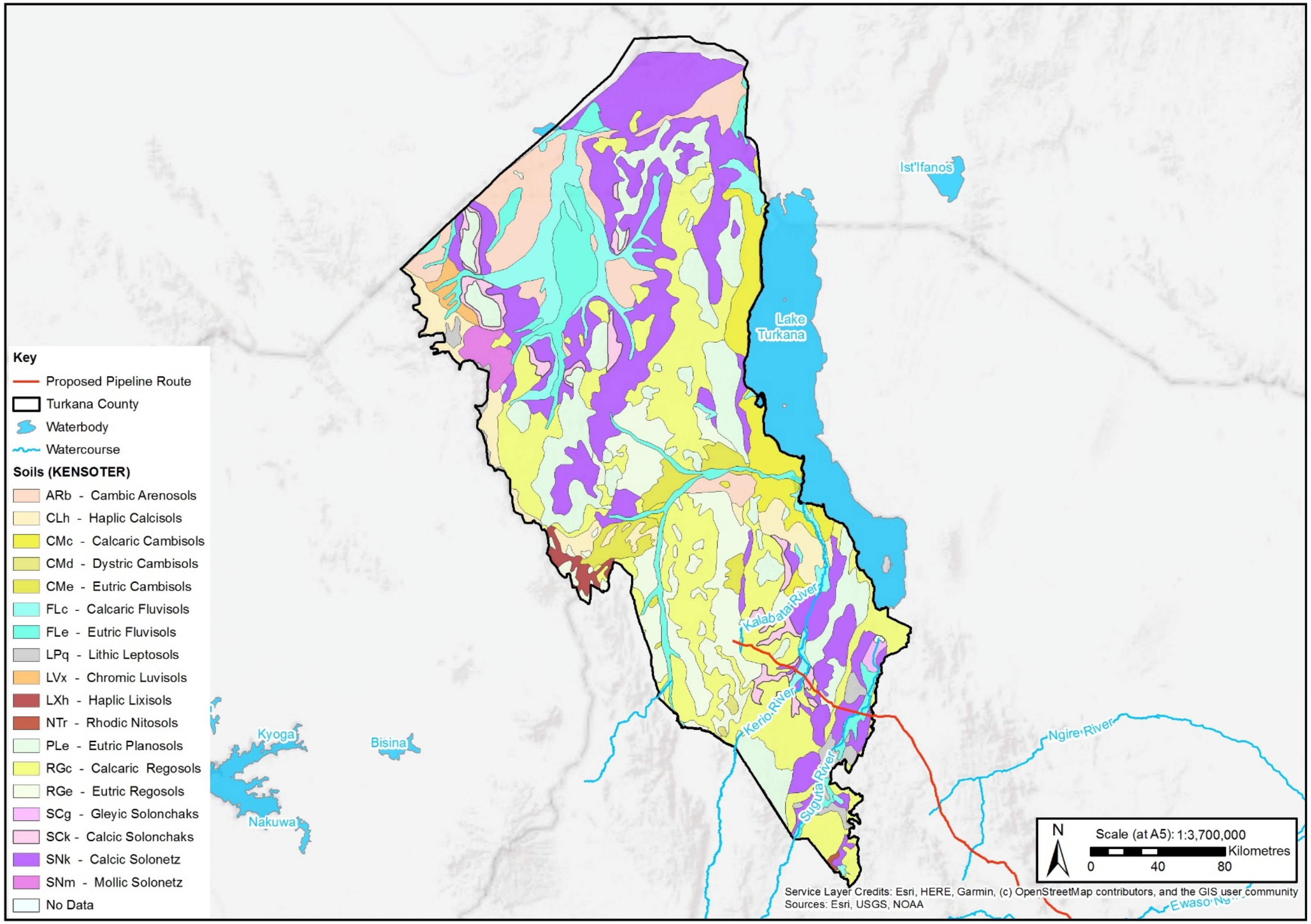


Figure 6.5-4: Soil types encountered within Turkana

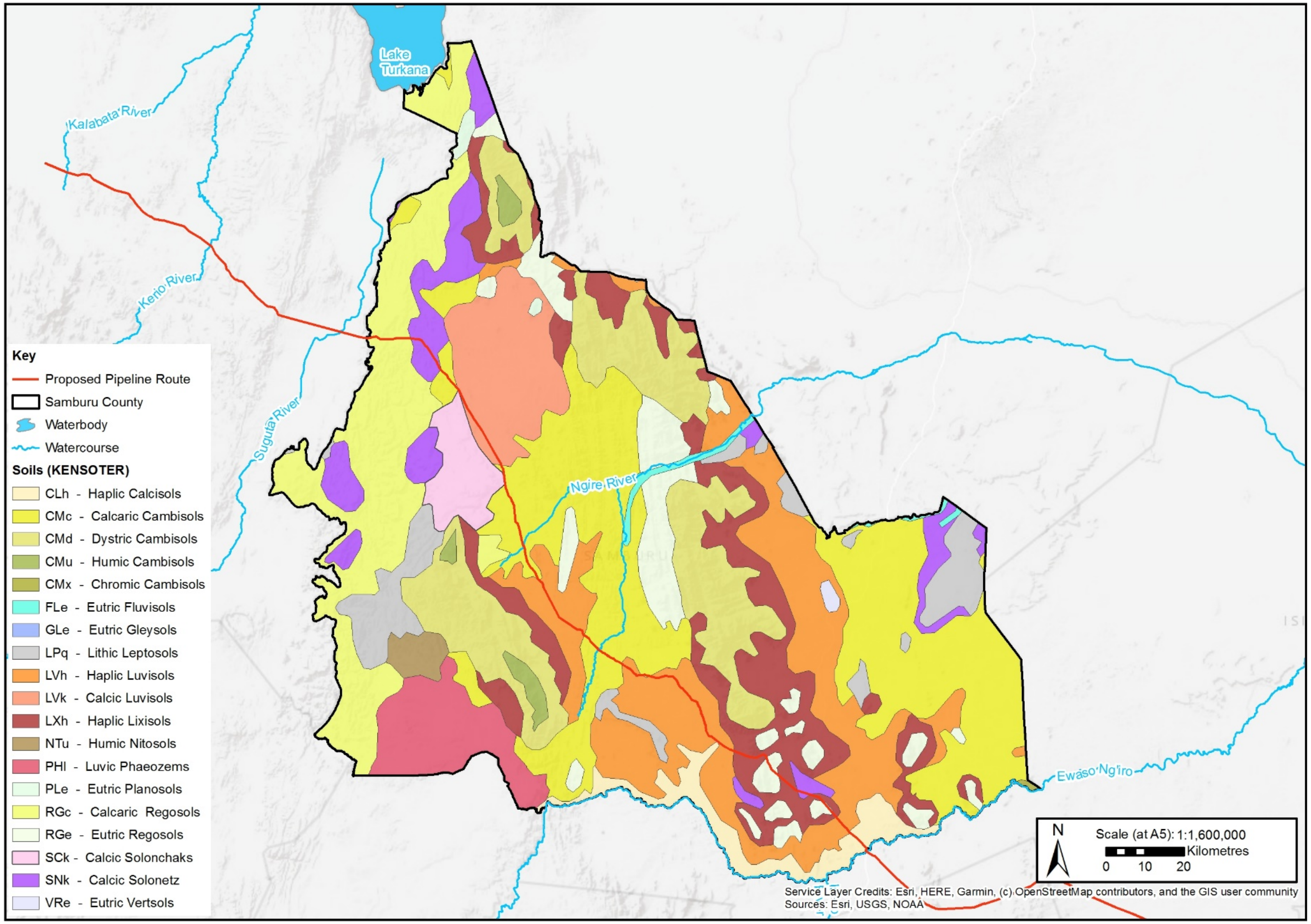


Figure 6.5-5: Soil types encountered within Samburu

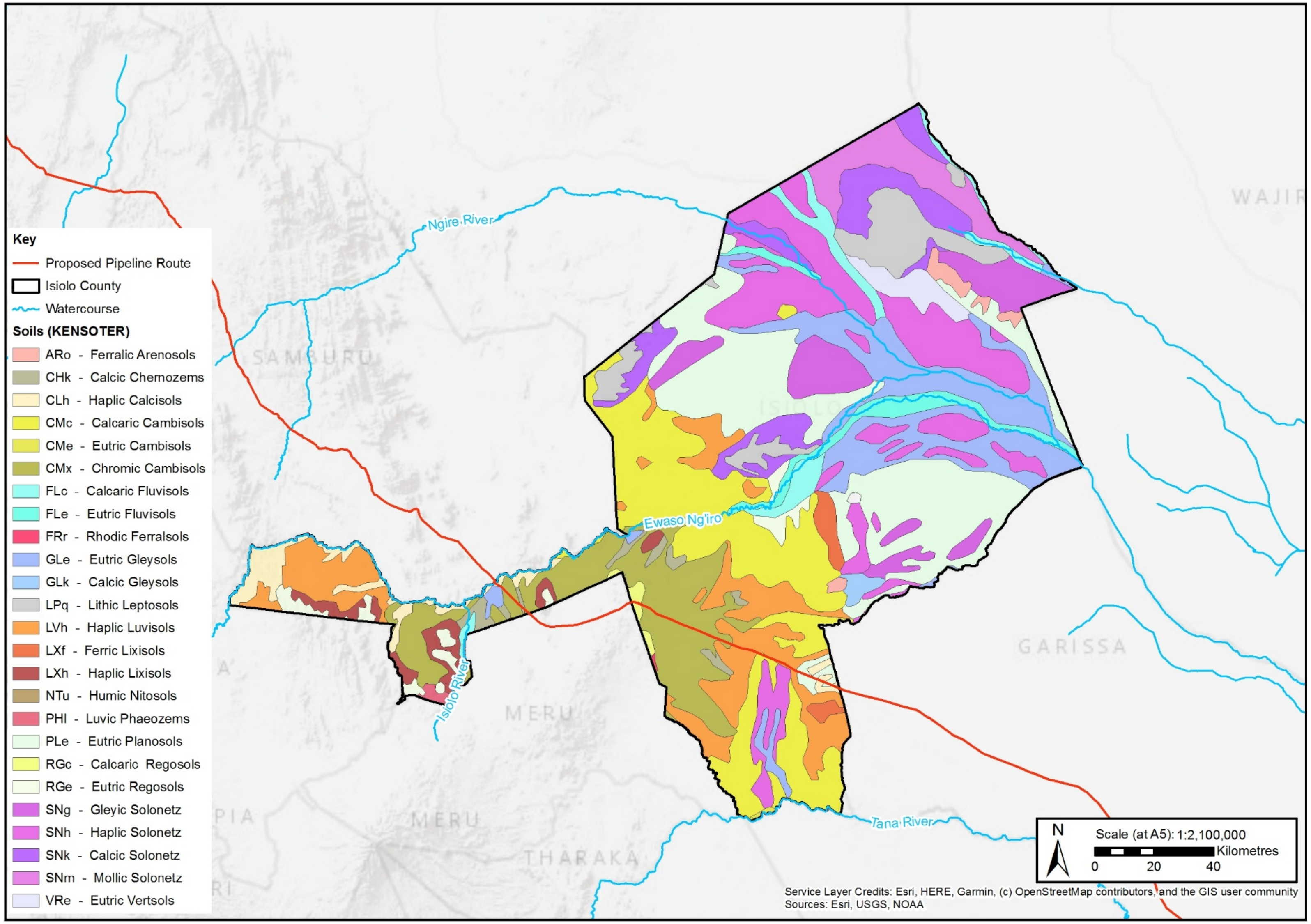


Figure 6.5-6: Soil types encountered within Isiolo

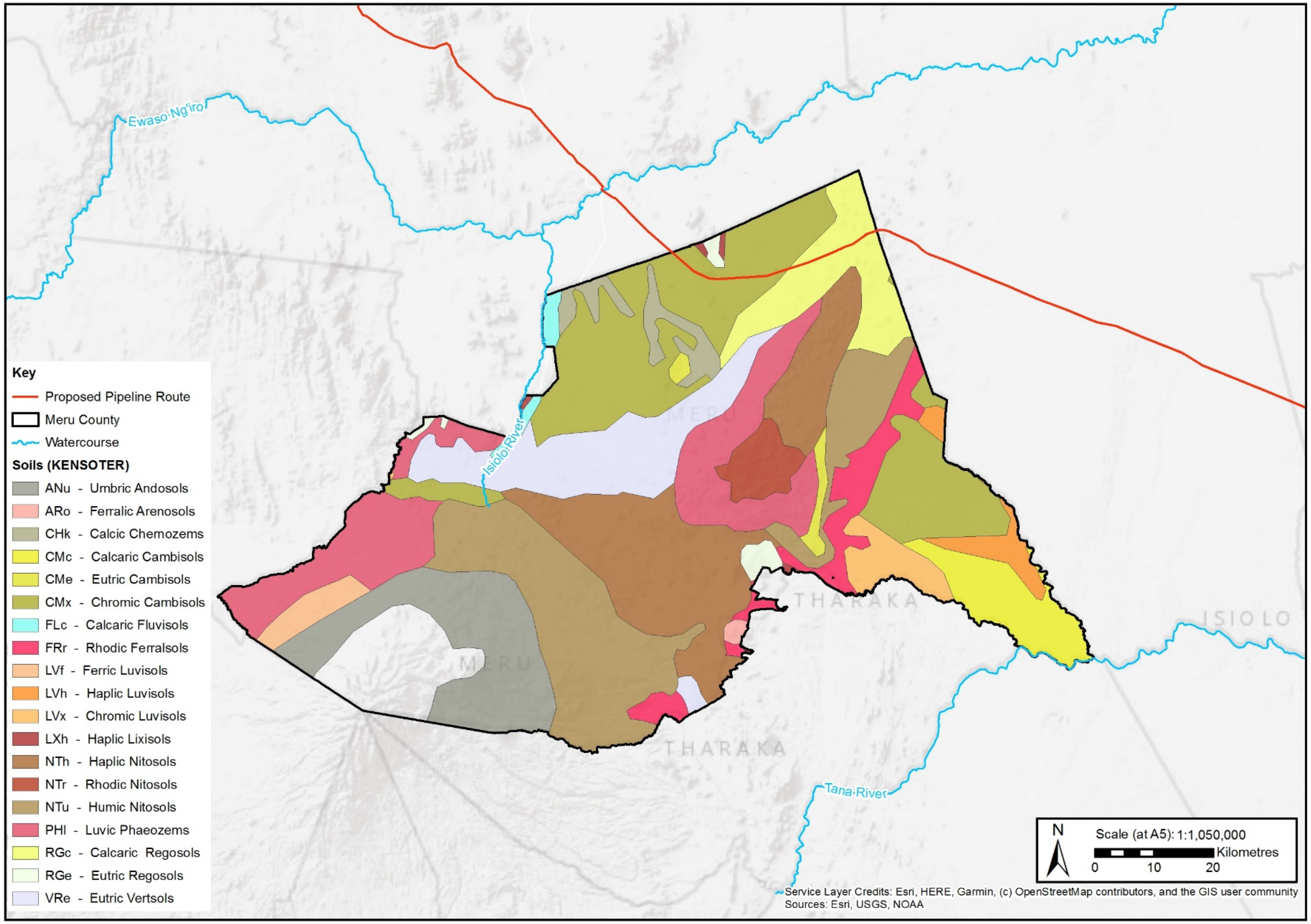


Figure 6.5-7: Soil types encountered within Meru

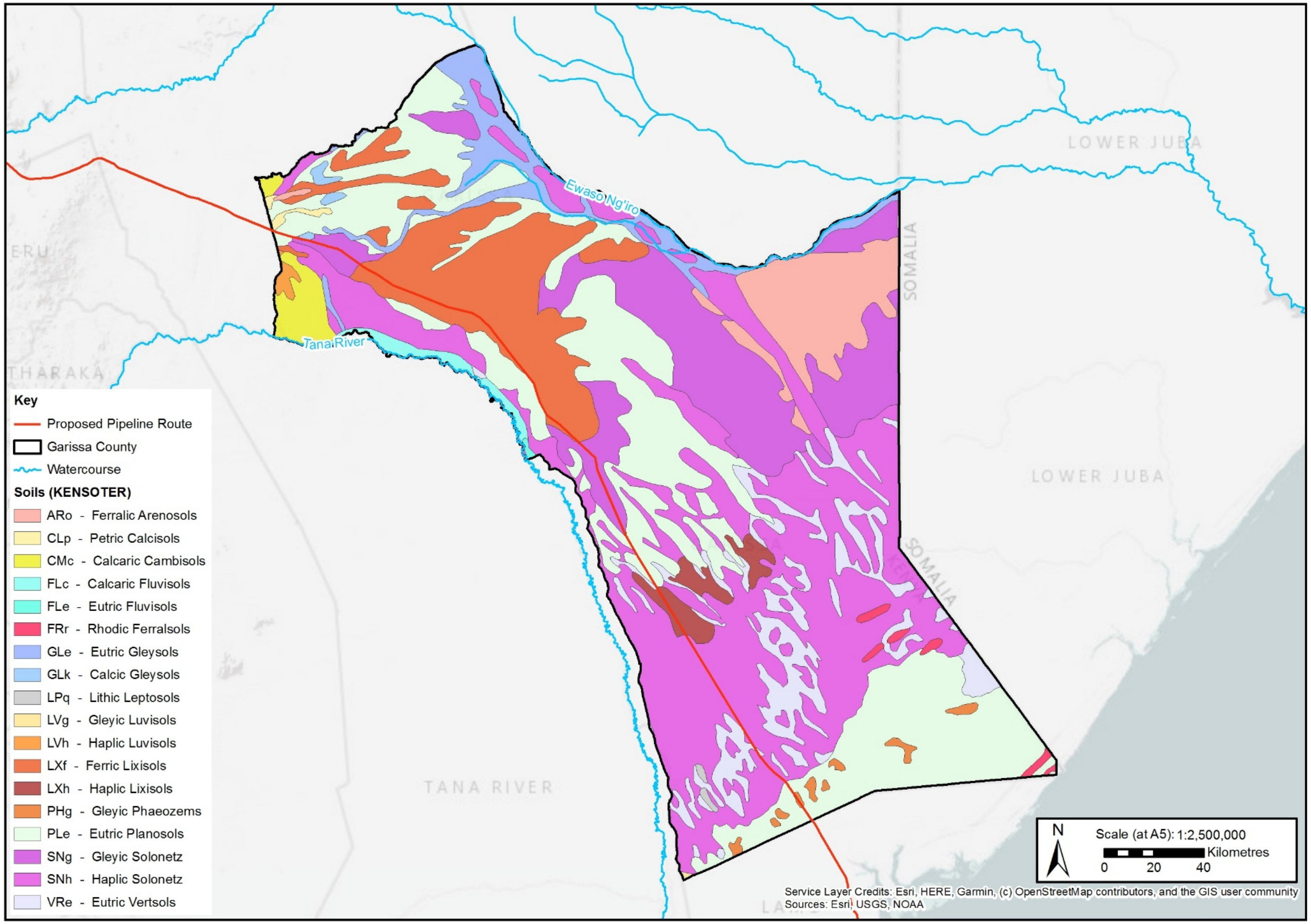


Figure 6.5-8: Soil types encountered within Garissa

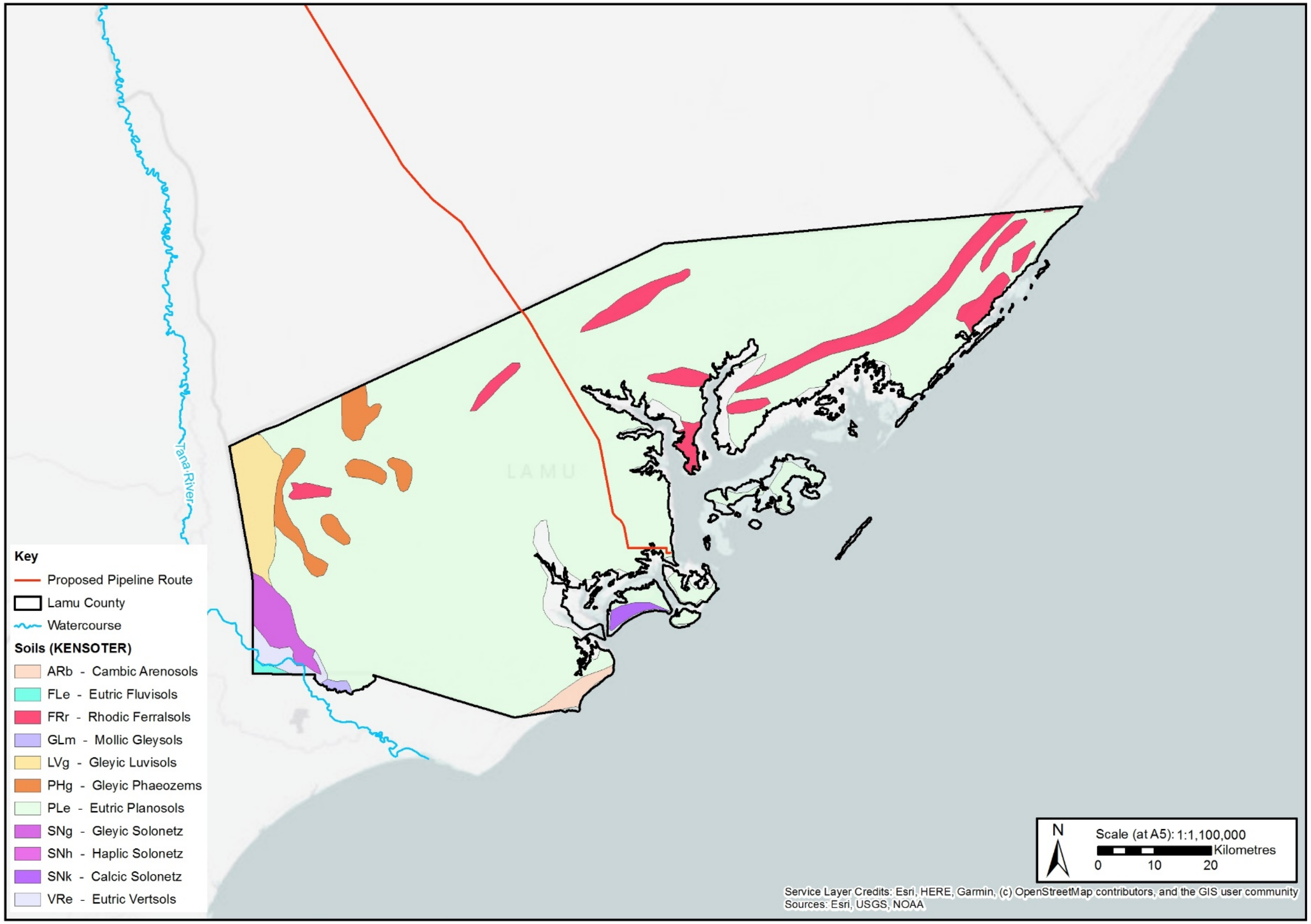


Figure 6.5-9: Soil types encountered within Lamu

Mapped Soil Distribution

The common soils (occupying greater than 8 % of the centreline) along the proposed route are Eutric Planosols, Calcaric Regosols, Gleyic Solonetz, Haplic Solonetz, Haplic Luvisols and Ferric Lixisols. Specific extents along the pipeline centre line for each soil are found in Table 6.5-1. Soils near the LEF are more variable than the soils adjacent the LMT. Regosols and Solonetz are found sporadically along the route with few sections greater than 10 km in length. Fluvisols are found near water crossings and on flood plains of rivers.

Soil texture varies from sandy to clayey along the AoI. A summary of the extent of each soil texture determined from ICPAC[4] mapping is presented in Table 6.5-2. Soils are typically finer textured at the beginning of the route KP 0 and textures become coarser around KP650 until the Lamu Marine Terminal.

Table 6.5-2: Extent of different soil textures along the pipeline centreline

Soil Texture	Extent of Pipeline	
	Kilometre (km)	%
Sandy	88	10.7
Loamy	101	12.2
Clayey	513	62.5
Very Clayey	121	14.7
Total	**825**	**100**

Soils Encountered during Ground Investigations

The recording of the presence of soils and the description of the soils was not commonly included in the preliminary findings of the geotechnical investigation (Treavic Geosystem and Engineering Ltd., 2018/2019). The presence of 'Top Soils' was noted at the surface in trial pits located at KP104, KP116, KP145, KP170, KP195, KP270, KP272, KP284, KP290, KP296 and KP298, which are all located in Samburu county. The thickness of the material identified as top soils ranges from 0.2 m to 0.6 m. The material is typically described as silty clay, sandy silt or silty sand that is reddish, yellowy orange or yellowy brown in colour. The locations of the LLCOP trial pits and boreholes are shown in the Drawings 6.4-1 to 6.4-8.

Laterites were occasionally encountered in the trail pits in Samburu County (KP100, KP116, KP195, KP245 and KP350). These were usually logged between 0.3 m and 1.2 m below the surface. Soils were not recorded in any of the other trial pit locations or in any of the boreholes. The surface geology was otherwise typically logged as comprising silty sands, silty clay, gravelly silt, gravelly sand and silty gravels.

Soil Erosion Potential

The Wood Group Geohazard report (Wood Group, 2018a) includes information about the soil types present along pipeline and a qualitative erosion risk assessment. Based on common practice in the oil and gas industry, the report used a threshold of 10t/ha/year as acceptable upper limit, which was reduced to 5t/ha/year for sensitive sites (e.g. slopes along rivers). Most of the soils encountered were classified as medium or high erosion potential. Those classified as low had higher erosion potential when present on slopes. The erosion risk presented in the Wood Group report for each soil type is summarised in Table 6.5-3. The locations along the pipeline where these soil types are present is also indicated.

[4] Kenya Soil Survey, 1997: Soil physical and chemical properties of Kenyan soils GIS dataset.

Table 6.5-3: Soil erosion risk for each soil reference group

Soil Reference Group	Risk Rating	Rationale	Pipeline Locations
Arenosols	High	Prone to wind erosion and easily turned to dunes.	0.00 km to 6.34 km
Calcisols	Medium/ High	Lack of vegetation makes prone to wind and water erosion.	110.50 km to 121.60 km 292.31 km to 300.40 km 414.39 km to 440.34 km
Cambisols	Medium/ High.	Erosion likely on slopes when surface is bare	121.60 km to 128.41 km 150.92 km to 181.73 km 202.08 km to 214.96 km 301.70 km to 335.37 km 358.24 km to 391.03 km
Fluvisols	Medium	Erosion potential in vicinity of rivers	43.70 km to 49.81 km 88.77 km to 95.15 km
Lixisols	High	Crust can develop leading to low rain infiltration, presenting an erosion risk from sudden overland flows and wind.	253.53 km to 262.65 km 268.95 km to 274.12 km 279.29 km to 287.09 km 468.22 km to 522.00 km 655.24 km to 677.91 km
Luvisols	Low/ Medium	Typically low, but erosion prone on slopes.	128.41 km to 150.92 km 181.73 km to 202.08 km 214.96 km to 253.53 km 287.09 km to 292.31 km 391.03 km to 414.39 km
Phaeozems	Low	Erosion by wind may occur after prolonged droughts.	811.17 km to 814.73 km
Planosols	Low	Wind erosion possible if soils allowed to dry out.	63.22 km to 75.38 km 631.03 km to 655.24 km 749.66 km to 811.17 km 814.73 km to 824 km (Lamu Marine Terminal)
Regosols	High	Weakly developed soil structure and horizons makes these soils prone to erosion	6.34 km to 36.02 km 56.89 km to 60.48 km 75.38 km to 77.92 97.78 km to 110.52 km 262.65 km to 268.95 km 281.60 km to 284.91 km 335.37 km to 358.24 km
Solonchaks	Medium	Erosion due to wind	49.81 km to 56.89 km
Solonetz	Medium	Erosion due to wind	36.02 km to 43.70 km 60.48 km to 63.77 km 77.92 km to 88.77 km 95.15 km to 97.00 km 97.00 km to 97.78 km 274.12 km to 279.29 km 440.34 km to 468.22 km 587.31 km to 631.03 km 677.91 km to 749.66 km

6.5.4.3 Geology and Soils Overview for the AoI

An overview of the general geological and soils information for each county that has been collated from the secondary baseline sources is presented in Table 6.5-4. The information includes the soil reference groups, landforms and geological formations present in each county, along with the KP. Specific details on each soil type are described in the sections that follow.

Table 6.5-4: Extent of the pipeline route in each county and geologic formations and soil types found

County	KP Start and End	Landforms	Mapped Geological Formations in AoI	Soil Reference Groups
Turkana	0 - 99	Rolling hills, some steep slopes, with wide valleys	Precambrian crystalline baseline gneisses, schists and granulites overlain by Tertiary and Quaternary alkaline lavas, tuffs, the Turkana Grits, and sandstones (including the Lower and Upper Auwerwer Sandstones) separated by shales. Unconsolidated alluvium and colluvial deposits are present in the valleys.	Regosols, Planosols, Solonetz, Solonchaks, Fluvisols
Samburu	98 - 303	Undulating steep-dipping terrain, hills and flood plains	NeoProterozoic crystalline basement rocks (Mozambique Belt) and Paleogene-Neogene lavas (basalts, phonolites and trachytes). Quaternary sediments (alluvium and colluvium, calcareous and lacustrine sediments, agglomeratic ash and residual soils) are also present at the surface, particularly in the south of the county.	Calcisols, Cambisols, Lixisols, Luvisols, Solonetz
Isiolo	303 - 319 356 - 433	Rolling hills to level terrain	Extrusive igneous deposits. Quaternary colluvial (unconsolidated) deposits. Outcrop of the Neoproterozoic bedrock (Mozambique Belt) mapped 18 km northwest of Station 9	Calcisols, Cambisols, Luvisols, Planosols, Chernozems
Meru	319 - 356	Volcanes with variable slopes and level to rolling areas	Quaternary and Plio-quaternary extrusive igneous rocks (mainly ash, basalt flows, phonolites and tuffaceous material)	Cambisols, Regosols
Garissa	433 - 769	Level to gently undulating	Quaternary and Tertiary sedimentary deposits, including colluvial deposits and sandstones/sands	Solonetz, Planosols, Lixisols, Phaeozems, Vertisols
Lamu	769 - 824	Sand dunes	Quaternary deposits including estuarine deposits, sand, clay and coral limestone	Planosols

6.5.4.4 Geohazards

The East African Rift System (EARS) is a zone of crustal extension. It runs over 3000 km from Mozambique to the Afar depression. The crustal extension causes a system of normal faults; the surface expression of which is a series of basins (rift valleys) that are separated from each other by uplifted sections that form escarpments. The northwest end of the LLCOP is in the Lokichar Basin that has formed within EARS. The main active rift with respect to the LLCOP is the Suguta Valley. Baseline information on the geohazards associated with this rifting, and the geomorphology it creates, are summarised in this section.

Faulting

The Geohazard Desk Study (Wood Group, 2018a) states that "*the closest and therefore most significant faults* [in relation to the LLCOP] *are those related to the Kenya Rift and in particular the Lokichar Fault and faults bounding the Suguta Valley*". The northern end of LLCOP is where most of the major faults shown on small scale mapping are present (Figure 6.5-10, background mapping from CGMW, 2016). The mapped major faults become less frequent through Samburu and Isiolo Counties, and none are mapped where the pipeline passes through Meru, Garissa or Lamu Counties.

The map of structural lineaments in this northern area is reproduced in Figure 6.5-11. The review that was then undertaken of earthquake distribution provided no clear evidence of seismic events that could be directly attributed to these features and the Lokichar Fault was determined to be inactive (Wood Group, 2018a). The mapping was then ground truthed to find evidence of recent sediment deformation and fracturing that could be associated with active tectonics and was considered in agreement with geological mapping. The main active rift within the LLCOP project area was determined to be the Suguta Valley. Twenty locations were identified where the LLCOP route crosses a fault lineament indicating the pipeline is potentially at risk from active faulting (Wood Group, 2018).

Following additional work, a Fault Hazard Assessment Report was issued (Wood Group, 2019). The study analysis is based on an in-depth review of available literature, detailed morpho-structural evaluations and field observations from a dedicated site visit.

The conclusion of the study was that any movements of the faults would be small and could be accommodated by the pipeline without requiring special pipeline fault crossing design. However, further field evaluation is recommended for the faults to the west of the Suguta Valley and, should any potential large fault movements be identified, the pipeline should be designed to accommodate this movement without risk of failure.

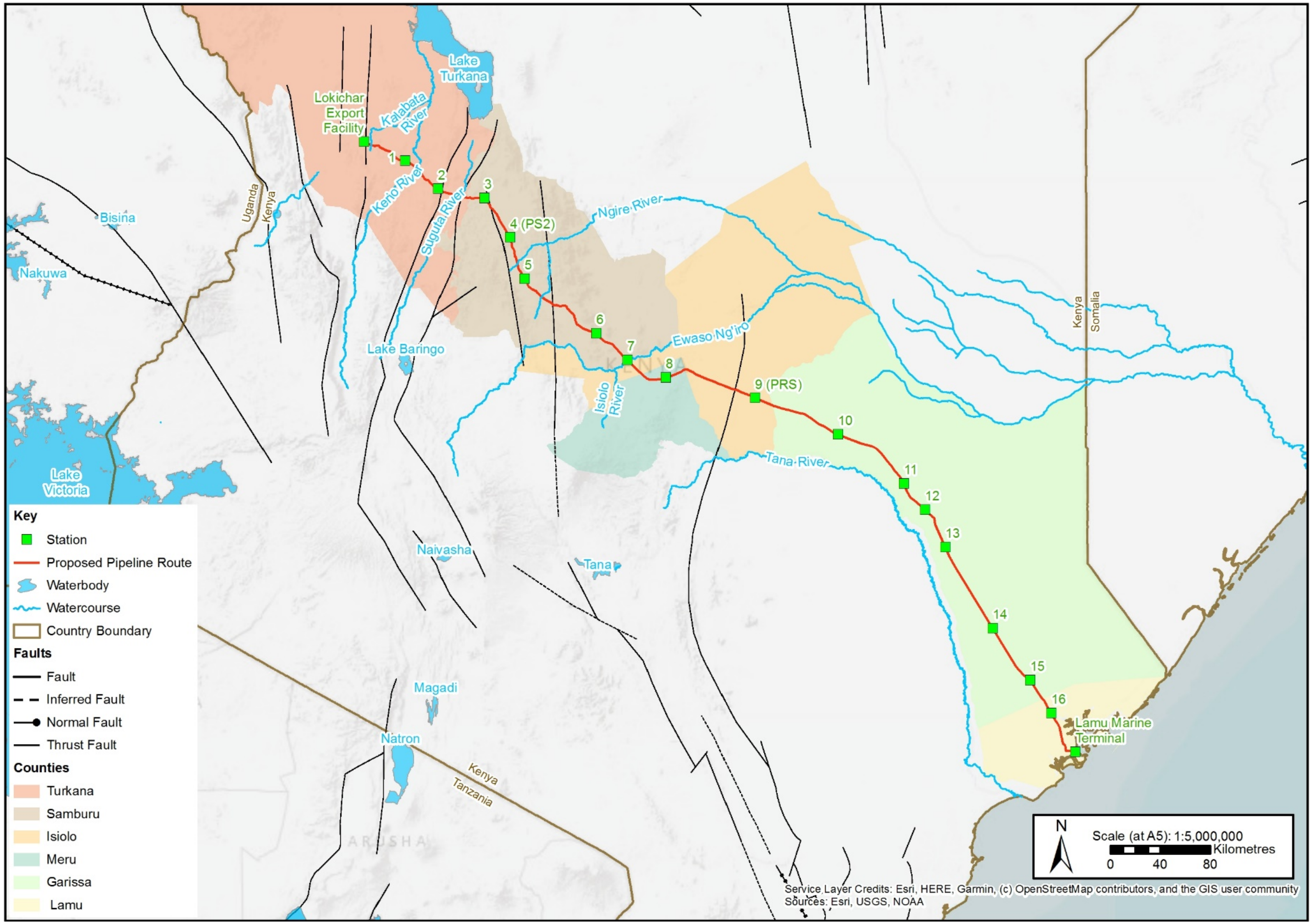


Figure 6.5-10: Major mapped faults

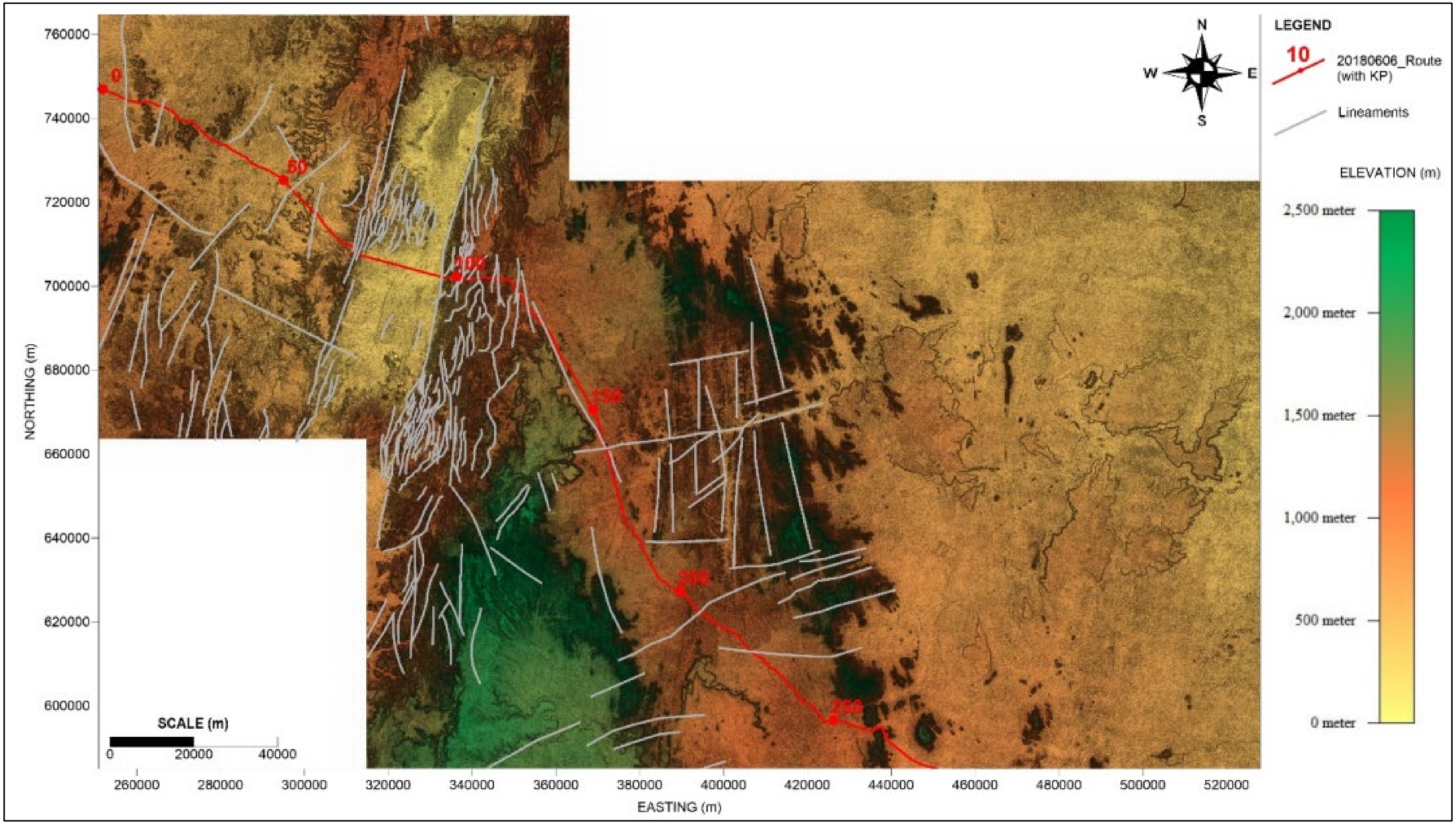


Figure 6.5-11: Structural lineaments in the Suguta Valley (after Wood Group, 2018a)

Seismicity

Kenya is vulnerable to seismic activity associated with the presence of the active EARS. The overall earthquake hazard level is considered low in Kenya compared to neighbouring countries (GSDRC, 2013). Even though the risk is still low, the highest hazard levels within Kenya are in the northwest and southwest of Kenya.

The location, magnitude and depth of earthquakes recorded in the region of the LLCOP between 1912 and 2018 are presented in Figure 6.5-13 and Figure 6.5-14. The eastern branch of the EARS in which the Suguta Valley is located has been characterised by earthquake swarms of low magnitude that mostly occur between 10 km and 25 km depth.

It is concluded in the Wood Group (2018) report that there is a decrease of seismic hazard towards the coastal area (Lamu). A conservative estimate is presented based on a 4.5 mm/yr extension rate for the rift in the report's study area that implies magnitude 7 seismic events have a recurrence interval between about 500 and 1000 years. It is also stated in the Wood Group (2018) report that, in comparison to the whole of the EARS, the Kenya Rift shows a relatively low seismic activity.

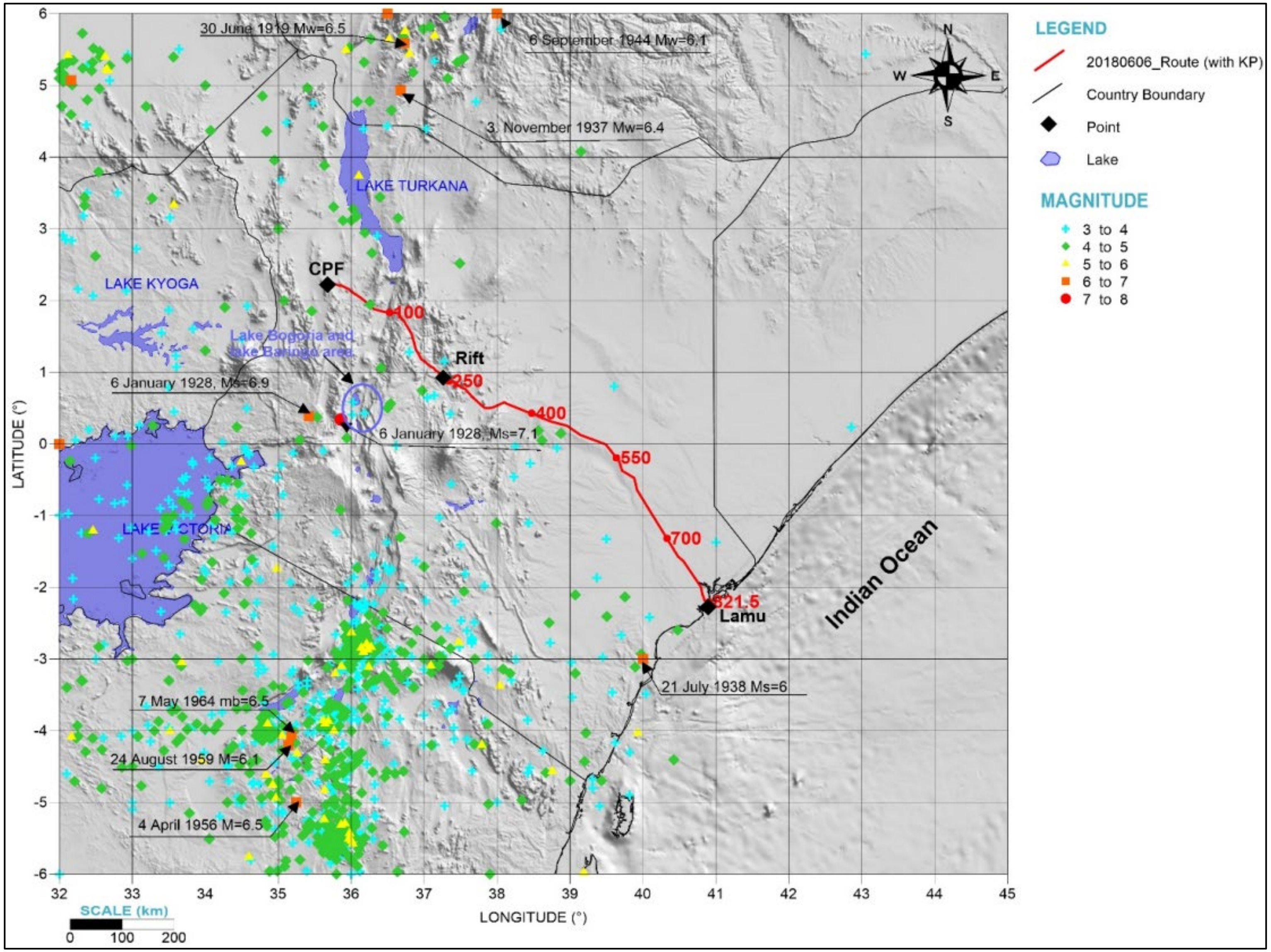


Figure 6.5-12: Earthquake locations and magnitude 1912-2018 (after Wood, 2018a)

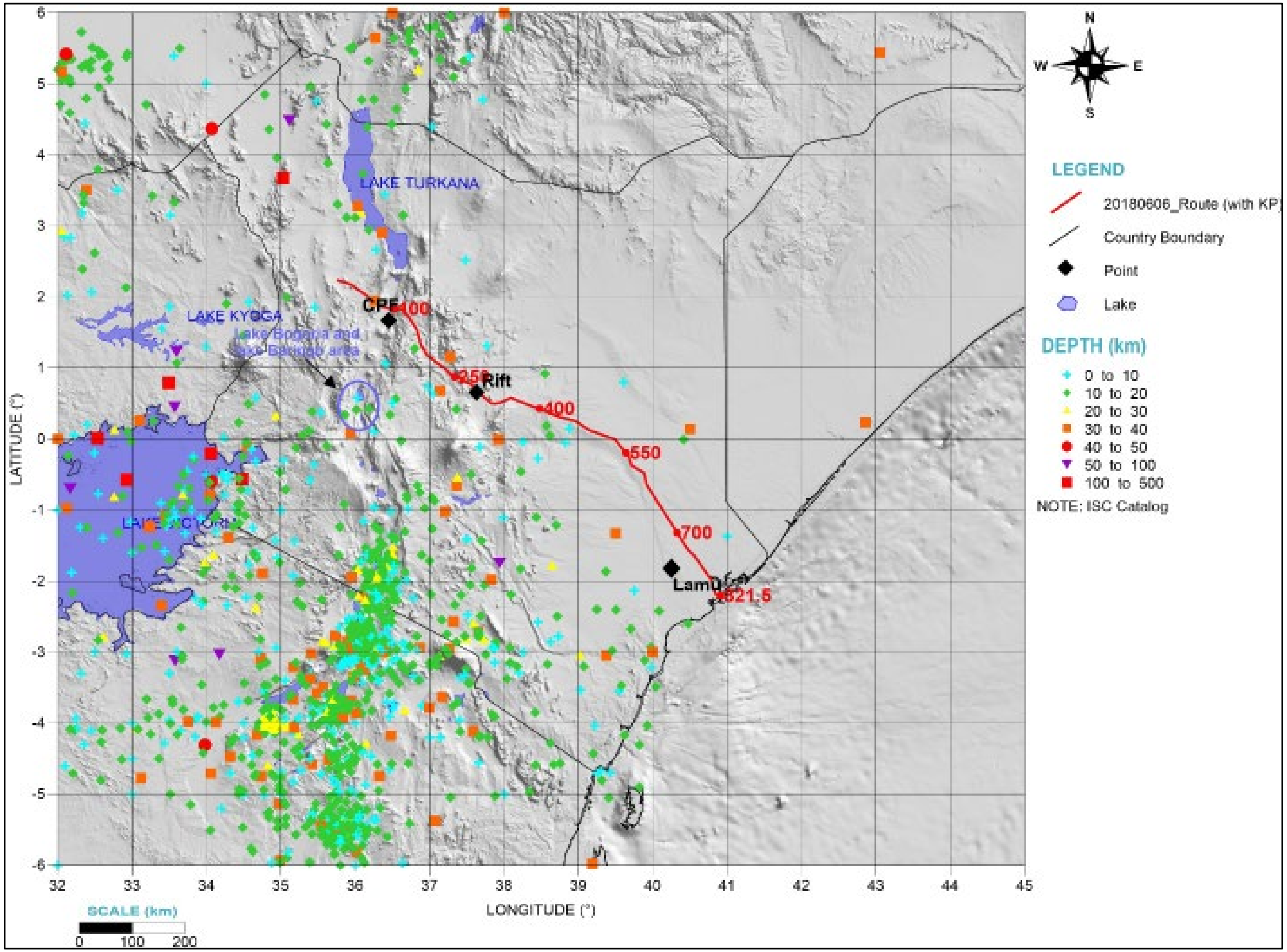


Figure 6.5-13: Earthquake depth distribution 1912 to 2018 (after Wood Group, 2018a)

Volcanicity

Due to the extension of the EARS, active volcanoes are present in the region. Active volcanoes are mapped along the eastern side of the EARS towards the northern end of the LLCOP (Figure 6.5-14). Volcanoes represent potential sources of impact to the LLCOP because of lava and pyroclastic flows.

Wood Group (2018) identified no active volcanicity along proposed LLCOP route. The closest volcano to the proposed route is the Namarunu, which last erupted c 8,500 years ago and is located in the Suguta valley about 15 km north. The next closest volcano is Emuruangogolak in the Suguta Basin, 26 km to the southeast. The active shield volcano “the Barrier” on the southern shore of Lake Turkana is 50 km to the north of the LLCOP. All of the volcanoes in proximity to the LLCOP are shield volcanoes and have been effusive and non-explosive eruptions.

No pyroclastic fall deposits have been observed along the corridor and the proposed pipeline does not cross any recent lava flows, with the exceptions of KP300 to KP304 where a relatively recent (age unknown, but perhaps Holocene) lava flow deposit was observed (Wood Group, 2018a). The Geohazard Desk Study concludes that the risk of lava flow impact on the pipeline can be considered negligible.

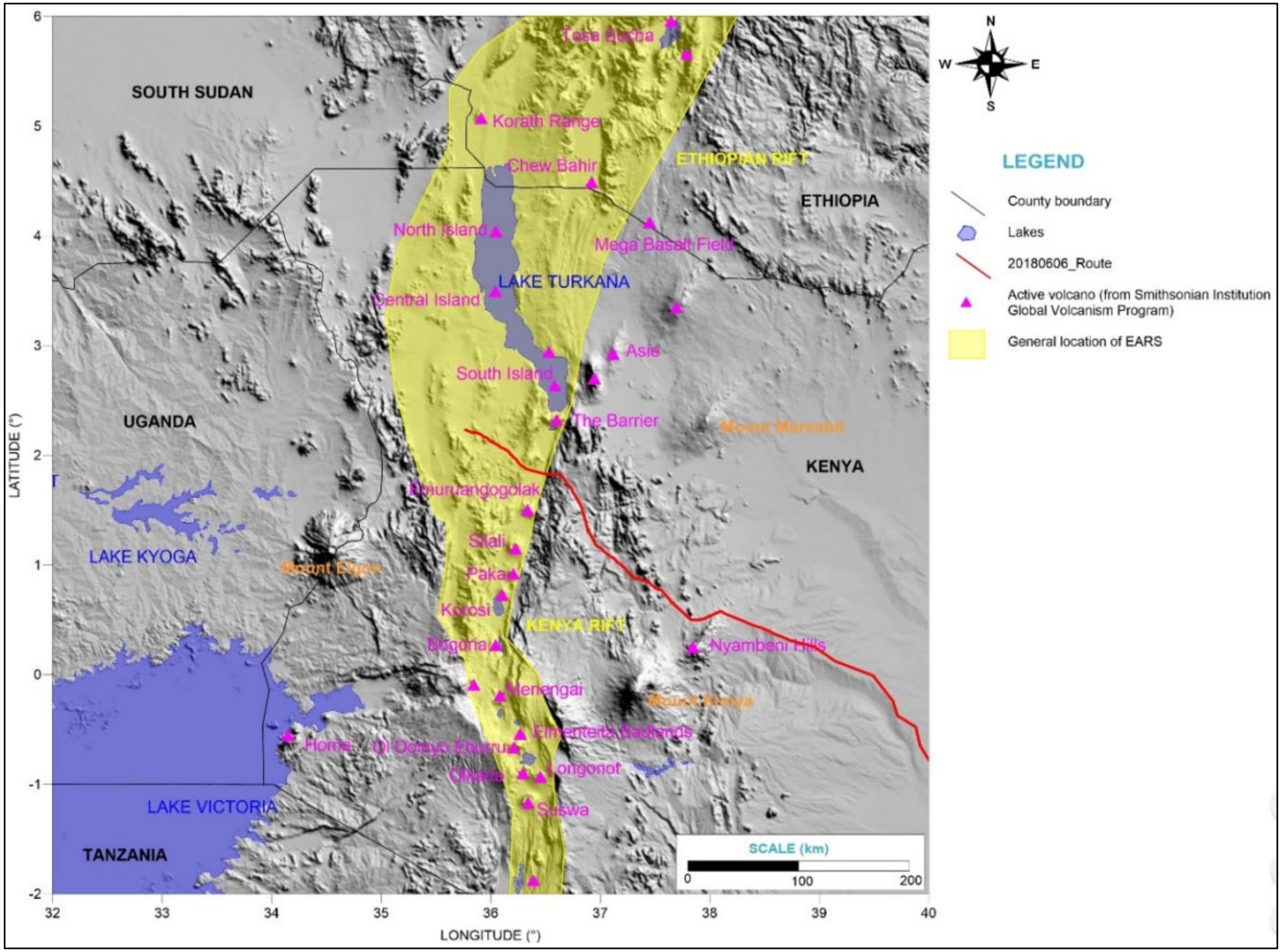


Figure 6.5-14: Active volcanoes in the EARS (after Wood Group, 2018a)

Landslides and Slope Stability

The route elevation profile along the proposed route is shown in Figure 6.5-15. Landslides and slope instability can be caused by steep sloping topography. The majority of the landslides in Kenya are reportedly triggered by water and/or human activities, with slope saturation by water being the primary cause (Wood Group, 2018a).

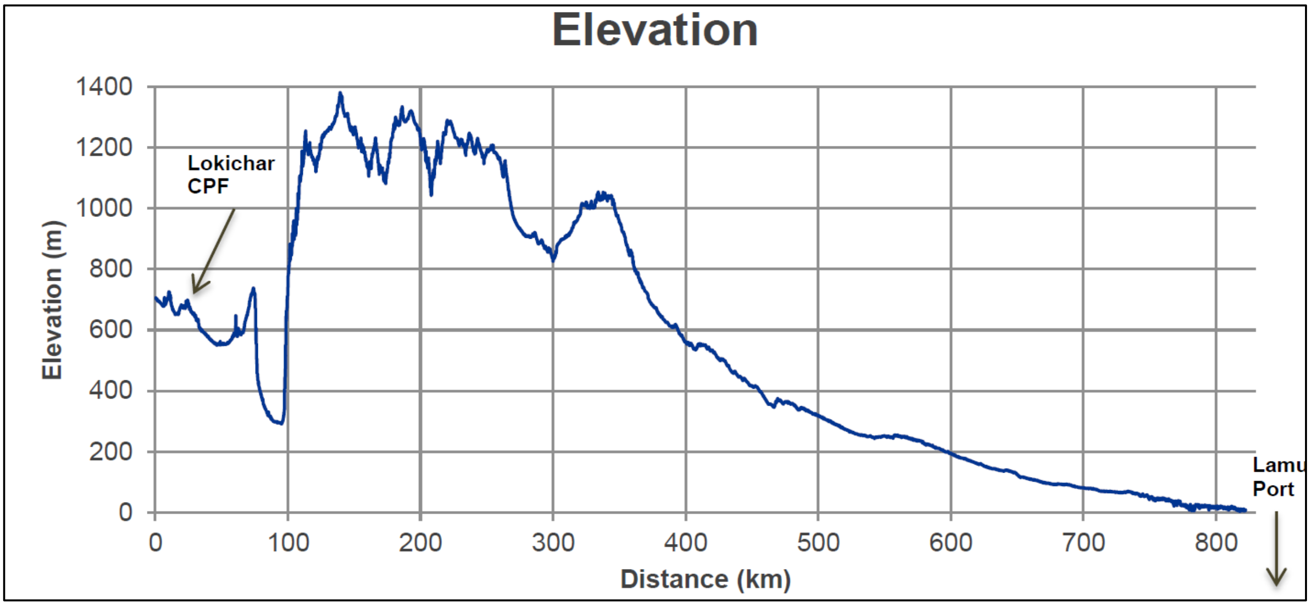


Figure 6.5-15: Route elevation profile from Lokichar to Lamu

A map of landslide prone areas in Kenya (Figure 6.5-16), taken from Wood Group (2018; originally developed by the Kenya Mines and Geology Department), provides an indication on the distribution of observed landslides in the LLCOP region. However, the reporting of observed landslide will be biased to populated areas, so there could have been landslides along the less or un-populated parts of the LLCOP corridor that were not reported.

The Wood Group (2018) report states that, although the LLCOP route unavoidably crosses areas of relatively steep topographic gradient, it does not appear to cross significant active landslides. Only one landslide crossing is listed in the geohazards register. This is a very shallow potentially active landslide that was observed to cross the LLLCOP corridor at about KP97 and is located at the base of the Eastern Suguta valley escarpment. A second, well-defined landslide was observed near the LLCOP corridor at KP355. However, this landslide, did not directly intersect the LLCOP corridor. There it typically limited soil thickness along the LLCOP corridor, so the risk presented by landslides to the pipeline is negligible.

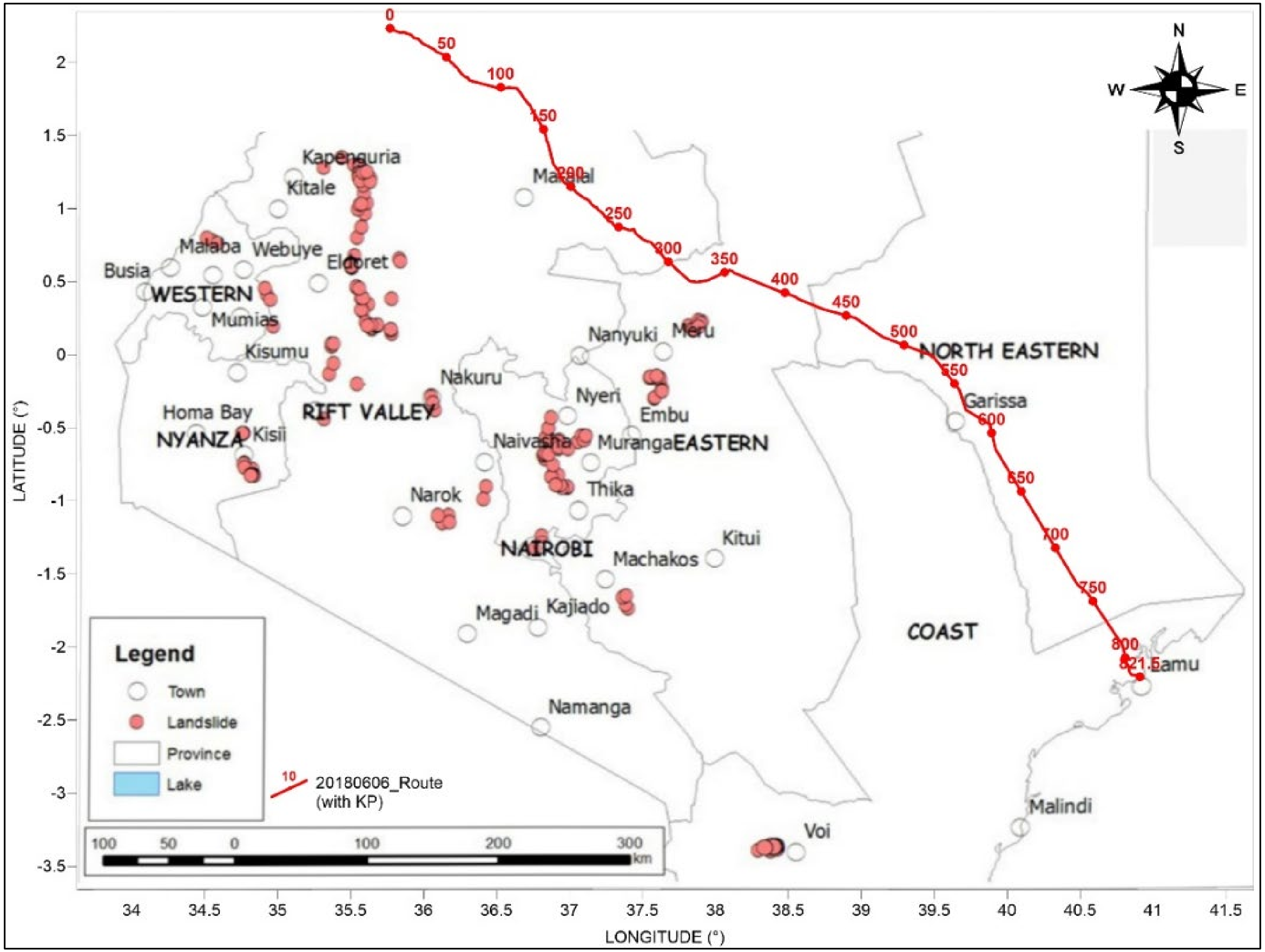


Figure 6.5-16: Landslide prone areas in Kenya (after Wood Group, 2018a)

6.6 Biodiversity, Ecology and Protected Areas – Freshwater Aquatics, Terrestrial Flora and Fauna

6.6.1 Introduction

This section describes the baseline terrestrial and freshwater aquatic biodiversity within the proposed route of the Project. The baseline description has been based on a literature review and consultation with stakeholders and experts (secondary assessment) and the results of two baseline field surveys (primary assessment) conducted during the dry season (June 2018) and wet season (October and November 2018). The terrestrial and freshwater aquatic baseline, as described in this section, is defined as:

- Terrestrial flora and fauna (birds, mammals, reptiles, amphibians and invertebrates); and
- Freshwater aquatic ecosystems (fish and aquatic macroinvertebrates).

6.6.2 Area of Influence

The AoI for the biodiversity assessment (Figure 6.6-1), within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes a 25 km buffer along the entire pipeline, plus wherever the buffered route intersected a defined protected area or area of biological importance, that area is incorporated into AoI (Golder, 2018b).

Potential direct impacts such as changes in habitat availability, composition and quality caused by land take, sensory disturbance (light, noise, vibration), air emissions and dust from the project operation or construction may include direct and indirect disturbances to biota, which could extend beyond a confined area and, therefore, the size of the buffer.

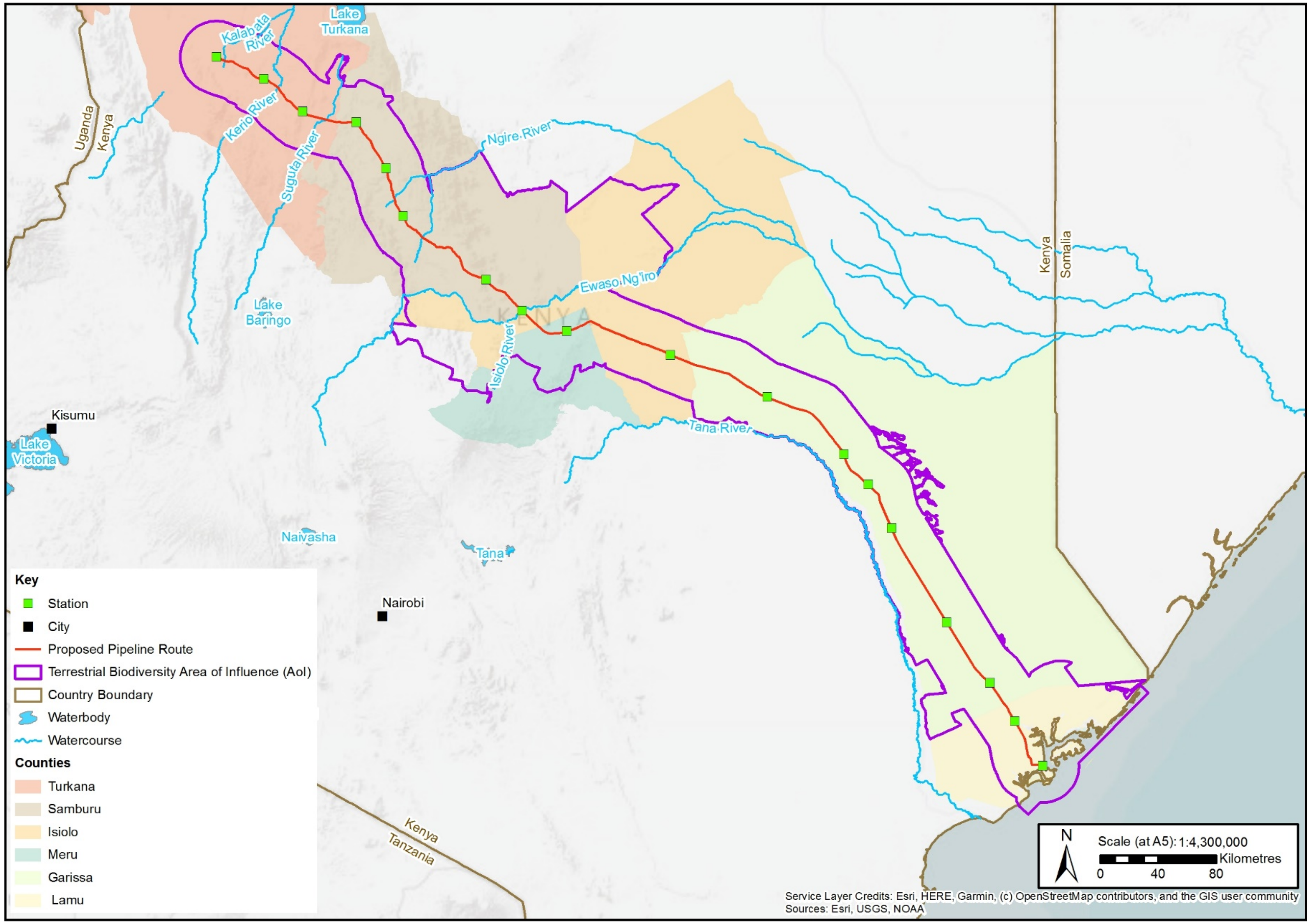


Figure 6.6-1:The terrestrial biodiversity AoI

6.6.3 Methods – Primary Data

Primary data sources included land cover mapping and classification for the AoI, and a seasonal field sampling programme. The field sampling programme occurred from June to November 2018 to encompass the long and short wet seasons, and covered vegetation and flora, invertebrates, herpetofauna, birds and mammals.

Vegetation and Flora

The data collected over two seasonally representative field sampling programmes was also used to verify the ecosystems and habitats identified in the area during the review of secondary data.

The flora and vegetation community baseline survey methods included the following:

- Description of plant communities. Spot sampling was used to compile an inventory of plant species (i.e. trees, shrubs, forbs, and grasses), and to characterise the vegetation communities;
- Searches for the presence of Kenyan-listed and IUCN Red-listed plant species, in particular: CR, EN, and VU species; CITES-listed species; other priority plant species listed by the Kenya Wildlife Service (KWS); regionally/locally endemic species, range-restricted species and species of local importance (including ethnobotanical importance); and any threatened vegetation communities;
- Identification of populations and distribution of invasive and pest plants; and
- The ecological integrity and extent of existing vegetation communities.

Invertebrates

Sampling methods included:

- Active, timed habitat searches and sweep net surveys conducted during the day at each survey location;
- Observational qualitative presence/absence surveys;
- Voucher specimens were retained for taxonomic purposes and deposited in the collection of the NMK.

Herpetofauna

The survey was focussed within the Project footprint, and adjacent areas within the AoI identified as being of high potential to support species of conservation concern.

- Active, timed habitat searches during the day at each sampling location;
- Voucher specimens were retained for taxonomic purposes, and deposited in the NMK collection; and
- Species were also recorded opportunistically.

Birds

Sampling focussed on each of the identified vegetation communities and habitats within the AoI to identify bird communities and populations:

- Point counts were done in areas of rugged terrain, densely vegetated habitats, and habitats that were heterogeneous or highly fragmented; and
- Data from targeted bird surveys was supplemented with incidental observations recorded by the ornithologist and from surveys targeting other taxonomic groups.

Bird species of conservation concern, and their respective habitat associations, were identified, to inform the biodiversity receptors to be used in the impact assessment phase.

Mammals

Surveys for mammals covered medium-large and small mammals (volent and non-volent), with different sampling techniques employed to cover the three different groups which included:

- A remote camera trapping operation;
- Interviews with local people were conducted throughout the AoI. Whenever the field team encountered local people during surveys, they were questioned on their knowledge of mammals observed in the area. This included gathering information on how often they had seen these animals, the most recent sighting of the animals, and any interesting observations. A pictorial field guide (Kingdon, 1997) was used to assist conversations;
- Tracks, droppings, hair and other field signs were evaluated in accordance with surveyor's experience to determine the presence of mammal species; and
- Searches of potential bat roosts were made, and bat detectors utilised to determine the potential presence of bat species.

Constraints

Access constraints were experienced during the June 2018 surveys south of Garissa. In addition, sections near Lamu, where the Project crosses an area near the Boni Forest, was also excluded due to security concerns. In addition, the viability of installing short-term traps, such as pitfalls, was established during the planning phase and when within the AoI. The ability to pitfall trap was often governed by security and access. Habitual movement of ecologists along the pipeline route was avoided to minimise security risks. By its nature, the habitual checking of pitfall traps over an extended period of time presents risks as previously described. As such, the availability of pitfall data is limited as described herewith.

6.6.4 Methods – Secondary Data

Expected Species & Communities

Expected species lists for the AoI were compiled using the sources:

- Potential natural vegetation of Eastern Africa (Van Breugel et. al., 2015);
- Global Biodiversity Information Facility (GBIF, 2019) https://www.gbif.org/;
- Integrated Biodiversity Assessment Tool (IBAT, 2019) https://ibat-alliance.org/;
- Map of Life species by location tool (MoL, 2019);
- National Museum of Kenya (NMK) herbarium records;
- Consultation with specialists in each of the specific disciplines; and
- Other published scientific studies, and historical and recent reports related to the Project and wider area.

6.6.5 Species of Conservation Concern

Using the expected species lists, a screening of the AoI was completed to identify species of conservation concern (SoCC) that could occur in the AoI that could interact with Project components.

The following attributes formed the basis of the screening:

- Globally threatened species: These include internationally recognised IUCN Red-Listed CR(EN) and Vulnerable (VU) species, as defined by the IUCN Red List guidelines;
- Nationally threatened species: These include species listed under the sixth schedule of the Kenyan Wildlife Conservation and Management Act (2013); priority species listed in the Kenya National Biodiversity Strategy and Action Plan (NBSAP) (Ministry of Environment and Natural Resources, 2000), and species identified by KWS as priorities for conservation action (KWS, 2017);
- Migratory/Congregatory species: Species listed on Appendix I and II of the Convention on Migratory Species (CMS), also known as the Bonn Convention. This convention, to which Kenya is a signatory, aims to conserve terrestrial, aquatic and avian migratory species throughout their range, and species whose individuals gather in large groups or colonies;
- Species listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES): As a signatory to the CITES convention, Kenya has obligations to protect species listed on Appendices I, II and III, from over-exploitation; and
- Restricted-range or endemic species: Restricted-range species are defined as species with global ranges (extent of occurrence (EOO) of 50,000 km^2 or less (Eken et al. 2004; Holland et al. 2012). For most terrestrial vertebrates (e.g. mammals, birds, reptiles and amphibians), and invertebrates (e.g. insects and arachnids), global ranges of 50,000 km^2 or less, are considered appropriate in global conservation practice (Eken et al. 2004). Thresholds for other invertebrates (particularly, aquatic and terrestrial molluscs) and aquatic species (e.g. fish) are typically set at 20,000 km^2 (Holland et al. 2012).

Species with the abovementioned attributes were identified using the following sources:

- IUCN (2018); and
- IBAT (2019).

6.6.6 Ecosystems of Conservation Concern

Ecosystems of importance to the public, government agencies, scientific community and Non-Governmental Organisations (NGOs)) occurring within the AoI were identified including:

- Internationally recognised sites of biodiversity importance, such as Important Bird Areas (IBA), Endemic Bird Areas (EBA), Key Biodiversity Areas (KBA), Ramsar sites, WWF Ecoregions;
- Nationally designated and protected areas, and other areas that may have specific conservation and management requirements, as set out in national Kenyan wildlife legislation and policy; and
- Important habitat types outside of protected areas, such as wetlands being crossed by the pipeline, or landscape features with importance in maintaining key ecological processes and functions needed to support and maintain important biodiversity attributes, such as forests forming ecological corridors between protected areas.

6.6.7 Primary Data – Field Survey Results

This section presents the results of the field surveys conducted during the June 2018 advanced field work and the October and November 2018 full field surveys.

6.6.7.1 Vegetation and Flora SoCC

A map showing the locations of vegetation sampling sites is provided as Figure 6.6-2 below. The field surveys confirmed six broad vegetation communities along the pipeline footprint:

- Acacia-dominated communities;
- Commiphora-acacia communities;
- Pristine forest communities;
- *Vachellia tortilis* woodland communities;
- Riparian communities; and
- Disturbed shrubland community.

The following descriptions relate to the likely SoCC habitat communities from the list above. Full descriptions for all communities are presented in Annex II of the ESIA.

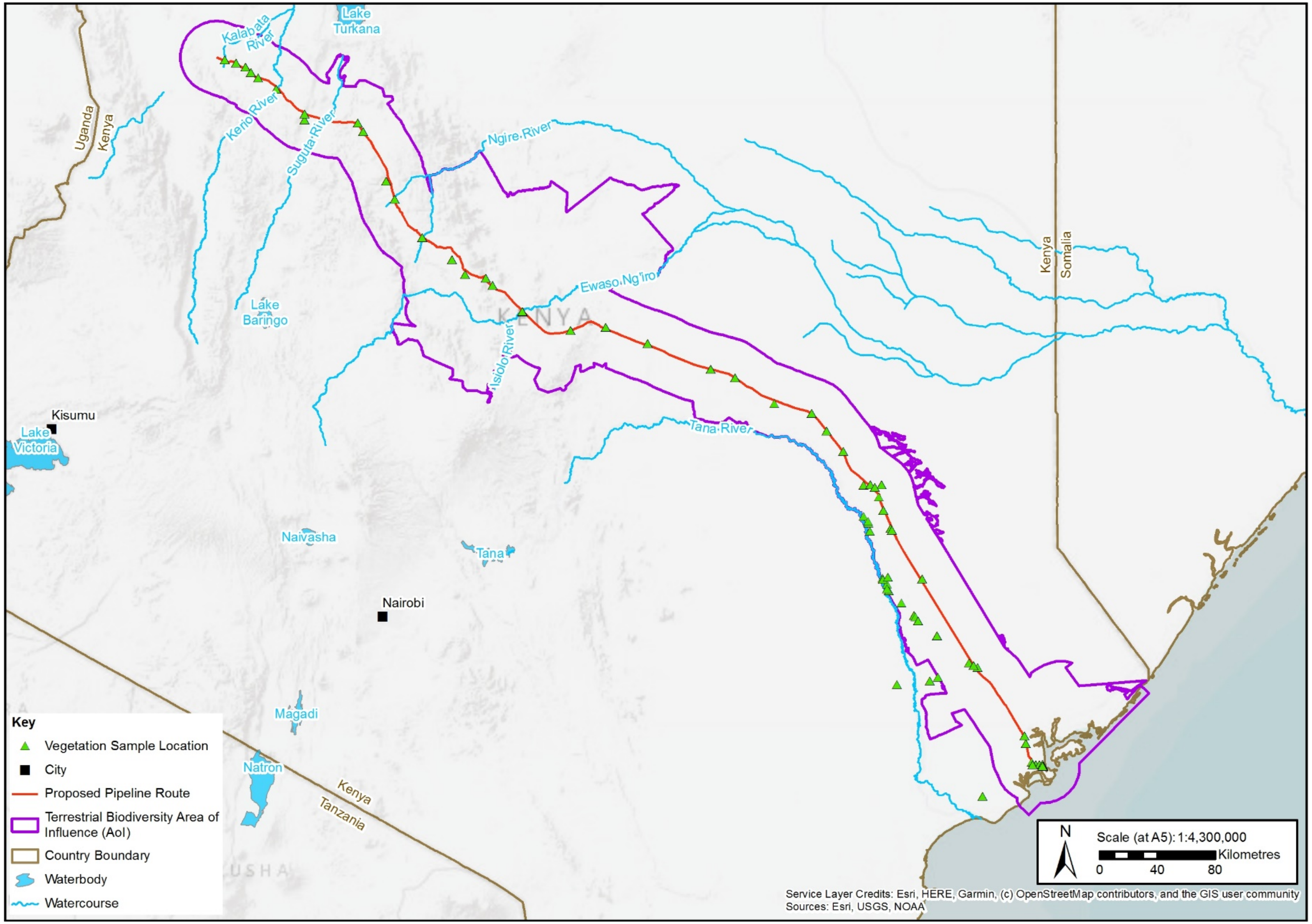


Figure 6.6-2: Vegetation and habitat community sampling locations within the AoI

Vachellia reficiens Shrubland Community

This vegetation community was recorded at locations in the Samburu and Turkana counties in the central and north-western portions of the Project footprint.

Forty-one plant species representing 22 families were recorded in this community. Six families contributed 51% of the overall plant species diversity, with the highest diversity recorded in the Fabaceae and Capperaceae (caper family) (Table 6.6-1).

Vachellia reficiens is the dominant plant species in this community. This hardy plant species usually grows in rocky areas in semi-desert and arid shrubland. It is an abundant dominant species of arid shrubland throughout Kenya.

Table 6.6-1:Most diverse plant families within the Vachellia reficiens vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	8	19.5
Capparaceae	4	9.8
Solanaceae	3	7.3
Acanthaceae	2	4.9
Amaranthaceae	2	4.9
Asparagaceae	2	4.9

6.6.7.1.1 Commiphora-Acacia Communities

This vegetation community was recorded at a single location in the central portion of the Project footprint in Isiolo County.

Three plant families contributed to 63.2% of the overall species diversity in this community (Table 6.6-2). Diversity was depauperate with 19 plant species recorded.

Commiphora baluensis was the dominant plant species in this vegetation community. This East African tree species occurs in Tanzania, Kenya and Ethiopia (POTW, 2019). It grows on rocky ground and can reach a height of 20 m.

Table 6.6-2: Most diverse plant families within the Commiphora dominated vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	4	21.1
Malvaceae	4	21.1
Poaceae	4	21.1

6.6.7.1.2 Pristine Forest Communities

This vegetation community was recorded at two locations in the eastern portion of the pipeline route and corresponds to the Coastal Mosaic vegetation community delineated by Van Breugel et. al. (2015).

A total of 67 plant species in 25 families were recorded in this vegetation community. Four (4) plant families contributed to 57% of the overall species diversity (Table 6.6-3). Nineteen (19) grass species were recorded in this community (Table 6.6-3).

Grass species recorded in this community included *Panicum maximum*, *Hyparrhenia filipendula*, *Heteropogon contortus* and three species of Eragrostis. Tree species observed during the field survey included *Combretum aculeatum*, *Dalbergia melanoxylon* and *Ziziphus mucronata*.

Table 6.6-3: Most diverse plant families within the Forest vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Poaceae	19	28.4
Fabaceae	8	11.9
Rubiaceae	6	9.0
Malvaceae	5	7.5

6.6.7.1.3 Riparian Vegetation Communities

These vegetation communities were recorded at various points in the northern half of the Project footprint and comprised the following sub-communities:

- Riparian gallery forest;
- Riparian heavily invaded by *Prosopis juliflora;*
- Riparian vegetation in grassland;
- Riparian scrubland;
- Riparian vegetation with sand dunes and *Hyphaene compressa*; and
- Riparian woodland.

Riparian gallery forest communities

This vegetation community was recorded at a site in the north of the Project footprint, west of Baragoi. Six plant families together contributed to 63% of the plant species diversity (Table 6.6-4). Nineteen plant species were recorded in this community.

Plant species recorded in this community included *Grewia tenax*, *Vachellia tortilis*, *Ziziphus mauritiana* and *Z. mucronata.*

Table 6.6-4: Most diverse plant families within the riparian gallery forest community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Amaranthaceae	2	10.5
Euphorbiaceae	2	10.5
Fabaceae	2	10.5
Malvaceae	2	10.5
Rhamnaceae	2	10.5
Solanaceae	2	10.5

Riparian heavily invaded by *Prosopis juliflora* Community

This vegetation community was recorded on the western bank of the Kerio River in the north-western portion of the Project footprint.

Seven plant families contributed to 71% of the plant species diversity (Table 6.6-5). The highest plant species diversity was recorded in the Asteraceae, Fabaceae and Poaceae families (Table 6.6-5). Twenty-four plant species were recorded in this community.

This community was characterised in part by the presence of *Prosopis juliflora*, a highly invasive weed from Mexico, South America and the Caribbean. Other invasive plant species recorded in this community included *Datura stramonium*, also from Mexico and *Tagetes minuta*, from South America. The presence of these invasive plant species is indicative of a high degree of anthropogenic disturbance at the site.

Native plant species recorded in this community included *Vachellia tortilis*, *Ficus sur* and *Lannea rivae*.

Table 6.6-5: Most diverse plant families within the riparian heavily invaded with *Prosopis juliflora* community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Asteraceae	3	12.5
Fabaceae	3	12.5
Poaceae	3	12.5
Amaranthaceae	2	8.3
Capparaceae	2	8.3
Euphorbiaceae	2	8.3
Solanaceae	2	8.3

Riparian vegetation in grassland community

This vegetation community was recorded in the central portion of the Project footprint where the corridor passes through Meru county.

Twenty plant families were recorded at this site, but four families contributed 50% of the plant species diversity (Table 6.6-6). Thirty-two plant species were recorded at this site including *Balanites aegyptiaca*, *Boscia coriacea*, *Combretum aculeatum*, *Croton dichogamus* and *Diospyros scabra.*

Table 6.6-6: Most diverse plant families within the riparian vegetation in grassland community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	6	18.8
Capparaceae	4	12.5
Malvaceae	4	12.5
Anacardiaceae	2	6.3

Riparian vegetation with sand dunes and *Hyphaene compressa* community

This vegetation community had a limited extent and was only recorded at a single site in the Suguta valley in the north of the Project footprint. Plant species diversity in this community was low and comprised of seven families and eight species, including the alien invasive weed *Prosopis juliflora.*

This community was characterised by the presence *Hyphaene compressa*, the East African doum palm. This plant species is abundant and widespread in East Africa and is a vital socioeconomic resource for rural pastoralists and agro-pastoralists (Cosiaux et al., 2017).

Riparian woodland community

This vegetation community was recorded at locations in the far north-west of the Project footprint in Turkana county as well as in the central part of the corridor in Isiolo county.

Twenty-seven plant families and 67 plant species were recorded in this community. Nine plant families contributed 66% of the plant species diversity (Table 6.6-7). The most diverse plant families were Fabaceae and Poaceae with 10 and 6 species respectively (Table 6.6-7).

Abundant plant species in this community included: *Salvadora persica*, *Acalypha indica*, *Calotropis procera*, *Cordia sinensis*, *Grewia tenax*, *Solanum coagulans*, *Vachellia reficiens* and *Vachellia tortilis.*

Table 6.6-7: Most diverse plant families within the riparian woodland vegetation community along with the percentage contribution of each to the overall diversity

Family	Number of species	% contribution
Fabaceae	10	14.9
Poaceae	6	9.0
Solanaceae	6	9.0
Amaranthaceae	5	7.5
Apocynaceae	5	7.5
Acanthaceae	3	4.5
Cleomeaceae	3	4.5
Malvaceae	3	4.5
Salvadoraceae	3	4.5

6.6.7.1.4 Plant Species of Conservation Concern (SoCC)

The SoCC encompasses two aspects, firstly, non-native plant species that pose a threat to indigenous vegetation communities and ecosystems due to their potential for encroachment. Secondly, native plant species that are of conservation concern because they are at risk of extinction due to anthropogenic impacts.

Non-Native Invasive Species

The list of recorded plant species was evaluated against a database of alien invasive plant species known to occur in Kenya (GISD, 2019). Seven invasive plant species were recorded during the surveys (Figure 6.6-10). Invasive plant species were primarily recorded in riparian vegetation communities, with a few also recorded in acacia-dominated vegetation communities (Figure 6.6-10).

Common Prickly Pear (*Opuntia vulgaris*) is native to South America but has been translocated globally as a source of fruit and fodder (GISD, 2019; CABI, 2019). It is a large, spiny tree-like cactus that has a tendency to spread rapidly via seed and from broken cladodes (‘leaves’ or pads), forming impenetrable thickets that crowd out native plants and forage species and restrict the movement of people and livestock (CABI, 2019). Common Prickly Pear was recorded in the riparian woodland at a site in the central region of the Project in the vicinity of Archer’s Post.

Jimsonweed (*Datura stramonium*) is an annual herb that reaches up to 2 m in height. It originated from tropical America and now has a global footprint (CABI, 2019). It competes aggressively with native plants and crops, forming dense monospecific stands. Jimsonweed was recorded in riparian vegetation communities at sites in the central and northern portions of the Project footprint.

Mesquite (*Prosopis juliflora*) is native to Colombia and Venezuela. It has shown itself to be a very aggressive invader, especially in frost-free arid and semi-arid natural grasslands. This has led to the declaration of Mesquite as an invasive and/or noxious weed in many African countries notably Kenya, Ethiopia and Sudan, Pakistan and other Asian countries, and in Australia and South Africa (CABI, 2019). Environmental disturbances typically caused by humans, such as over-grazing and increased bush fire rates (due to poor land management), stimulate Mesquite growth and aggravating its impacts (GISD, 2019). It has been shown that this plant promotes the transmission capacity of the malaria parasite by providing the *Anopheles* mosquitoes with sugar during dry periods when sugar sources from native plant species are largely unavailable (Muller et al., 2017). Mesquite was recorded in riparian vegetation communities and the *Vachellia reficiens* shrubland community at sites in the central and northern portion of the Project footprint. Eradication of Mesquite has proven to be extremely difficult or impossible once it has become established (GISD, 2019).

Bristly Foxtail (*Setaria verticillata*) in an invasive grass species that originated in Europe (GISD, 2019). It is often listed as one of the two or three most important weeds in a wide range of crops, within and outside its native range, and it can also become dominant in grassland (CABI, 2019). Bristly Foxtail has inflicted considerable environmental and economic costs in regions it has invaded (GISD, 2019). This species was recorded at sites in acacia woodland vegetation communities in the eastern portion of the Project footprint in Garissa country.

Bitter Apple (*Solanum campylacanthum*) is a small evergreen herbaceous shrub that originated in Africa, the Middle East and India. It is listed as introduced and invasive in Kenya (CABI, 2019). It typically grows in disturbed areas, such as roadsides and can form dense stands, to the detriment of native plants (CABI, 2019). The unripe fruits are toxic to livestock (CABI, 2019). Bitter Apple was recorded in riparian, acacia and disturbed shrubland vegetation communities in the central, northern and far eastern portions of the Project footprint.

Stinking Roger (*Tagetes minuta*) is an erect, woody annual herb with strongly odorous foliage (CABI, 2019). It originated in South America, and has been deliberately distributed across the tropics, subtropics and several temperate countries as an ornamental, medicinal or perfume plant as well as accidentally as a weed (CABI, 2019). Stinking Roger is primarily a weed of cultivated and disturbed areas.

The origin of Common Cocklebur (*Xanthium strumarium*) is uncertain but believed to be Central and South America. It is an annual much-branched herb that rapidly forms large stands, displacing other plant species (CABI, 2019). It is a major weed of row crops such as soybeans, cotton, maize and groundnuts in many parts of the world, including North America, southern Europe, the Middle East, South Africa, India and Japan (CABI, 2019). Common Cocklebur was recorded at a site in the dwarf acacia shrubland vegetation community in the far north-west of the Project footprint.

Table 6.6-8: Alien invasive plant species recorded along the Project footprint along with the vegetation communities they were recorded in

Family	Species	Vegetation Community
Cactaceae	*Opuntia vulgaris*	Riparian woodland
Solanaceae	*Datura stramonium*	Riparian woodland
		Riparian scrubland
		Riparian heavily invaded by *Prosopis juliflora*
Leguminosae	*Prosopis juliflora*	Riparian vegetation with sand dunes and *Hyphaene compressa*
		Vachellia reficiens shrubland
		Riparian woodland
		Riparian scrubland
		Riparian heavily invaded by *Prosopis juliflora*
Poaceae	*Setaria verticillata*	Acacia woodland/shrubland
Solanaceae	*Solanum campylacanthum*	Riparian scrubland
		Broadleaf woodland community
		Vachellia reficiens shrubland
		Riparian scrubland
		Acacia woodland/shrubland
		Disturbed shrubland community
Asteraceae	*Tagetes minuta*	Riparian scrubland
		Riparian heavily invaded by *Prosopis juliflora*
Asteraceae	*Xanthium strumarium*	Dwarf acacia shrubland

Whilst not recorded during baseline surveys Bitterweed (*Parthenium hysterophorus*), a native of Central America is spreading within East Africa. This species has been recorded in coffee plantations around Kiambu and Nyeri districts, around Nairobi city, Kajiado and Naivasha. Recent reports indicate that, *P. hysterophorus* has spread into Masai Mara and the Lake Victoria basin in Uganda and Kenya. This species is particularly virulent, the plant is unpalatable to livestock so its invasion results in grazing shortages. It also produces allelopathic substances that deters other plants from germinating and growing near it, as such it can quickly out compete native grassland species[1].

[1] https://keys.lucidcentral.org/keys/v3/eafrinet/weeds/key/weeds/Media/Html/Parthenium_hysterophorus_(Parthenium_Weed).htm Accessed 01/08/19

Native Species of Conservation Concern

Eight IUCN listed plant species were recorded during the baseline surveys:

- *Afrocanthium kilifiense* is a shrub or small tree that is confined to areas of dry lowland forest and *Brachystegia* woodland in Kenya. It is listed as VU by the IUCN due to the continuing degradation of lowland forest and woodland habitats associated with coastal development and small-scale agriculture (IUCN, 2019). During baseline surveys this plant species was recorded in the pristine forest vegetation communities in the far east of the Project footprint;
- *Eragrostis perbella* is a VU grass species that occurs in Kenya, Somalia and Tanzania (POTW, 2019). It grows in coastal bushland, woodland and grassland and during the baseline was only recorded in the pristine forest vegetation community in the east of the AoI. Along the Kenyan coast this species is threatened by mining activities and loss of habitat due to agriculture (IUCN, 2018);
- *Blepharis turkanae* is listed as VU by the IUCN (IUCN, 2018). This species was recorded in the far west of the Project footprint west of the Suguta Valley;
- *Uvaria kirkii* is a scrambling shrub that grows in coastal bushland, scrub, thickets, grassland, *Brachystegia* woodland, lowland forest and Hyphaene savanna along the African east coast (IUCN, 2019). It is listed as NT and threats include ecosystem conversion and degradation associated with coastal development and small-scale agriculture (IUCN, 2019). This plant species was only recorded in the pristine forest vegetation community in the far eastern extent of the Project footprint;
- *Dalbergia melanoxylon* is listed as NT in the IUCN Red list (IUCN, 2018). This species was recorded at two sites in the far eastern portion of the AoI;
- *Dialium orientale* is listed as NT in the IUCN Red list (IUCN, 2018). This species was recorded at two sites in the far eastern portion of the AoI in the vicinity of Lamu Port;
- *Senegalia thomasii* is a small tree or shrub endemic to the southern and central parts of Kenya (GBIF, 2018). Based on historical records, the core of its distributional range is situated in the south of Kenya just north of Kilimanjaro and the Tanzania border (Figure 6.6-3). Outliers have been recorded to the north, east and west of this core range. A second disjunct population core occurs in the central part of the country and overlaps with the AoI and Project footprint (Figure 6.6-3). The EOO of these two core areas amounts to 17,472 km^2 therefore qualifying this species for CH status in terms of Criterion 2, however, the presence of outliers suggests that its actual EOO could be significantly larger. *S. thomasii* was recorded at two sites along the pipeline route, the first at Sware in Samburu County and at Kachiuru in Meru County. Both records were in riparian vegetation communities; and
- *Aloe deserti* is a small succulent shrub that grows on sandy and stony soil in dry *Acacia* woodland and at the edge of deciduous thickets (IUCN, 2018). Its range is restricted to the southern and central parts of Kenya and north-eastern Tanzania (GBIF, 2019). Based on historical records, the core of this species distributional range is situated in the south of Kenya north of the Tanzania border but also extending into the northern part of Tanzania. No previous records exist of this species within the AoI. *A. deserti* was recorded at two sites along the Project footprint. At Nachola in the north of the Project footprint *A. deserti* was recorded in the broadleaf woodland vegetation community. At Archer's Post *A. deserti* was recorded in riparian scrubland along the Ewaso Ng'iro River. The baseline survey records of this species within the AoI represent a considerable range extension. The IUCN gives the EOO of this species as 53,481 km^2 (IUCN, 2018). Calculation of its EOO based on historical records obtained from GBIF (2019) put its EOO at 52,700 km^2.

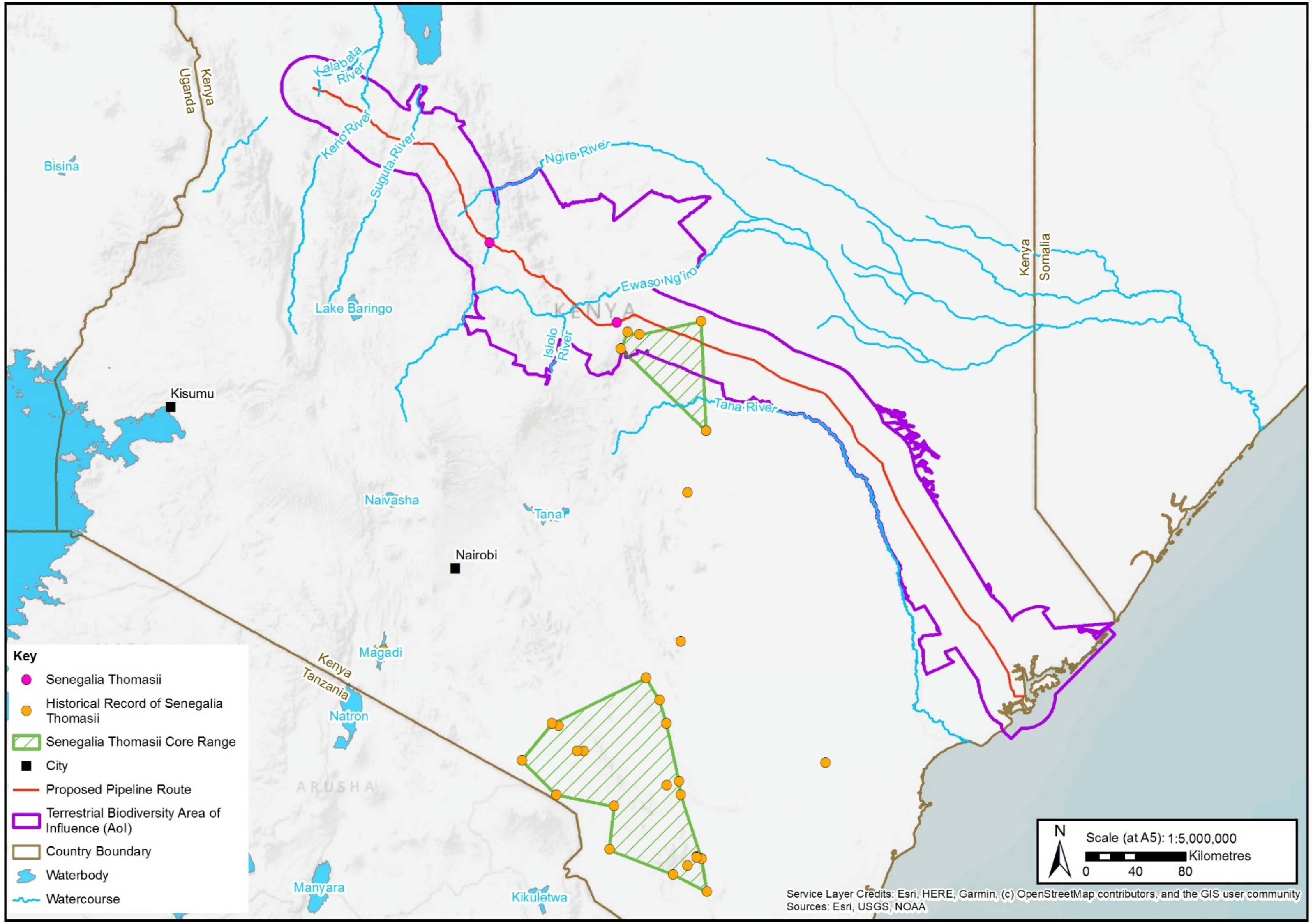


Figure 6.6-3: Senegalia thomasii distributional range

6.6.7.2 Birds

A map showing the location of the bird sampling sites is provided in Figure 6.6-4 below.

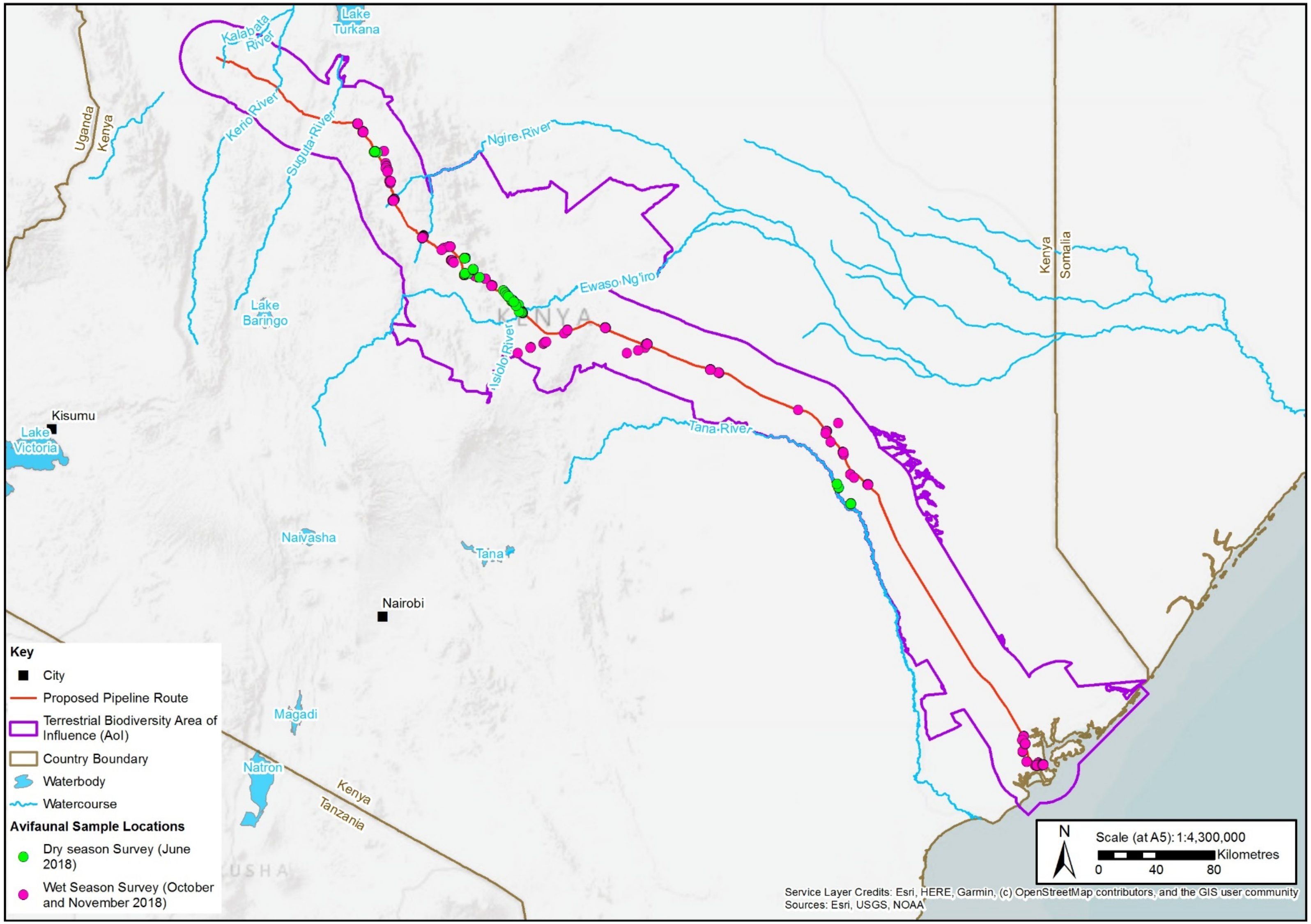


Figure 6.6-4: Avifauna sampling sites within the AoI

Two hundred and thirty-five bird species were recorded along the proposed pipeline route. This represents 21% of the 1100 bird species expected in Kenya (EANHS, 2009).

A breakdown of the number of species recorded per survey is listed below:

- June 2018 survey: 114 species; and
- October & November 2018 survey: 182 species.

A full list of bird species recorded during the baseline biodiversity assessment is provided in Annex II.

6.6.7.2.1 Bird Species of Conservation Concern

The secondary data search identified 69 bird SoCC expected to occur in the AoI. Of these, eight SoCC were confirmed during the biodiversity baseline surveys.

Steppe Eagle (*Aquila nipalensis*) is listed as EN in the IUCN Red List and was recorded at three sites in the AoI during the dry season field survey. This migratory species breeds in Eastern Russia and overwinters in parts of eastern and southern Africa (IUCN, 2018). The primary threat facing the Steppe eagle is loss of habitat both in its breeding and overwintering habitats, secondary threats include impacts with transmission lines, hunting and persecution and pollution (IUCN, 2018).

White-backed Vulture (*Gyps africanus*) has a widespread, but shrinking distribution across Sub-Saharan Africa (IUCN, 2018). Threats to this species include loss of wild ungulates leading to a reduced availability of carrion, hunting for trade, persecution, electrocution on transmission lines and poisoning (IUCN, 2018). This species was recorded at three sites in the central portion of the Project footprint between Garba Tula and Swari during both baseline surveys.

Hooded Vulture (*Necrosyrtes monachus*) occurs primarily in southern, eastern and western Africa (IUCN, 2018). Its distributional range is decreasing due to non-target poisoning, capture for traditional medicine and bushmeat and direct persecution (IUCN, 2018).

Migratory species were also recorded namely Pallid Harrier (*Circus macrourus*), European Roller (*Coracias garrulus*), Semi-collared Flycatcher (*Ficedula semitorquata*) and Spur-winged Lapwing (*Vanellus spinosus*).

Somali Ostrich (*Struthio molybdophanes*) was recorded at two locations during the dry season survey. Somali Ostrich is an arid adapted species that occurs in north-east Africa, with its range incorporating Ethiopia, Somalia, Djibouti and Kenya (IUCN, 2018). Threats to this species include over harvesting of both adults and eggs as well as degradation of its habitats (IUCN, 2018). Figure 6.6-5 shows the location of observations of bird SoCC during both surveys.

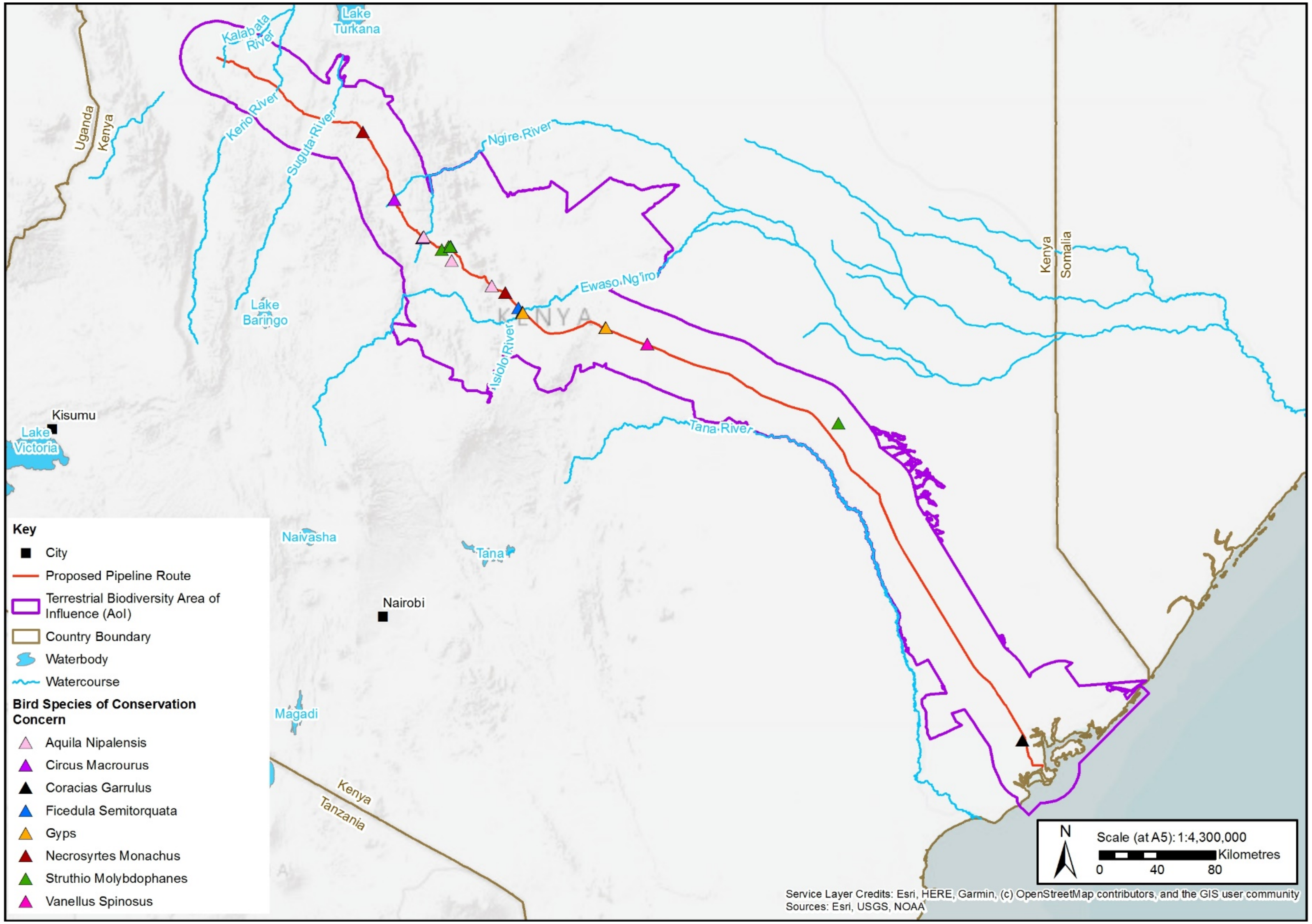


Figure 6.6-5: Bird species of conservation concern (SoCC).

Although bird SoCC were observed widely across the Project footprint, including in the vicinity of the port in the east of the AoI, observations were concentrated in an area between Archers Post and Baragoi. European roller was the only bird SOCC which was not recorded at least once in this area.

Figure 6.6-5 also shows the high density of bird SoCC in the area of the Project footprint between Archers Post and Baragoi in the north.

6.6.7.3 Mammals

A map of the mammal sampling locations is provided in Figure 6.6-6 below.

Based on the literature review 170 mammal species are expected to occur in the AoI. Eighty-four mammal species were recorded over the course of the Jun 2018 and Oct and Nov 2018 baseline field surveys representing 49.4% of the expected mammal diversity.

A breakdown of the number of species recorded per survey is listed below:

- June 2018 survey: 19 species; and
- October and November 2018 survey: 83 species.

Guenther's Dik-dik (*Madoqua guentheri*) and Spotted Hyaena (*Crocuta crocuta*) were the most widely recorded species within the AoI and were both recorded at 13 locations over the course of two surveys. Cape hare (*Lepus capensis*) was recorded at 12 locations over the course of the two baseline surveys.

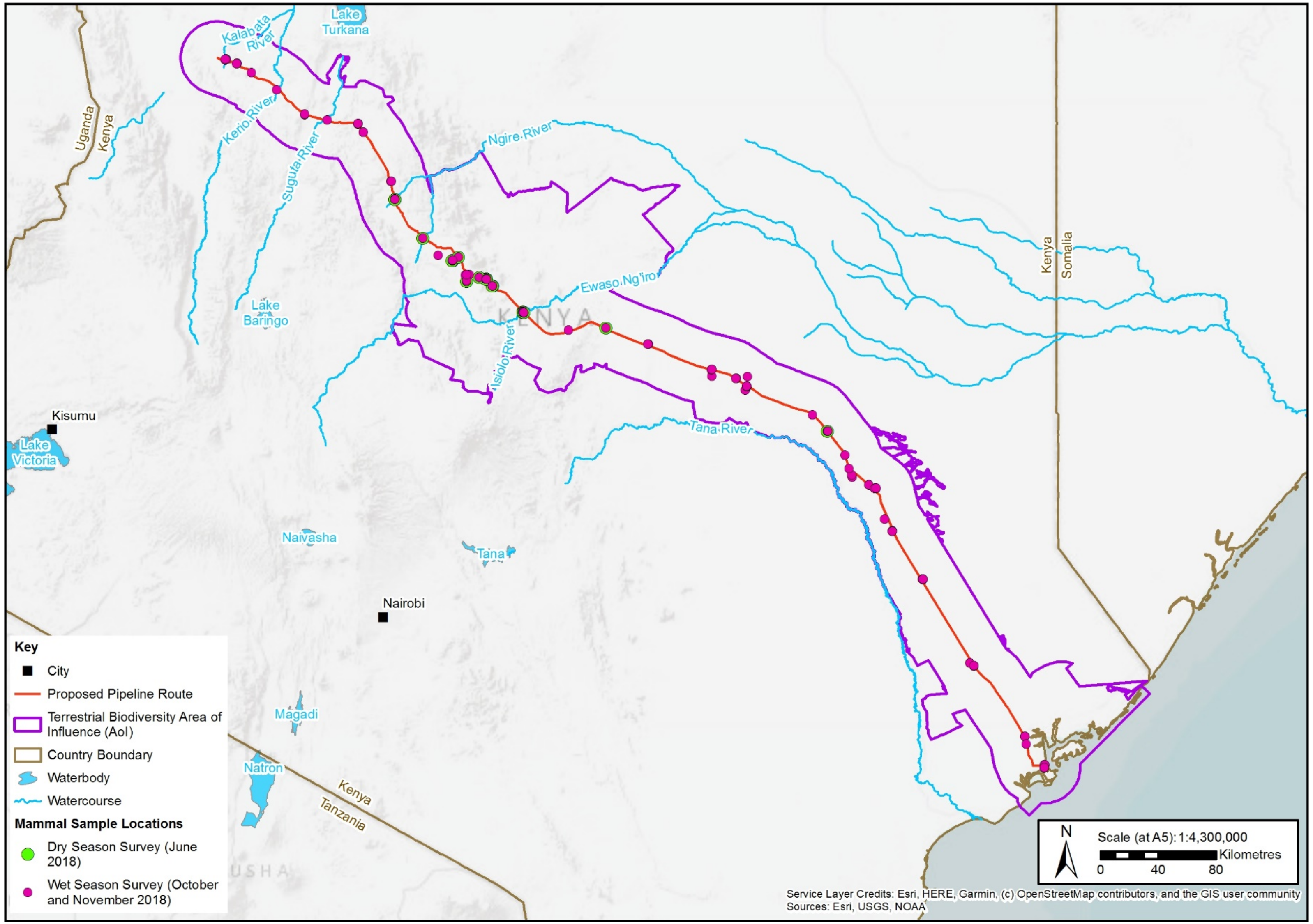


Figure 6.6-6: Mammal sampling locations

Thirty-five species were only recorded at a single location over the course of the two baseline field surveys (Table 6.6-9). These species may occur in low densities within the AoI or may represent cryptic species that are difficult to detect.

Table 6.6-9: List of mammal species only recorded at a single location over the course of two baseline surveys

Common name	Species
Cheetah	*Acinonyx jubatus*
Impala	*Aepyceros melampus*
Neumann's grass rat	*Arvicanthis neumanii*
African grass rat	*Arvicanthis niloticus*
Bushy-tailed Mongoose	*Bdeogale crassicauda*
Sokoke Dog Mongoose	*Bdeogale omnivora*
Hirola	*Beatragus hunteri*
Large headed forest shrew	*Crocidura grandiceps*
Greater gray-brown musk shrew	*Crocidura luna*
Unidentified Musk shrew	*Crocidura sp. 3*
Unidentified Musk shrew	*Crocidura sp nov*
Unidentified Musk shrew	*Crocidura sp.1*
Unidentified Musk shrew	*Crocidura sp. 2*
Common tsessebe	*Damaliscus lunatus*
Wahlberg's epauletted fruit bat	*Epomophorus wahlbergi*
Somali bushbaby	*Galago galarum*
Kenya coast galago	*Galagoides cocos*
Slender mongoose	*Herpestes sanguineus*
Common hippopotamus	*Hippopotamus amphibius*
White-tailed mongoose	*Ichneumia albicauda*
Zorilla	*Ictonyx striatus*
Side-striped jackal	*Canis adustus*
Suni	*Neotragus moschantus*
Klipspringer	*Oreotragus oreotragus*
East African oryx	*Oryx beisa*
Bat-eared fox	*Otocyon megalotis*
Northern greater galago	*Otolemur garnettii*

Common name	Species
Lion	*Panthera leo*
Ochre bush squirrel	*Paraxerus ochraceus*
Four-toed elephant shrew	*Petrodromus tetradactylus*
Flat-headed bat	Platymops sp
Golden-rumped elephant shrew	*Rhynchocyon chrysopygus*
Shrews	*Suncus sp*
Emin's gerbil	*Taterillus c.f. emini*
Greater kudu	*Tragelaphus strepsiceros*

6.6.7.3.1 Mammal Species of Conservation Concern

Based on the literature review 39 mammal SoCC are expected to occur in the AoI. Of these, sixteen were recorded during the baseline surveys (Table 6.6-9) including Striped Hyaena (*Hyaena hyaena*) Figure 6.6-7.

Figure 6.6-7: Striped hyaena. Photographed from a camera trap within the AoI.
Courtesy of Bernard Agwanda.

Table 6.6-10: Mammal SoCC recorded during the baseline surveys

Scientific Name	Common Name	Conservation Status					Site
		Kenya	IUCN Red List	CMS	CITES	Other	
Bdeogale omnivora	Sokoke Dog Mongoose	-	VU	-	-	-	Mrand Lam_b
Beatragus hunteri	Hirola	CR	CR	-	-	-	Ruq Ija_b
Cephalophus adersi	Ader’s Duiker	CR	VU	-	-	-	Bar Lam_b Mrand Lam_b Lamu Port_b
Crocidura sp. (new)	White-toothed Shrew	-	-	-	-	-	Sugu_b
Equus grevyi	Grevy's Zebra	EN	EN	I	I	-	Basa_b West_b Wamb_b Lest_b
Galagoides cocos	Kenya Coast Galago	-	LC	-	II	-	Kili Lam_b
Gerbillus cosensis	Cosens's Gerbil	-	DD	-	-	-	East of Kala_b Maru_b Sugu_b
Rhynchocyon chrysopygus ssp. Mandelai (new)	Golden-rumped Sengi	-	EN	-	-	-	Bar Lam_b
Hyaena hyaena	Striped Hyaena	EN	NT	-	III		Naku_b Sugu_b Rahol_b
Loxodonta africana	African Elephant	EN	VU	II	I/II	-	Uaso East_b Namu_b West_b
Lycaon pictus	African Wild Dog	EN	EN	II	-	-	Ruq Ija_b

Scientific Name	Common Name	Conservation Status					Site
		Kenya	IUCN Red List	CMS	CITES	Other	
Oryx beisa	Beisa Oryx	-	EN	-	-	-	Sank_b
Otolemur garnettii	Garnett's Greater Galago	-	LC	-	II	-	Kili Lam_b
Panthera leo	Lion	EN	VU	II	I/II	-	Garb_b
Panthera pardus	Leopard	EN	VU	II	I	-	Uaso Nyi_b Uaso East_b Garb_b Bur East_b Mrand Lam_b
Acinonyx jubatus	Cheetah	EN	VU	II	I	-	Uaso Nyi_b Uaso East_b Garb_b Bur East_b Mrand Lam_b

Baseline survey within the AoI considered the presence or indeed likely absence of the critically endangered Hirola (*Baetrugus hunter)* in Garissa County which was once a stronghold for this species. Anecdotal evidence provided by local herdsmen indicated that Hirola were not just confined to the Ishaqbini Hirola Conservancy which is in effect a restricted (fenced) conservancy. The herdsmen indicated that a herd of Hirola exist some 5 km from the Project footprint. However, despite efforts to locate the herd or indeed any physical evidence such as dung from this species, none was found.

Whilst the Project is technically within the extant natural range for this species the remaining population outside of the Ishaqbini Community Conservancy is likely to be virtually extinct. Indeed, surveys in 2011 suggested a population of 402-466 animals (ca 280-330 mature individuals) within their natural range (King et al. 2011). However, numbers have fallen steadily since; few if any remain in Arawale National Reserve. The population in Ishaqbini Community Conservancy outside the predator-proof sanctuary fell from 152 in 2008 to 63 in 2016, though some of this decline is accounted for by the 48 animals transferred into the sanctuary: these had increased to 97-103 in February 2016 (King et al. 2016).

The total population is now likely to contain <250 mature individuals. Consultation with the Hirola Conservation Program and review of the Abdullahi (2019) report indicates that one of the biggest threats to Hirola conservation is the spread of the invasive and alien *Acacia reficiens* tree which has transitioned former open grassland habitats into scrubby bare ground mosaic habitats of little conservation value. Habitat restoration for reducing fragmentation, and semi-captive breeding have been high on the list in efforts to recover the ailing population of Hirola. Sanctuary-bred Hirola are to be released in their historic range that includes current areas that form part of the AoI (Abdullahi, 2019).

The endangered Grevy's Zebra (*Equus grevyi*, Figure 6.6-8 and Figure 6.6-9 below)) are known within the AoI. Kenya supports approximately 90% of the global population of Grevy's Zebra (KWS, 2012). Furthermore, habitat in and around the Wamba region is recognised as providing 'core' habitat for foaling and weaning (KWS, 2012). Within the Wamba and Samburu areas a number of Grevy's watering holes and nursery habitat were identified.

African Elephant (*Loxodonta africana,* Figure 6.6-10 below*))* hold large migratory territories within the AoI. Elephants, and signs of elephant were recorded in many areas of the mid and upper Project AoI. The Ewaso Ng'iro provided a number of records of elephant as the river offers feeding and dispersal opportunities into the broader region. Elephant herds contained elder and juvenile individuals indicating that successful breeding and hierarchical development is being facilitated.

Baseline surveys within the Suguta valley were assisted by the use of helicopter to enable biodiversity experts to access areas otherwise impossible on foot or 4-wheel drive vehicle. SoCC mammals recoded in the Suguta valley included Cheetah (*Acinonyx jubatus)* (Figure 6.6-11) and Striped Hyaena.

Figure 6.6-8: Male Grevy's Zebra holding territory at Westgate Conservancy within heavily grazed sub-optimal habitat

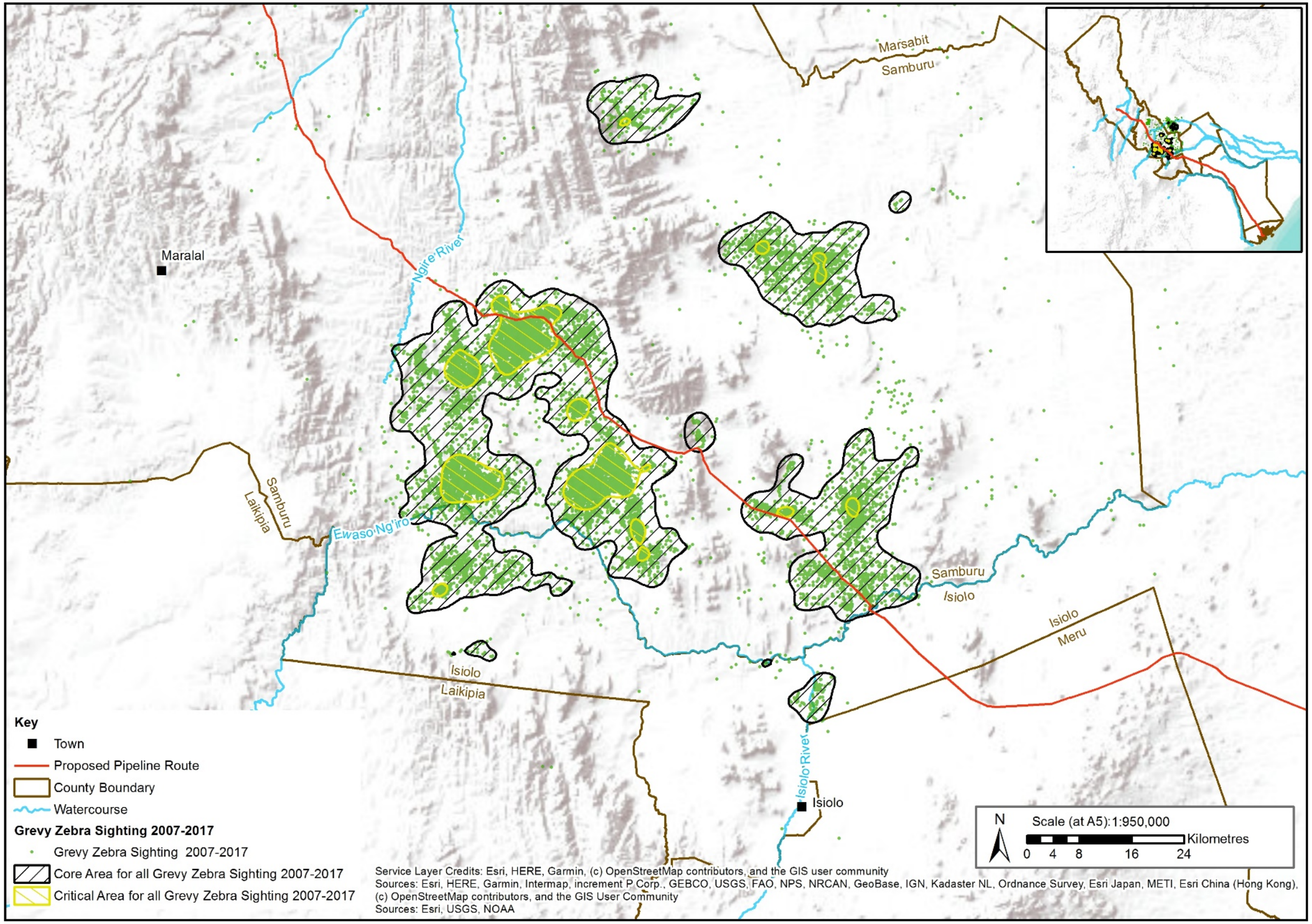


Figure 6.6-9: Grevy Zebra sighting locations

Figure 6.6-10: Elephant moving between Buffalo Springs and Shaba

Figure 6.6-11: Cheetah photographed from a helicopter in the Suguta Valley.
Courtesy of Bernard Agwanda.

Biodiversity Connectivity

Field survey, desk study and consultation with local experts and NGO's has revealed an ecological network of connectivity for medium and large mammals. A review of the KWS report on Wildlife Corridors and Dispersal Areas authored by Ojwang et al (2017) was a key source of information.

Elephants are migratory, and part of this region's population is known to move onto the Laikipia plateau at the beginning of the dry season, and then to disperse northward to pastoralist areas in Samburu, a distance of more than 100 km, with the advent of the short rains (Ojwang et al, 2017).

Consultation with local expert Bernard Agwanda of National Museum of Kenya (NMK) revealed that elephant dispersal routes occur between Maralal (West of Wamba) toward the Matthews Range. Seasonal preference for dispersal along these routes is understood to be during December to February and May to July. In addition, and notably, elephants also use dispersal habitat between Samburu and Matthews Range on the border of the Kalama and Namunak Conservancy (ref. 1772867.553.207, Biodiversity Baseline, Annex II) and as shown in Figure 6.6-12. This figure shows areas of habitual movement marked as blue dots in the Figure below.

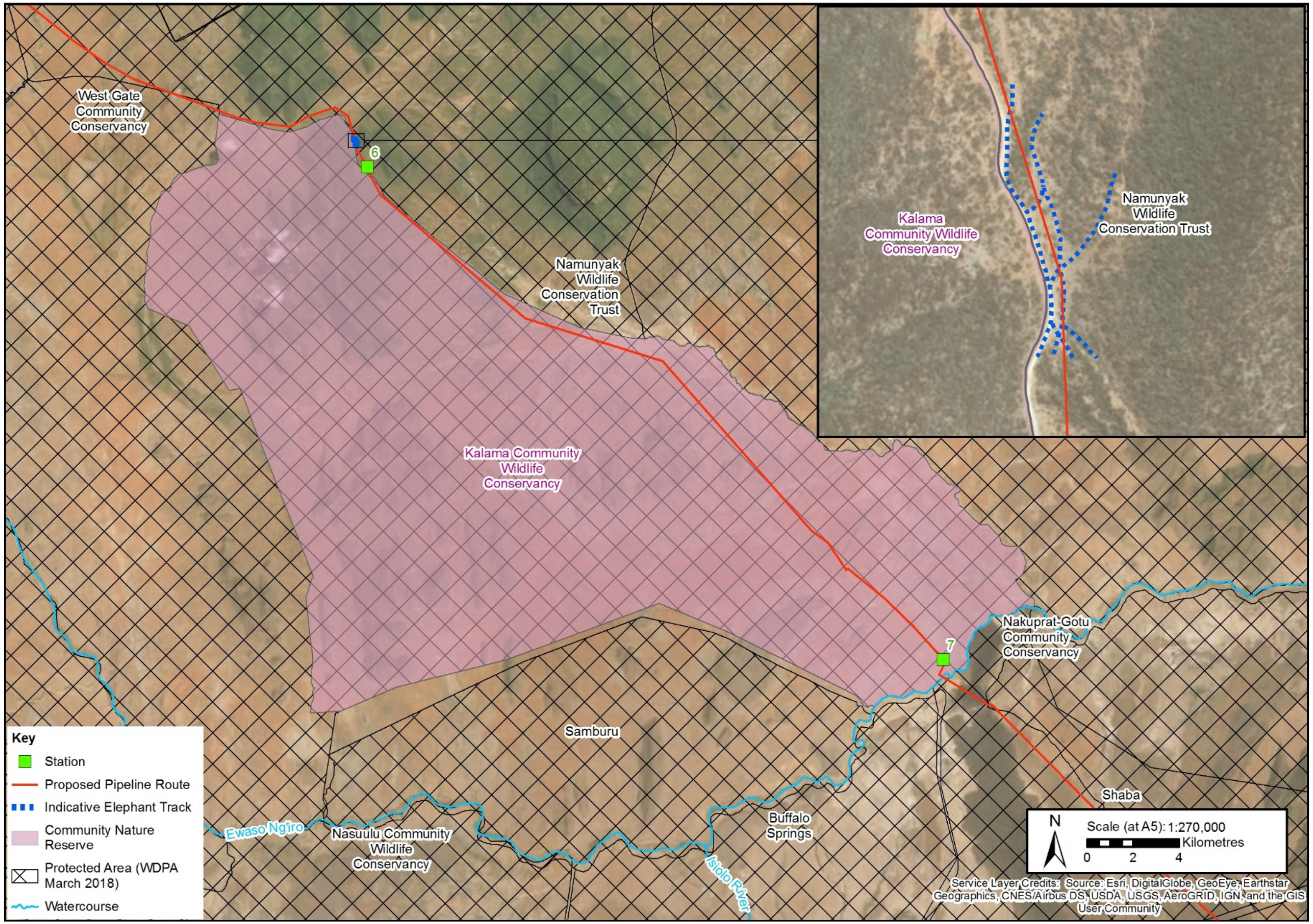


Figure 6.6-12: Elephant tracks and field signs on the border of the Kalama and Namunyak Conservancy

In addition, Grevy's Zebra are understood to disperse from their Samburu stronghold to the North West in the direction of Mlima Blue and toward Sibiloi some distance away. Similarly, African Wild Dog (*Lycaon pictus*) a species listed as endangered under Kenyan legislation is also known to habitually use dispersal areas around Samburu and within Kalama Conservancy. Specifically, when this species moves between Samburu, Kalama or West Gate and Namunyak Wildlife Conservancy (Ojwang et al., 2017).

The movement of mammal species within these areas are indicative of seasonal dispersal and more ad hoc movements triggered by requirements to reach other habitats, which may include protected areas such as Matthews Range or West Gate, or disturbance factors such as pressure from pastoralists grazing livestock.

6.6.7.4 Reptiles and Amphibians

Figure 6.6-13 shows the location of reptile and amphibian sampling sites.

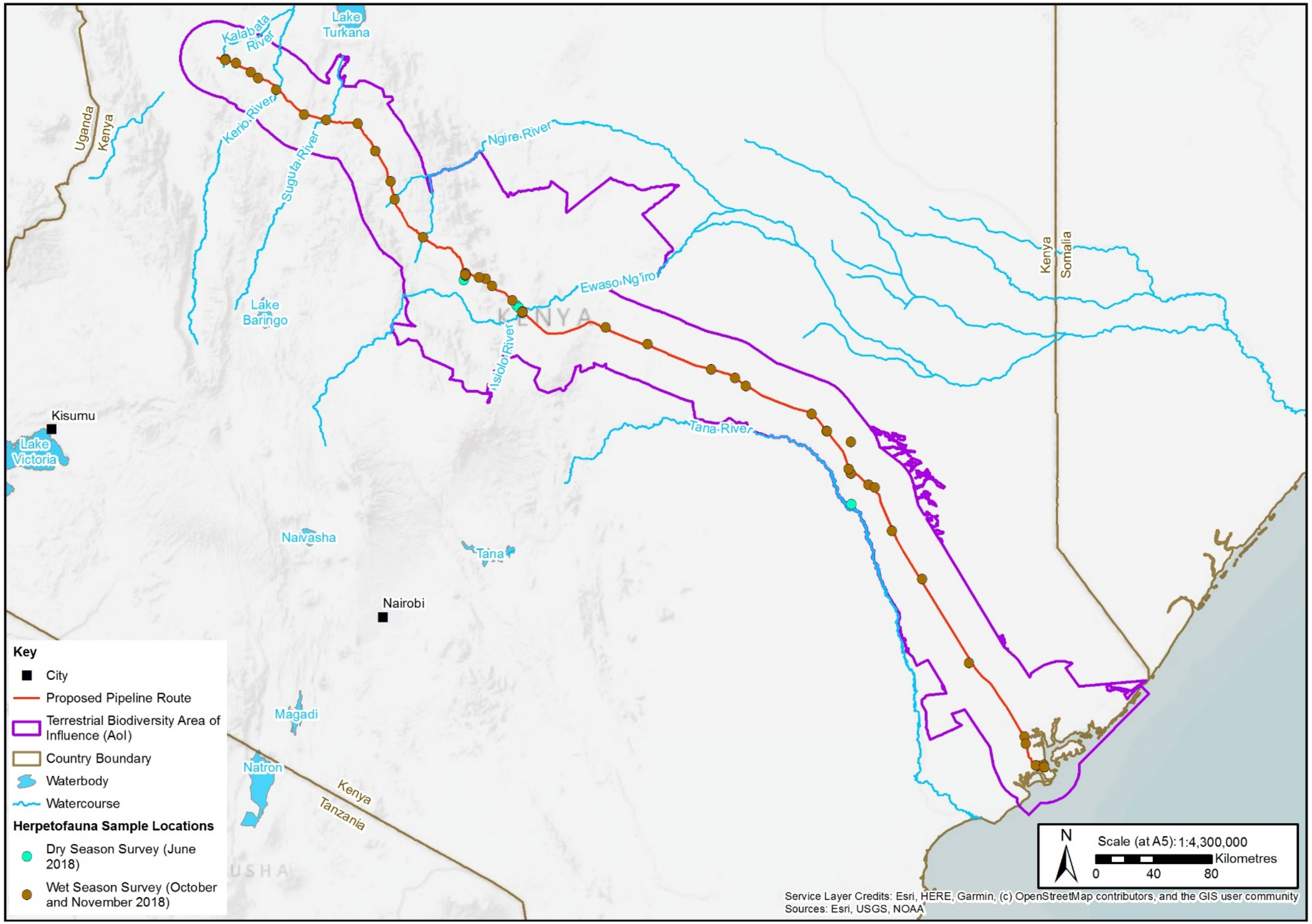


Figure 6.6-13: Reptile and amphibian sampling locations

Fifty-nine species were recorded within the AoI (44 reptile species, and 15 amphibian species). A full list of herpetofauna species recorded during the baseline biodiversity assessment is provided in Annex II of the ESIA.

A breakdown of the number of species recorded within the AoI per survey is listed below:

- Wet season survey: 22 species (16 reptile and 6 amphibian); and
- Dry season survey: 56 species (42 reptile and 14 amphibian).

6.6.7.4.1 Regional and Habitat Distribution

Herpetofauna communities varied in accordance with the diversity of habitat characteristics. These results are presented in full within Annex II. The following results focus on SoCC within the herpetofauna group.

6.6.7.4.2 Reptile and Amphibian Species of Conservation Concern

Two previously undescribed reptile species were recorded during the baseline surveys. Figure 6.6-14 shows the locations of the herpetofauna SoCC recorded during the wet and dry season field surveys.

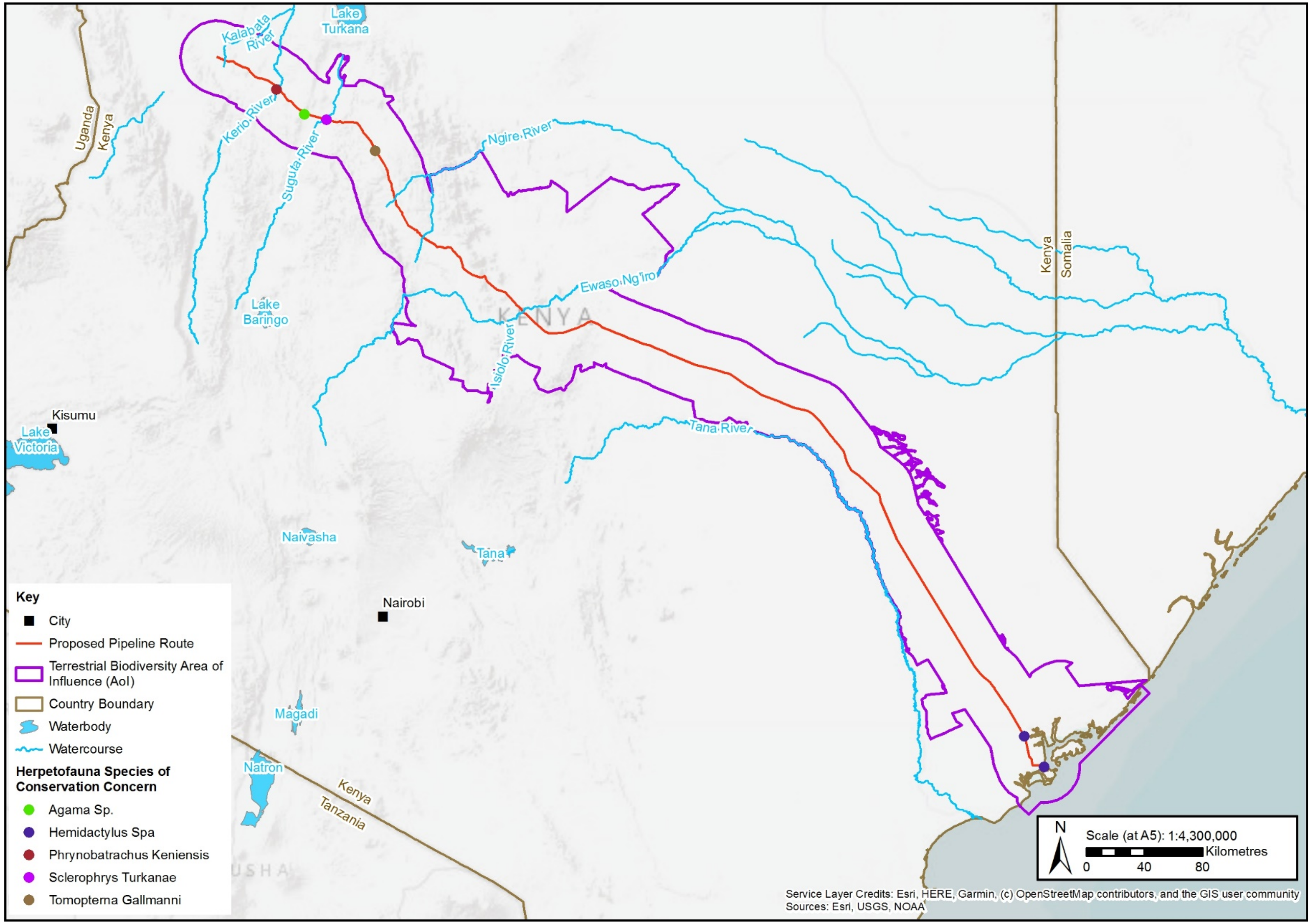


Figure 6.6-14: Herpetofauna species of conservation concern

The four range-restricted amphibian species were all recorded in the far northern section of the Project footprint (Figure 6.6-14). Kenya River Frog was recorded to the west of the Suguta Valley. Lake Turkana Toad and the undescribed Agama species were both recorded in the vicinity of the Suguta Valley. Gallmann's Sand Frog was recorded to the south of Baragoi. The previously undescribed *Hemidactylus* sp. was recorded in the vicinity of Lamu in the east of the AoI.

6.6.7.4.3 Invertebrates

Figure 6.6-15 shows the location of invertebrate sampling sites within the AoI. A total of 203 invertebrate genera were recorded within the AoI, whilst 103 genera were identified to species level, with 155 species recorded. Invertebrate baseline results and discussions on the habitats that support specific genera are presented in Annex II.

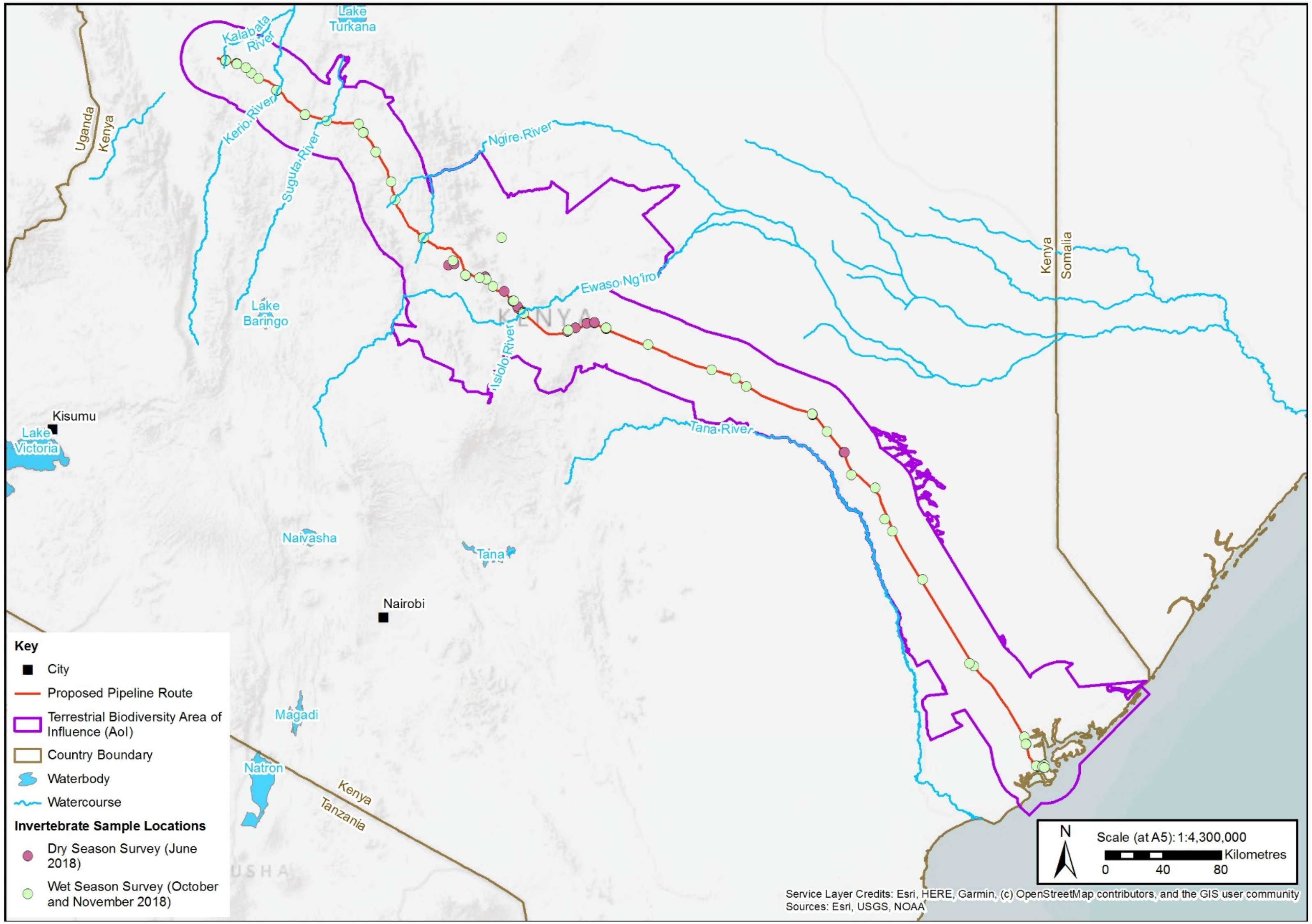


Figure 6.6-15: Invertebrate sampling locations

A breakdown of the number of genera recorded within the AoI per survey is listed below:

- Wet season survey: 96 genera; and
- Dry season survey: 166 genera.

6.6.7.5 Aquatic Ecosystems

Figure 6.6-16 shows the location of the aquatic baseline survey sites.

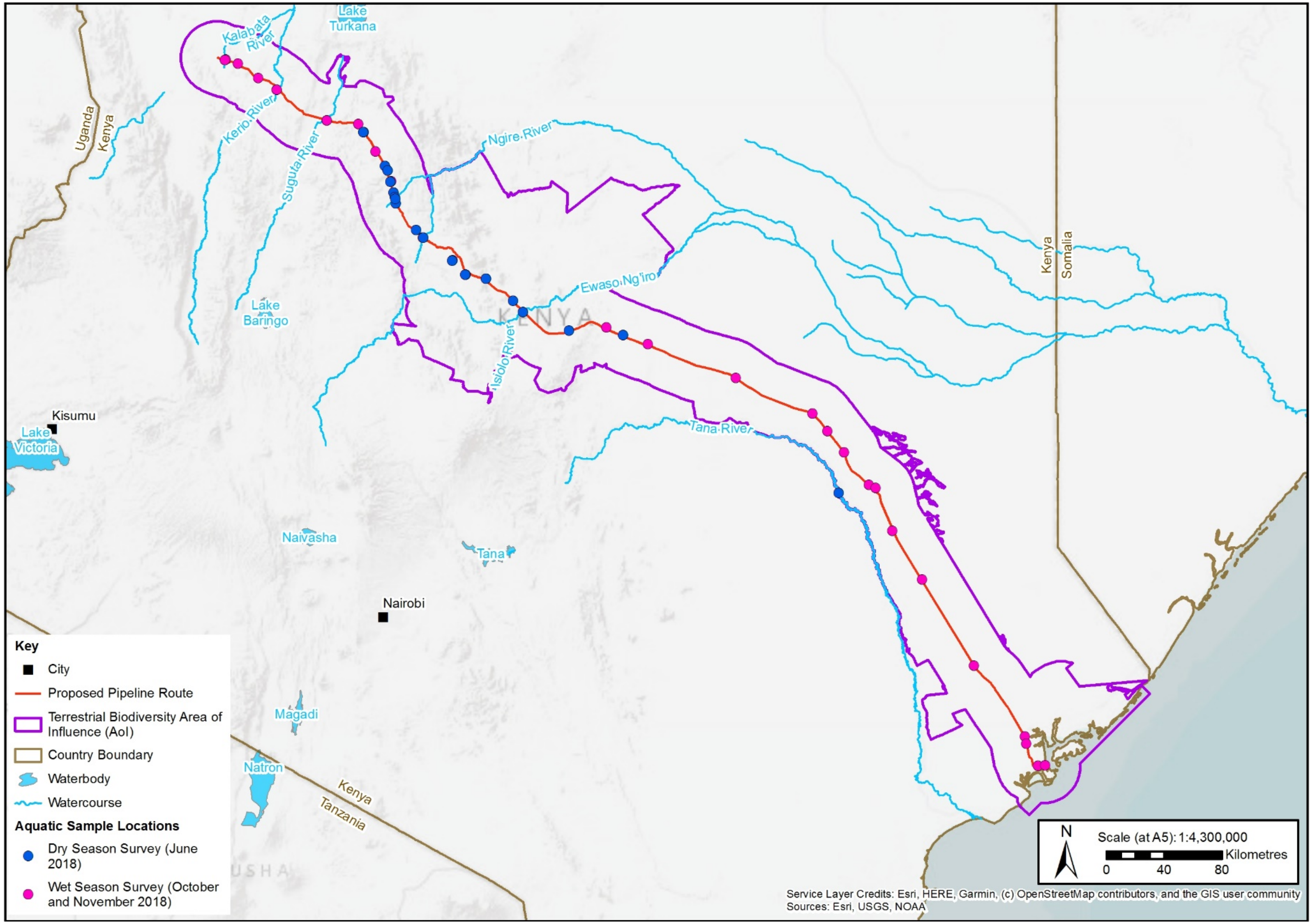


Figure 6.6-16: Aquatic sampling locations within the AoI

Two aquatic baseline surveys were conducted at the locations of pipeline crossings along the Project footprint the first in June - July 2018, and the second in October - November 2018. The aquatic surveys included data gathering on water quality, presence of fish species, and presence of aquatic macroinvertebrate species, as discussed below.

6.6.7.5.1 Aquatic Species Diversity

Ten fish species were recorded throughout the survey work within the AoI; these species are detailed in Table 6.6-11 below, together with their sampling locations.

Table 6.6-11: Fish species recorded throughout survey work, and their sampling locations

Species	Locality					
	Dipu Dam (Lamu)	Ewaso Ng'iro River	Kerio River	Suguta River	Ziwa (Tana River)	Total
Bagrus sp.	-	1	-	-	-	1
Clarias gariepinus	-	1	1	1	1	4
Enteromius neumayeri	-	-	1	-	-	1
Enteromius sp.	-	-	1	-	-	1
Labeo cylindricus	-	1	-	-	-	1
Oreochromis niloticus sugutae	-	-	-	1	-	1
Oreochromis sp.	-	1	1	1	-	3
Oreochromis spirulus spirulus	1	-	-	-	-	1
Protopterus affinis amphibius	1	-	-	-	-	1
Synodontis schall	-	-	1	-	-	1
Grand Total	2	4	5	3	1	15

The Kerio River supported the highest diversity of fish species, with 5 species recorded throughout the survey work. Conversely, Ziwa (an ox-bow lake) was recorded to have the lowest diversity of fish species, only recorded to support African Catfish (*Clarius gariepinus)* (Table 6.6-11). The African Catfish was the most frequently recorded species throughout the survey work, found in four of the five water features where fish species were recorded. Species in the genus *Oreochromis* were similarly frequently recorded, again being found in four of the five water features where fish were recorded.

A number of aquatic macroinvertebrates were also recorded throughout the survey work, including specimens in the families Euarthropoda (Whirligig Beetles), Nepidae (Water Scorpions), Belostomatidae (Giant Water Bugs), and Dytiscidae (Diving Beetles). In addition, Molluscs were recorded in a number of locations, whilst two leech species were recorded, namely *Lethocerus* sp., and *Dytiscus marginalis.*

6.6.7.5.2 Aquatic Faunal Species of Conservation Concern

The literature review identified four aquatic macro-invertebrate species and 23 freshwater fish species potentially within the AoI. Of these, two species were recorded during the baseline field surveys, namely:

- Neumayer's Barb (*Enteromius neumayeri*), recorded in Kerio River; and
- A subspecies of Nile Tilapia (*Oreochromis niloticus sugutae*), recorded in Suguta River.

6.6.7.6 Secondary Data – Literature Review and Consultation

The following sections describe the international and national context for biodiversity within the AoI, as determined through review of existing literature and databases.

6.6.8 Secondary Data - Biodiversity Context

6.6.8.1 WWF Ecoregions

The proposed 824 km pipeline crosses six ecoregions (World Wildlife Fund (WWF), 2019). Of these, three are listed as Critical/Endangered, and three as Vulnerable (WWF, 2019). A map of the pipeline in relation to the 6 ecoregions is provided in Figure 6.6-16.

- Northern Zanzibar-Inhambane coastal forest mosaic (Ref: AT0125): listed as **Critical/Endangered;** much of the coastal section of the pipeline falls into this ecoregion (WWF, 2019). This ecoregion represents the northernmost extent of the eastern and southern African coastal forest belt, and is found in Somalia, Kenya and Tanzania (WWF, 2019). It supports many endemic species, at a density among the highest in the world, mostly concentrated in forest habitats (WWF, 2019).
    - Species richness is boosted by the combination of forest, savanna, woodland and wetland species that all occur in this ecoregion.
    - The forest habitats in this ecoregion have been severely fragmented, primarily by agricultural activities and continuously increasing human density.
    - There are few protected areas in this ecoregion.
- East African mangroves (Ref: AT1402): listed as **Critical/Endangered**, the eastern portion of the pipeline terminates in this ecoregion (WWF, 2019).
    - This habitat type provides nurseries for fish and prawns and enhances the biodiversity of surrounding marine habitats while providing vital habitat for migratory birds, marine turtles (including one CR and two Endangered (EN) species), dugongs, whales and dolphins.
    - Eastern African mangroves are threatened in many areas by overuse and conversion by a growing human population that utilises the mangroves for rice farming, shrimp aquaculture, and for construction materials and the timber trade (WWF, 2019).
    - There are several protected areas in this ecoregion.
- East African montane forests (Ref: AT0108): a portion of the western section of the pipeline route passes through this **Critical/Endangered** ecoregion, and further patches are found elsewhere within the AoI although not directly crossed by the pipeline.
    - This ecoregion is found at altitudes between approximately 1,000 to 3,500 m along a chain of isolated mountain ranges stretching along the Rift Valley from southern Sudan to northern Tanzania.
    - This ecoregion contains moderate levels of species richness and relatively low rates of endemism when compared to the other tropical forest ecoregions around the equatorial belt of Africa.

  - Avifaunal diversity and endemism rates are moderate.
  - Mammal endemism is more pronounced and includes a number of strictly endemic mammal species.
  - The herpetofaunal assemblage is of interest and contains several strictly endemic species, particularly chameleons.
  - There are several protected areas in this ecoregion. In most areas forest and montane grassland habitats outside of the protected areas have been converted to agricultural or other human use (WWF, 2019).
- Masai Xeric grasslands and shrublands (AT1313): listed as **Vulnerable**, a portion of the western section of the pipeline crosses through this ecoregion (WWF, 2019). This ecoregion covers most of north central Kenya and extends into south-western Ethiopia.
  - The ecoregion is moderately rich in species but has a low level of endemism.
  - Most habitats of this ecoregion have been considerably degraded by heavy grazing of domesticated livestock.
  - A comparatively small area of good quality habitat remains in the few protected areas (WWF, 2019).
- Northern Acacia-Commiphora bushlands and thickets (AT0711): listed as **Vulnerable;** most of the central and western portions of the pipeline lie in this ecoregion (WWF, 2019). This ecoregion covers much of lowland Kenya. In the north, it transitions into drier savanna and semi-desert. In the south it grades into wetter Southern Acacia-Commiphora bushland and thicket in the vicinity of the Kenya – Tanzania border. The fauna and flora reflect the transitional nature of the ecoregion, with a mixture of drought-adapted and tropical savanna species.
  - Mammalian species diversity in this ecoregion is high, but few species are strictly endemic.
  - Avifaunal diversity is high with low endemism levels.
  - This ecoregion is reasonably well-protected within a well-functioning system of national parks and other reserves (WWF, 2019).
- Somali Acacia-Commiphora bushlands and thickets (AT0715): listed as **Vulnerable;** a portion of the eastern section of the pipeline crosses this ecoregion (WWF, 2019). This ecoregion covers the largest portion of the Horn of Africa and extends into the north-eastern corner of Kenya. A high number of endemic, arid-adapted species are found in this ecoregion.
  - It is a centre of endemism for mammals, including the Critically Endangered (CR) hirola (*Damaliscus hunteri*).
  - Human population within this ecoregion is low due to the very limited agricultural potential.
  - Although much of this ecoregion remains unfragmented and intact, large mammal populations have been severely depleted due to hunting pressure associated with a lack of sufficient enforcement.
  - There are several protected areas in this ecoregion, some of which harbour the last remaining populations of desert-dwelling ungulates.

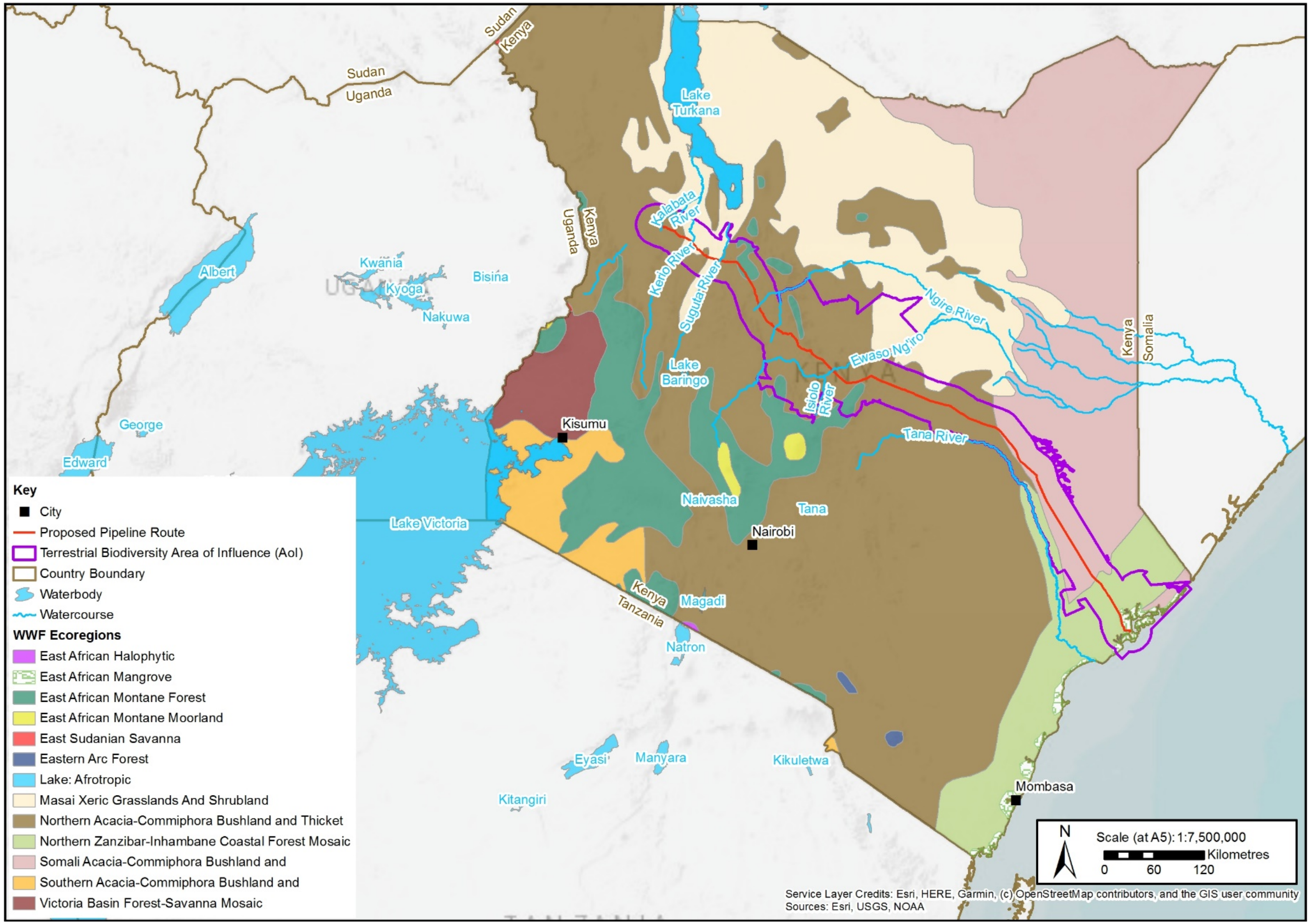


Figure 6.6-17: WWF Ecoregions within the AoI

Table 6.6-12 presents a breakdown of the surface area of the AoI by ecoregion. Northern Acacia-Commiphora bushlands and thickets is the dominant ecoregion in the western and central portion of the AoI, comprising 56.9% (Table 6.6-12). Somalia Acacia-Commiphora bushlands and thickets is the dominant vegetation community in the eastern portion of the AoI, comprising 5.6%.

Northern Zanzibar-Inhambane Coastal Forest Mosaic forms the dominant vegetation community along the Kenyan East coast, just inland of the mangrove communities. This vegetation community also extends inland along the Tana River and comprises 10.3% of the AoI. Masai Xeric Grasslands and Shrublands comprises 9.4% of the AoI, but only intersects with the Project Footprint in the far north-west between the Kerio River and Suguta Valley.

Table 6.6-12: Breakdown of WWF Ecoregions in terms of area and percentage contributions to the total surface area of the AoI

ECO Name	Area (Ha)	Percentage of AoI (%)
East African Montane Forests	224,488.6	3.6
Northern Zanzibar-Inhambane Coastal Forest Mosaic	634,509.9	10.3
Northern Acacia-Commiphora Bushlands and Thickets	3,508,753.6	56.9
Somali Acacia-Commiphora Bushlands and Thickets	962,165.1	15.6
Masai Xeric Grasslands and Shrublands	581,752.7	9.4
East African Mangroves	103,456.8	1.7
Unclassified	151,692.2	2.5
Total	***6,166,818.8***	***100.0***

6.6.8.2 Vegetation Communities

Habitats within the AoI are presented in Figure 6.6-17. Based on Van Breugel *et. al*. (2015), the Project footprint directly impinges on nine vegetation communities (Table 6.6-13), with a further 12 communities occurring within the broader AoI.

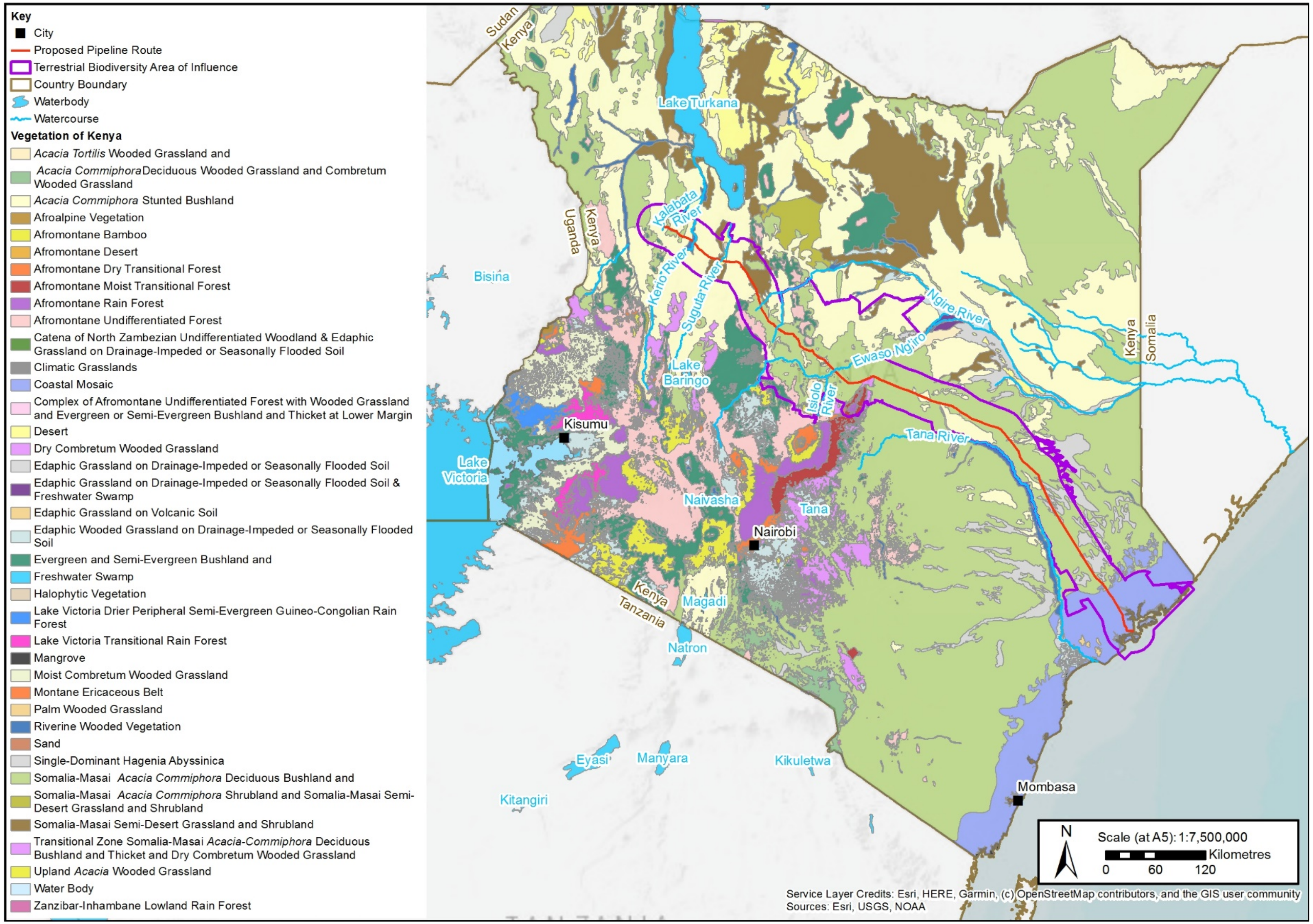


Figure 6.6-18: Vegetation communities within the AoI

Three communities dominate the AoI. The westernmost portion of the pipeline is dominated by Acacia-Commiphora stunted bushland (Bds). The central part of the pipeline and AoI is dominated by Somalia-Masai Acacia-Commiphora deciduous bushland and thicket (Bd), which is the dominant vegetation community within the AoI coinciding with approximately 440 km of the central portion of the pipeline alignment. The eastern part of the pipeline and AoI is dominated by coastal mosaic (CM).

Table 6.6-13: Vegetation communities directly crossed by the pipeline footprint or that occur within the AoI and project footprint (Van Breugel et al. 2015)

Vegetation Community
Project Footprint
Acacia-Commiphora stunted bushland
Coastal mosaic
Desert
Dry combretum wooded grassland
Edaphic grassland on drainage-impeded or seasonally flooded soils
Mangrove
Riverine wooded vegetation
Somalia-Masai Acacia-Commiphora deciduous bushland and thicket
Somalia-Masai semi-desert grassland and shrubland
AoI
Acacia tortilis wooded grassland and woodland
Afromontane bamboo
Afromontane dry transitional forest
Afromontane moist transitional forest
Afromontane rain forest
Afromontane undifferentiated forest
Climatic grasslands
Edaphic wooded grassland on drainage-impeded or seasonally flooded soils
Evergreen and semi-evergreen bushland and thicket
Halophytic vegetation
Moist Combretum wooded grassland
Upland Acacia wooded grassland

6.6.8.3 Protected Areas

The World Database on Protected Areas (WDPA) was assessed in order to identify protected areas within the AoI. A map showing protected areas within the AoI (based on the WDPA) is provided in Figures 6.6-18 to 6.6-21. Twenty-nine protected areas are located within the AoI (Table 6.6-14). These protected areas range from national parks and reserves to community reserves and private ranches (Table 6.6-14).

All the protected areas are nationally designated reserves, except for Mount Kenya National Park/Natural Forest, which is a declared United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Site. The World Heritage site includes the Lewa Wildlife Conservancy and Ngare Ndare Forest Reserve (LWC-NNFR), which is connected to Mount Kenya National Park via a wildlife corridor. This corridor provides connectivity for elephants moving between Mount Kenya and the larger conservation complex of the Somali/Maasai ecosystem (UNESCO, 2019).

A large conglomeration of protected areas is situated where the AoI crosses through the Samburu, Isiolo, Laikipia and Meru Counties.

Table 6.6-14: Protected Areas located within the AoI based on the WDPA along with their designations and designation types

Name	Designation	Designation Type
Project Footprint		
Rahole	National Reserve	National
Nyambene	National Reserve	National
West Gate Community Conservancy	Community Nature Reserve	National
Kalama Community Wildlife Conservancy	Community Nature Reserve	National
Meibae Community Conservancy	Community Nature Reserve	National
Namunyak Wildlife Conservation Trust	Community Nature Reserve	National
Nakuprat-Gotu Community Conservancy	Community Nature Reserve	National
Awer Community Conservancy	Community Nature Reserve	National
AoI		
Arawale	National Reserve	National
Kiunga	National Reserve	National
Dodori	National Reserve	National
Shaba	National Reserve	National
Samburu	National Reserve	National
Buffalo Springs	National Reserve	National
Mathews Range	Forest Reserve	National
Nyambeni	Forest Reserve	National

Name	Designation	Designation Type
Ngaia	Forest Reserve	National
Pate Marine Community Conservancy	Community Nature Reserve	National
Ngare Ndare Community Conservancy	Community Nature Reserve	National
Nasuulu Community Wildlife Conservancy	Community Nature Reserve	National
Ol Lentille Conservancy	Community Nature Reserve	National
Sera Community Conservancy	Community Nature Reserve	National
Biliqo-Bulesa Community Conservancy	Community Nature Reserve	National
Kiunga Marine Conservancy	Community Nature Reserve	National
Ishaqbini Hirola Community Conservancy	Community Nature Reserve	National
Il Ngwesi Community Trust	Community Nature Reserve	National
Leparua Community Conservancy	Community Nature Reserve	National
Lekurruki Conservancy Trust	Community Nature Reserve	National
Mpus Kutuk Community Conservancy	Community Nature Reserve	National

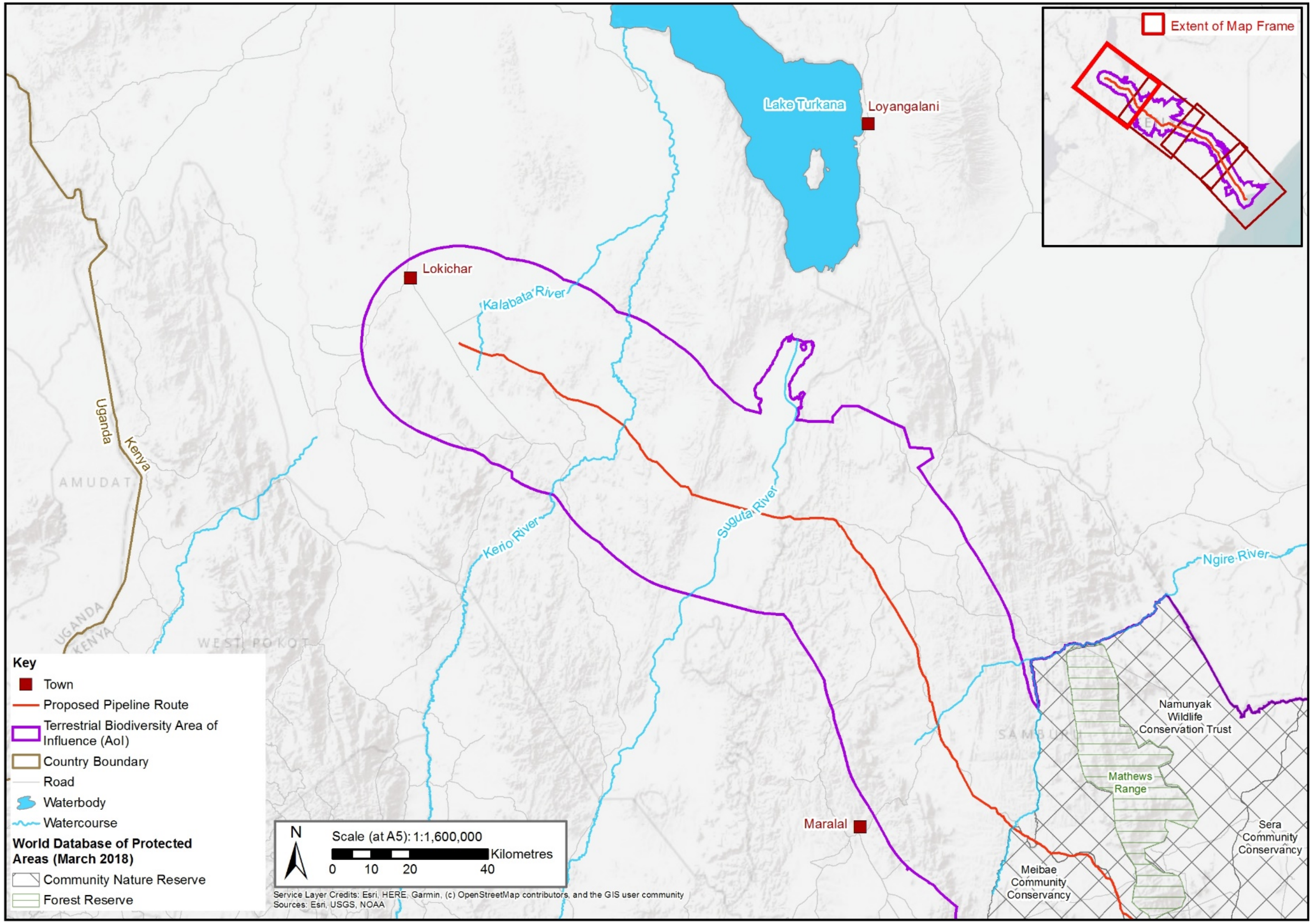


Figure 6.6-19: World database of protected areas (1)

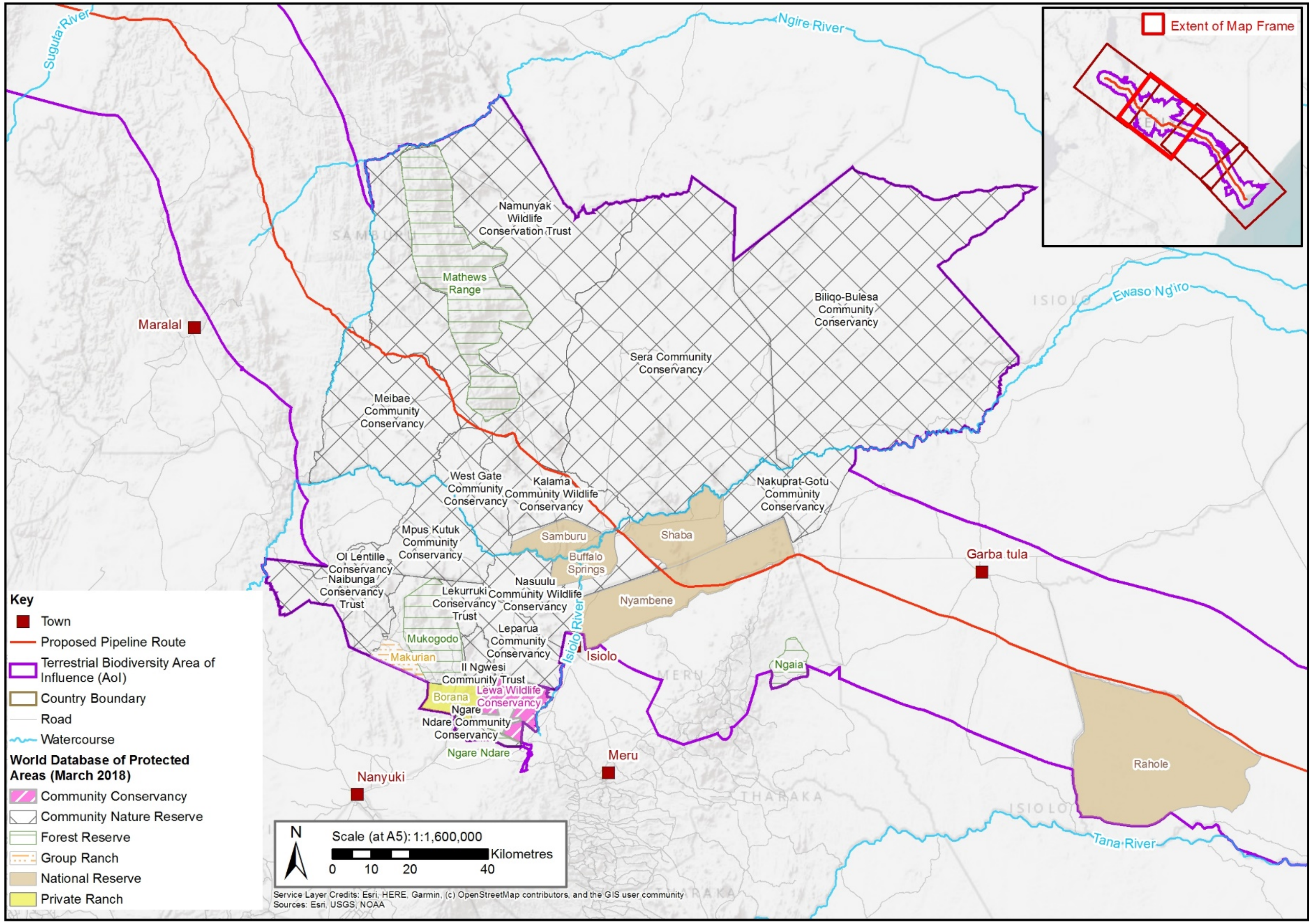


Figure 6.6-20: World database of protected areas (2)

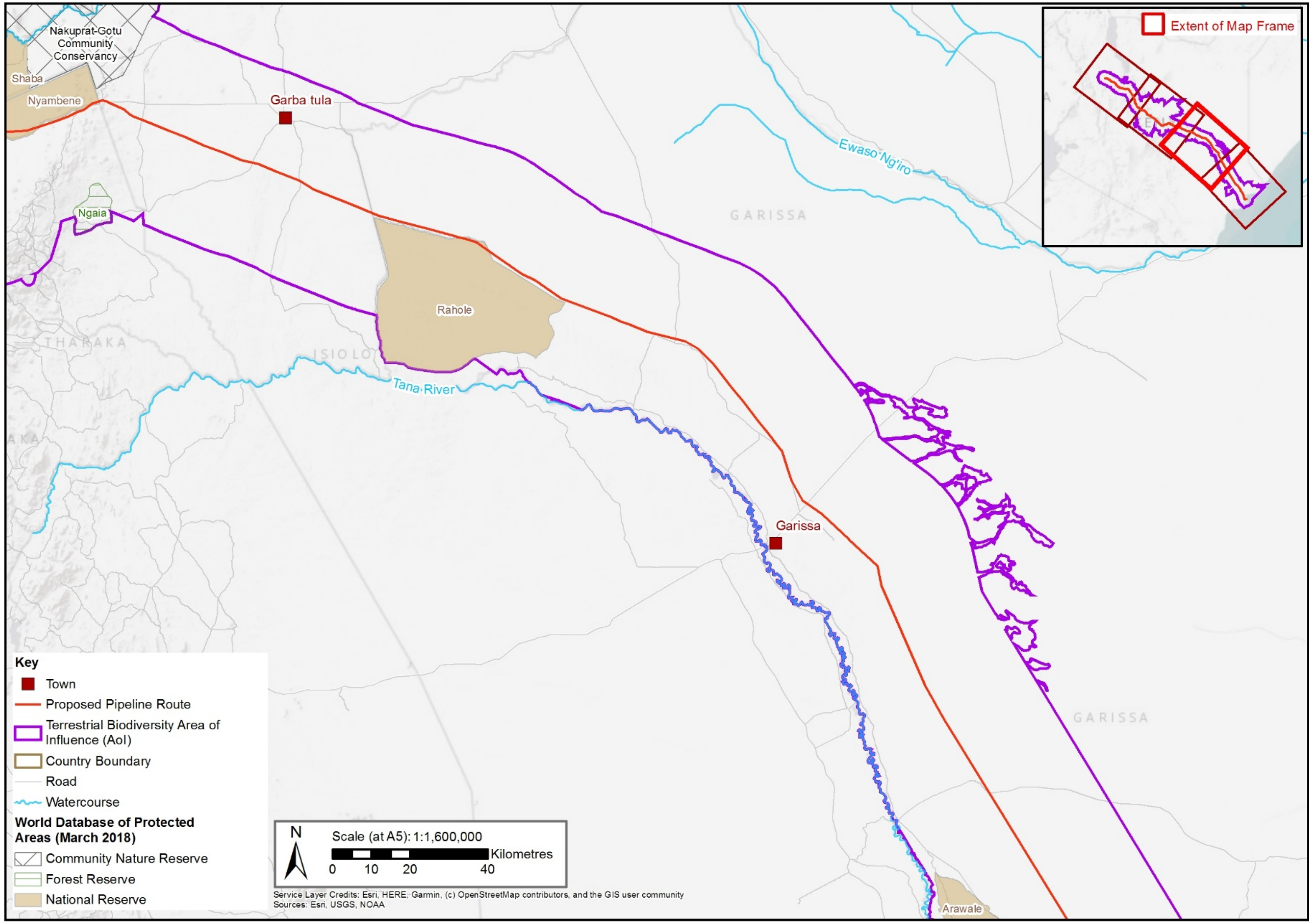


Figure 6.6-21: World database of protected areas (3)

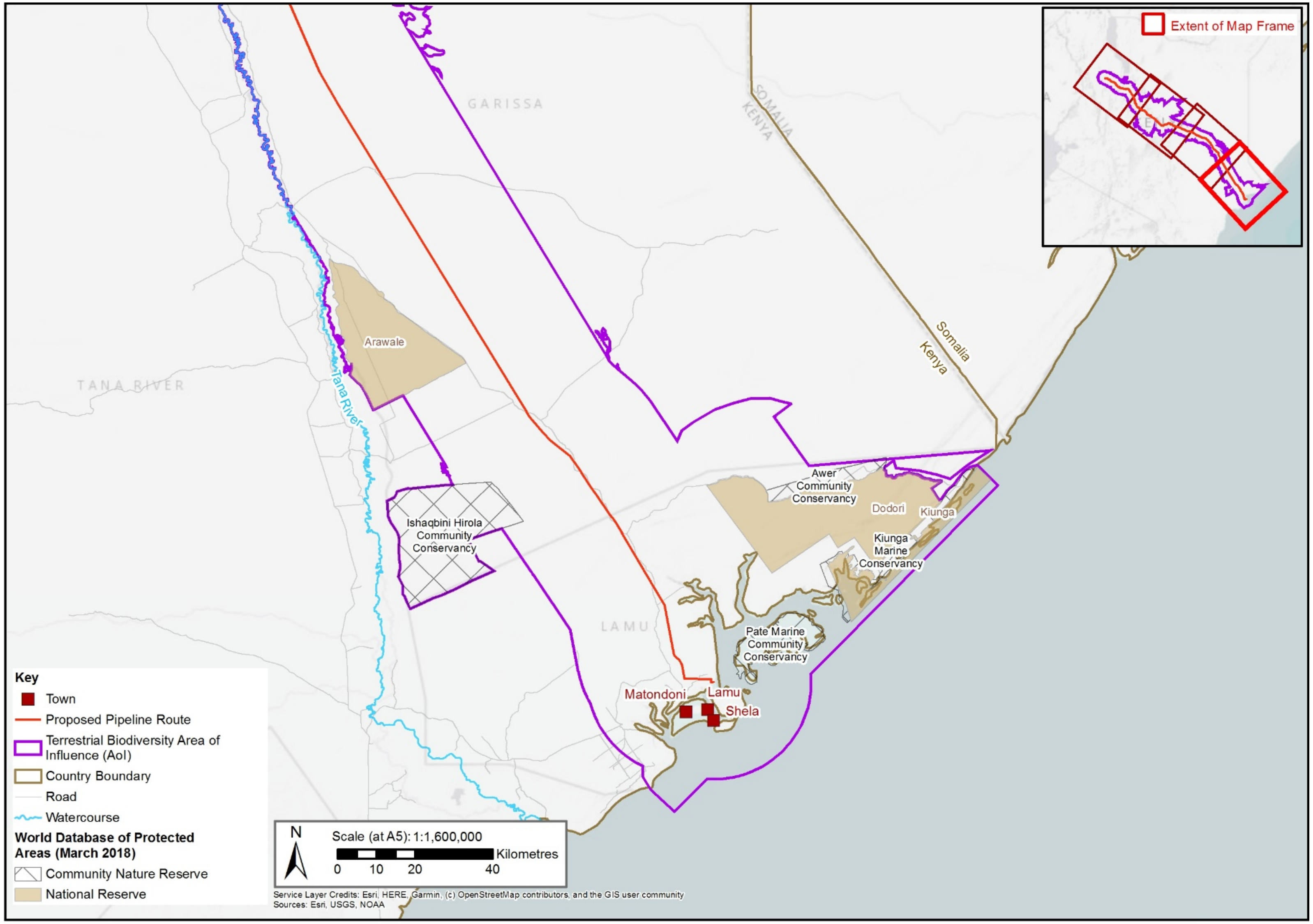


Figure 6.6-22: World database of protected areas (4)

6.6.9 Biodiversity Baseline Summary

The following conclusions were reached based on the results of the Project biodiversity baseline assessment:

- Acacia dominated vegetation communities dominated the Project footprint with the exception of the easternmost portion of the AoI where it transitions to forest mosaic vegetation community:
  - The proposed pipeline traverses several Forest Reserves that are identified as Key Biodiversity Areas.
- The proposed Project traverses protected areas including:
  - Community Conservancies; and
  - National Reserves.
- Eight bird SoCC were confirmed during the biodiversity baseline surveys;
- The mammal assessment identified 16 SoCC including areas of core and critical habitat for the endangered Grevy's Zebra;
- Sites with high mammal diversity corresponded with drainage lines and rivers including the Suguta Valley in the north of the Project footprint and the Ewaso Ng'iro River in the central part of the AoI, as well as protected areas such as Kalama Community Wildlife Conservancy, Nakuprat-Gotu Community Conservancy and Rahole National Reserve as well as the forest mosaic vegetation community in the east of the AoI. This highlights the importance of these habitats as hotspots of mammal diversity;
- Three range restricted amphibian species were recorded over the course of the baseline assessment;
- Two invertebrate SoCC were recorded over the course of the baseline field surveys namely Brown-veined White Butterfly (*Belenois aurota*) and African Migrant Butterfly (*Catopsilia florella);*
- Two SoCC fish species were recorded during the baseline field surveys, namely:
  - Neumayer's Barb (*Enteromius neumayeri*), recorded in the Kerio River; and
  - A subspecies of Nile Tilapia (*Oreochromis niloticus sugutae*), recorded in the Suguta River; and
  - The presence of SoCC fish species further confirms the importance and sensitivity of rivers and drainage lines as key biodiversity habitats.

6.7 Biodiversity, Ecology and Protected Areas - Marine Flora and Fauna

6.7.1 Introduction to the Marine Biodiversity Baseline

The following sections describe the physical and biological baseline conditions of the marine environment that are relevant to the Project. The estuarine and marine scope of this baseline assessment, based on primary and secondary data, includes the following components:

- Physical Components:
  - Physical Oceanography;
  - Geomorphology;
  - Underwater acoustics;
  - Illumination; and
  - Water and Sediment Quality.
- Biodiversity Components:
  - Marine Mammals;
  - Sea Turtles;
  - Fishes;
  - Benthic Habitats (including coral reefs and seagrass beds); and
  - Mangroves.
- Marine and Coastal Protected Areas and Key Biodiversity Areas.

6.7.2 Area of Influence

The Project will use an existing berth where footprint impacts have largely already occurred during its construction: these impacts were analysed in the ESIA for the Construction of the First Three Berths of the Proposed Lamu Port and Associated Infrastructure (Ministry of Transport, 2013).

The AoI for this marine biodiversity assessment (Figure 6.7-1) within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes a 10 km buffer around the berth plus wherever the buffered route intersected a defined protected area or area of biological importance, that area is incorporated into AoI.

There is also potential for synergistic and cumulative impacts to occur with wider activities at the port which are within the AoI, and these may also occur at the seascape level (see Section 6.7.3) with respect to the movement of some species within and outside the AoI.

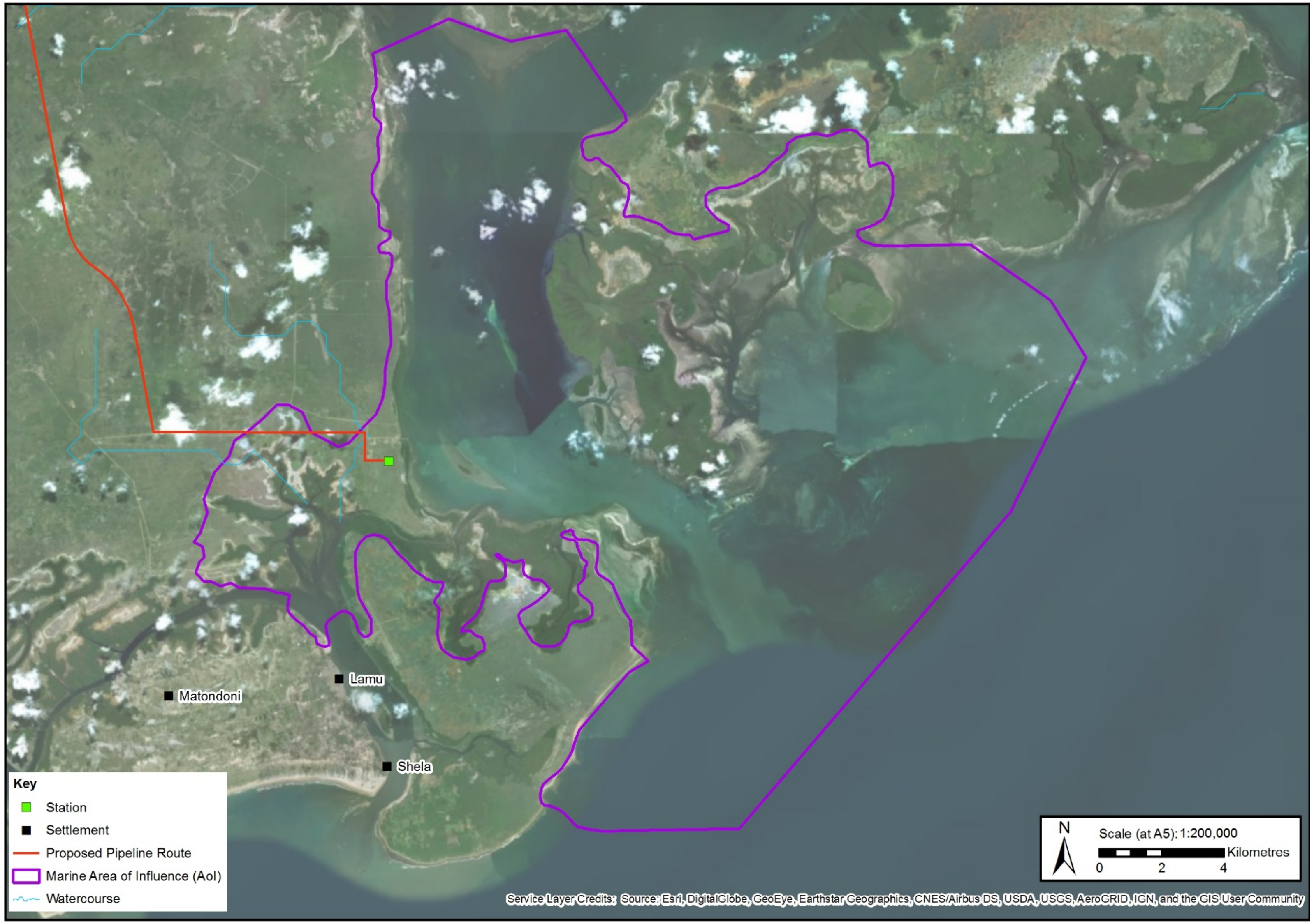


Figure 6.7-1: AoI for the baseline assessment

6.7.3 Consideration of Seascape

In addition to the AoI, baseline conditions are considered at a seascape level to determine the regional significance of the Project site and the features within the AoI. This is a precautionary approach that is intended to take direct, indirect and cumulative impacts into account based on broad ecological functions that are usually present in the marine environment. The core requirement of addressing baseline at the seascape level is to ensure that the ESIA does not only consider the Project site or the AoI, but also the wider importance of features that may be affected by the Project. The seascape assessment takes account of, for example, populations, migratory movements, habitat connectivity, habitat continuation and definition of wider eco-regions or biomes where there are similar conditions. Consideration of baseline at the seascape level is particularly important when assessing the presence of critical habitats and legally protected or internationally recognised areas.

For marine biodiversity, the boundary of an appropriate spatial area of analysis will vary by habitats and species, and in some instances, can be large. It is therefore not always appropriate to define single area boundaries for discussion of baseline conditions, and it often requires consideration of highly mobile and transient species with wide ranges across common pelagic habitat. It also requires an understanding within a highly dynamic system with both local and far-field connectivity and ecosystem function linkages. The use of broad seascape areas can help to simplify assessments where there is clear delineation for a wide range of important ecosystem functions. However, the majority of baseline components for this project are considered at a broad Lamu-Kiunga seascape scale (Figure 6.7-2). As discussed below, this area comprises a continuous important habitat of a mainland and island archipelago system with a common habitat complex of mangrove, patchy and marginal reef systems, seagrass beds and exposed sandy beaches. This overall habitat complex provides ecosystem functions for sea turtles (nesting and foraging habitat), reef and pelagic fish (spawning, nursery, foraging) and marine mammals (transient waters and foraging habitat). The area also encompasses legally protected areas, internationally recognised areas and Locally Managed Marine Areas (LMMAs), with potential for connectivity across these sites and other non-protected designated areas. For wide ranging and/or migratory megafauna species that may not have a specific ecosystem function connection with the Lamu-Kiunga seascape a broader spatial area of analysis is required. For such species there is a need to consider areas of aggregation, recruitment, or other specific habitat features of importance to the species at an appropriate scale.

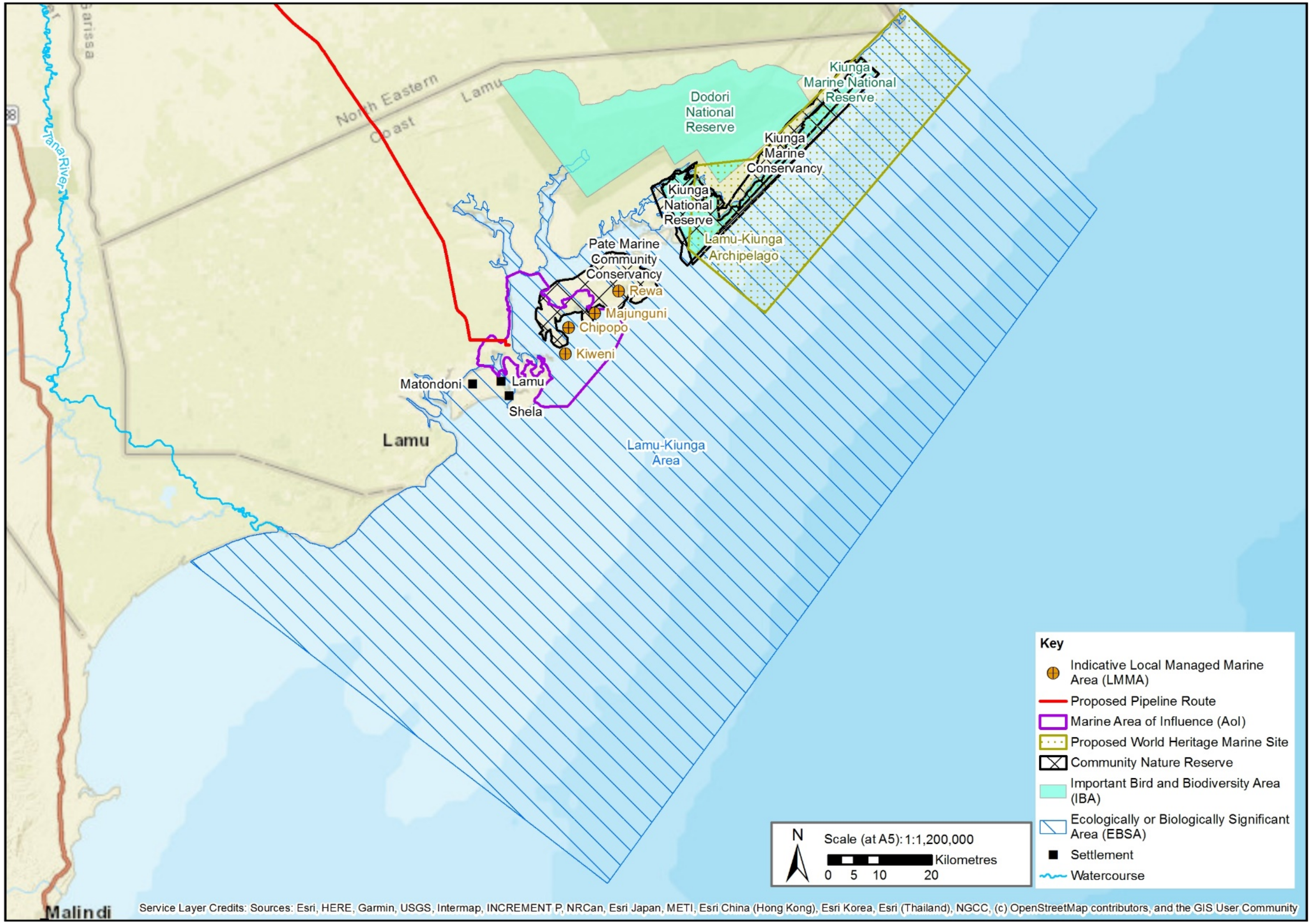


Figure 6.7-2:Seascape for the baseline assessment

6.7.4 Approach and Methods

Primary Data Gathering

Primary data was collected for mangroves, water and sediment quality. Field surveys of mangrove areas within the AoI were completed between 12 and 16 November 2018. The methods for the survey are presented in Annex II. In summary, mangrove structure was characterised through measurement of plots and visual description along 18 transects marked from the lower to the higher tidal zone of the forests in order to capture the structural variability related to tidal flooding frequency.

Water and sediment samples were collected in ten sampling stations (Figure 6.7-3) during two different monsoon seasons: The South-east Monsoon (4 and 5 July 2018) and the North-east Monsoon (13 to 17 November 2018, Figure 6.7-4)). Annex II of the ESIA provides more detail on the methods and results of the survey. Sampling points were chosen according to a sampling design that included:

- At the surroundings of the potential location of the Project berth and underwater pipeline route: P1 and P3;
- From the Project berth area to the offshore zone of the AoI, following the prevalent path of the coastal currents[1]: P1 to P8;
- Close to sensitive biodiversity components, such as coral reefs, seagrass beds, mangrove forests and sea turtle breeding sites: P4 to P8;
- At the mouth of tidal channels that may bring effluents from urban settlements to the AoI: P2; and
- At control sites: C1 and C2, positioned so that they would not be directly influenced by the Project activities in the future and, at the same time, would not be close to relevant sources of contamination (for example, large villages, urban settlements).

A detailed description of the methods of collection for these components are presented in Annex II.

The ongoing construction of the Lamu Port is likely changing the baseline conditions in varying degrees, such that the value of collecting additional primary data for specific components should be re-evaluated at a future date, taking into consideration the port construction and operational planning, and the requirement to reduce uncertainties related to key environmental components. Since the Project will utilise existing berth (constructed as part of the Lamu Port development), the main impacts on the marine environment will be associated with operational activities; these will require ongoing adaptive monitoring. The baseline for the port relates to conditions before construction commenced as reported by the ESIA study already completed (Ministry of Transport, 2013). Where data are absent or there are uncertainties in the baseline understanding, a precautionary approach has been adopted, which recognises the potential presence of high biodiversity values where this is considered possible.

Secondary Data Gathering

A biodiversity characterisation, based on the available secondary data, was completed for all components (ecosystems and ecological features). In addition to the Environmental Impact Assessments (EIAs) produced for other large projects inside the AoI (that is, Lamu Port and the Lamu Coal Power Plant), an extensive literature review was completed. Research institutions and non-governmental organisations (NGOs) that are known to carry out assessment, monitoring and conservation activities in the region were contacted and provided relevant information. These NGOs were:

- Kenya Marine and Fisheries Research Institute (KMNFRI);

[1] In the ESIA of the Lamu Port (Ministry of the Transport, 2013) the results of the sediment transport modelling indicate that the currents tend to always drive suspended solids from the project site directly to the ocean.

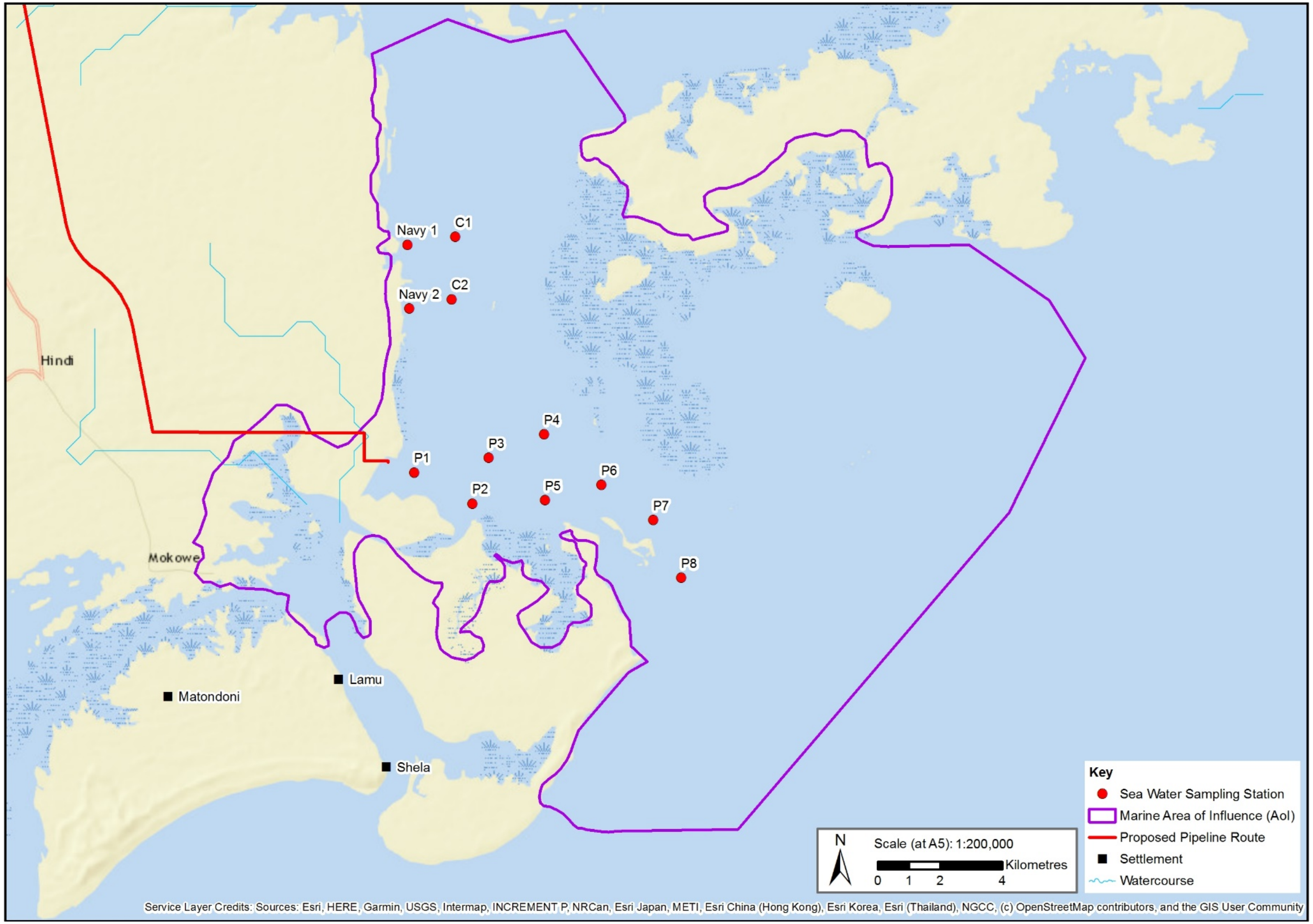


Figure 6.7-3: Marine water and sediment sampling location

- Egerton University (Faculty of Environment and Natural Resources Development);
- World Wide Fund for Nature (WWF);
- Lamu Marine Conservation Trust (LaMCoT); and
- Watamu Marine Association (WMA).

In addition to the secondary data obtained from the literature review, international data banks were assessed, for example:

- Integrated Biodiversity Assessment Tool (IBAT: https://www.ibat-alliance.org/), which consolidates data from:
  - IUCN Red List of Threatened Species;
  - World Database on Protected Areas (WDPA);
  - World Database on Key Biodiversity Areas;
- UNEP WCMC Ocean Data Viewer (http://data.unep-wcmc.org/);
- The World Resources Institute (WRI) Data Sets (https://www.wri.org/resources);
- The Globcurrent Project (http://www.globcurrent.org);
- Sea Temperature Portal (https://www.seatemperature.org); and
- The Marine Traffic Portal (https://www.marinetraffic.com).

6.7.5 Results

6.7.5.1 *Primary Data Gathering – Water Quality*

Water parameters selected for this study included those listed in the Kenyan national water quality guidelines for discharge into the environment (Legislative supplement No. 36/2006), and additional parameters that are not listed in those guidelines but could possibly be affected by Project activities. The water quality results were compared with the Kenyan guideline values, and the acute and chronic thresholds for marine surface water listed in the "*Screening Quick Reference Tables*" prepared by National Oceanic and Atmospheric Administration (NOAA) (Buchman, 2008). The latter are derived from the primary entry in the United States of America Ambient Quality Criteria, followed by the lowest of Tier II secondary acute values (SAVs), or other available standards or guidelines.

Lowest observable effect levels (LOELs), previously published by the United States Environmental Protection Agency (USEPA), are also included since these are the main reference for many national standards (Buchman, 2008). As there are no sediment quality standards in Kenya, the parameters selected for this baseline include those that could possibly be affected by Project activities. The results were compared with the Threshold Effect Level (TEL) and the Probable Effect Level (PEL), as per MacDonald et al. (1996).

No international water quality limits were exceeded. The only parameters that exceeded the Kenyan limits were total phenols, TSS and selenium, for both the sampling events during the North-east and South-east Monsoon season. While selenium and TSS exceed the national thresholds by up to five times, total phenols reached 0.05 mg/l, which is 50 times higher than the guideline threshold (which is 0.001 mg/l). However, as previously mentioned, the Kenyan standards were established for effluent discharge into the environment, not to environment water standards for certain types of use. They were used only as a reference in the absence of environmental water standards. Hence, reference concentrations may be over, or underestimated, for some parameters in contrast to if they referred to environment water quality.

There were no relevant differences in the water quality between the two seasons sampled, the same parameters present exceedances in both periods, although there are fewer exceedances during the South-east Monsoon season. These differences could be due to the heavy rains that fall at the start of this season, which could dilute parameters of interest (Tortell, 1998; Samoylis et al., 2015).

When compared to the data obtained from the previous ESIAs (that is, Ministry of Transport, 2013; Amu Power, 2016), TSS show exceedances that were not recorded previously. Data collected for this ESIA show values of 8 and 79 mg/l, while in the Amu Power survey (2016) they ranged from 2 to 5 mg/l, and in the survey reported by Ministry of Transport (2013) they varied from 0.09 to 0.12 mg/l. The elevated levels observed in this study's baseline were most likely due to port construction activities (that is, dredging, land reclamation works and vessel movements). Such elevated TSS levels are likely to be temporary, occurring cyclically after each maintenance operation of the port following completion of the construction activities; for example, maintenance dredging.

Overall, survey results from the sampling stations around the Project footprint showed good water quality, with very few traces of human impact. It appeared that construction of the port has not had a marked impact water quality. This information should be taken into consideration as standards are set for future assessments during, and after, the Project construction.

Except for station P2, where sediments were silty, the results indicated that sediments in the study area were sandy, corroborating the previous studies regarding sediment grain size. The predominance of sandy bottoms associated with a low percentage of organic matter reduces the potential for retention of contaminants. Exceedances of the threshold levels previously described for sediment parameters were noted for Arsenic (As) and Tin (Sn) compared to TEL. In the case of As, they were limited, with concentrations up to 50% higher than TEL. However, in the case of Sn, concentrations were generally more than two orders of magnitude higher than TEL. Since Sn was not previously quantified it is not possible to make a comparison, while As did not exceed the limits described in either the Lamu Port ESIA (Ministry of Transport, 2013) or the power plant ESIA (Amu Power, 2016). On the other hand, Cadmium (Cd), which was below reference levels in this assessment, was found to be over the TEL in the previous studies. As previously mentioned for the water quality sections, the relatively higher levels of As recorded during this assessment may have been related the activities associated with the port construction, that is, dredging could have resuspended heavy metals from deeper layers, which then settled in the upper sediment layer.

6.7.5.2 Primary Data Gathering – Mangrove

Forest structure was characterised in the fringe forests of 12 transects. Five were located within the area that may be affected in the footprint (that is, MS1, MS 2A, MS 2B MS3 and MS4), where potential impacts to the mangroves might occur. The other seven transects (MS5A, MS5B, MS7, MS10, and MS11 MS12A, MS12B) were located to gain a general characterisation of the mangroves in the AoI which could be affected by an unplanned event. Soil samples were also collected in transects for particle size analysis.

Across all sampling sites (Figure 6.7-4), 336 trees were recorded, which comprised the five typical species: *Ceriops tagal*, *Rhizophora mucronata*, *Bruguiera gymnorrhiza*, *Avicennia marina* and *Soneratia alba*. In terms of relative species dominance (as a percentage of basal area), *R. mucronata* was dominant in most of the transects. Other species identified in Lamu in previous studies (Government of Kenya, 2017), but not encountered in this study, include *Xylocarpus granatum, Xylocarpusza mollucensis* and *Lumnitzera racemosa*. Mangroves in the area surveyed exhibited a degree of zonation in some locations, with *S. alba* being the most outward (i.e. seaward) species, followed by *C. tagal*, *R. mucronata*, *B. gymnorrhiza* and finally dwarf/shrubby *A. marina* towards the landward side of the mangrove belt. This zonation, however, was not observed in the relatively narrow belts of mangrove where it was contiguous with terrestrial forest. This pattern of species zonation accords with previous assessments carried out in the region (Ministry of Transport, 2013; GOK, 2017b).

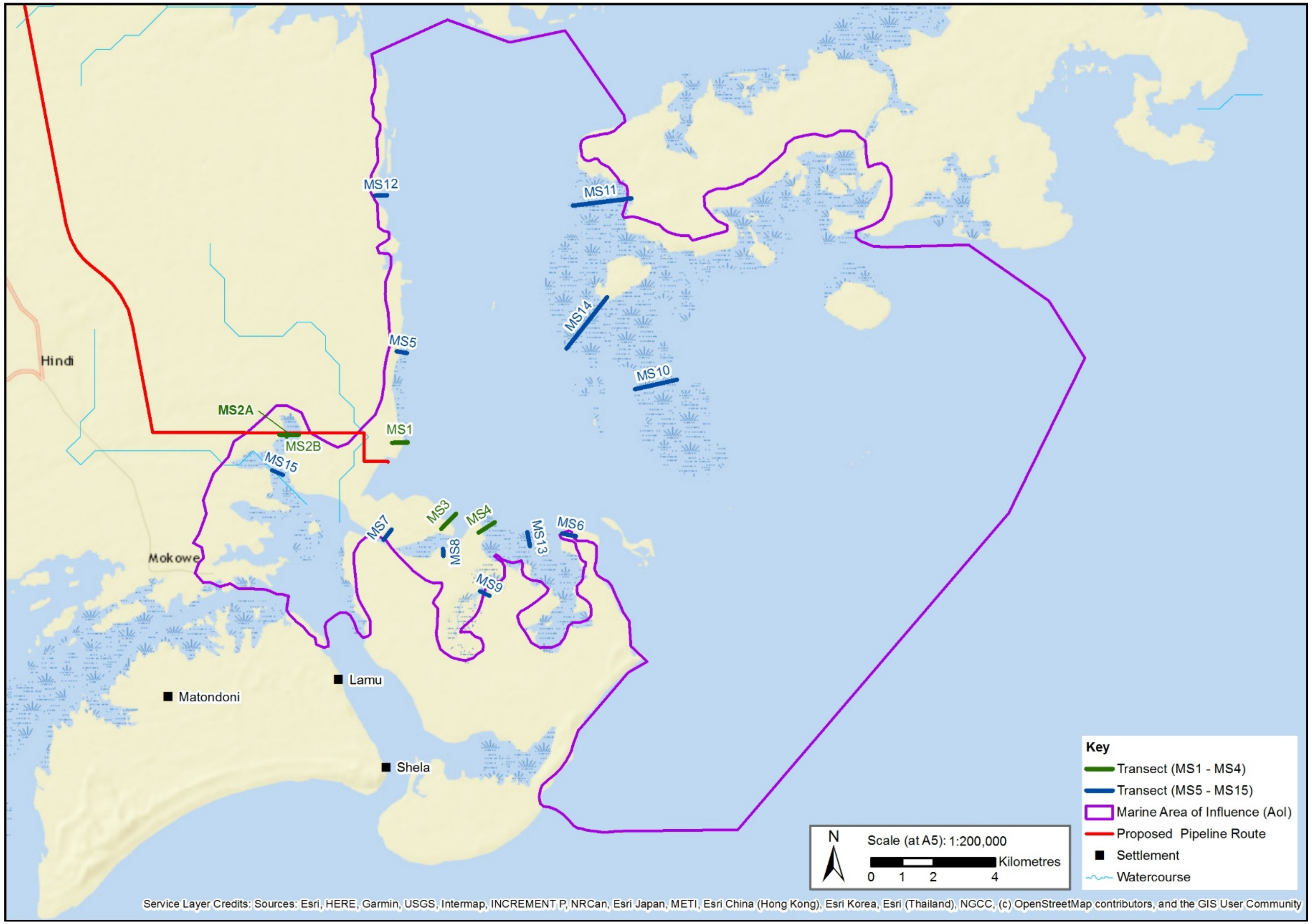


Figure 6.7-4: Mangrove transect location

Plots MS2A and MS2B are located in an area that may be affected by the footprint of the Project. Plot MS2A was dominated by shrubby and dwarfed *Avicennia marina*, and plot MS2B was more mixed, comprising *Rizophora mucroanata* and *Ceriops tagal*. Most surveyed areas show relatively low species diversity with plots MS5b and MS7 being most mixed. The total biomass (kg/plot) was lowest at plot MS1 followed by MS4, MS2A, MS2B and MS12A.

Other surveyed areas showed much greater biomass. In general, the species closer to the sea were structurally better developed in terms of stem diameter, tree height and density. The transect showing the highest tree density was MS1; it decreased across plots MS2A, MS2B and MS3, with the lowest density being recorded in plot MS4. Regarding plots outside the Project footprint, high tree density was observed in plots MS5B, MS7 and MS12, with a lower density recorded in plot MS10. *Rhizophora mucronata* and *Avicennia marina* species were found to have a high basal area in transects MS1, MS2A and MS2B and MS4, implying that they are relatively well developed in these areas.

There were few observations of cut stumps at the plots, indicating little or no wood extraction by local communities in the area. The few recordings of cut stumps were in plots MS7 (6 cuts), and MS8, MS13 and MS15 (all 1 cut). Natural die backs were also recorded and observed in plot MS2A (four dead stumps), and in plots MS9 and MS13 (one dead stump).

The non-forested areas were largely comprised of sandy beaches, mudflats, which transformed to sand flats, and, finally rangelands and agricultural fields furthest from the sea. Fauna observed in the mangrove zone consisted mainly of mollusc species: oysters, such as *Brachydontes* spp.; and crabs, such as *Scylla serrata*, *Uca* spp. and *Sesarmidae* species.

Sand dominated the soil composition in all sampling stations, except one where silt composition was comparatively higher.

6.7.5.3 Secondary Data Gathering - Physical Oceanography

Monsoons

In general, the seasonality of the meteorological-oceanographic conditions in the Western Indian Ocean are driven by the monsoon system. The Lamu-Kiunga area is within the Northern Monsoon Coastal Current eco-region of Kenya (Osuka et al., 2016), with the monsoons arriving on this coast from the north-east and south-east (Government of Kenya, 2009). The North-east Monsoon blows from November to March, with the months of March and April being transition months dominated by east-south-east winds, while the South-east Monsoon occurs from May to July (or August, according to different sources). Between September and November, the North-east Monsoon gradually re-establishes (Tortell, 1998; Government of Kenya, 2010). The South-east Monsoon (especially from July to August) is when the greatest wind speed and largest wave heights occur (ELP, 2012). The maximum wave heights offshore near Lamu are 6 m and 8 m during the North-east and South-east Monsoons respectively, while wave conditions are usually calmer during the inter-monsoon periods (for example, March to April) (ASCLME, 2012).

Kenya is characterised by heavy rains during March to early June, during the transition months, and the start of the South-east Monsoon due to strong incursions of maritime air from the Indian Ocean. Short rain periods occur between October and November, just before the onset of the North-east monsoon (Tortell, 1998; Samoylis et al., 2015). Thereafter, rainfall rapidly decreases, reaching its minimum during the North-east Monsoon (January and February) (Tortell, 1998).

Currents

There are four different ocean currents that influence the coastal waters of Kenya (Tortell, 1998; Government of Kenya, 2009; Government of Kenya, 2017a). During the South-east monsoon, the East African Coastal Current (EACC) meets the Somali Current (SC) beyond Malindi, and flows north to the Horn of Africa while, during the North-east Monsoon, the meeting point with the reversed SC is between Malindi and Lamu, creating a convergence zone and a new current, the Equatorial Counter Current (ECC) (Tortell, 1998; ASCLME, 2012; Samoylis et al., 2015). Convergence zones are important for enhancing concentrations of nutrients and primary production, which attracts megafauna. Tortell (1998) and Samoylis et al. (2015) suggest that in the zone near Lamu and Kiunga, the convergent movement of the currents towards the offshore would generate an upwelling process adjacent to the Lamu-Kiunga region. This would enhance nutrient circulation and primary productivity in the marine ecosystem (Osuka et al., 2016).

Tides

The main source of data and information regarding the physical oceanography of the Lamu-Kiunga Estuarine System is the Lamu Port ESIA (the Port ESIA) (Ministry of Transport, 2013). Sampling for the Port ESIA was completed using current metres located at the mouth of Manda Bay and at the port berth locations. Data were collected for 45 days over the South-east and the North-east Monsoon transition phase (that is, November to December 2010). Another data set was derived from a one-year time series (for 2009) obtained from the Lamu tide gauge, which is installed at a fishery jetty on Lamu Island.

The tide at the estuarine and Lamu tide gauge stations is semi-diurnal, with two unequal peaks during the day. The amplitudes of the neap tides are:

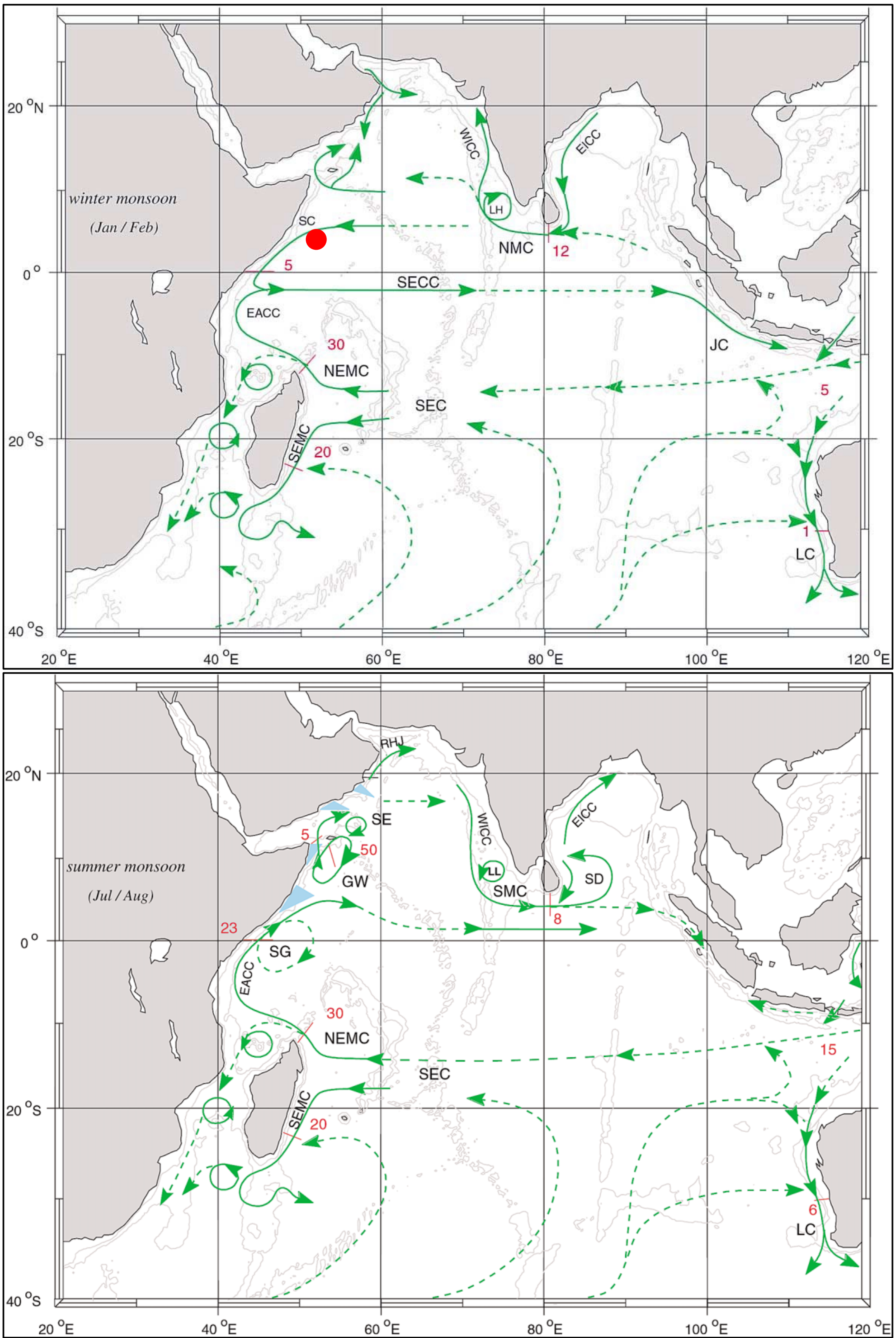
- 0.99 m for the Lamu tide gauge station; and
- 0.92 m for the oceanic station at the mouth of Manda Bay.

The amplitudes of the spring tides are:

- 2.93 m for Lamu tide gauge station; and
- 3.10 m for the oceanic station at the mouth of Manda Bay.

According to the Ministry of Transport (2013), the two main currents at the oceanic station in Manda Bay are the ebb and flood currents created by the tide. They are separated by about 180° (310° for the flood, and 130° for the ebb), and the maximum spring velocity is 0.80 m/s during ebbs and 0.50 m/s during floods. This asymmetry is not pronounced during neap tide. The energy of the two currents and the periods are also different: ebb currents are stronger, with a period of about 5.8 hours, while flood currents are weaker, with periods of about 7 hours. This asymmetry is explained in the port ESIA by the different flow dynamics of ebb and flood currents mainly due to the influence of mangrove areas. The phenomenon of the ebb dominance, with longer ebb periods and faster ebb velocities, is known to occur in other estuarine systems (for example, Shetye and Gouviea, 1992; Mazda et al., 1995; Brown and Davies, 2010).

The information regarding the tidal range, tidal period and current velocity is consistent with the data available for other areas of Kenya. Inshore waters of Kenya experience, in general, semidiurnal tides with tidal range of 3.14 m during spring tides and 1.07 m during neap tides. Moreover, tidal currents rarely exceed 1 m/s of velocity (ASCLME, 2012).



SC = Somali Current	SMC = Southwest Monsoon Current	NMC/NEC = Northeast Monsoon Current, also called North Equatorial Current
SG = Southern Gyre	SECC = South Equatorial Countercurrent	EACC = East African Coastal Current
GW = Great Whirl	SJC = South Java Current	EICC = East Indian Coastal Current
WICC = West Indian Coastal Current	SEC = South Equatorial Current	NEMC = Northeast Madagascar Current

Figure 6.7-5: Main currents of the Western Indian Ocean during the (upper) NE-Monsoon – or winter monsoon – and (lower) SE-Monsoon – or summer monsoon.

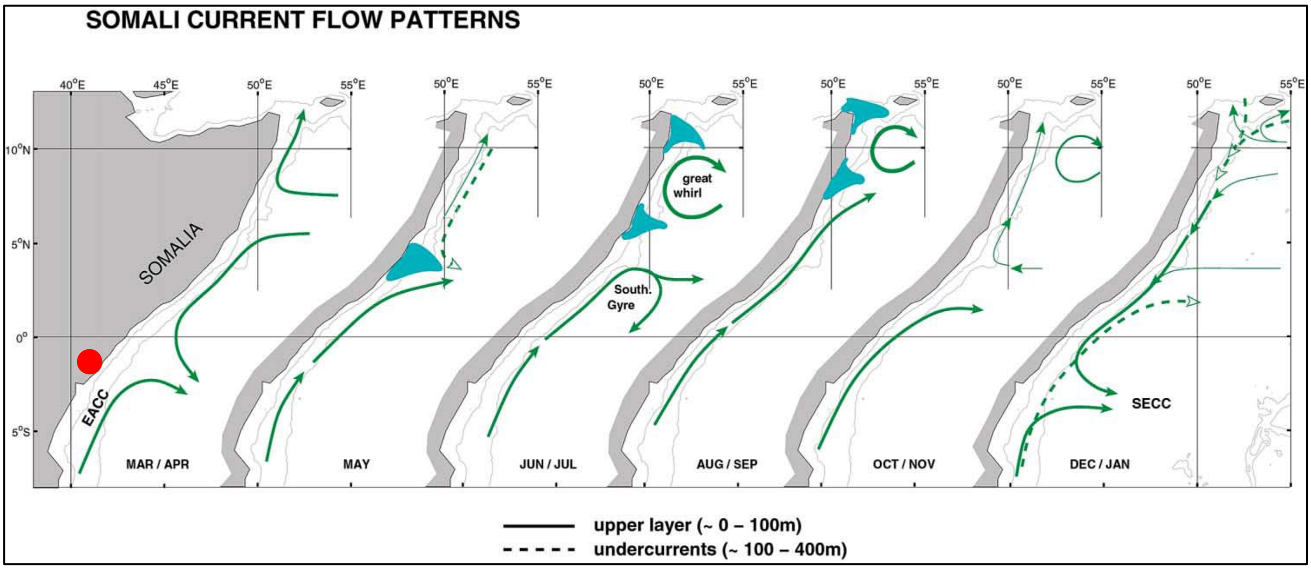


Figure 6.7-6: Schematic diagram of the Somali current flow pattern during the course of a year demonstrating the convergent and divergent process that take place in the region and are likely to enhance primary production. Red dot represents the location of Lamu (source: Schott and McCreary, 2001)

EACC= East Africa Coastal Current, SECC= South Equatorial Counter current (called ECC in other sources)

Geology and Geomorphology

Kenya has about 600 km of low-lying coastline, which is formed as a result of coastal erosion due to the scarce supply of sand from rivers. The coastline is followed by a line of hills up to 300 m high, except in the southern part where hills can reach 1000 m. Just a few metres above the current sea level, extensive fossil reefs are present (Tortell, 1998), which are often used as building material (Government of Kenya, 2009). The seascape north of Malindi has an irregular continental shelf spreading from 4 to 6 km off Kiunga for up to 60 km (Tortell, 1998; Osuka et al., 2016). Otherwise, the continental shelf is typically about 25 km wide. The geology of the islands comprises fossilised sand dunes and beaches of the Pleistocene age. The coastline of Lamu is mostly rocky, consisting of Quaternary sediments that are in contact with Jurassic sediments and the Precambrian basement. It has few indentations and is rimmed by a narrow beach (Osuka et al., 2016) and mangrove sedimentary environments.

Bathymetry

Bathymetric data were collected by EGS (Vietnam) Limited under contract to Japan Port Consultants Limited for the Ministry of Transport in 2010, prior to dredging activities currently being undertaken for the development of Lamu Port. Therefore, the results do not represent an accurate current baseline for areas that have been influenced by port development works. Prior to port construction, at the centre of Manda Bay a channel nearly 60 m deep was present, extending to the mouth of the bay. Outside the bay, in the open sea, the depth steadily increased. Apart from the channel, the water depth within Manda Bay is between 0-30 m, with shallower water in the inner bay.

Underwater Sound

The marine environment is inundated with sounds generated both by natural sources (for example, breaking waves, rain, wind or marine life), and man-made sources (for example, marine traffic, coastal development, exploration activities or military exercises). Some of these sounds are continuously present almost everywhere in the ocean, this background sound being termed ‘ambient noise’. Little data are available on underwater ambient noise in the AoI. However, based on the information retrievable in the review literature, an estimation of natural and man-made sources currently occurring in the area is provided in the following sections.

Man-made sources

Maritime traffic

The AoI is not currently located on busy maritime routes. Manda Bay was rarely used by ships prior to the start of the construction of Lamu Port in 2015. Since that time, traffic has significantly increased (www.marinetraffic.com) (Figure 6.7-7).

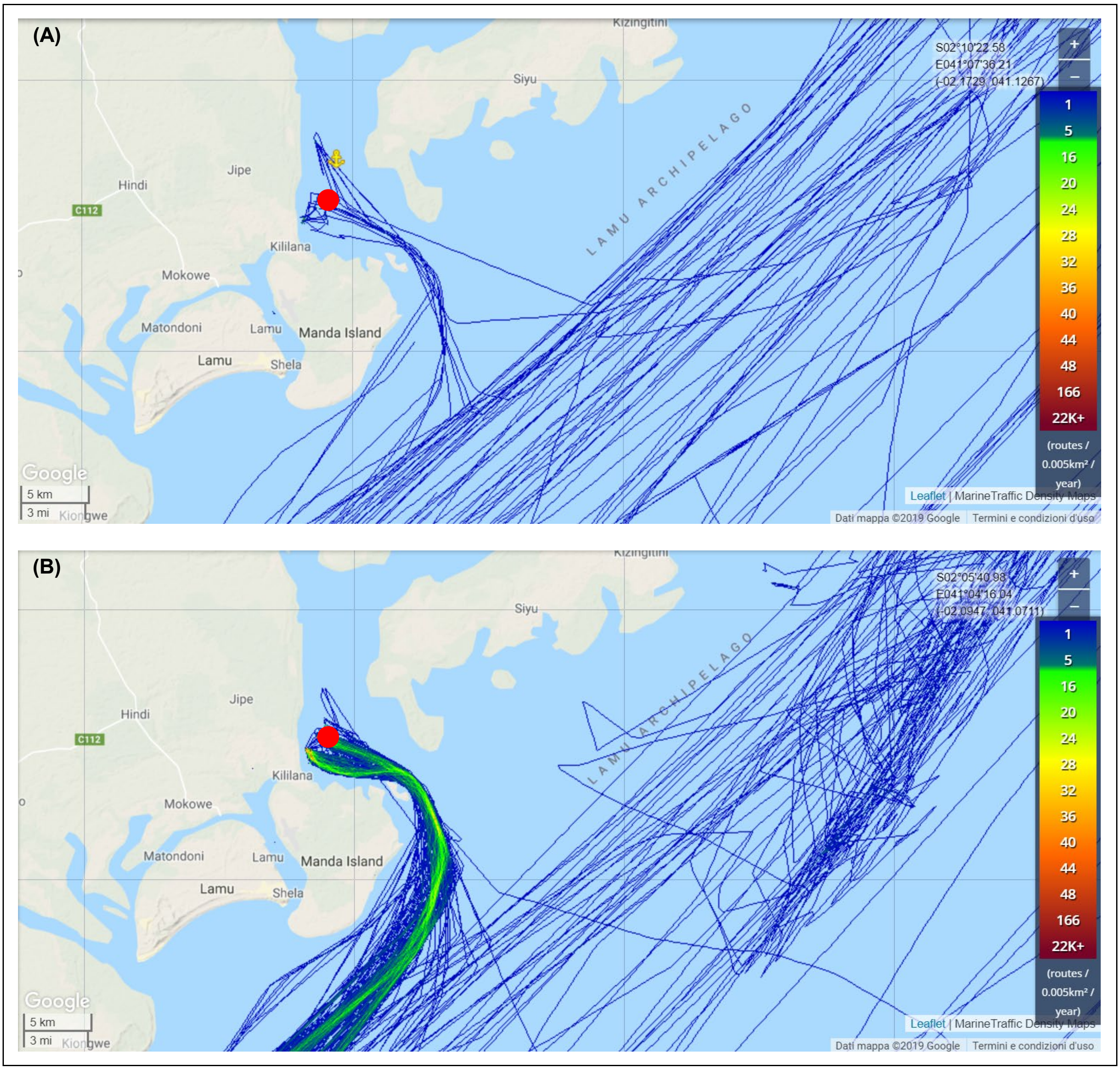


Figure 6.7-7: Maritime traffic in the seascape in (A) 2016 and (B) 2017 (Source: www.marinetraffic.com). The red point indicates the approximate location of the LLCOP Project footprint area

The port is currently under construction and, hence, not highly navigated yet. The vessels currently docked (that is, at January 2019) are mainly cargo vessels. A dredger, an edible-oil tanker, and fishing vessel are registered according to the Marine Traffic portal. Except for the fishing vessel, for which no data exist, all the docked vessels exceed 80 m in length.

The AoI is also expected to be frequented by artisanal fisheries. However, these may be considered negligible in terms of underwater noise, since canoes or low-power engines are usually employed.

Oil & Gas exploration and exploitation activities

The Project's marine AoI is located inside Oil and Gas Block L4, which is licensed to Zarara Oil and Gas by the Government of Kenya. According to Energy-Pedia (2019), a new exploration well (Pate-2) is being drilled in the vicinity of an abandoned natural gas well (Pate-1), whilst a third one (Pate-3) is expected to be drilled in the future. However, as all three wells are located onshore they are considered to be outside the AoI.

Construction/demolition works

The construction of the port includes dredging, pile-driving and installation of other concrete structures. Dredgers are known to emit non-impulsive noise at low frequencies (< 100 Hz), with a Sound Pressure Level (SPL) of 160 dB re 1 µPa at 1 m on average while operating (Boyd et al., 2008). Pile-driving can emit both impulsive (hammering) and/or a non-impulsive (vibrating) sounds, depending on how it is carried out. Usually, both methods are employed together. The SPL of pile-driving works ranges from 190 to 210 dB re 1 µPa at 1 m on average (Leunissen and Dawson, 2018), but the level of sound is dependent upon facrors such as pile size and substrate.

Considering that construction works for the port are expected to last until 2030, those activities are expected to be the most influential on underwater ambient sound levels within the AoI.

Natural sources

Natural factors contributing to underwater noise include wind, rain and waves. Generally, wave noise generated by the wind is dominant. In addition, animals (for example, fish, shrimps and cetaceans) emit sounds in the natural environment, especially for communication. All cetaceans, including the species known to occur, or potentially occur, in the AoI produce sounds for communication, orientation and navigation purposes. Source levels for the tonal sounds are around 170 to 180 dB re 1 µPa at 1 m, while echolocation clicks range from a source level of up to 226 dB re 1 µPa at 1 m for the bottlenose dolphin (*Tursiops truncatus*) (Richards et al., 2007).

Illumination

The AoI is characterised by an absence of large human settlements. There is a small resort on the north coast of Manda Bay (Manda Bay Lodge) and very little infrastructure along the western coast of the channel. The nearest town is Lamu, which could cause the greatest diffuse illumination. However, the new port development and a proposed coal fired power plant (Amu Power, 2016) will increase localised illumination (although the latter is some distance to the north). There is no available information regarding levels of light emission during the construction and operational phases of Lamu Port (Ministry of Transport, 2013), but for reference Lyttelton Port (2014) reported that light emissions caused illumination of 10 lux (for comparison, the illumination level of moonlight is between 0.5 lux and 1 lux.

The increase in local vessel movements will have already led to greater transient light emissions. The level of light emission from the artisanal fishery is negligible.

Water and Sediment Quality

Data sources for the AoI and surrounds are taken from:

- A survey performed in August 2012 as part of the ESIA studies for the construction of the Lamu Port in Manda Bay (Ministry for Transport, 2013); and
- A survey performed in January 2015 as part of the ESIA studies for the building of a coal fired power plant in in the Kwasasi area of Hindi/Magogoni sub-county (21 km north of Lamu town) (Amu Power, 2016).

In both cases, data collection was carried out before the onset of construction of the coastal facilities.

Sediment in the surveyed areas was predominantly sandy (> 80%), and total organic carbon (TOC) levels very low, leading to a low capacity to retain contaminants.

The analysis of those data available for water and sediment indicates that generally good quality conditions exist, with very few exceedances of national and international toxicity thresholds. Few exceedances were observed in the ESIA of the coal fired power plant for: pH, total nitrogen, TDS, fluoride, *E. coli*, biological oxygen demand (BOD_5) and (chemical oxygen demand (COD). However, a few considerations must be made regarding those exceedances:

- pH was slightly lower than the international chronic threshold for only a single station;
- The other parameters were present in all or some samples, with concentrations higher than the Kenyan national standards. However, those standards were established for effluent discharge into the environment, not environment water standards for certain types of use and were used only as a reference in the absence of environmental water standards. Hence, reference concentrations may be over- or underestimated for some parameters; and
- BOD_5 and COD have unusually high levels for environment water. Even if the samples refer to sewage water, the reported concentrations would be considered high. Hence, it is likely that some type of inorganic contamination (possibly by chloride or nitrite) may have affected the results.

Regarding sediment quality, only Cd and Copper (Cu) presented exceedances, but never to the PEL. The former presented exceedances to TEL in all sampling stations, while the latter exceeded TEL only at the Lamu Bay station.

6.7.5.4 Secondary Data Gathering - Biological

Marine Mammals

Various marine mammal studies have been completed in Kenya at local and national scales, but the coverage across the whole of the country is incomplete and data gaps exist. There is limited information on the presence, or absence, of marine mammal species in the northern Kenya, including within the Lamu-Kiunga seascape. Recent local research is focused on marine parks, such as Watamu. National surveys have included historic aerial sightings undertaken in the mid-1990s (Wamukoya et al., 1997; Kenya Wildlife Service, 1996). The most comprehensive recent survey of marine mammals in Kenya was organised by the Kenya Marine Mammal Network (KMMN), a non-governmental organisation (NGO) that undertakes marine research in Kenya on behalf of local and international partners. However, the area of survey excluded northern Kenya. When there is such data paucity, it is important that precautionary approaches are adopted. Therefore, it has been considered possible that all species recorded in Kenyan waters could be resident or occasionally present in the AoI or wider Lamu-Kiunga seascape, if their behaviour suggests potential for this to be the case.

Based on a literature review and consultation with marine mammal experts in Kenya, the species with confirmed presence in Kenyan waters are presented in Table 6.7-1.

Table 6.7-1:Marine mammal species confirmed in Kenyan waters

Common Name	Scientific Name	IUCN Red List Status
Indian Ocean humpback dolphin	*Sousa plumbea*	Endangered
blue whale	*Balaenoptera musculus*	Endangered
sperm whale	*Physeter macrocephalus*	Vulnerable
dugong	*Dugong dugon*	Vulnerable
Cuviers beaked whale	*Ziphius cavirostris*	Least Concern
humpback whale	*Megaptera novaeangliae*	Least Concern
melon-head whale	*Peponocephala electra*	Least Concern
common minke whale	*Balaenoptera acutorostrata*	Least Concern
pantropical spotted dolphin	*Stenella attenuate*	Least Concern
striped dolphin	*Stenella coeruleoalba*	Least Concern
common bottlenose dolphin	*Tursiops truncates*	Least Concern
long-beaked common dolphin	*Delphinus capensis*	Least Concern
Fraser’s dolphin	*Lagenodelhis hosei*	Least Concern
Risso’s dolphin	*Grampus griseus*	Least Concern
rough-toothed dolphin	*Steno bredanensis*	Least Concern
short-beaked common dolphin	*Delphinus delphis*	Least Concern
Blainvilles beaked whale	*Mesoplodon densirostris*	Data Deficient
false killer whale	*Pseudorca crassidens*	Data Deficient
Bryde’s whale	*Balaenoptera edeni*	Data Deficient
Indo-pacific beaked whale	*Indopacetus pacificus*	Data Deficient
short-finned pilot whale	*Globicephala macrorhynchus*	Data Deficient
orca	*Orcinus orca*	Data Deficient
Indo-pacific bottlenose dolphin	*Tursiops aduncus*	Data Deficient
spinner dolphin	*Stenella longirostris*	Data Deficient

An understanding of the general habitat preferences of marine mammals is necessary in order to consider the potential value of the seascape and AoI for these species. Of the species listed in Table 6.7-1, the following are likely to be present in nearshore waters: humpback whale, Indian Ocean humpback dolphin, bottlenose dolphin (also in deeper waters), long-beaked common dolphin, spinner dolphins (resting during the day), pantropical spotted dolphin (during the day), and dugong. Other species may also occur in coastal water at times, including Bryde's whale, blue whale, minke whale and orca. The marine mammal species that are present in Kenyan waters include migratory and congregatory species. The Lamu-Kiunga seascape, including the AoI, may provide ecological functions for such migratory species, including transit or more localised foraging and nursery habitat.

Blue whales can be found in coastal waters, but they generally prefer deep offshore waters and have only been recorded in Kenya in far offshore waters, in depths of 2,990 m to 4,705 m (Barber et al. 2016). Based on the timing and geographical location, Barber et al. (2016) state that the blue whales recorded may have been either Antarctic blue whales (*Balaenoptera musculus intermedia*, classified as Critically Endangered by IUCN and Endangered in Schedule 6 of the Kenya Wildlife Act (Cap 376)), Madagascar pygmy blue whales (*Balaenoptera musculus brevicauda*) or northern Indian Ocean blue whales (*Balaenoptera musculus musculus*).No blue whales were recorded in shallower waters during transit to the survey area (Barber et al. 2016), and records elsewhere in shallower water have usually been in areas with narrow continental shelves or immediately adjacent to deeper water (Branch et al., 2007). The habitat area of blue whales is large, and their movements in Kenya waters are unknown, which supports the need to act in a precautionary manner while there is uncertainty about the presence and behaviour of such wide-ranging and highly mobile marine mammal species as blue, minke and Bryde's whales, both in Kenyan waters and in the south-west Indian Ocean more generally.

In 1996, 540 dolphins were counted in Ungwana Bay and the Lamu archipelago (Wamukoya et al., 1997). Of these, 40 were observed in Ungwana Bay, and 500 in areas outlying Manda and Pate Islands (Samoilys et al., 2011). A dolphin species of note is the Indian Ocean humpback dolphin, which is classified by the IUCN as Endangered. This species has a restricted distribution, and small populations, where they are present. It prefers shallow nearshore waters, where it is threatened by coastal and nearshore human activities (Braulik et al., 2015; Braulik et al., 2016; Braulik et al., 2017). Information on the extent of occurrence (EOO) and population of this species is very limited in Kenyan waters and even at regional or global scales. In Kenya, they have been recorded in Shimoni in southern Kenya, and in the Malindi-Watamu area in central Kenya. The population estimate for Shimoni is 104 individuals. Braulik (2015) states the overall estimate for Mozambique, Tanzania and Kenya, at the time of writing, is 455 individuals. However, these data only reflect the abundance of known populations, and may exclude populations that have been recorded by the KMMN in the coastal waters of Malindi and Watamu. There are no absolute abundance estimates from anywhere north or east of Kenya within the known range of this species.

Humpbacks whales have been recorded in the seascape, travelling from feeding grounds in the Southern Ocean to breed off the east African coast. They usually migrate into east African waters between June and December (Richmond, 2012); with a peak in Kenyan waters in August (S. Trott pers. comm. 2018). Consultation with experts in Kenya would suggest that the majority of the whales move south out of Kenyan waters in September, or October at the latest: this pattern is consistent with records in northern Kenya closer to the AoI (S. Trott, pers. comm. 2018). Again, the lack of data for northern Kenya does provide limitations to this understanding.

Between 2011 and 2013, research by the KMMN recorded 198 humpback whale sightings in Kenya, and a catalogue of 61 humpback whale individuals has been compiled. Again, this may not represent the total number of whales present due to the distribution of the survey effort. The whales that are present along the Kenyan coast are most likely from the South-west Indian Ocean sub-population, known as Breeding Stock C, and are historically considered to comprise sub-stock C1 - a genetically distinct group (Cerchio et al., 2013), but satellite tagging undertaken for whales in Madagascar indicates some interchange between sub-stocks C1 and C3. The estimated population of Breeding Sub-stock C1 is approximately 6,000 individuals for the Mozambique nearshore coast, although it is expected to be higher overall for when taking account of whales present in more northern areas (Cerchio et al., 2013).

Cerchio et al. (2013) report on humpback whale movements during the breeding season between Madagascar and northern Kenya and Somalia using satellite tagging of whales to the east of Madagascar between 24 July and 3 August 2013. The results showed a mother and calf to be located in the Lamu area in late August, and also the movement of a male humpback whale in Somali waters at around the same time. The research also showed that the mother and calf remained within 50 km of Lamu for 5 days before the tag stopped transmitting, potentially demonstrating some localised behaviour in this area. In addition to these satellite data, a mother and calf were sighted in Manda Bay on 13 October 2011 (KMMN, 2012).

A small number of dugongs have been recorded in the Lamu archipelago feeding on seagrass beds (Samoilys et al., 2011. The Lamu-Kiunga seascape is recognised important dugong habitat (Church and Obura 2006; Government of Kenya, 2009). Areas of potential foraging importance may include the KMNR, Dodori and Mongoni creeks, and the Siyu Channel between Pate Island and the mainland. Aerial surveys in the Lamu Archipelago counted ten individuals in 1994, and six individuals in 1996 (Wamukoya et al. 1997; Samoilys et al., 2011). The sightings in 1996 include animals in the Siyu channel and near Manda Toto Island. During the same period, several clear feeding trails were also observed in areas off Faza, Uvondo and Ndau islands (Wamukoya et al. 1997; Samoilys et al., 2011). In 2002 there were anecdotal reports of between five and eight animals, including two calves, at Siyu Channel and Kiunga Muini (Wamukoya et al. 1997; Samoilys et al., 2011).

Sightings of dugong have become very rare and Osuka et al. (2016) suggest that the infrequency of sightings it is likely to have become extinct in this area. This statement does, however, need to be treated with caution due to the lack of recent research focused on dugong populations. However, available evidence from dugong sightings in Kenya, in addition to their vulnerability to nearshore human impacts, make this a species of conservation concern.

Sea Turtles

Five sea turtle species are reported to occur in Kenyan waters, including the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive ridley turtle (*Lepidochelys olivacea*), loggerhead turtle (*Caretta caretta*) and leatherback turtle (*Dermochelys coriacea*). These species have the following IUCN Red List classifications:

- Green turtle: Endangered;
- Hawksbill turtle: Critically Endangered;
- Olive ridley: Vulnerable;
- Loggerhead turtle: Near Threatened (SW Indian Ocean subpopulation); and
- Leatherback turtle: Critically Endangered (SW Indian Ocean subpopulation).

Sea turtles occupy various habitats throughout their lifetime, including nesting beaches and coastal, neritic (shallow) and oceanic waters. They are also subject to broad movements for foraging and breeding migrations. Therefore, the baseline understanding of sea turtles needs to be considered broadly, which is reflected in the information provided below.

Between 2008 and 2010, WWF and the KWS collaborated on the tagging of 14 green turtles, and a single hawksbill turtle, with the majority of activity occurring in the KMNR. Data are available at: http://www.seaturtle.org/tracking/index.shtml?project_id=307. The data shows that there is connectivity of green turtle nesting beaches in Kenya and Tanzania and Somalia. The data also shows more localised activity in line with that already explained above. There is potentially some connectivity between nearshore waters in the Project area and nesting grounds in the Chagos Archipelago for green turtles. Olendo et al. (2017) also reported upon catch and release tagging programmes in the KMNR, which provided some evidence that green turtles returned to the same beaches to nest over multiple years, but they stated that a low level of recapture limits the understanding of turtle movements in the archipelago. Therefore, impacts in the AoI need to be considered at a local, regional and international level.

Only the green turtle, hawksbill turtle, and olive ridley turtle commonly nest on beaches in Kenya, with the green turtle known to nest in significantly greater numbers than other species (Olendo et al., 2017, Okemwa et al., 2006; Okemwa et al., 2004; Frazier 1975; Wamukoya et al., 1996a; Nzuki and Muasa, 2005). Olendo et al. (2017) state that between 1997 and 2013, nesting data from beaches within the Kiunga Marine National Reserve (KMNR) shows that 97.5% of nests were by green turtles, 1.5% by hawksbill turtles, 0.4% were olive ridley turtles, and 0.5% unidentified nests. The leatherback turtle and loggerhead turtle are not thought to normally nest in Kenya (Frazier 1975; Okemwa 2002; Okemwa et al. 2004; Okemwa et al., 2004). However, these species have been recorded in offshore waters, mainly through records of strandings, and are, therefore, expected to be migrating and foraging in Kenyan waters. Loggerhead turtle strandings have been recorded in the Lamu-Kiunga seascape, but at a low level. Sightings of leatherback turtles are rare in Kenyan waters, and although it is expected that they would most probably occur in deep waters between October and March (Hamann et al., 2006), the presence of this species in the Lamu-Kiunga seascape, including the AoI, cannot be discounted.

At the time of writing of their report, Okemwa et al. (2004) stated that monitoring of sea turtle nesting activities covered 31% of the overall coastline. There is therefore a data paucity across the whole Kenyan coast, which limits the full understanding of nesting incidence, and an absence of nesting records where potential nesting habitat exists along the Kenya coastline cannot be assumed to be confirmation of the absence of turtle nesting. The same applies when determining the importance of different areas and overall species population levels, because this is also a function of data availability.

Figure 6.7-8 identifies some known nesting sites in Kenya using data compiled in the Environmental Sensitivity Atlas for the Coastal Area of Kenya (KenSea) (Tychsen, 2006). This information is based on historic coarse mapping and should only be considered to provide a very indicative overview of where sea turtle nesting has been recorded. As an example, the data suggest a high priority nesting site to the north-east of Manda Island. However, consultation with Lamu Marine Conservation Trust (LaMCoT), which undertakes sea turtle nesting research on the island, suggests that nesting is focused to the south in the Takwa area (S. Wanjiru, pers. comm., 2018; A. Salim, pers. comm., 2018).

Okemwa et al. (2004) reported upon the status of sea turtles in Kenya, with reference to data collated by the Kenya Sea Turtle Conservation Committee (KESCOM), which was established in 1993 to provide a national integrated approach to sea turtle conservation. They provide a summary of nesting data collated by groups along the Kenya coastline between 1997 and 2000, and state that key nesting sites include: Jumba Ruins; Kijipwa and Nyali along the Mombasa beach stretch; Kiungawini and Mongo Shariff along the Kiunga beach stretch; and the Watamu beach stretch. Green turtles represented 91% of nests reported. It was acknowledged at the time of writing of their report that there were gaps in knowledge for the distribution of key nesting sites especially in sections where accessibility is poor, such as the stretch between Malindi and Lamu. They also report upon turtle strandings, which gives an indication of the turtle species present in Kenyan waters. Fifty-four per cent of the turtle strandings were green turtles, 6% were hawksbill turtle, 2% were loggerhead turtles and 1% were leatherback turtles; the remainder were unidentified.

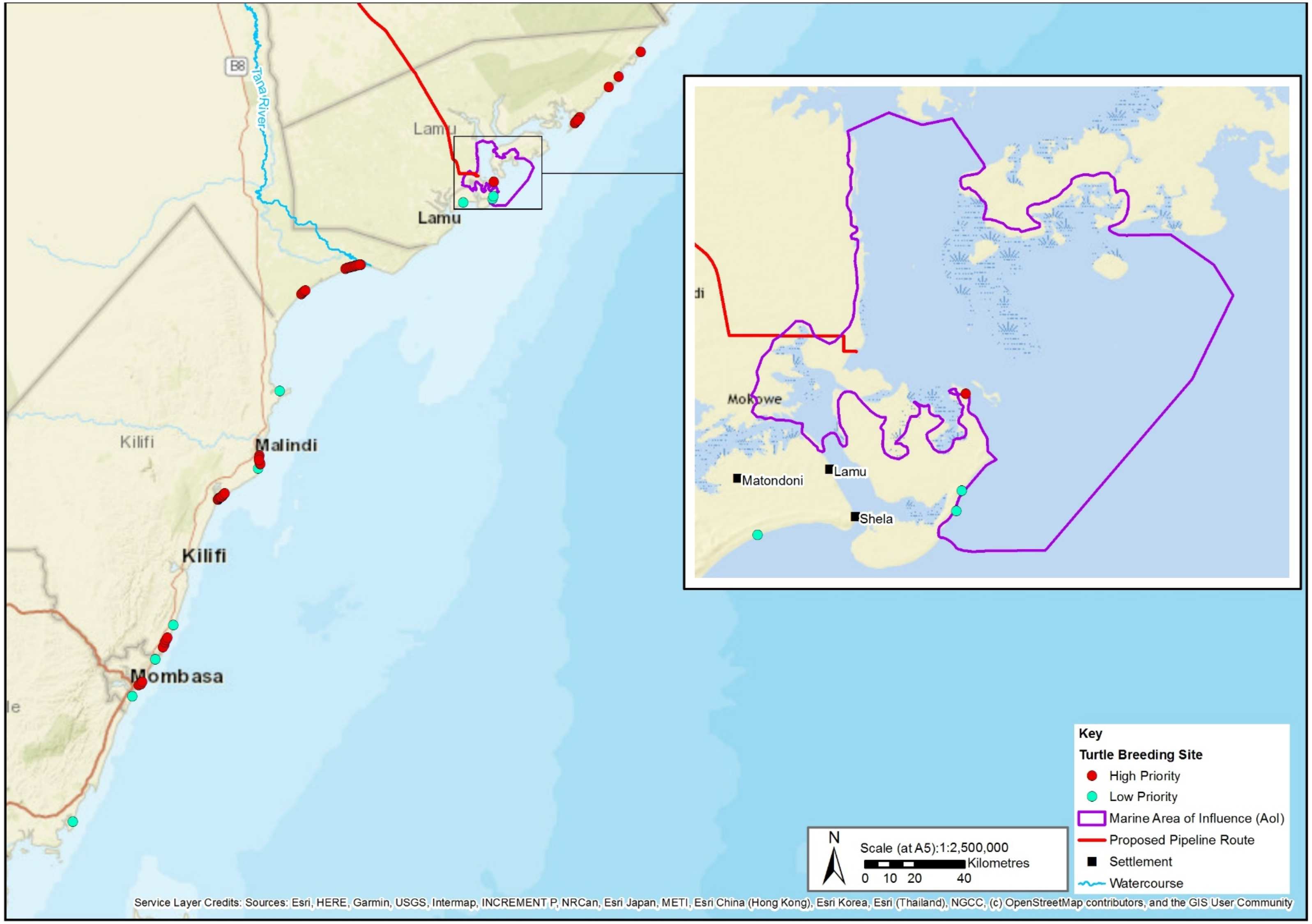


Figure 6.7-8: Known sea turtle nesting areas in Kenya - blue denotes low priority nesting sites; red denotes high priority nesting sites. Each point represents 1 km coastline (sourced from the World Resources Institute – origin UNDP et al., 2006)

Within the Lamu-Kiunga seascape, data on nesting events have been collected on beaches over a long period by local conservation groups (e.g. LaMCoT and WWF) with local community support (Olendo et al., 2017; S. Wanjiru, pers. comm. 2018). The Lamu-Kiunga seascape provides the most significant nesting beaches for sea turtles in Kenya and is estimated to support >60% of reported nests (Olendo et al., 2017). Offshore seagrass beds, coral reef areas, and associated algal beds provide important foraging habitat for sea turtles. In this regard, the seascape represents a significant foraging resource for sea turtles.

Within the seascape area, the main areas of nesting activity occur on beaches in the KMNR and on Manda Island and Lamu Island (Okemwa et. al. 2004). Within the KMNR, Rubu Island, Kiwayu Island, and Kiunga provide important nesting habitat (Olendo et al., 2017). Long-term monitoring has been completed at Kiunga, Rubu Island, Mvundeni, Mkokoni and Kiwayu. Consultation with LaMCoT confirmed that the main known nesting beach on Manda Island is along the easterly, exposed coast at Takwa (S. Wanjiru, pers. comm., 2018; A. Salim, pers. comm., 2018). This area is located on the boundaries of the AoI, as shown in Figure 6.7-9, although as this is where local monitoring effort is focused the possibility of nesting where there is less or no monitoring, either elsewhere on the island or other areas where habitat allows, cannot be discounted. This may include beaches that afford nesting habitat north of the Takwa nesting beach, nearer to the Project site.

Nesting data for Takwa beach show an annual mean of 34 nests per year between 1997 and 2018 (LaMCoT, unpublished data). Olendo et al. (2017) report that the peak nesting period in the KMNR is between March and July, with over 74% of nests recorded during this period, which correlates with the South-east Monsoon and associated rainfall and sea surface temperature. Nesting activity is highest in May but was confirmed to occur all year round. Olendo et al. (2017) also report that there are higher levels of nesting in the KMNR than at Takwa and Shela beaches, ranging from an annual mean of 141 to 791 nests at Kiwayu, Mkokoni, Mvundeni, Rubu and Kiunga (Rubu had the highest annual mean, at 791 nests).

All of the sea turtles mentioned above are classed as migratory, with species that are breeding and nesting in the area also defined as congregatory. Sea turtles are potentially wide-ranging across their life cycle, and individual species show different patterns of movement, remaining local or travelling long distances to other areas. This understanding is important to determine how activities in the AoI may have a broader impact.

Anthropogenic threats to sea turtles include high levels of poaching (for eggs and meat) by local communities and fisheries by-catch (trawling and artisanal). The Government of Kenya has put in place legislation to protect sea turtles, i.e. the Wildlife Act (Cap 376). There is no legislation protecting key nesting and foraging habitats utilised by sea turtles, except for those falling within legally protected areas. Olendo et al. (2017) reported on that sites monitored in the KMNR showed levels of predation at 16.5% of nests.

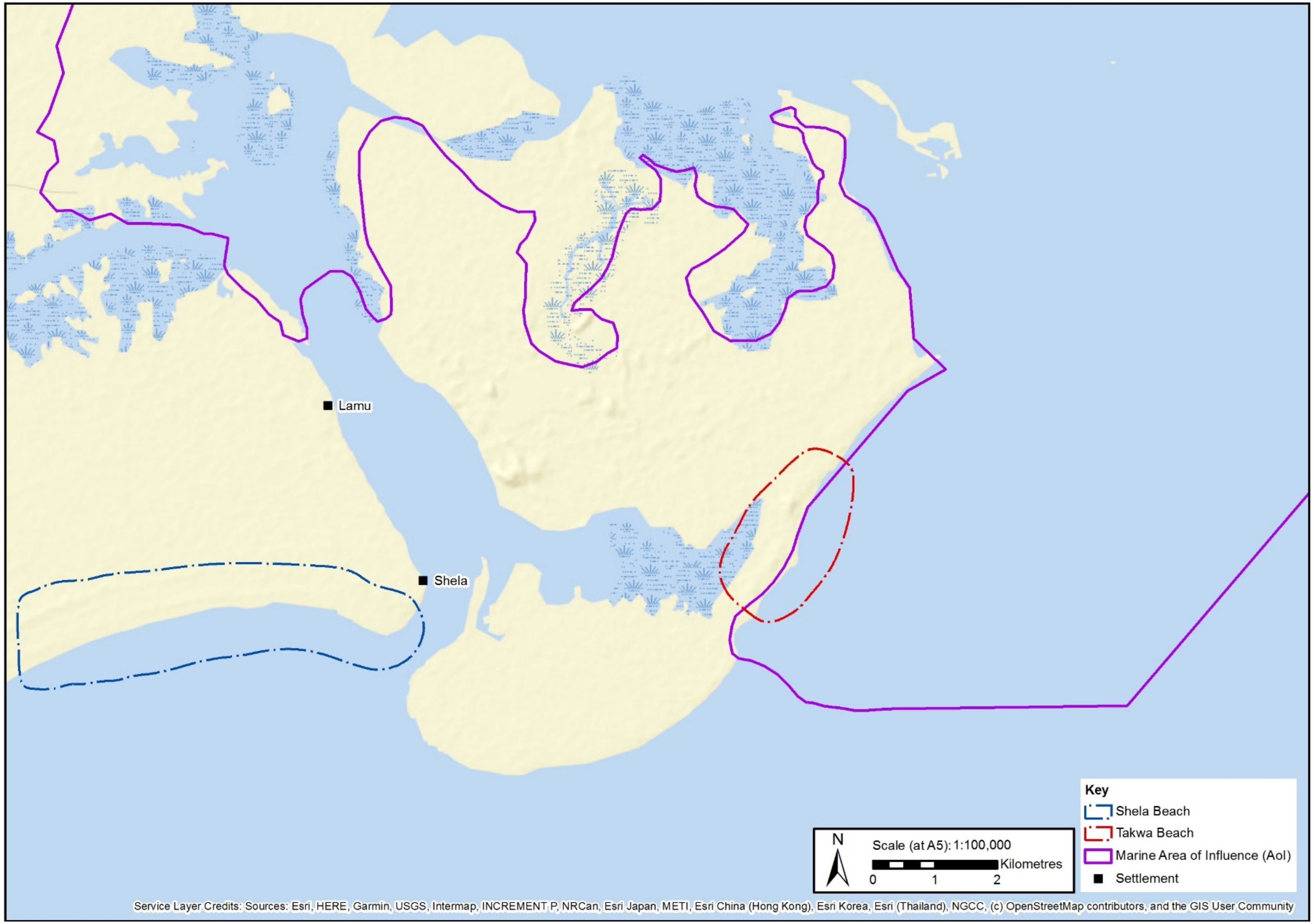


Figure 6.7-9: Known nesting beaches on Lamu Island and Manda Island that are monitored by LaMCoT – Shela is in blue and Takwa is in red

Fish

Cartilaginous fish (Chondrichthyes) are known to be present in the AoI (Osuka et al., 2016). Aerial surveys conducted in 1994 along the Kenyan coast, as part of the Marine Resources Inventory of the KWS, showed the presence of sharks and whale sharks, with major concentrations in Ungwana Bay and in the areas around Manda and Pate islands. Furthermore, rays were spotted along all the Kenyan coast (Wamukoya et al., 1996b). A black tip reef shark (*Carcharhinus melanopterus*) was observed during the surveys for the Lamu Port (Ministry of Transport, 2013).

Three of the six species of sharks regularly seen and fished for in the Pate Island-Kiunga area (Osuka et al., 2016) are classified as Endangered according to IUCN:

- Whale shark (*Rhincodon typus*) (Pierce and Norman, 2016);
- Scalloped hammerhead (*Sphyrna lewini*) (Baum et al., 2009); and
- Great hammerhead (*Sphyrna mokarran*) (Denham et al., 2007).

The other three (that is, blacktip reef shark (*Carcharhinus melanopterus*), whitetip reef shark (*Triaenodon obesus*) and tiger shark (*Galeocerdo cuvier*) are classified as Near Threatened (Huepel, 2009; Smale, 2009; Simpfendorfer, 2009). Zebra shark (Stegostoma fasciatum), also Endangered, is not frequently sighted or fished but is likely to occur in the area.

Nine species of rays were recorded in the area (Osuka, 2016), four of them are classified as Vulnerable according to the IUCN:

- Giant manta ray (*Manta birostris*) (Marshall et al., 2018);
- Giant guitarfish or whitespotted wedgefish (*Rhynchobatus djiddensis*) (Dudley and Cavanagh, 2006);
- Blotched fantail ray (*Taeniurops meyeni*) (Kyne and White, 2015); and
- Honeycomb stingray (Himantura uarnak) (Manjaji Matsumoto et al., 2016).

The others are classified as Near Threatened (i.e. spotted eagle ray (*Aetobatus narinari*), Kyne et al, 2006; bluespotted ray (*Taeniura lymma*); Compagno, 2009) or Data Deficient (i.e. bluespotted sting ray (*Neotrygon kuhlii*), Kyne and Finucci, 2018; blackspotted torpedo (*Torpedo fuscomaculata*), Pheena, 2004; Gulf torpedo (Torpedo sinuspersici), Smale, 2006).

The narrow sawfish (*Anoxypristis cuspidata*), which is listed as Endangered by the IUCN (D'Anastasi et al., 2013), and appears in Appendix I of the CITES, is found in Ungwana Bay and the lower reaches of the Tana River where it thrives on shallow muddy habitats. In this area, other important sawfish species are thought to be present including the Critically Endangered *Pristis pectinata* (smalltooth sawfish), *Pristis pristis* (largetooth sawfish), *Pristis zijsron* (green sawfish) (Samoilys et al., 2011), but the presence of these species in the Lamu Archipelago is unknown (Samoilys et al., 2011).

Osuka et al. (2016) recorded 189 species belonging to 19 families of fish associated with coral reefs in the Pate Island and Kiunga Area. These numbers are considered low in comparison with southern reefs but are expected for these northernmost reefs. The biomass of fish recorded during that 2016 survey was lower than that recorded in 2008 (Osuka et al., 2016). The most abundant species of fish associated with coral reefs in the AoI is the parrotfish (Scaridae), followed by the surgeonfish (Acanthuridae). Other types of fish found were rabbitfishes (Siganidae), sweetlips (Haemulidae), emperors (Pomacanthidae), snappers (Lutjanidae), angelfishes (Pomacanthidae), goatfishes (Mullidae), groupers (Serranidae), butterflyfishes (Chaetodontidae), wrasses (Labridae) and triggerfishes (Balistidae) (Ministry of Transport, 2013; Amu Power 2016). Most of the fish were recorded in the channel between Manda Island and Pate Island.

The main types of fish caught in the Lamu archipelago are reef, seagrass and sand-associated demersal species, such as scarids (parrotfish), scavengers (lethrinids, lutjanids, haemulids) and signanids. In addition, pelagic fish species, such as cavallies, jacks, mackerel, barracuda, kingfish, tuna, sharks and rays are also caught in large quantities (Murage, undated).

Other fish species of conservation concern found in the seascape include the Endangered Napoleon wrasse (or humphead wrasse) (*Cheilinus undulatus*) (Russell, 2004); the endemic angelfish of the Red Sea/Gulf of Aden, (*Apolemichthys xanthotis*); and the brown-marbled grouper (*Epinephelus fuscoguttatus*) (Ministry of Transport, 2013; Samoilys et al., 2011; Osuka et al., 2016). Samoylis et al., (2011) recorded three juvenile females of Napoleon wrasse on the deeper slope at Pazarli reef, which is located south-east of Pate Island. This sighting, supported by the observation of another juvenile during the port ESIA survey (Ministry of Transport, 2013), could be indicative of a spawning aggregation of the Napoleon wrasse in this area, in particular near the Pazarli reef (Samoylis et al., 2011). Benthic Habitats

The AoI is characterised by the presence of three types of benthic habitats:

- coral reefs: typically, these are fringing coral reefs but also occur as patch reefs (Osuka et al., 2016).
- seagrasses: which grow mostly on sandy to sandy-muddy sediments from the intertidal zone down to a depth of 20 m or more (Tychsen, 2006); and
- soft bottom sediment: which occur from the surface to the deepest zones (50 to 60 m at the centre of the channel);

Myriad of algae, invertebrates and fish (described in Section 0) including threatened species, inhabit these habitats, and are discussed in this section.

Benthic Habitat Map

A habitat map has been developed to define the spatial distribution of the main benthic habitats in the AoI, and is presented in Figure 6.7-10. It was created in GIS using the available information on benthic habitat distribution, as described in the following sub-sections and summarised below:

- Coral reefs distribution map for Kenyan coasts produced by: UNDP, KMFRI, and Geological Survey of Denmark and Greenland (GEUS) (2006);
- Global coral reefs distribution map gridded at 500 m resolution compiled by Institute for Marine Remote Sensing, University of South Florida (IMaRS/USF), Institut de Recherche pour le Développement (IRD), UNEP-WCMC, The WorldFish Center, and WRI (2011);
- Map of the distribution of coral reefs and mangroves in the area of Pate and Lamu islands and the Kiunga Marine Reserve as reported in Obura et al. (2012);
- Map of the distribution of coral reefs and mangroves compiled by WWF-East Africa Regional Programme Office as reported by Samoilys and Kanyange (2008); and
- Database of seagrasses distribution available at RCMRD (2015): only the category ‘Submerged Vegetation’ was also considered.

In some sections of the map the coral distribution is not precise, as witnessed by the overlapping with some areas of mangroves, recognisable in the satellite orthophoto. This limitation is due to differences in the scale and gridding levels of the available database. Other sections of the AoI do not have enough data regarding the benthic composition, are not categorised.

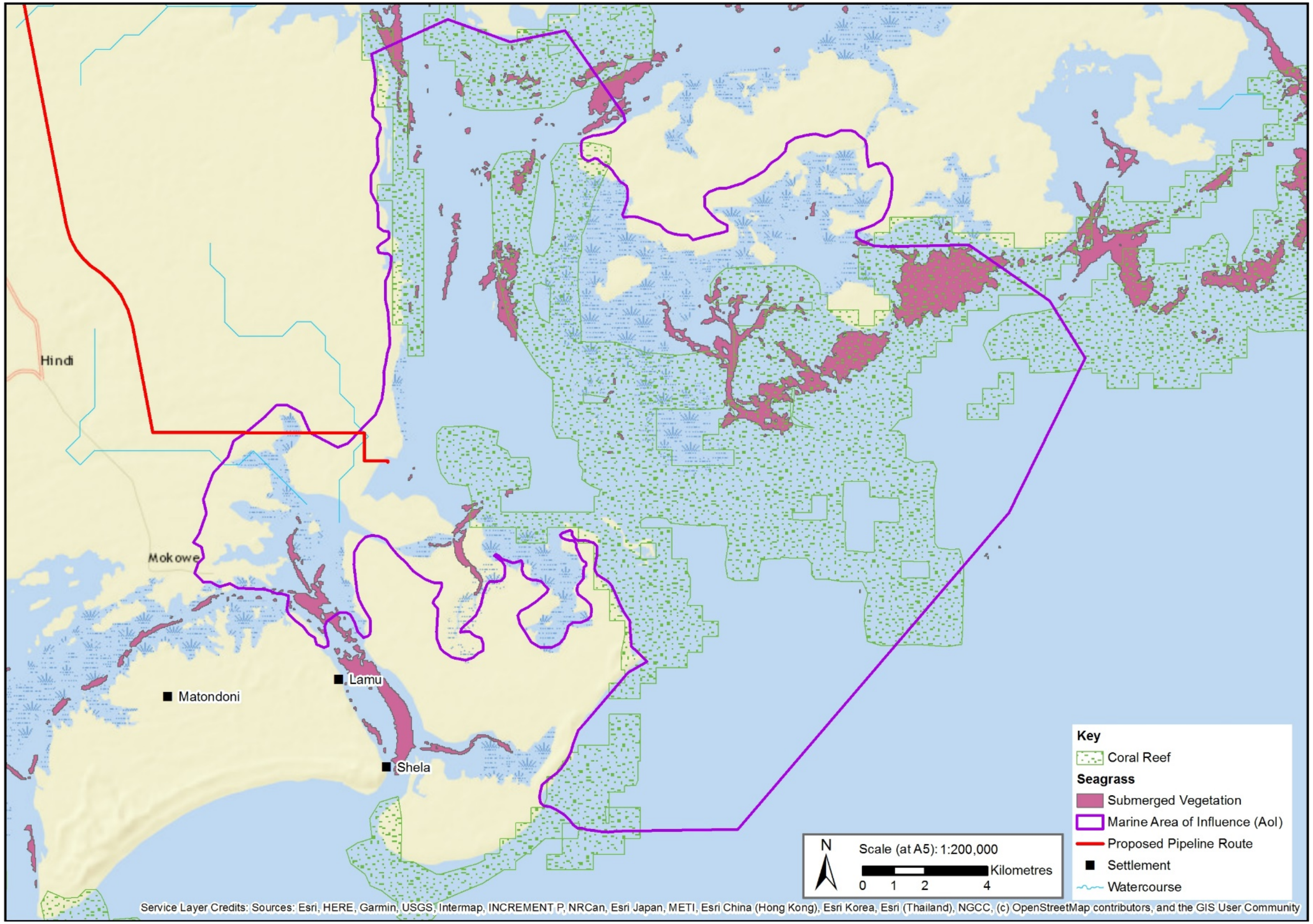


Figure 6.7-10: Benthic habitat distribution within and adjacent to the AoI (Elaborated by Golder GIS analyst based on UNDP, 2006; Samoilys and Kanyange, 2008; Institute for Marine Remote Sensing et al., 2011; Obura et al., 2012; RCMRD, 2015

Coral Reefs

In Kenyan coastal waters, coral reef habitats occur from the surface to a depth of 20 – 25 m (Tychsen, 2006), and cover an estimated area of 624.55 km^2 (Osuka et al., 2016). In the AoI and seascape, fringing coral reefs are present to the south-east of Manda Island, south-west of Pate Island, on the peninsula between Mongoni and Dodori creeks, and along the nearshore zone of Kiunga. A small coral reef was located in the footprint of the port, but it is likely that it has already been adversely impacted by construction activities (based on recent satellite imagery, January 2019) as addressed in the port ESIA Report (Ministry for Transport, 2013).

The richness of corals around Pate is low, with 157 species assessed by Obura (2008). These reefs have been described as a mixture of species from the Arabian Sea, Red Sea and southern zones of Africa (for example, the Mozambique Channel) (Obura et al., 2012). This low species richness is suggested to be due to the remoteness of this zone from the known hotspot of coral biodiversity (that is, 10°S), the poorer environmental conditions due to the influence of the Somali current (Obura et al., 2008), and the sediment discharge of rivers, which are particularly abundant along this part of the Kenyan coast (Tychsen, 2006).

In 1998, an El Niño event caused an anomalous increase in water temperature in the Indo-Pacific Ocean, which led to a mass mortality event among corals and other species (Obura et al., 2008). Nearly 90% of the corals on the Kenyan coasts died during this event, and they seem not to have totally recovered. In fact, the remoteness of these coral zones, and the slow growth of those species, make the recovery harder (Tychsen, 2006; Obura et al, 2008; Samoilys et al., 2011; Obura et al., 2012). Coral reefs in the Kiunga Marine National Reserve (KNMR), north-east to the Lamu archipelago, near the Somali border, suffered nearly a 60% loss of coral cover due to both the 1998 El Niño event and an algal bloom in 2002, which affected these reefs and the associated fish fauna (Church and Obura, 2006).

Coral reefs in this far northern region of Kenya have a unique mix of species from the Red Sea/Arabian Gulf, which are not found further south. They can contain coral genera that are rare in Kenya and endemic to East Africa or northern West Indian Ocean/Arabia region. Species that have been noted by local research in this regard include *Horastrea indica*, *Siderastrea savignyana*, *Caulastrea connata* and *Moseleya* species (Church and Obura, 2006; Samoilys et al., 2011; Osuka et al., 2016). Other unique coral species that are present in the northern reef system include the north-west Indian Ocean, Red Sea and the Gulf of Aden species *Porites nodifera*, *P. columnaris*; and *Coscinaraea columna*; *Pachyseris rugosa*, *Turbinaria reniformis*, *T. mesenterina*, *T. peltata*, *T. stellulata*, *Catalaphyllia jardinei* and *Physogyra lichtensteini*, which although present in this area, have a broader range (Obura, 2008; Osuka et al., 2016).

Samoilys et al. (2011) found large massive *Porites* spp., and a bank of *Goniopora* sp., in a survey in northern Kenya. More recently, Osuka et al. (2016) and the Ministry of Transport (2013) have conducted rapid surveys in the Lamu-Kiunga seascape, including the AoI, which showed a low coverage of corals (25% to 35%), with a dominance of *Porites* spp. and the presence of 15 other genera (mainly *Favites, Goniastera, Coscinaraea* and *Favia*). Osuka et al. (2016) recorded the presence of *Horastrea indica*, *Turbinaria mesenterina*, *T. peltata*, T. stellulata. The Ministry of Transport (2013) identified both *Turbinaria* spp. and *Horastrea* spp.

Amu Power (2016) assessed the habitats in Manda Bay and reported coral reefs in the deeper sections (20 – 25 m) where the Wange Creek meets the bay. These reefs, which occupied between 10% to 30% of the sea bottom, were of the inner type, fringed in patchy communities in the sheltered sections of the bay. Besides the genera already identified in the previous surveys, Amu Power (2016) recorded *Horastrea indica*, a critical habitat trigger species.

The percentage of cover, and the number of colonies of corals within the AoI, are listed in the port ESIA (Ministry of Transport, 2013). This represents the baseline before port construction activities were started. Hard corals were the second most abundant benthic habitat, both in the zone near Lamu Port and the channel of Manda Bay, with 26% cover in the channel and 35% near the berth area. Within the coral genera, massive *Porites* spp.

was most abundant, both in terms of coverage area and the number of colonies, and it was present both in the Manda channel and berth areas. Surveys identified a greater number of colonies and species richness in the channel area in comparison to the port footprint area.

Seagrass Beds

Seagrass beds are considered to be among the most threatened ecosystems on earth, and they are of high biodiversity value due to the important ecosystem functions they provide for marine animals such as fish, sea turtles and dugong (including spawning, nursery and foraging). The dominant species across the seascape, including the AoI, is *Thallasodendron ciliatum* (Church and Obura, 2006), which is also found near coral reefs (Samoilys et al., 2011). *Syringodium isoetifolium*, *Cymodocea serrulata*, *C. rotundata*, *Halodule wrightii*, *H. uninervis*, *Enhalus acroroides* and *Zostera capansis* are also present (Samoilys et al., 2011; Osuka et al., 2016).

During the port EISA studies (Ministry of Transport, 2013) seagrass sampling was conducted and, in addition to the aforementioned species, *Halophila ovalis* and *H. stipulacea* were recorded. The most abundant species was *Syringodium isoetifolium* (Ministry of Transport, 2013). In addition, Amu Power (2016) recorded *Thalassia hemprichii* (common in shallow water next to mangroves) and *Ruppia maritima*. The most abundant species were *Halodule wrightii* and *Cymodocea rotunda* (on the high intertidal zone), followed by *Thalassia hemprichii* (common in shallow waters, next to mangroves), *Enhalus acoroides*, *Thalasondedron ciliatum*, *Halophila* spp and *Syringondium isoetifolium* (in the shallow to medium-deep waters in coral reef zones).

Mangroves

Mangroves are coastal ecosystems occurring in sheltered intertidal zones of tropical and subtropical regions of the world. They are mainly composed by tree and shrub species possessing adaptations to: living in an unstable soil; coping with frequent submersion and low oxygen levels in the soil; and dealing with high levels of salinity in the water. Associated with the plants are resident fauna (for example, crabs and snails), equally adapted to the niche environmental conditions observed in the mangroves, and non-resident fauna (for example, fishes, birds and mammals) which are also considered part of the ecosystem.

The AoI is located within the East Africa Mangroves Global 200 ecoregion. The Global 200 provides a list of 238 ecoregions that have been selected by WWF as forming the "*world's most unique, irreplaceable and biologically diverse regions.*" This ecoregion is defined by WWF as being critical or endangered (Olson and Dinerstein, 2002) and it encompasses an extensive coastal in Mozambique, Tanzania, Kenya and Somalia. Over 60% of Kenya's mangrove forest is located in the Lamu-Kiunga seascape (Osuka et al., 2016) and these mangrove habitats are therefore considered to be important at a local, regional, national and ecoregion level.

Mangrove forests along the Kenyan coast cover approximately 61,271 ha (Government of Kenya, 2017a). The country has lost about 20% of its original mangrove cover (Government of Kenya, 2017b), which represents about 450 ha (0.7%) loss and degradation of mangrove cover per year. This is close to the mean global rate of mangrove deforestation (1%/year) (FAO, 2003).

The AoI is located on a sheltered coastline, with dense mangrove coverage within a continuous mangrove system that forms a key biological component of the coastal and marine Lamu-Kiunga landscape and seascape (Figure 6.7-11). Other important mangrove regions in Kenya include Tana, Mida Creek, Kilifi, Mombasa and Gazi-Vanga (Murage, undated). Over 60% of Kenya's mangrove forest coverage is located in this Lamu-Kiunga area, covering an area of 37,350 ha (Osuka et al., 2016; Government of Kenya, 2017a). There is high connectivity between the Lamu-Kiunga mangrove belt and the nearby coral reefs and seagrasses, facilitating the use of mangroves as nursery grounds by fish species.

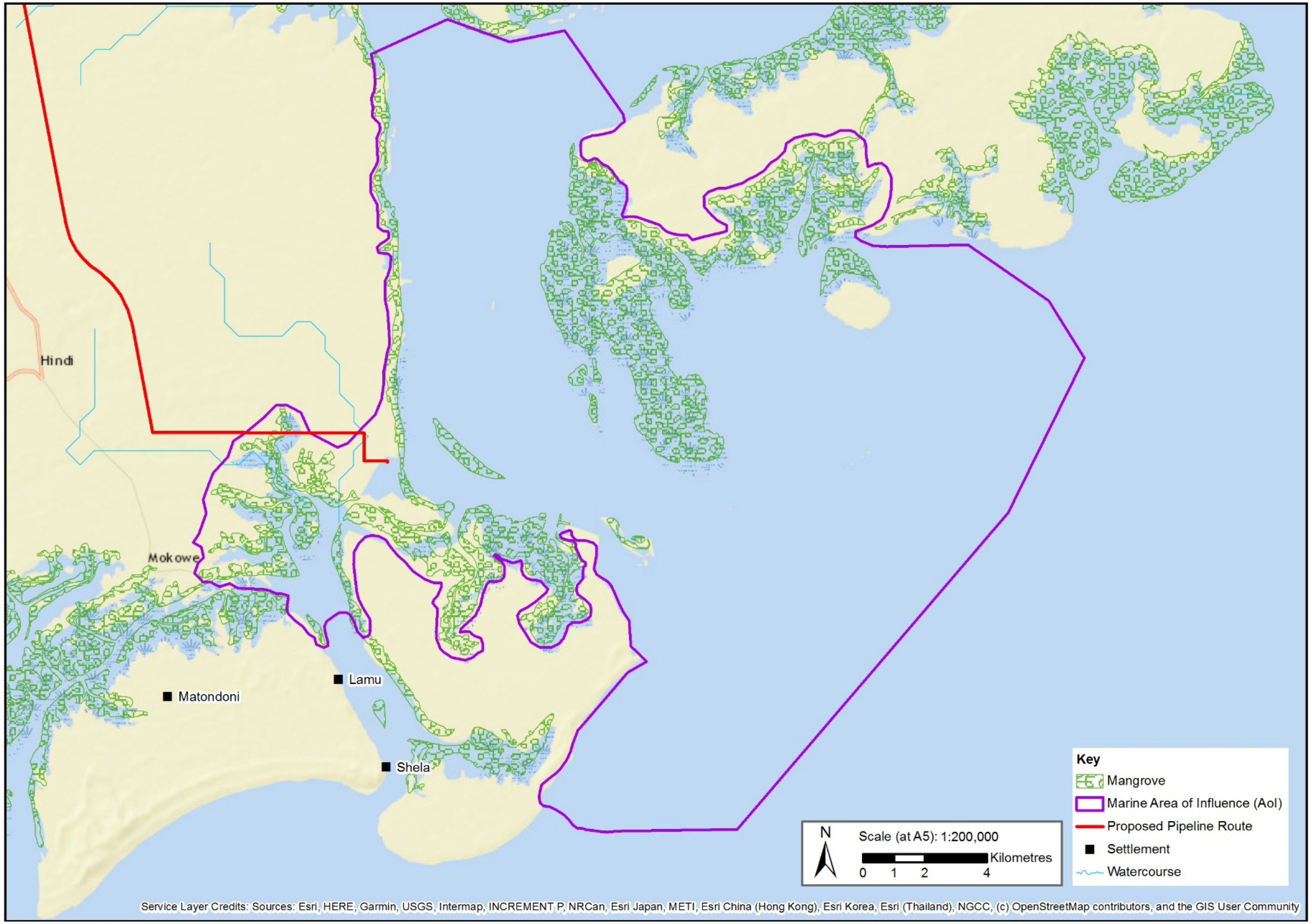


Figure 6.7-11: Mangrove cover within and adjacent to the AoI (source: RCMRD, undated)

The total area of mangroves inside the AoI is 5,967 ha. This area includes the Pate Island Swamp unit, the largest in the Lamu-Kiunga area. Behind the mangrove forests, in the high intertidal zones, extensive non-vegetated tidal flats which resemble salt flats (or hypersaline flats) occur. These are a natural feature of the mangrove ecosystem formed by very low tidal frequency and long-lasting water deficit conditions (that is, levels of evapotranspiration that are higher than precipitation). Salt flats are considered to be buffer zones for mangrove forest migration in response to climate change and, in some cases, are known to export large amounts of nitrogen sequestered by cyanobacteria to the forest. However, classification of the above-mentioned tidal flats as salt flats (and thus a feature of the ecosystem) is yet to be confirmed in the field.

Eight mangrove tree species occur in the Lamu-Kiunga estuarine complex: grey mangrove (*Avicennia marina*), black mangrove (*Bruguiera gymnorrhiza*), red mangrove (*Rhizophora mucronate*), spurred mangrove (*Ceriops tagal*), *Lumnitzera racemose*, *Soneratia alba*, *Xylocarpus granatum* and *Xylocarpus mollucensis* (Government of Kenya, 2017a). The dominant species in the AoI are *Rhizophora mucronata*, *Ceriops tagal*, *Sonneratia alba* and *Avicennia marina* (Ministry of Transport, 2013; Osuka et al., 2016).

Mangroves of Kenya display a typical zonation of species that is greatly influenced by tidal frequency, geomorphology, and salinity (Government of Kenya, 2017a). A typical zonation of mangrove in Kenya starts with *Sonneratia alba* on the seaward margin, followed by large trees of *Avicennia marina* and *Rhizophora mucronata*. In the creeks, a *Rhizophora-Avicennia* mix is dominant. *Avicennia* is found mostly on the landward side but can also be found in seaward areas.

6.7.5.5 Secondary Data Gathering - Protected Areas and Relevant Biodiversity Areas

The AoI overlaps one protected area, the Pate Marine Community Conservancy (Figure 6.7-12). This area was declared in 2010 and covers 192 km^2 (according to the World Database on Protected Areas). It includes significant areas of mangroves, coral reefs and seagrass beds that are of importance to local artisanal fishery communities. Community Conservancy areas are, according to Kawaka et al. (2015), Protected Coastal Zones defined by the Kenyan Environmental Management and Coordination Act (1999) as protected areas.

The AoI completely overlaps with a portion of the Ecologically or Biologically Significant Area (EBSA) 'Lamu-Kiunga Area'. EBSAs are defined by the Convention on Biological Diversity (CBD) and, although they do not have status of protected areas, they are recognised as areas that serve important purposes, supporting healthy functioning of oceans and the many services they provide (https://www.cbd.int/ebsa/about). the Lamu-Kiunga Area is considered part of six priority landscapes involved in the implementation of climate change adaptation components of WWF programmes, and these contain mangrove and tidal flat habitats recognised as some of the most extensive and species-rich along the entire coast of East Africa. They provide very important value in terms of biodiversity, climate protection (blue carbon), fishery, nature-based tourism and coastal protection (The Clearing-House Mechanism of the Convention on Biological Diversity, 2015).

Other protected or biologically or ecologically important areas within 20 km of the AoI include:

- Dodori National Reserve (IUCN management category II), also an Important Bird and Biodiversity Area (IBA);
- Kiunga Marine National Reserve (IUCN management category VI), also an IBA, which has been designated a UNESCO-Man and the Biosphere Reserve;
- Kiunga Marine Conservancy (Community Nature Reserve; not reported in the IUCN management categories); and
- A proposed UNESCO World Heritage Site: Lamu-Kiunga Archipelago.

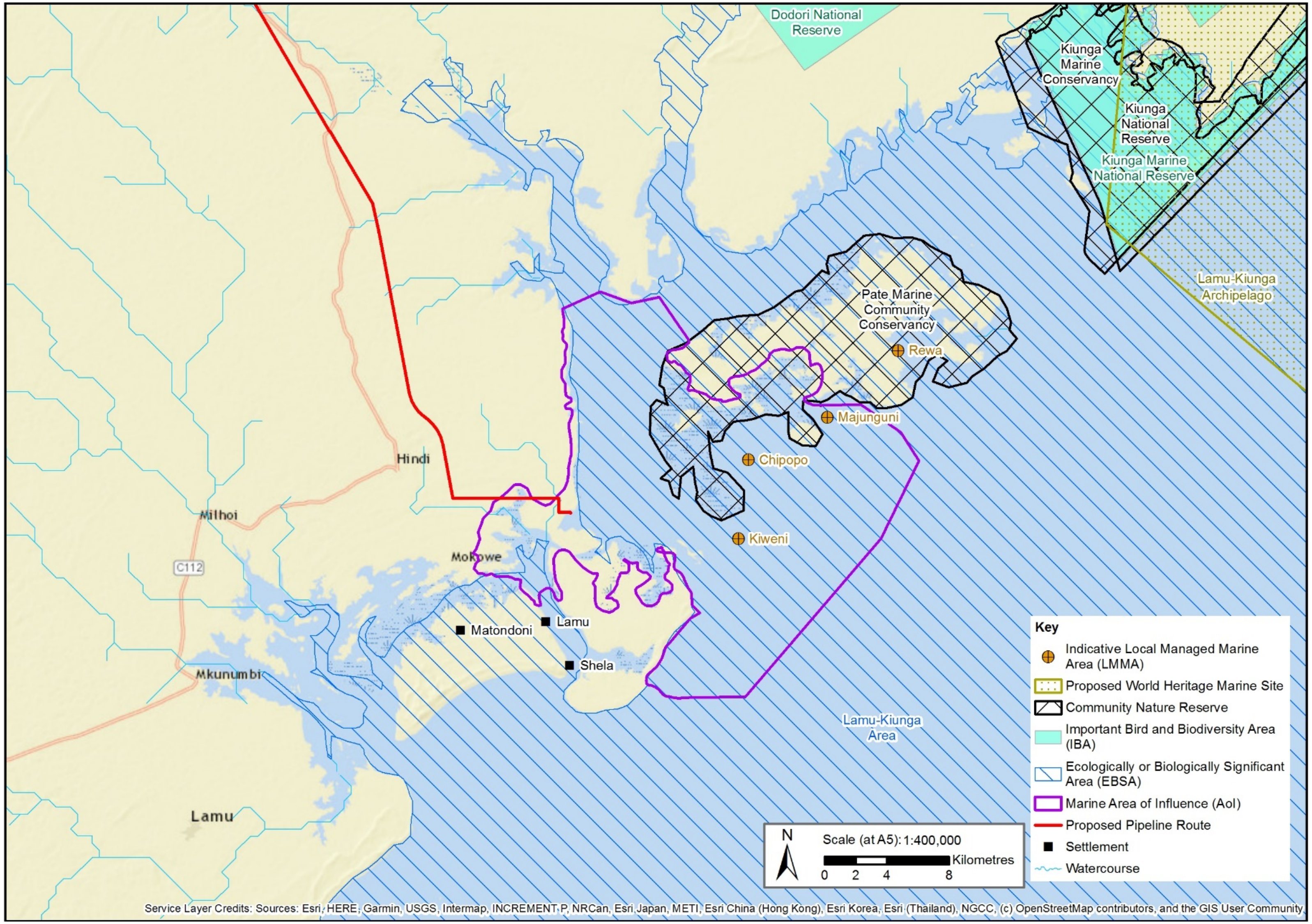


Figure 6.7-12: Protected areas, biologically or ecologically significant areas

In addition to the above, the Kweni Locally Managed Marine (LMMA) is located approximately 6 km from Lamu Port to the south of Pate Island. The site lies adjacent to the channel that forms the navigation approaches to the port. It comprises an area of 57.7 ha and includes coral reef, seagrass beds, fish nursery, and foraging habitat for species such as sea turtles and dugong. Samoilys et al. (2011) noted that the protection of areas such as the Kiweni LMMA has improved localised fish stocks. The area also provides wider ecosystem services, including for locally managed eco-tourism (Murage, undated). The Pate Marine Community Conservancy (PMCC) has been established in 2012 to improve the management of LMMAs around Pate Island, including Kweni.

6.7.6 Baseline Summary Sites, Habitats and Species of Conservation Concern

The consolidated results of the primary and secondary data gathering has resulted in a number of key biodiversity species, habitats and protected areas of relevance to the AoI. They are as follows:

Protected Areas

- Pate Marine Community Conservancy;
- Lamu-Kiunga EBSA; Kiunga Marine National Reserve;
- Kiunga Marine Community Conservancy;
- Lamu-Kiunga Archipelago (proposed UNESCO World Heritage Site); and
- Dodori National Reserve (Terrestrial: IUCN management category II).

Habitats

- Mangroves;
- Coral reefs; and
- Sea grass beds.

Species

- Indian Ocean humpback dolphin (Endangered, IUCN);
- Dugong (Vulnerable, population recently reported as potentially in single figures recently recorded in single figures or locally extinct);
- Humpback whale (listed as Least Concern, but of conservation concern due to its migratory behaviour);
- Hawksbill and leatherback turtles are Critically Endangered and green turtle (the most common species nesting in the area) is Endangered (IUCN 2009). All are likely to forage on offshore seagrass beds, coral reef areas, and associated algal beds;
- Avifauna including species listed under the Kenyan Wildlife and Conservation Management Act (2013); and
- Fish species including (several shark and ray species, Napoleon wrasse) including species listed under the Kenyan Wildlife and Conservation Management Act (2013).

6.8 Landscape and Visual

6.8.1 Introduction

The landscape and visual baseline desk study has been undertaken to:

- Establish the key characteristics of the landscape; and
- Assess the visual baseline by characterising baseline visibility from key locations.

6.8.2 Area of Influence

The AoI for the landscape and visual assessment (Figure 6.8-1), within which data has been gathered for the baseline, comprises the areas of potential visual effects during operations and construction of the Project, based on analysis completed within the ESIA. It includes an area comprising a 10 km buffer around each station along the pipeline.

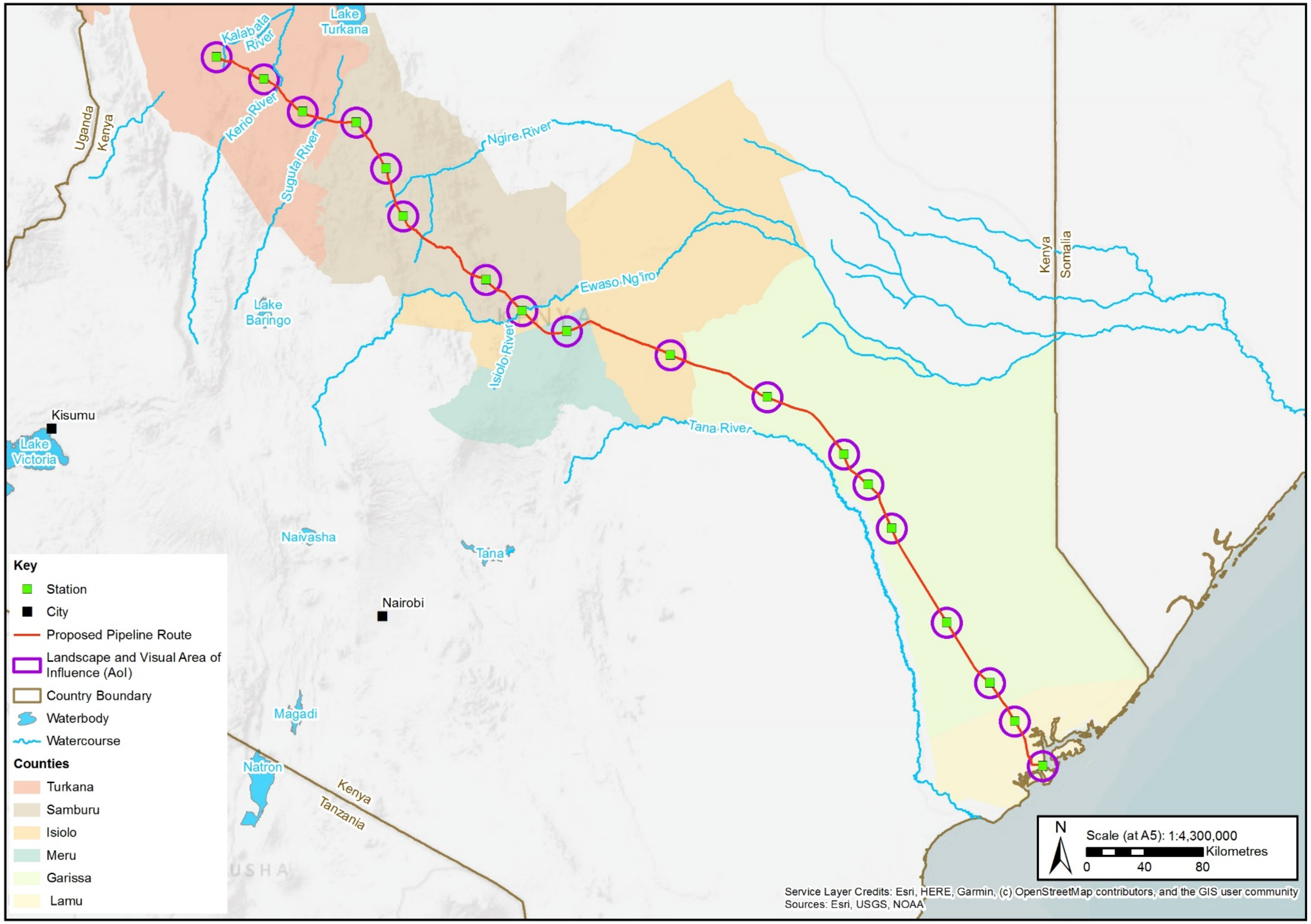


Figure 6.8-1: Landscape and Visual AoI

6.8.3 Method

6.8.4 Data Sources

Primary data was captured during field survey in March 2019. The locations of a number, of stations, were visited to assess and record the existing visual and landscape character conditions. The locations visited were:

- Station 4;
- Station 5;
- Station 6;
- Station 7;
- Station 9;
- Station 10; and
- Lamu Port.

Secondary data was captured through an extensive desk-based study, which included a range of aerial imagery and digital surface models (DSMs).

During the review of secondary data sources, 32 Points of Interest (POIs) were identified, representing a wide range of potential receptors, including a range of features of cultural and ecological interest. These are presented in Drawing 6.8-1 in the Landscape and Visual Baseline Report (Annex II). Protected areas are presented in Figure 6.8-2.

6.8.5 Landscape Character

It is a distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another. The landscape assessment is a process of identifying and describing variation in the character of the landscape.

Areas displaying similar characteristics are referred to as 'Landscape Character Areas' (LCAs). LCAs are made up of recognisable patterns or elements (physical and perceptual) that occur consistently, in a particular area, and define its character, or 'sense of place'.

The process of assessing the landscape character was based on review of available aerial photography and topographical maps as well as previous studies, in terms of:

- Natural elements;
- Human-made elements;
- The topographical character of the site and its surroundings and potential occurrence of landform;
- Features of interest;
- The presence of water bodies;
- The general nature and level of disturbance of existing vegetation cover; and
- The nature and level of human disturbance and transformation evident.

The landscape characterisation was digitised using baseline vegetation and landcover datasets. ArcGIS 10.4.1 was used to process the data to determine the landscape. The terrain datasets were used to create a realistic terrain within the AoI.

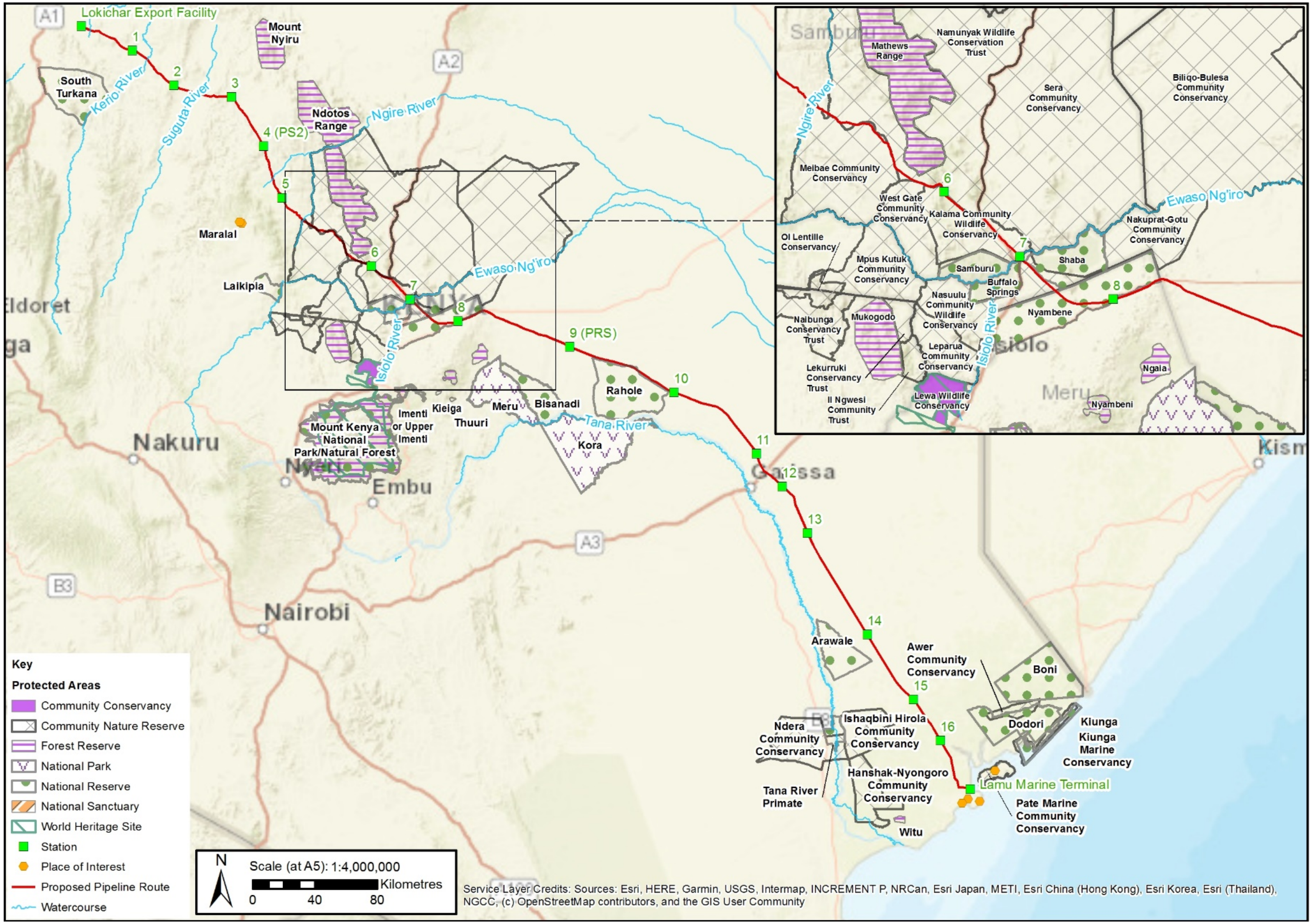


Figure 6.8-2: Protected Areas and POIs along the LLCOP route

6.8.6 Visual

The secondary data, aerial imagery and the DSM were assessed for the following within the AoI during an initial desk-based review, to ascertain the baseline visual characteristics:

- Settlements and homesteads;
- Luggas and vegetation types forming riparian habitat, which supported trees of heights up to 30 – 40 m;
- Access routes, such as roads and trackways; and
- Terrain characteristics.

Subsequently, during fieldwork undertaken in March 2019, photographs were taken from a selection of representative field viewpoints to ascertain baseline visibility. Figure 6.8-3 presents these locations.

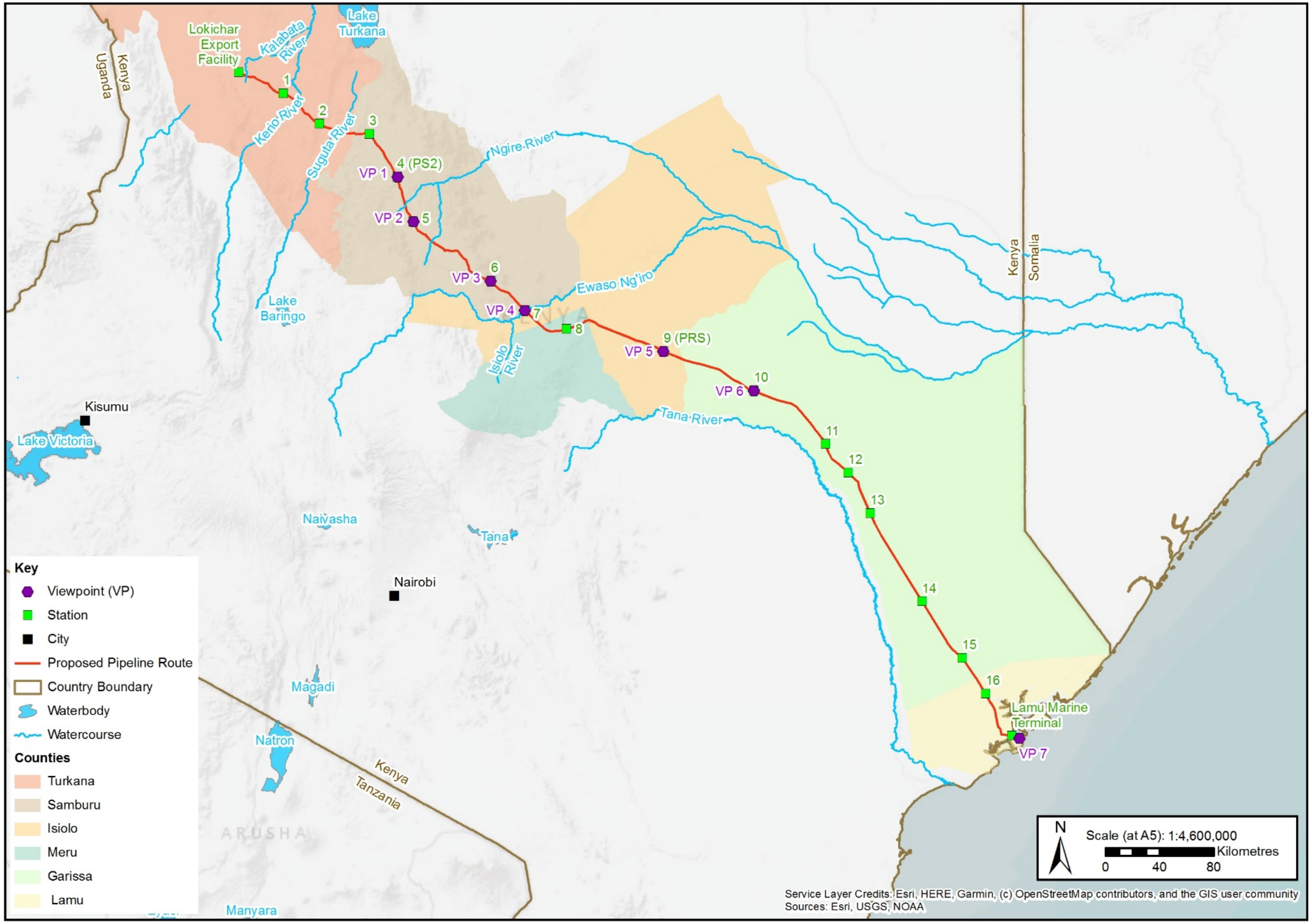


Figure 6.8-3: Photo location from baseline data gathering

6.8.7 Results

6.8.7.1 Landscape Character Areas

A number of LCAs are present along the pipeline route, from Lokichar to Lamu. LCA boundaries do not necessarily indicate an abrupt change in landscape characteristics; the transition between the different areas may be gradual, especially the boundaries between the undulating scrub bushland LCA and the dense bushland scrub LCA. These categorisations are not related to whether habitats are natural or modified.

In total four LCAs were identified within or adjacent to the AoI:

- LCA 1 – Dense Shrub:
  - Dense scrub communities in the landscape. There is little existing infrastructure, apart from roads and access roads and few distinctive elements of notable quality and rarity within this LCA; and
  - Landscape or protected area designations present, including Namunyak Wildlife Conservation Trust.

Figure 6.8-4: LCA 1 - Dense shrub (Station 6)

- LCA 2 – Grassland:
  - Grassy open expanse frequented by herders and farmers. There is little existing infrastructure, apart from roads and access roads and few distinctive elements of notable quality and rarity within this LCA. Seascape also present at LMT: and
  - Landscape or protected area designations present, including Samburu National Reserve, Buffalo Springs National Reserve Shaba National Reserve, Sera Community Conservancy.

Figure 6.8-5: LCA 2 – Grassland (Station 4)

- LCA 3 – Scattered Scrub:
  - Extensive spread of scattered scrub in the landscape. There is little existing infrastructure, apart from roads and access roads and few distinctive elements of notable quality and rarity within this LCA; and
  - Landscape or protected area designations present, including, West Gate Community Conservancy, Nyambene National Reserve, Nakuprat-Gotu Community Conservancy and Rahole National Reserve.

Figure 6.8-6: LCA 3 - Scattered shrub (Station 9)

- LCA 4 – Forest:
  - Extensive nature of the forest in landscape. There is little existing infrastructure, apart from roads and access roads and few distinctive elements of notable quality and rarity within this LCA; and
  - There are no landscape or protected area designations present.

The LCA for each Station is presented in Drawings 1 to 18 in the Landscape and Visual Baseline Report (Annex II).

6.8.7.2 Field Survey

The results of the field survey are presented in Table 6.8-1. Seven viewpoints were identified to provide a representative sample of the typical view experienced by the local population (Figure 6.8-3). The photographs are presented in Drawings 19 to 25 in the Landscape and Visual Baseline Report (Annex II).

Table 6.8-1: Field Survey Results

Station	Photo Location	Visual Description	Corresponding LCA
Station 4	Adjacent to Station 4	Wide open vistas with the occasional large tree. The topography is flat to slightly undulating.	Grassland; Grassy expanse frequented by herders.
Station 5	Adjacent to Station 5	Mixture of dense and sparse vegetation offering natural screening and limited views.	Scattered Scrub; dominated by Acacia-Commiphora stunted bushland. Shrub species in these plant committees typically reach heights of 4 m.
Station 6	Adjacent to Road	Sparse vegetation offering natural screening and limited views.	Dense Scrub; dense scrub communities, such as Acacia-Commiphora/stunted bushland and Somalia-Masai Acacia-Commiphora deciduous bushland and thickets vegetation communities extend across the eastern and central parts of the AoI, scrub heights typically reach 4 m.
Station 7	200 m south of Station 7	Wide open vistas with scattered shrub and low-lying undergrowth. The topography is relatively flat.	Grassland; Grassy expanse frequented by herders and farmers. Archers Post village lies adjacent to the station location. The landscape is eroded due to the removal of natural vegetation and grazing pressures on the surrounding landscape.
Station 9	Adjacent to Station 9	Sparse vegetation offering some natural screening and relatively limited views.	Scattered Scrub; dominated by Acacia-Commiphora stunted bushland. Shrub species in these plant committees typically reach heights of 4 m. Grassland; Grassy expanse frequented by herders.
Station 10	Garissa-Modogashe Road adjacent to Station 10	Sparse vegetation offering some natural screening and relatively limited views.	Scattered Scrub; Shrub species in these plant committees typically reach heights of 4 m. Tree and scrub heights range from 6 m to 18 m.
Lamu Port	Manda Bay Hotel	Wide open vistas from the Hotel of the seascape.	Coastal Marine; the landscape vegetation is a grassy expanse. The topography of the landscape is flat. Tree species range in height from 4 m to 10 m.

6.9 Cultural Heritage

6.9.1 Introduction

The purpose of the cultural heritage baseline study was to collect objective and scientifically defendable data of sufficient breadth and quality to characterise baseline cultural heritage conditions within the Area of Influence (AoI) of the Lokichar to Lamu Crude Oil Pipeline Project (LLCOP).

Cultural heritage is comprised of both tangible and intangible components. Tangible heritage includes moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), palaeontological, historical, cultural, artistic, and religious values; or unique natural features or tangible objects that embody cultural values, such as sacred groves, rocks, lakes and waterfalls (IFC, 2012).

Intangible heritage, also known as "*living heritage*" or "*living culture*", includes practices, representations, expressions, knowledge and skills handed down from generation to generation. In this report, intangible heritage is described both in the cultural practices that are undertaken in the Project area, as well as through the living heritage sites that occur in the landscape. These living heritage sites are the tangible locations where intangible heritage is experienced or performed (e.g. spiritual ceremonies at religious monuments). Also included in living heritage sites are locations where communities have identified a collective "*attachment to place*" or "*sense of place*".

6.9.2 Area of Influence

The AoI for the cultural heritage assessment (Figure 6.9-1), within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes an area comprising 5 km buffer along the entire pipeline, where cultural heritage sites (both tangible and intangible) may be present.

6.9.3 Method

Consulting both primary and secondary data sources, a combination of desk-based study (secondary), key informant interviews (primary) and field survey (primary) was used to characterise baseline conditions for cultural heritage in the AoI. The Right of Way (RoW), a 26 m wide corridor within which construction disturbance is likely to occur, is located within the AoI and was the subject to more detailed baseline characterisation. Spatial analysis of all cultural heritage data was completed using GIS software.

Cultural heritage studies were led by competent professionals from NMK, with complementary work related to key informant interviews completed by ESF. All primary data gathering was completed in accordance with Kenyan legislation and guidance pertaining to cultural heritage protection, in particular the Environmental Management and Co-ordination Act (EMCA) 1999, and the National Museums and Heritage Act (2006). Detailed findings are presented in the Cultural Heritage Baseline report (Annex II) and the Social Baseline report (Annex II).

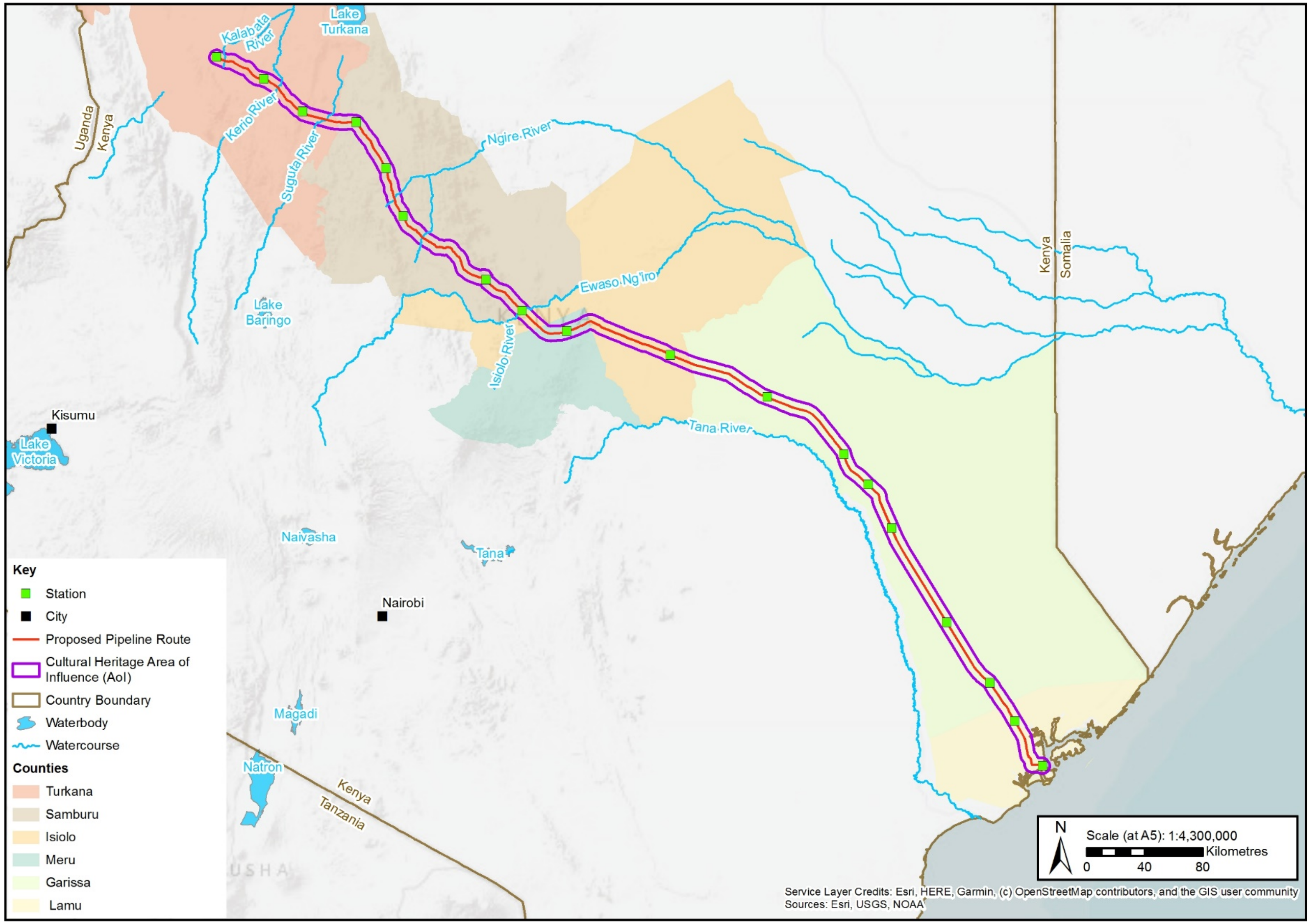


Figure 6.9-1: Cultural Heritage Potential AoI

6.9.3.1 Desk-Based Study

Published and unpublished reference material was reviewed to identify cultural heritage sites located in the AoI, to identify areas of potential for the presence of such sites and to provide regional context in which to interpret the established baseline conditions. The results were also used to identify areas to target with field work.

The Lake Turkana basin, owing to its internationally recognised archaeological and palaeontological significance, has attracted a wealth of academic research, which is used to inform the NMK cultural heritage dataset. These records are the key source of information for previously recorded sites in the AoI, including statutory protections afforded to them. While valuable, it is important to recognise that NMK records are biased towards sites of higher assessed significance. More modest cultural heritage sites, such as local churches, are unlikely to be found in NMK records.

In addition to the NMK cultural heritage dataset, the following information sources were consulted:

- UNESCO World Heritage List;
- Accession reports and field notes from different research missions;
- LLCOP Stage 2 Baseline Survey Field Survey Reports for Cultural Heritage Survey in Lamu, Samburu/Isiolo Section, Turkana and Garissa/Sankuri Area (Annex II);
- W.P. and K.E. Ndiema. 2014. Report on Prehistory Heritage Monitoring and Conservation During Tullow Oil Seismic Data Acquisition Block 10BA, Kenya. Unpublished report on file with Tullow Oil plc.;
- Aerial photographs; and
- High resolution satellite imagery of the AoI.

6.9.3.2 Key Informant Interviews

Prior to the commencement of the cultural heritage baseline study, cultural heritage data of a non-archaeological nature had been collected by the Golder social team, as is described in detail in the LLCOP Social Baseline report (Annex II). Where relevant information was collected by the social assessment team, it has been incorporated into the Cultural Heritage Baseline report (Annex II).

Key Informant Interviews (KII) or meetings specific to cultural heritage were undertaken at settlements in proximity within the AoI and led by the NMK. KIIs and meetings were completed with community leaders and Elders and sought to document the following:

- Sites of cultural significance to communities (i.e. living heritage sites), including religious, sacred or ritual sites and cemeteries or burial areas;
- Settlement patterns and current land use in the AoI; and
- Local traditions and practices (i.e. intangible heritage) that are important to the communities.

Several interviews were held in Hindi Sub-County with community leaders, religious leaders, and Elders from communities which overlap the pipeline alignment, including the Sub-Locations of Hindi, Bargone and Bodhei. Four meetings were held in Lamu to discuss cultural heritage as it relates to the Project. Detailed findings are presented in the Cultural Heritage Baseline report (Annex II) and the Social Baseline report (Annex II).

6.9.3.3 Field Survey

Field survey involved walking over a survey corridor along the pipeline route looking for evidence of tangible and living heritage sites and recording the locations of identified sites. The survey corridor was up to 1 km wide; up to 500 m on either side of the Project centreline where topographically possible. Field investigations concentrated on accessible and safe areas with known cultural heritage sites based on the results of the KII's and the desktop study. Residents near the field survey areas were queried for information on both tangible and intangible heritage, including living heritage sites.

A survey team comprised of three cultural heritage specialists completed a systematic walkover survey following transects spaced 20 m apart. The survey was limited to remains visible at the surface and unobscured by vegetation or loose surface material. In areas where erosion has cut deep gullies, these exposures were inspected for evidence of cultural materials such as stone tools and fossil bone.

Cultural heritage sites, features and objects were photographed using a Canon D700 18.1 M/P DSLR camera and mapped with a recreational grade GPS (Garmin GPSMAP 62S) using the WGS 84 datum. Field notes include a brief site description and salient details such as dimensions, setting and associated finds.

Not all of the AoI was subject to field inspection due to logistical/access constraints and security concerns (Table 6.9-1). Another limitation experienced during field surveys was the prohibition from recording the locations of burials and cemeteries, including previously recorded burials and cemeteries, in some locations.

Table 6.9-1: Cultural Heritage Field Survey Coverage

County	ROW Survey Coverage (km)	ROW Survey Coverage Gap (km)	Total Linear Survey Distance within AoI (km)	Total Linear Survey Distance beyond AoI (km)
Turkana	82	17	447	695
Samburu	204	0	939	186
Isiolo	92	0	174	0
Meru	38	0	38	0
Garissa	201	135	202	0
Lamu	55	0	55	0
Total	**672**	**152**	**1,855**	**881**

6.9.4 Results

A total of 129 cultural heritage sites were identified in the AoI. As shown in Table 6.9-2, there are three major site categories: archaeological (n=70), living heritage (n=48) and palaeontological (n=4). In addition, there are two hybrid categories where more than one site type is present in a given locality, namely archaeological/living heritage (n=5) and palaeontological/living heritage (n=2). The locations of these archaeological, living heritage and palaeontological sites are shown in Figures 6.9-2 to 6.9-8, with further details provided in the Cultural Heritage Baseline report (Annex II).

Table 6.9-2: Site Type Counts and Percentages

Site Type	Count	Percentage (%)
Archaeological	70	54
Archaeological/Living Heritage	5	4
Living Heritage	48	37
Palaeontological	4	3
Palaeontological/Living Heritage	2	2
Total	**129**	**100**

Figures 6.9-2 to 6.9-8 present the locations of sites identified in the AoI, with the majority identified in Turkana, Samburu, Isiolo, Garissa and Lamu.

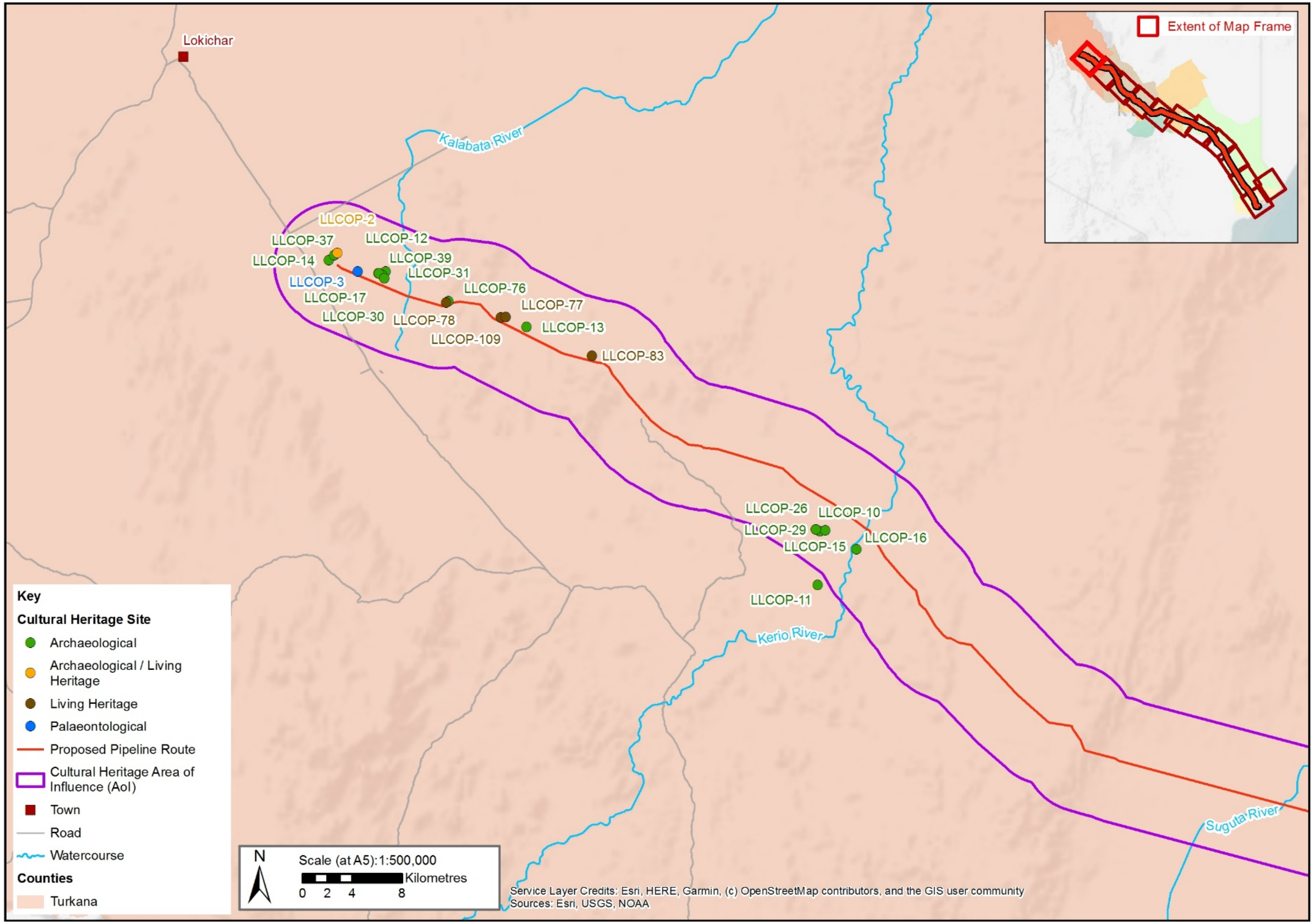


Figure 6.9-2: Cultural Heritage Sites (Turkana)

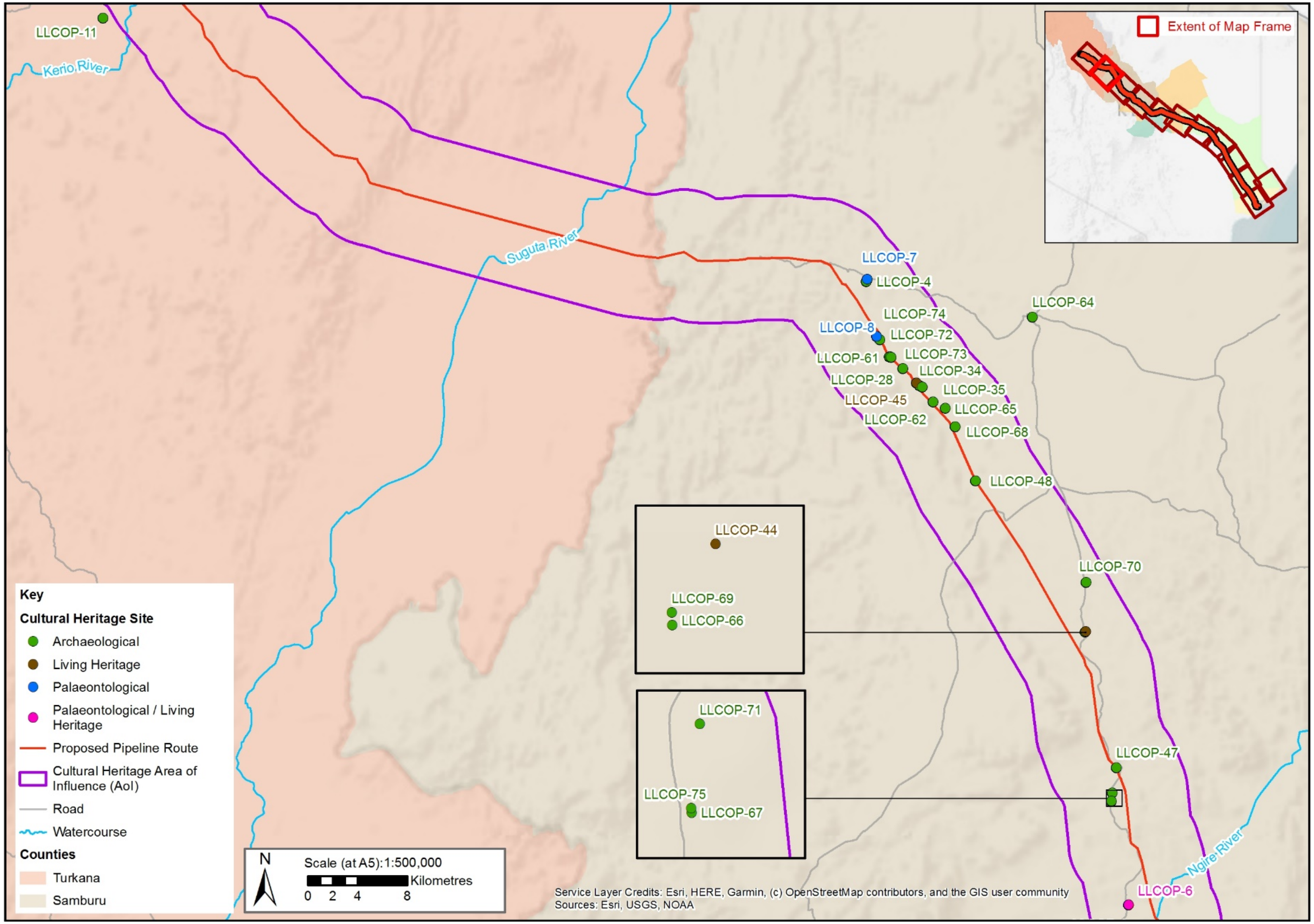


Figure 6.9-3: Cultural Heritage Sites (Turkana and Samburu)

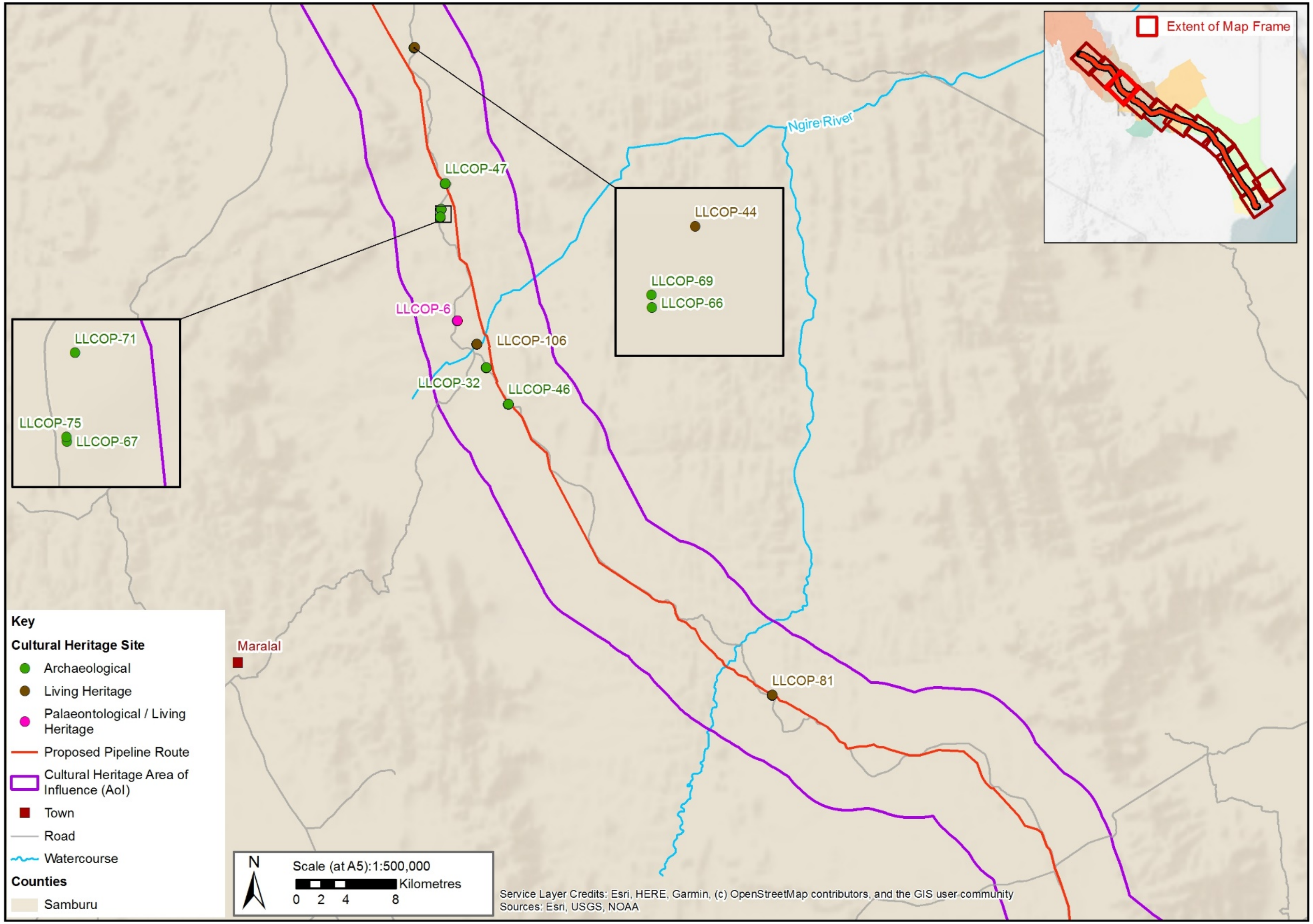


Figure 6.9-4: Cultural Heritage Sites (Samburu)

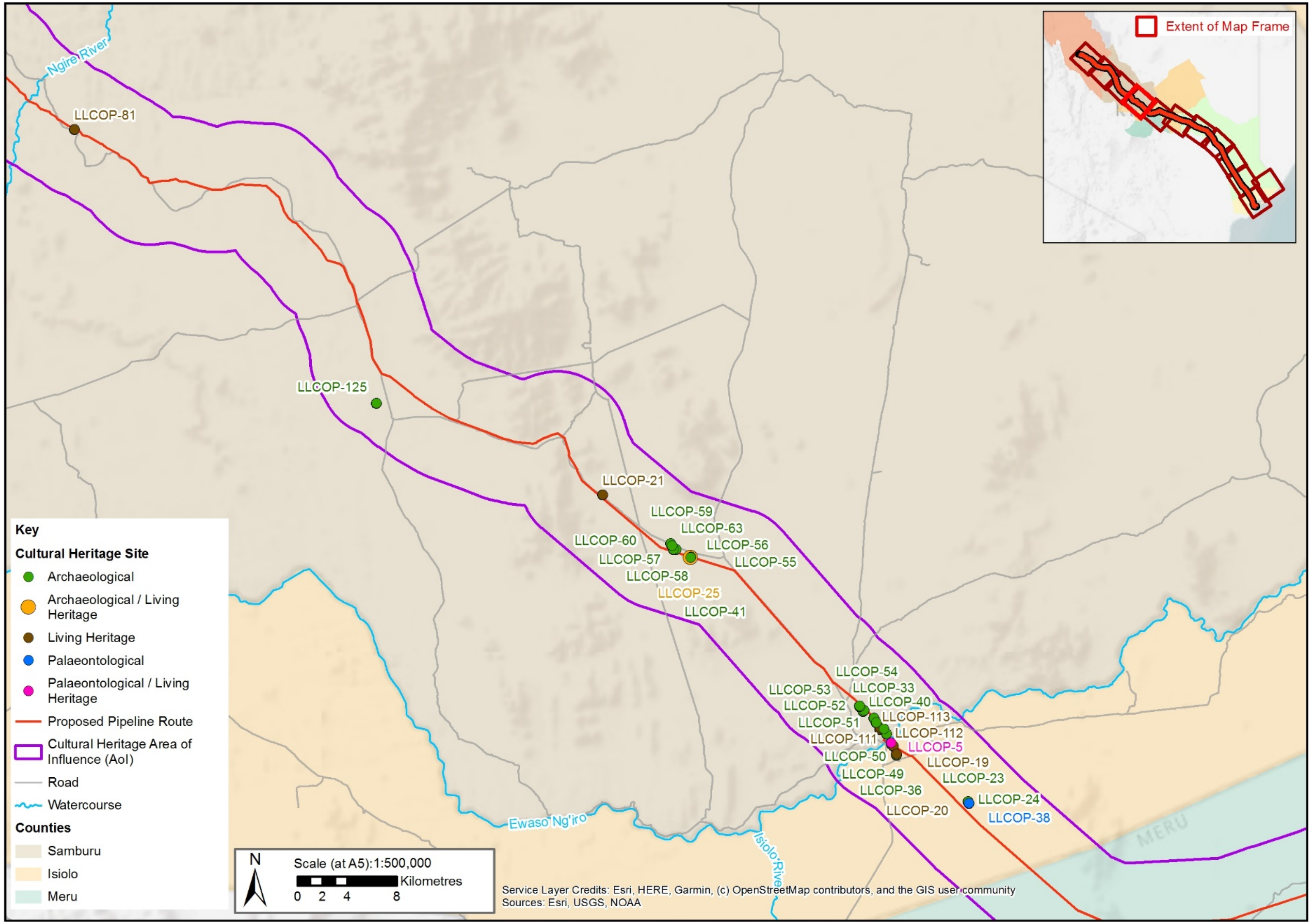


Figure 6.9-5: Cultural Heritage Sites (Samburu and Isiolo)

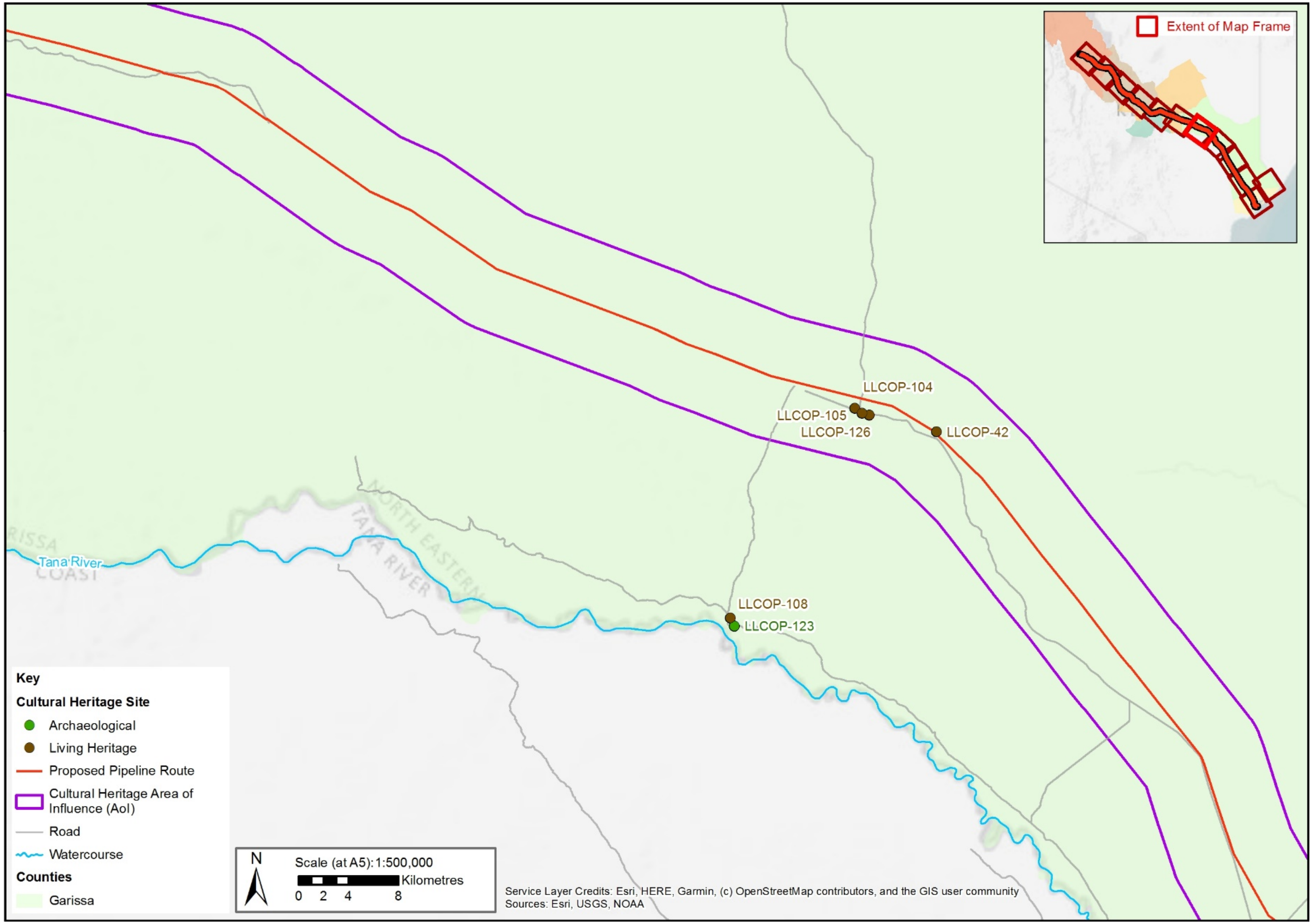


Figure 6.9-6: Cultural Heritage Sites (Garissa)

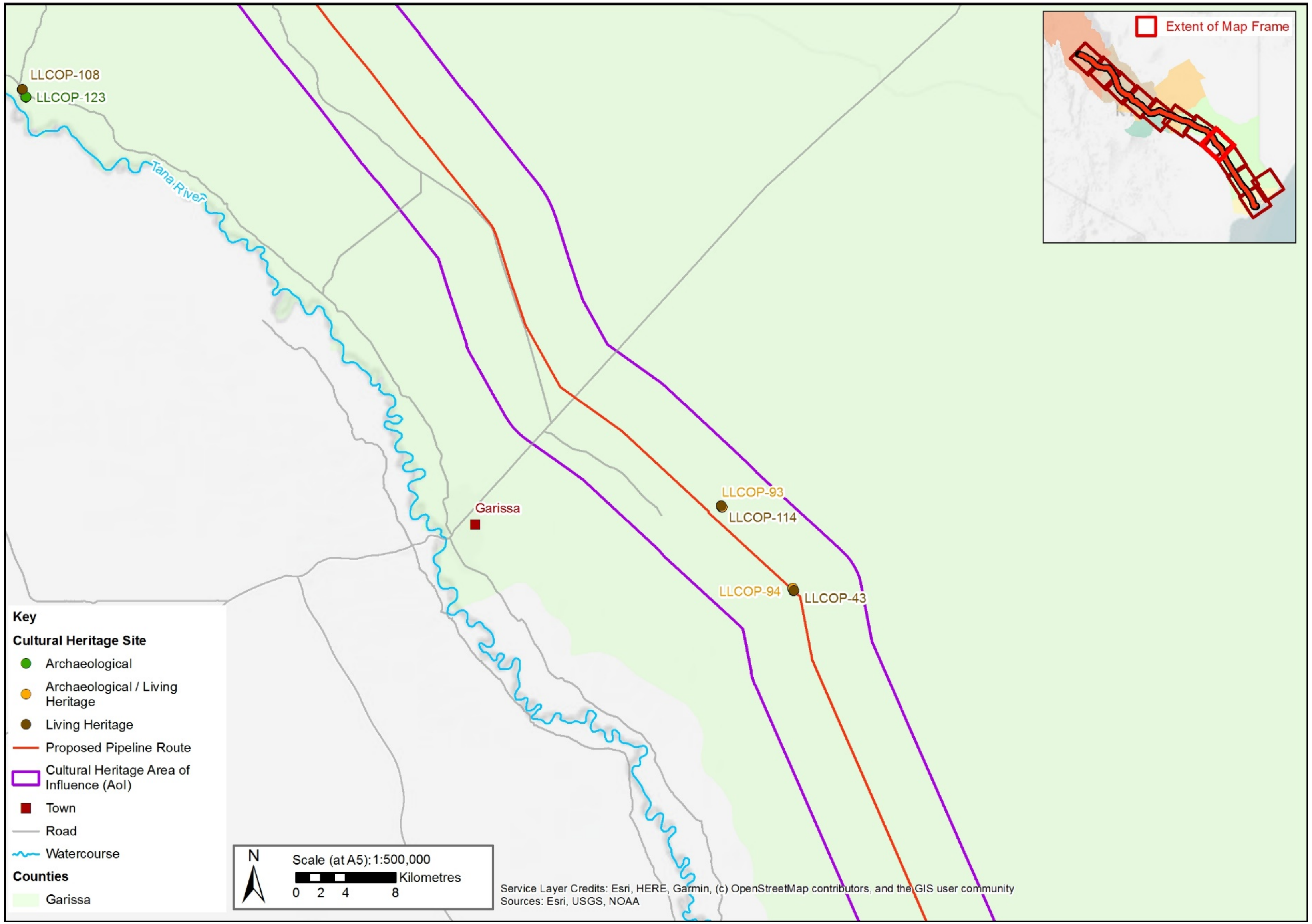


Figure 6.9-7: Cultural Heritage Sites (Garissa)

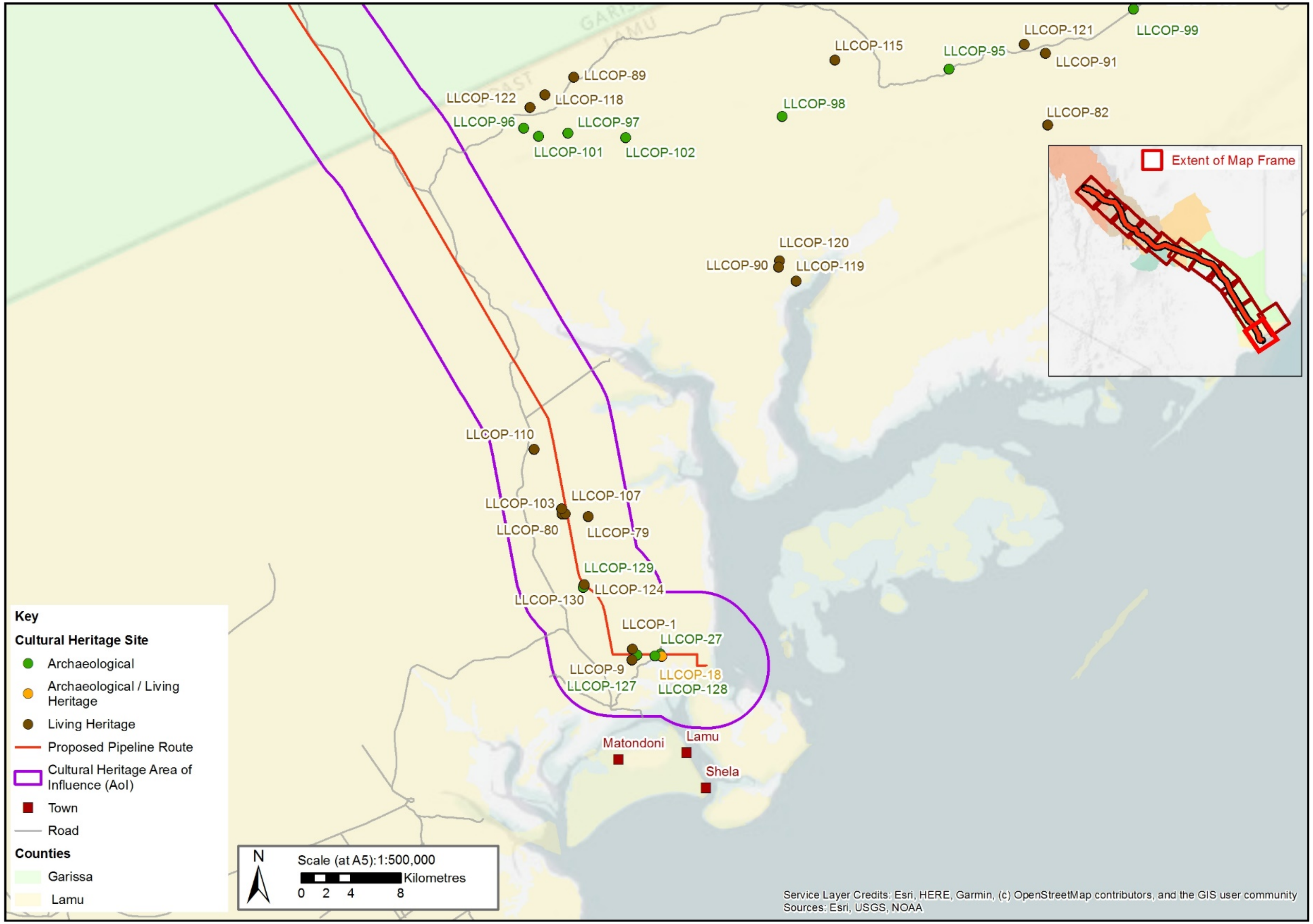


Figure 6.9-8: Cultural Heritage Sites (Lamu)

6.9.5 Archaeological Sites

Archaeological sites are summarised in Table 6.9-3 and Table 6.9-4, with single burial sites the most common type at 60% overall. When combined with the other sites containing archaeological burials, the overall percentage rises to 65% of all archaeological sites and 50% of all site types combined.

Table 6.9-3: Archaeological Site Types, Counts and Percentages

Archaeological Site Types	Count	Percent (%)
Burial Site, multiple (LLCOP-11, 40, 41 and 123)	4	6
Burial Site, multiple; Lithic Artefact, scatter (LLCOP-33)	1	1
Burial Site, single (LLCOP-46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 95, 96, 97, 98, 99, 100, 101, 125, 127, 128 and 129)	42	60
Lithic Artefact, isolated find (LLCOP-13 and 14)	2	3
Lithic Artefact, scatter (LLCOP-4, 12, 32, 34, 35, 36, 37 and 39)	8	11
Monument (LLCOP-102)	1	1
Ostrich Egg Shell Bead (LLCOP-10, 15, 16, 17, 23 and 24)	6	9
Pot Sherds (LLCOP-26, 27, 28, 29, 30, 31)	6	9
Total	**70**	**100**

Figure 6.9-9: Close-up of select finds from MSA site (LLCOP-12)

Table 6.9-4: Archaeological/Living Heritage Site Types, Counts and Percentages

Archaeological / Living Heritage Site Types	Count	Percentage (%)
Burial Site, multiple (LLCOP-18)	1	20
Burial Site, multiple (recent and archaeological); Potsherds and Beads (LLCOP-25)	1	20
Lithic Artefact Scatter/Burial (LLCOP-2)	1	20
Settlement (LLCOP-93 and 94)	2	40
Total	**5**	**100**

6.9.6 Living Heritage Sites

Different cultural traditions are practiced in the different regions through which the proposed pipeline corridor runs, each with its own observations and beliefs. However, common to the inhabitants is a livelihood based upon pastoralism (and hunting and gathering for the Aweer of Lamu). These populations are highly reliant upon the local environment and depend on grazing, hunting and the collection of medicinal and food plants. Table 6.9-4 to Table 6.9-6 summarise the different types of living heritage sites documented within 5 km of the proposed alignment. Sacred/Ritual sites (n=16/29%) and Settlements (n=16/29%) are the most common, followed by sites with Burials (n=11/20%).

Other examples of ceremonial sites include a traditional meeting place near the river at Barsaloi and another site that consists of two tall Acacia trees next to a women's bead-making shed at Archers Post (LLCOP-105).

Table 6.9-5: Living Heritage Site Types, Counts and Percentages

Living Heritage Site Types	Count	Percentage (%)
Beads, modern (LLCOP-45)	1	2
Burial Items, Ostrich Egg Shell Fragments (LLCOP-19, 20 and 21)	3	6
Burial Site, multiple (LLCOP-108, 111, 112 and 113)	4	8
Burial Site, multiple; Sacred/Ritual Site (LLCOP-110)	1	2
Burial Site, single (LLCOP-109)	1	2
Sacred/Ritual (Feasting) (LLCOP-77 and 78)	2	4
Gathering Location (LLCOP-106)	1	2
Sacred/Ritual Site (LLCOP-81, 82, 83, 105, 107, 115,116, 117, 118, 119, 120, 121, 122, 124 and 130)	15	31
Settlement (LLCOP-9, 42, 43, 44, 84, 85, 86, 87, 88, 89, 90, 91, 92, 114)	14	29
Subsistence Extraction Area (LLCOP-79, 80, and 103)	3	6
Subsistence, Pastoral (stock pens) (LLCOP-104 and 126)	2	4
Well (LLCOP-1)	1	2
Total	**48**	**100**

Figure 6.9-10: Ngasenon site (LLCOP-82)

Table 6.9-6: Living Heritage/Palaeontological Site Types, Counts and Percentages

Palaeontological / Living Heritage Site Types	Count	Percentage (%)
Burial Site, multiple; Fossil Bone – unspecified (LLCOP-5)	1	50
Burial Site, single; Fossil Bone – unspecified (LLCOP-6)	1	50
Total	**2**	**100**

6.9.7 Palaeontology

Several fossil-bearing sites with large mammal fossils, and fossil wood were recorded in the Nachola area (Table 6.9-6 and Table 6.9-7). Fossil teeth fragments (LLCOP-37) were found near "*Monkey Hill*". No fossil hominid remains were identified.

Table 6.9-7: Palaeontological Site Types, Counts and Percentages

Palaeontological Site Types	Count	Percentage (%)
Bovid (LLCOP-3)	1	25
Fossil Bone – unspecified (LLCOP-7 and 8)	2	50
Mammal Teeth (LLCOP-38)	1	25
Total	**4**	**100**

6.9.8 Summary

The present baseline study covering the proposed Lokichar to Lamu Crude Oil Pipeline Project corridor has established that the AoI is a sensitive cultural landscape with a diverse range of cultural heritage sites including many burial sites and archaeological sites of considerable antiquity. A total of 129 sites were documented in the AoI. However, due logistical/access and security constraints and the sampling methods employed, not all areas have been subject to field survey and it is likely that additional sites may exist in those areas that were not reached. Therefore, it will be key to set up a protocol for identification and management on cultural heritage sites identified during the construction process.

6.10 Physical and Social Infrastructure

6.10.1 Introduction

A baseline study was undertaken to describe the socio-economic and health conditions in the LLCOP AoI. This section (Physical and Social Infrastructure) and sections 6.11 Community Health, Safety and Security, 6.12 Economics and Employment and 6.13 Livelihoods, provide summaries of the complete social baseline and health baseline report (Annex II) upon which changes from the Project on the social environment are measured.

6.10.2 Area of Influence

The Project spans six counties across Kenya, starting in Turkana County, and cutting across Samburu, Isiolo, Meru, Garissa, and Lamu. All have the potential to experience social impacts directly or indirectly from the LLCOP Project.

The AoI for all 4 social assessments (Figure 6.10-1), within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes an area comprising 25 km buffer along the entire pipeline. There are 49 known communities and towns located within a 25 km buffer around the pipeline route. Annex II includes figures showing all these communities by county. The communities are identified as potentially affected by virtue of their proximity to the Project; their higher potential to benefit from employment and other Project benefits; their potential to experience direct environmental effects such as change to water resources, as well as induced effects such as increased in-migration and disruption to seasonal grazing and pastoral livelihoods. Table 6.10-1 and Figure 6.10-1 presents the communities considered in the Project AoI.

Table 6.10-1: Area of Influence Communities

County	Communities
Turkana	Kalapata, Katilia, Lokichar, and Lokori
Samburu	Archers Post, Baragoi, Barsaloi, Lerata, Maralal, Nachola, Nakaroni, Suyian, Swari, and Wamba
Meru	Kaichuru Village, Kandebene, Laare Town, Meru Town, and Mutuati
Garissa	Balambala, Bola Town (Kamuthe), Bothai, Bouralgy, Dagoob, Galbert Township, Garissa Town, Kalagosk (Kamuthe), Kamuthe Town, Korakora, Mansabubu, Masalani, Modika, Saka, Sankuri, and Shimbiri
Isiolo	Boji, Garba Tula, Isiolo (central), Ngara Mara, and Yaq Barsadi
Lamu	Hindi, Jipe, Kiliana, Mokowe, and Pate

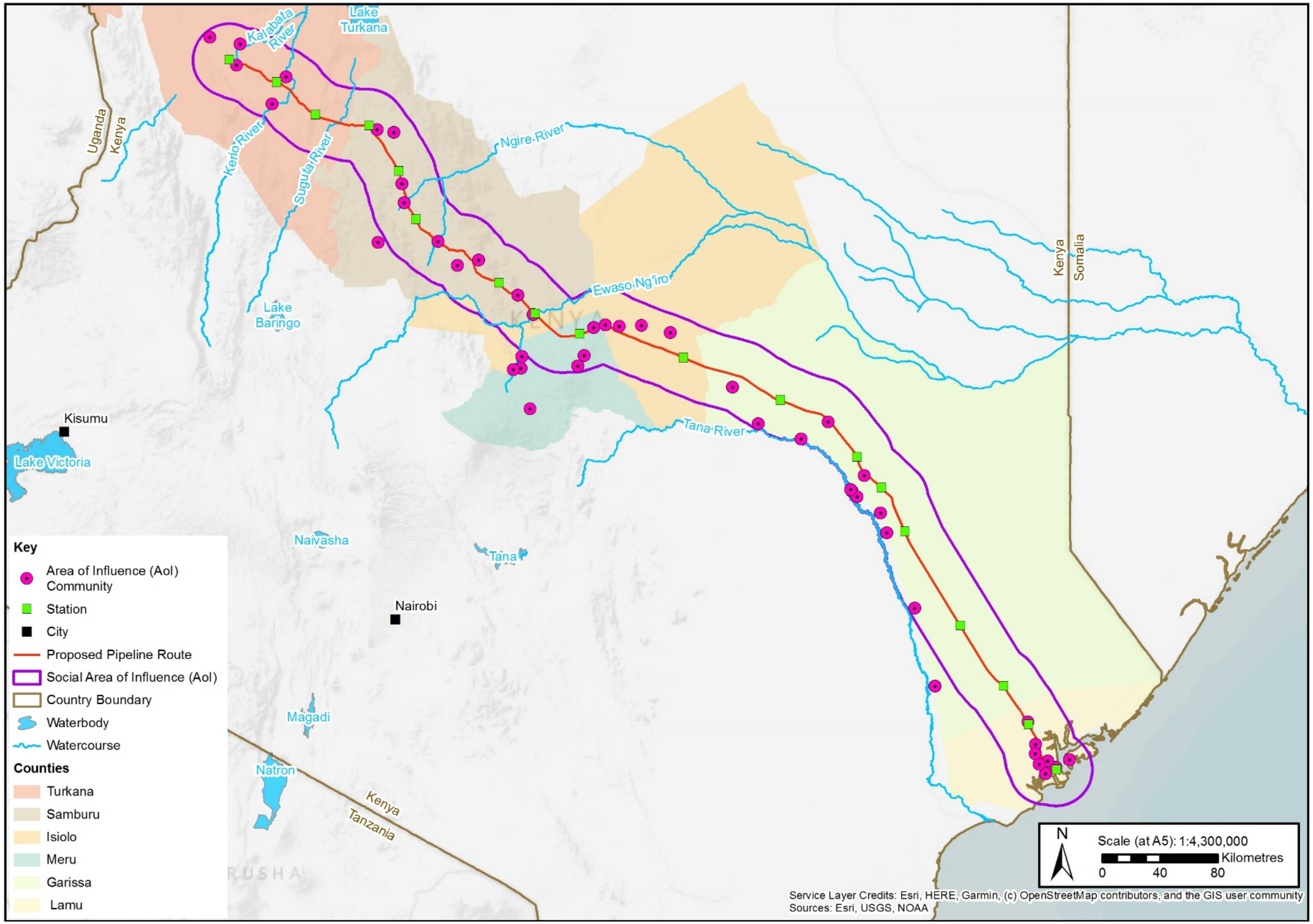


Figure 6.10-1:Communities in the Area of Influence

6.10.3 Methodology

6.10.3.1 Approach

A key component of social impact assessment is to include baseline characterisation of physical and social infrastructure and this involved the following steps:

- Identify the AoI within which the effects of the Project on socio-economic conditions will be evaluated, in this case communities within a 25 km buffer around the proposed pipeline route;
- Identify parameters used to characterise socio-economic conditions in AoI communities, including from review of Scoping Consultations held in June 2018 and detailed in the Scoping Report (Annex I); and
- Design and carry out literature review and data collection programs to characterise capacity and quality of physical and social infrastructure and collect information to support assessing the effects of the Project on socio-economic conditions.

6.10.3.2 Parameters

The potential effects of the Project on socio-economics in this sub-section were described for physical and social infrastructure including water, sanitation and waste, energy sources, roads, communication and education services. Health and policing services are discussed in the baseline summary on Community Health, Safety and Security (Section 6.11).

6.10.3.3 Data Collection

Socio-economic data was collected, analysed and reported on using the following sources:

- The Stakeholder Engagement Report (Annex III of the ESIA) – summary of consultations during the ESIA process that includes a discussion of key concerns;
- Literature review and secondary data collection – government reports, academic literature and information from civil society groups; and
- Primary data collection – interviews with key individuals and focus group discussions.

6.10.4 Water

Water infrastructure in the vast majority of AoI communities is very limited and typical due to their remote locations, climate, and poverty level. More developed water infrastructure such as piped water can only be found in urban communities and urban centres in Isiolo and Lamu. The rural AoI communities rely on more basic infrastructure that is often located at considerable distances from settlements (e.g. 10-20 km). In addition to accessibility issues, most AoI communities face water availability challenges as rainfall in the counties is erratic and bimodal[1]. The majority of the six counties (Turkana, Samburu, Lamu, Garissa) are water scarce, especially during the dry seasons. Between rainy seasons many of the counties face physical and economic water scarcity and recurrent droughts. Permanent rivers are found in the majority of the counties[2]. In addition to permanent water bodies, all counties rely on seasonal streams, groundwater sources (i.e. wells, waterholes and boreholes) and surface water (i.e. earth dams, sand/subsurface dams, water pans).

Unimproved sources of water (e.g. pond, dam, lake, stream/river, unprotected springs and wells) in the AoI communities generally have poor water quality as they are not protected and are at risk of contamination. This is an issue in Samburu and Garissa. While boreholes are used in every county, they are more prominently used in the AoI communities in Turkana, rural Isiolo, and Meru. Access to water is another major issue with many

1 Two rainy seasons (long rains typically between March and May and short rains between October and December, except in Lamu where it occurs between mid-April to end of June (long rains) and November and December (short rains)).

2 Turkana and Lamu do not have permanent rivers.

having to travel considerable distances (e.g. an average distance of 25 km in Garissa County) for access to clean water, especially during the dry season. In Isiolo County, the low-lying areas are vulnerable to floods which have been exacerbated because of climate change. Added pressure is placed on the water infrastructure in the dry season when people and livestock from other counties come in search of water.

With the exception of Lake Turkana[3], few naturally occurring surface water bodies are found in Turkana. In the AoI communities, ephemeral rivers known as *luggas* or *laghas*, semi-permanent rivers, man-made water bodies (i.e. water pans, water catchments) and boreholes are used as the primary water sources. Recurrent drought and overgrazing have placed strain on water resources in Turkana County, resulting in a general decline in the quantity and quality of water for domestic and productive use. During drought, the falling water tables lead to low yielding boreholes and longer wait times at water points (TCG, 2017). In general, urban centres and some market centres have piped water closer to settlements while more remote areas have water points further away, ranging from 10-20 km. In recent years, improvements to the rural water infrastructure has seen over 200 boreholes being drilled and the upgrading or rehabilitation of several water schemes. However, the current water infrastructure remains at capacity and there is inadequate water to meet demand (TCG, 2016a).

In Samburu, livestock herders indicated that the only water source for livestock in the AoI communities are the local rivers that are located away from the Project. Other water sources in the Samburu AoI communities include unimproved sources of water. The AoI urban centres in Samburu (Archers Post, Maralal and Wamba) have major water supply schemes supplied by the Samburu Water and Sanitation Company in collaboration with the Department of Water. Water quality in the county is generally poor, with most surface water and shallow wells not being protected and at risk of contamination. Human habitation along catchment areas, lack of proper sanitation and sewage services in the major urban centres are major sources of water contamination (SCG, 2018).

Water availability in Isiolo County varies throughout the year, depending on the season (Mati et al., 2005). There are severe shortages of water during times of drought, which is a common occurrence in the county. There is no piped water in the rural areas, meaning few households have potable water at home and must rely on boreholes. In general, access to water in Isiolo County comes from four major sources including direct use of natural water sources such as rivers, streams and springs; developed surface water sources, such as earth dams, sand/subsurface dams, tanks and pans; developed groundwater such as wells, waterholes and boreholes; and emergency water supply by the government using tankers (Mati et al., 2005). In Isiolo, the Project crosses two of the three main county rivers, the Ewaso Ng'iro and Isiolo. The Ewaso Ng'iro River is the most important water source in Isiolo, especially for livestock watering and herders and their livestock often come to the river from the north during dry periods.

In the rural AoI communities in Meru (Kaichuru Village and Kandebene), the main water source for livestock are boreholes (Barajadi, Gachuru, Kandebene, Matabithi), dams (Batalo, Kungu, Karuya, and Kandebene), streams (Lanyiru) and rivers (Rikindu and Wasonara). Laare Town is supplied by the diocese of Meru, springs (Laare, Kitawaa, Atununu and Kithingangu) and boreholes (Laare, Ntunene and Kiridora). The Lobua and Chokaa swamps are used to feed livestock. Commercial water vendors are also an important source of water in Igeme North sub-county. In Meru County, climate change has resulted in unpredictable rainfall patterns, which now start earlier or later than previously (MCG, 2018). Water levels have also decreased over time and during dry spells, downstream users receive little or no water at all.

In the AoI communities in Garissa, water is sourced primarily from the Tana River, water pans, boreholes, earth dams and seasonal dams. Water from other sources is generally unsafe and as such it is treated at household level with aqua tabs, water guards and other chlorine-based purifiers supplied by the relevant government

3 Although Lake Turkana is not near the Project, Lake Turkana contributes to the livelihoods of over 300,000 people, including pastoralists, fishermen and tourism operators. Recent developments have placed the lake and the livelihoods that depend on it in jeopardy.

departments. Other areas of the county rely on shallow wells, boreholes and water pans (Focus Group, Water and Sanitation, Kamuthe 2018; Appendix B). The county is generally water-scarce with acute water shortages experienced during the dry season. Various interventions have been undertaken to mitigate against these water shortages such as water tinkering and the activation of the rapid response team charged with the responsibility of repairing boreholes during drought (GCG, 2018). Approximately 24% of the population in Garissa County have access to safe water (GCG, 2018). Access to piped water is limited to the sub-county headquarters where approximately 27,725 households have a connection to piped water. The remaining population make use of unsafe water directly from the river, luggas, boreholes, shallow wells and pans. The average distance to the nearest water point is 25 km, suggesting that a large section of the county's population cannot access safe water for domestic purposes. For residents of Garissa Town, however, this distance has reduced considerably.

In the AoI communities in Lamu, groundwater is the primary source of water, which is accessed through boreholes and pipelines rising from wells to elevated tanks. In Mokowe and Hindi, water is also sourced from seasonal dams for livestock. There is an inadequate supply of clean water in many parts of Lamu County due to pressure of over utilisation, inadequate quantity due to land use practices, and water that is unsafe for human consumption (LCG, 2017). Moreover, demand for water has risen due to rapid population growth and urbanisation. People rely on shallow wells that have high salinity levels, which poses a major problem for residents since they have access to little fresh potable water. There are several lakes where clean water can be collected from but even those are under threat, including Lake Amu (LCG, 2017). The numerous water catchment areas and wetlands in Hindi ward are also under threat because of the encroachment of people, which leads to decreasing water quantity.

Wastewater infrastructure is also severely limited in the six counties. The vast majority of the AoI communities do not have access to developed sanitation facilities. Sewage service coverage is also found only in urban centers. Latrine coverage is most prevalent in Lamu County, Meru County and Garissa County (with coverage ranging from 50-78%). In the other three counties, households generally do not have access to sanitation facilities and open defecation is more prevalent than latrine use. This is due to poor awareness of good hygiene practices, lack of access to adequate safe drinking water, social dynamics, low literacy levels, low government prioritisation, traditional community practices and lack of appropriate local latrine materials. Poor sanitation and open defecation are also linked to numerous health issues such as diarrheal diseases and infectious diseases. In Isiolo County, flooding during the rainy season combined with the poor drainage system has resulted in negative health impacts to the population (ICG, 2018). Sanitation facilities and sewer systems in urban areas are inadequate as household domestic sewage is channelled to sewage treatment ponds. Where there is no sewer system, on-site sanitation facilities are provided through use of septic tanks and pit latrines. In rural areas households mostly rely on pit latrines while institutions use septic tanks (GOK, 2018a).

6.10.5 Waste

Limited waste disposal infrastructure is found in the six counties. The AoI communities typically do not have proper solid waste management facilities or adequate dumping sites as they are found mostly in urban areas. In rural areas surface dumping as a method of waste disposal is common, as well as the use of garbage pits, burning, and public garbage sites. In Turkana, illegal waste disposal has been dumped in the Turkwel River that runs through Lodwar (TCG, 2017). To address the same issue in Samburu County, officials have made efforts to fence dumpsites at Wamba and Archers Post and at a temporary dumping site in Maralal town (SCG, 2018). In Meru, waste and garbage disposal is managed by the county government in the town centres and marketplaces, and in rural areas private firms, garbage pits, burning, public garbage sites and farm manure are the common modes of disposal (MCG, 2013). Lamu County has only two secured disposal sites in Amu and Shella. Waste collection services are also based out of these communities and rely primarily on three tractors with four hydraulic transportation trailers (LCG 2018).

Major issues of concern revolve around the lack of storage, transport and disposal of waste. The lack of proper waste disposal infrastructure results in careless waste disposal which becomes a major source of environmental degradation, and contributes to air, water and soil pollution. In addition, poor waste disposal poses a health threat to communities. Lack of toilets and potable water combined with poor hygiene habits have contributed to increasing cholera outbreaks in Turkana County (ReliefWeb, 2018). Sewage service coverage is often found only in urban centres in the six counties. Current efforts are focused on building and expanding the sewage system in urban towns in Turkana County and Garissa County. Turkana County is now working on constructing latrines using local materials and construction techniques appropriate for the county's dry and loose soil conditions (Karanja et al., 2018).

6.10.6 Housing

Housing in the six counties is influenced by the availability of raw materials, cultural factors, climate and settlement patterns. Housing quality in the AoI communities is generally poor with housing units made of less durable materials. Rural households typically have earthen floors and walls made of wood, grass/reeds or a combination of mud/wood. The three types of pastoral housing can be categorised as temporary units, semi-permanent and permanent units. The *manyatta* is the most common type of homestead found in the counties of Turkana, Samburu, Isiolo, and Garissa and facilitate the semi-nomadic pastoral way of life. In Isiolo County, pastoral settlements have become increasingly sedentary, growing around service centres and water points. The risks of drought have also been a factor in the growth of partially settled households (Ashiba, 2018). Semi-permanent houses typically have mud walls and are roofed with makuti or mabatai in urban areas. Permanent housing in all counties are the least common and are mainly found in urban centres. In Lamu County, makuti or corrugated iron sheets are the most common roofing material and earthen floors are the most common wall material.

Pastoralists typically have multiple dwellings with specific designations. One dwelling is used for sleeping and a separate dwelling for the kitchen for example. Solid fuels (e.g. wood, charcoal, dung) are the primary fuel for cooking, especially in rural areas. Use of solid fuels for cooking increases indoor pollution and the risk of respiratory diseases. Poor housing conditions are common in all the Project counties and is directly linked to poverty and exposure to disease causing vectors.

6.10.7 Energy Sources

Limited electricity infrastructure is found in the six counties. Lamu County has the greatest access to electricity, with electricity access for 17% of households. For the remainder of the counties, access is sparse and is primarily limited to the larger urban centres. In Turkana County, only one community outside the AoI, is connected to the national electricity grid (TCG, 2016a). In Samburu, a total of 13 trading centres, or approximately 5,000 households in the main urban centres, have electricity[4] (SCG, 2018). In Meru and Garissa, access to electricity is also mainly found in a few trading centres and towns. In the AoI communities in Garissa County, only Balambala is connected to electricity (GCG, 2018). In Isiolo County, electricity access is being expanded due to a new 132 kV project that will supply the future tourist hub and associated infrastructure such as the Isiolo International Airport, the proposed Isiolo Resort City and the LAPSSET Project (Electric Energy Online, 2016). Most households in the six counties rely on traditional fuels (i.e. firewood, paraffin, tin lamps, charcoal) for lighting. Cooking is done predominantly with collected firewood. Challenges for the six counties to electricity development include weak transmission and distribution infrastructure, high power costs and low per capita consumption.

[4] including the AoI communities of Maralal, Archers Post, and Baragoi,

In the counties of Turkana, Samburu, Isiolo and Lamu, there exists the potential for tapping into renewable sources of energy such as solar, wind, and geothermal energy. Solar energy has been used in Turkana to power schools and purify drinking water in Lake Turkana and wind power is an emerging resource that can be developed due to the county receiving strong, predictable wind streams due to its geography (Business Daily Africa, 2017a; OpenIDEO, 2018; TCG, 2013; Lake Turkana Wind Power 2018). Samburu County has the potential for geothermal energy, and the largest wind project in Africa is in Marsabit County, which borders Samburu County, and also has the potential to be tapped into. In Isiolo County, a new 26 km 132 kv single circuit line will increase energy access to supply the future Isiolo Resort City, Isiolo International Airport, and the LAPSSET Project (Electric Energy Online, 2016). In Lamu County, a 20 Ksh billion wind farm is approved to proceed about 20 km from the proposed Lamu Port.

6.10.8 Transportation

Road infrastructure in the six counties is generally in poor condition with many roads in need of repair and maintenance. The roads in all counties are made predominantly of earth, with only a small proportion made of tarmac. Of the six counties, Meru County has the largest proportion of tarmacked roads at 10% while Samburu County has the largest proportion of gravel roads at 67%. The poor infrastructure can be attributed to the lack of equalisation funds for the traditionally marginalised regions in Kenya (LCG 2018). Table 6.10-2 presents the road conditions in the six counties.

Table 6.10-2: Road Conditions in Project Counties

County	Earth	Gravel	Tarmac	Total (km)
Turkana	91.1% (5,007 km)	8.8% (483 km)	8.8% (484 km)	5,496
Samburu	n/a	67.2% (1,081 km)	<1% (10 km)	1,607
Isiolo	75% (957 km)	22% (281 km)	3% (42 km)	1,276
Meru	81% (4,805 km)	n/a	10% (582 km)	5,968
Garissa	83% (2,245 km)	16% (420 km)	1% (36 km)	2,701
Lamu	n/a	n/a	<0.1% (6 km)	6,886

n/a = information was not available
Source: TCG, 2016a; SCG, 2018; GOK, 2018a; MCG, 2018; GCG, 2018.; LCG, 2016.

During the rainy season many sections of the earthen roads become impassable. Accessibility to some rural communities are limited due to the poor road conditions, serving as a barrier for communities in meeting their economic and development objectives. The poor-quality infrastructure impacts county livelihoods as it makes it difficult to send supplies into rural areas, exchange information, and facilitate trade with other regions. The poor road network also serves as a barrier to accessing employment opportunities for youth. The difficulties in road accessibility in the counties have therefore affected the overall economic growth of the counties. In Turkana County, most of the population only has the option of walking from one place to another. At present, no railways are found in the six counties. Lamu County has eight main jetties, mainly found in Amu Division that are used by passengers, fishermen and for loading goods. Currently the Lamu Port is under construction in Lamu County which will help connect to the county to other markets via 32 berths (LCG, 2018). Numerous airstrips are found in all counties but only Turkana, Isiolo and Lamu counties have airports.

6.10.9 Communication

Communication infrastructure in the six counties is uneven. While mail delivery and radio are the forms of communication with the greatest and most reliable coverage, there is still only a handful of post offices in most counties and radio coverage still does not extend to some remote areas. Radio stations are found in every county and are often relied upon as news sources for the rural population. Post offices are distributed across every county while more advanced forms of telecommunication infrastructure can often only be found in urban centres in the poorer counties (i.e. Turkana County and Samburu County). This has a notable impact on communications, investment and security as people must travel long distances to be connected. Mobile coverage is more prevalent in the more prosperous counties crossed by the Project such as Meru County, Lamu County, and Garissa County, which have coverages of approximately 95%, 75%, and 62% respectively (MCG, 2018; GCG, 2018; LCG, 2018). In Samburu County, mobile phone coverage is poor at 30%, while in Isiolo, mobile network coverage is at 8% and in Turkana County, it is found mainly in urban areas. Information on access to the Internet was not available for all counties. In Lamu County, Internet access was available only in 15% of the county (LCG, 2016).

6.10.10 Education

Education services (e.g. primary, secondary, higher learning institutions) are found in all six counties. Primary schools are the most prevalent type of learning institute, while there are dozens of secondary schools and only a handful of vocational training centres, colleges and universities in all counties. With rising populations, both inadequate staffing and school infrastructure are issues in all six counties. Very few vocational centres, colleges and universities are found in the AoI communities, typically only one to two are found in one or two AoI communities in Turkana, Samburu, Meru and Lamu. None are found in the AoI communities in the counties of Garissa and Isiolo.

The majority of residents in Turkana, Samburu, Isiolo and Garissa have no formal education, ranging from 54.1% in Isiolo County to 82.1% in Turkana County. The counties of Meru and Lamu have the highest educational attainment levels in the six counties with 17.5% achieving secondary education in Meru and 13.3% in Lamu. Educational attainment in the counties of Turkana, Samburu and Garissa are substantially lower compared to the national average. Subsequently, these counties have the lowest literacy rates out of the six counties, with a literacy rate of less than 40% compared to the national average of 78.7%. While more than half of residents in Isiolo do not have formal education, the county has a literacy rate of approximately 60%. Overall, education levels for the six counties are low, lower than the national average at both the primary and secondary levels except for in Meru County and Samburu County at the primary level (Table 6.10-1). Data on the educational attainment in the AoI communities was not available.

Table 6.10-3:Percentage of Educational Attainment in the Six Counties (2009)

County	None	Primary	Secondary	Total Population
Turkana County	82.1	14.5	3.3	749,235
Samburu County	68.1	25.6	6.3	195,312
Isiolo County	54.1	36.1	12.9	125,192
Meru County	20.7	61.9	17.5	1,205,470
Garissa County	74.4	19.7	5.9	433,709
Lamu County	32.8	53.9	13.3	89,394
Kenya	**25.2**	**52.0**	**22.8**	**34,024,396**

Source: KNBS and SID, 2013a-f

Although the introduction of free primary education in 2003 saw increases in student enrolment in the country overall, enrolment and transition rates from primary to secondary education are still low in the six counties compared to the national average. Challenges to educational attainment in these counties are attributed to a variety of causes such as poverty, high ancillary education costs[5], long commuting distances to schools, school understaffing, inadequate infrastructure (i.e. school facilities and utilities) and cultural practices such as early marriages. External events such as drought and inter boundary conflicts also disrupt education. The semi-nomadic way of life of the pastoralists also prevents children from staying in school as they move with their families in search of pasture and water in the dry season. Gender parity is another issue with lower rates of attainment for girls in all six counties, relating to issues such as poverty, biological changes, early marriage and girl-child labour. Poverty and insecurity are access issues found across all six counties but are more apparent in the less prosperous counties of Turkana, Samburu and Garissa. Alternative delivery systems, including mobile education, could assist both education infrastructure and literacy.

[5] e.g. school uniforms, school supplies

6.11 Community Health, Safety and Security

6.11.1 Introduction

A baseline study was undertaken to describe the socio-economic conditions in the LLCOP AoI. This section (Community Health, Safety and Security) provides a largely qualitative summary of the complete social baseline report (Annex II) upon which changes from the Project on the social environment are measured.

The following section presents a qualitative review of the health, safety and security baseline for the Project Counties.

6.11.2 Area of Influence

As described in Section 6.10.2, the Social AoI is a 25 km buffer around the proposed pipeline route and is presented in Figure 6.10-1.

6.11.3 Methods

6.11.3.1 Community Health

Data for the community health baseline was collected through various activities including:

- A desktop literature review describing a broad health status of the population, based on a systematic review of the 12 Environmental Health Areas[1] with reference to data at national, county and local level;
- Fieldwork and stakeholder engagement in the affected counties:
  - Participatory group meetings with stakeholders who have special knowledge of the health status and the social determinants of the Project area;
  - Key informant interviews with specific department heads or programme managers;
  - Health Facility Assessment using a modified Service Availability and Readiness Assessment (SARA) tool (Figure 6.11-1); and
  - Review of routine health system data and reports.

6.11.3.2 Safety and Security

Data for the safety and security baseline was collected through a desktop literature review of Castor Vali Africa's private database of reported incidents across counties crossed by the Project between 2016 and 2019[2] and other literature relating to policing and key security risks.

6.11.4 Community Health

6.11.4.1 Health Infrastructure

Primary (sub-county) hospitals, health centres, dispensaries and medical clinics are available in all six counties. Health facilities are most plentiful in the counties of Meru, Garissa and Lamu, which have the greatest number of primary hospitals, medical clinics and dispensaries. Health facilities in Samburu and Isiolo are less prevalent. A handful of secondary (county referral) hospitals are found only in Meru, Garissa and Turkana. The health facilities in the AoI communities are generally inadequate, sparsely distributed and understaffed in the face of growing populations. Approximately half of the facilities are public (government owned).

[1] Based on a World Bank Analysis, the International Finance Corporation uses 12 Environmental Health Areas: 1) Communicable diseases linked to the living environment; 2) Vector-related diseases; 3) Soil-, water- and waste-related diseases; 4) Sexually-transmitted infections, including HIV/AIDS; 5) Food- and nutrition-related issues; 6) Non-communicable diseases; 7) Accidents/injuries; 8) Veterinary medicine and zoonotic diseases; 9) Exposure to potentially hazardous materials, noise and malodours; 10); Social determinants of health; 11) Cultural health practices; and, 12) Health Services and systems capacity.

[2] Year to date as of 24 March 2019.

The health system challenges common to most AoI communities are poverty, service delivery (due to the long distances to health facilities) and poor and inadequate infrastructure and human resources (water infrastructure and healthcare infrastructure). Health system weaknesses and inefficiencies such as inadequate ambulances and weak referral systems also contribute to healthcare challenges. Figure 6.11-1 presents the health facilities where interviews were conducted to gain an understanding of the main health challenges in their target population as well as potential structural and operational challenges at facility level.

In the counties of Isiolo, Meru and Lamu, there are additional challenges such as high demand for services due to the high burden of communicable and non-communicable diseases. These counties also face challenges due to insecurity along their borders. In the poorer counties of Turkana, Samburu, Isiolo, and Garissa, the arid and semi-arid climate contribute to food insecurity and related health issues (i.e. malnutrition). The current drivers of food insecurity are water shortages (due to rainfall performance and lack of water storage facilities), conflict and insecurity and other hazards such as flooding and disease outbreaks. Additional contributors to food insecurity are unemployment, poverty, and limited access and availability of places to buy food. Many of the AoI communities crossed by the Project in Samburu and Isiolo County reported facing food insecurity. Table 6.11-1 presents the health system challenges in the Project Counties.

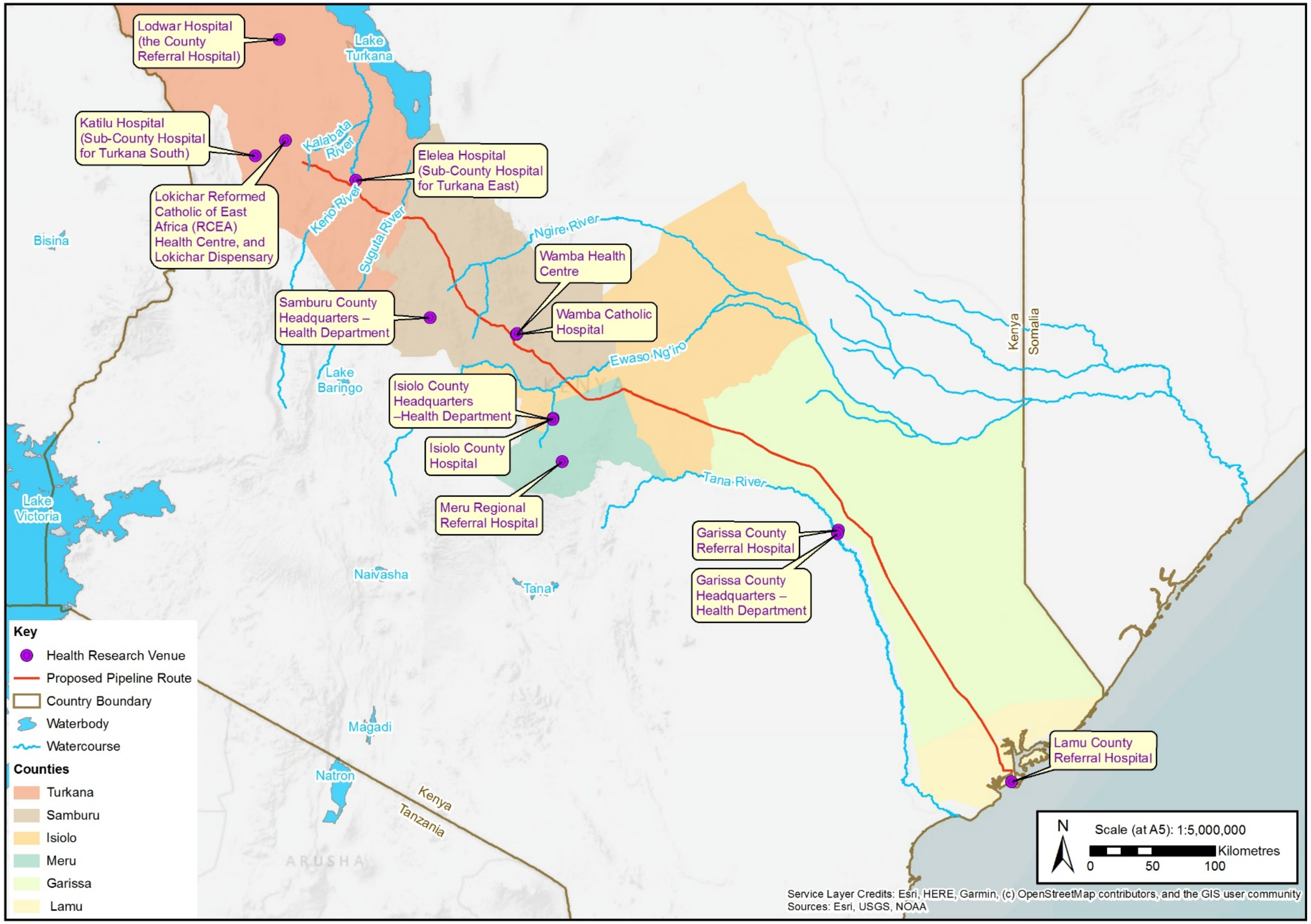


Figure 6.11-1: Health Research Venues

Table 6.11-1:Health system challenges in the Project area

Project County	Challenges	Contributing factors
Turkana	▪ Inadequate health infrastructure (35 km average distance to a health facility); ▪ Inadequate human resources; ▪ Food insecurity and malnutrition; ▪ High demand for health services; ▪ High burden of communicable and infectious diseases; ▪ Poor health seeking behaviour; ▪ Poor access to safe drinking water and sanitation; ▪ Insecurity and ethnic conflict; ▪ Nomadic lifestyle; ▪ Emerging burden of non-communicable diseases; ▪ Referral system challenges; and ▪ High illiteracy level.	▪ Arid and semi-arid climate (food insecurity); ▪ Historical marginalisation; ▪ Vastness and remoteness of geographical area, that is sparsely populated contributes to poor service delivery; ▪ Population influx in urban and peri-urban areas; ▪ Vulnerabilities associated with border location; ▪ Large refugee population; ▪ Negative cultural practices (such as use of traditional medicines); and ▪ Changes in lifestyle and rapid urbanisation.
Samburu	▪ Inadequate human resources; ▪ Inadequate health infrastructure; ▪ Poor health seeking behaviour; ▪ Negative cultural practices – such as female circumcision and beading; ▪ Food insecurity and malnutrition; ▪ Vastness of geographical area and sparse population; ▪ Insecurity; ▪ Poor access to safe drinking water and sanitation; ▪ High illiteracy level; ▪ Nomadic lifestyle; and ▪ Poverty	▪ High staff attrition rate, insecurity and remoteness makes place less attractive to staff; ▪ Vastness of geographical area, poor terrain and hard to reach areas contributes to poor heath seeking behaviour; ▪ Arid and semi-arid climate (food insecurity); and ▪ Historical marginalisation.

Project County	Challenges	Contributing factors
Isiolo	■ Inadequate health infrastructure (50 km average distance to a health facility); ■ Inadequate human resources; ■ High burden of communicable diseases; ■ Poor health seeking behaviour; ■ Food insecurity; ■ Nomadic lifestyle; ■ Insecurity and ethnic conflicts; ■ High illiteracy level; ■ Increasing burden of HIV; ■ Poverty; ■ Home deliveries and high maternal mortality; and ■ Poor sanitation coverage.	■ Historical marginalisation; ■ Vastness of geographical area and poor road network; ■ Arid and semi-arid climate (food insecurity); ■ Rapid population influx (especially Isiolo town); and ■ Health system inefficiencies such as inadequate ambulances and weak referral systems contribute to high maternal mortality.
Garissa	■ Inadequate health infrastructure (35 km average distance to a health facility); ■ Inadequate human resource capacity; ■ Inadequate medical supplies and equipment; ■ High illiteracy and poor awareness; ■ Food insecurity and malnutrition; ■ Nomadic lifestyle; ■ Insecurity; ■ Large refugee population (Dadaab camp); ■ High maternal mortality; ■ Vastness of county and remoteness of certain locations. ■ Poor immunisation coverage; and ■ Poverty.	■ Historical marginalisation; ■ Vastness of geographical area and poor road network; ■ Arid and semi-arid climate (food insecurity); ■ Health system weaknesses; and ■ Porous borders contribute to influx from Somalia.
Meru	■ Increasing burden of NCDs; ■ High burden of communicable diseases especially upper respiratory infections; ■ Inadequate medical supplies and consumables; ■ High demand for services; ■ Overstretched Meru RRH; ■ Increasing burden of road traffic accidents; and ■ Low immunisation coverage especially in the north.	■ Changes in diet and lifestyle; ■ Population influx and increasing mobility; ■ Overcrowded settlements in some areas; ■ Weakness of referral systems; and ■ Insecurity in the northern border with Isiolo.

Project County	Challenges	Contributing factors
Lamu	■ Increasing burden of NCDs; ■ High burden of communicable diseases; ■ Maternal health challenges; ■ Inadequate health infrastructure; ■ Inadequate medical supplies and consumables; ■ Accessibility challenges; and ■ Poor access to safe drinking water (in rural areas).	■ Changes in diet and lifestyle; ■ Overcrowded settlements in some areas (especially Lamu Island); ■ Insecurity especially in Lamu East; ■ County is made of several small islands (65 in number) some of which are hard to reach; and ■ Poor road network.

NCD = non-communicable diseases

6.11.4.2 Communicable and Non-Communicable Diseases

The burden of communicable diseases in the Project counties remains high with no particular trends over the preceding years, although outbreaks of cholera have occurred in the past in Garissa and Isiolo. The leading cause of morbidity in the AoI communities are respiratory infections and diseases, diarrhoeal diseases, skin diseases, pneumonia and unspecified fevers (Social Baseline, Annex II).

Acute respiratory infections are prevalent in each of the Project counties, attributed to environmental conditions such as poor housing, dry and dusty weather in most of the counties and cold weather in Meru. Poor housing was directly linked to poverty and exposure to disease causing vectors. Use of wood for cooking increases indoor pollution and the risk of respiratory diseases. Tuberculosis is also endemic in the Project area with the highest prevalence in Meru and Turkana.

HIV also remains one of the major causes of morbidity and mortality in the Project counties with the highest incident rates recorded in Lamu, Meru, Isiolo and Turkana (UNAIDS 2014). Drivers of HIV infection in the Project area include:

- High population mobility (linked to tourism) in Lamu County;
- Commercial trade in all county urban centres;
- Locations along major transport routes (specifically Isiolo and Turkana); and
- Injection drug use in Lamu and Meru.

HIV infections increased between 2013 to 2016 in Lamu, Meru and Isiolo while decreasing in Turkana, Garissa and Samburu (National AIDS Control Council 2018). Decreases were attributed to the scale up of interventions such as health education, free condom distribution, increased availability and uptake of HIV testing, care and treatment as well as reduction in HIV-related stigma. The increase recorded in Lamu (during 2013-2016) was linked to commercial sex activity stimulated by the Lamu port construction, tourism activities and injection drug use.

Most of the Project counties with the exception of Turkana and Lamu, lie within the low risk and seasonal malaria transmission zone (National Malaria Control Programme et al., 2016) (Social Baseline, Annex II). While malaria was once a major public health concern in Lamu, the burden of malaria in the county has significantly reduced and the disease no longer features among the top-ten. Malaria in Turkana County is high, with the disease ranking among the top-five morbidities in the county (Ministry of Health, 2019).

The risk of measles in the study area remains the greatest in Garissa County, which hosts the largest refugee camp in Kenya, with further risk of imported cases from Somalia. Arboviral diseases (arthropod borne viruses) occur in the Project area. These acute viral fevers (such as dengue, chikungunya, yellow fever, Rift valley fever) are transmitted by the day-biting Aedes mosquitoes which breed mainly in human-made containers.

Non-communicable diseases, notably hypertension, are an emerging concern. Malnutrition featured prominently among child morbidities in Turkana, Garissa, Isiolo, and Samburu but the burden could be underestimated as many mild to moderate cases remain at the community level and are not reported through the Health Management Information System (HMIS).

6.11.4.3 Accidents and Injuries

Road traffic accidents contribute significantly to overall morbidity and mortality in Kenya with nearly one-third of road traffic accidents in the country are fatal. Meru County recorded the highest number of road accidents and related deaths. Snake and dog bites are also reportedly common in Project counties. Generic snake antivenom is available in most local hospitals but less often in lower level health facilities. Nearly half of the dialysis patients at Garissa County Referral Hospital were snakebite victims.

6.11.4.4 Environmental Determinants of Health

The prevalence of soil, water and waste-related diseases are highly dependent on the availability of sanitation facilities, sanitation practices and access to safe drinking water. Access to safe drinking water and improved sanitation facilities is varied across the counties crossed by the Project. Within the Project area, access to safe drinking water was highest in Isiolo County (82%) and lowest in Turkana County (44%) while the rest of the counties recorded coverage between 49% and 71%. Groundwater (boreholes and shallow wells) is the most common source of drinking water in the Project area. Use of unsafe surface water (dams, seasonal rivers, lagoons) was reported, especially in Turkana, Samburu and Garissa and more so in rural areas. Improved sanitation facilities are found primarily in Meru County and Lamu County (with a coverage of 98% and 60%, respectively). Turkana and Samburu had the lowest access to improved sanitation facilities with 3% and 4% respectively. Due to the lack of sanitation facilities, open defecation is a significant challenge in Garissa, Isiolo and Samburu.

Diarrhoea is among the top five causes of disease burden nationwide, especially among young children, where it is responsible for 7% of all deaths. The high burden is associated with contaminated water, unhygienic practices in food preparation and improper waste disposal. Findings from KIIs show that diarrhoea was among the top five diagnoses in the study area with a variable burden across the different counties. The burden of diarrhoea was highest in Lamu, Turkana and Isiolo where it contributed at least one-third of the morbidity in children younger than five.

6.11.4.5 Social Determinants of Health

Substance abuse is a growing public health concern in the Project study area. Lamu County in particular reported drug abuse as a notable problem, especially in Lamu Island. Substance misuse is particularly common among the youth with high prevalence of intravenous drug use and consumption of illicit drugs such as cocaine, heroin and cannabis. The coastal town is also known for peddling and trafficking of illicit drugs. Garissa County reported increasing cases of drug abuse along the border with Somalia and among street children. Meru County reported abuse of narcotics, alcohol and khat (miraa)[3]. Khat is also widely consumed in Isiolo and Garissa. Samburu County reported increasing abuse of cannabis among the youth in urban areas – some of whom have required rehabilitation. Commercial sex activity was reported as a concern in Lamu, Meru, but less so in

[3] Miraa is locally grown and is considered a cash crop.

Garissa, Isiolo and Samburu. Substance abuse and commercial sex activity are emerging health challenges in Turkana. All Project Counties reported increasing cases of substance abuse.

Baseline findings show that gender-based violence is common in the study area, with teenage pregnancies and early marriages also being an important health concern in the AoI. Survey data from the 2014 KDHS show a high rate of teenage pregnancies in Samburu, Isiolo and Meru above the national average of 18%. Garissa and Lamu recorded a lower rate of 10%. The counties of Samburu, Isiolo and Garissa reported increasing cases of gender-based violence.

6.11.5 Community Safety and Security

The existing security situation in northern Kenya is volatile due to ethnic rivalries, competition for resources and under-resourced state security with limited capacity to enforce law and order across large swaths of territory. Marginalised populations, endemic poverty and transnational armed militants are important factors contributing to regional insecurity. Insecurity is a major concern cited by locals in all six counties the Project will traverse.

The counties with prominent nomadic pastoral communities (i.e. Turkana, Samburu, Garissa, Isiolo) have a long history of conflict related to competition over natural resources (i.e. pasture and water), cattle raiding between pastoralists and also between pastoralists and more permanently fixed communities. Cattle raiding has been a source of violence in northern Kenya for over 100 years and is an economic and cultural phenomenon as it allows raiders to expand their herds but can also be a rite of passage and test of manhood for young men seeking status.

Environmental changes have brought additional stresses to these communities. These changes include land degradation and an increased frequency of droughts and heavy rainfall which can intensify the frequency and ferocity of conflicts. These environmental factors fuel social conflicts in Northern Kenya. The economic and cultural tendencies of local populations vary with the physical geography and climate. Whereas arid counties necessitate nomadic pastoralist culture with highly mobile livestock herds and limited opportunities for crop farming; agro-pastoralism is more common in the semi-arid counties where integrated crop farming and livestock production systems are possible. There is a constant tension between these highly mobile and more "sedentary" cultures which can be exacerbated by fluctuations in weather, or manmade changes to water access, prime agricultural land, cattle trade routes and any other changes to the physical terrain.

Increased settlements and competing land resources for commercial ranching and wildlife conservation is also a contributing factor to the conflict in the pastoralist AoI communities. Aggrieved communities often use violence to regain possession of lost land or secure access to other resources. The spread of small arms in more recent times along with the commercialisation of livestock raiding, disputes over land tenure rights, banditry and predation, have seen raiding become more widespread, violent, sophisticated and destructive. Small arms and light weapons are more readily available due to ongoing conflicts in nearby South Sudan and Somalia. An overwhelming majority (as high as 100% by some estimates) of pastoralists in the region are armed. These pastoralists are thought to own the majority of over half a million illegal firearms estimated to exist in Kenya (Schilling et al., 2012).

Cross-border conflict between counties are an issue, along the borders of Turkana County and the northern portions of the County of Meru that border Isiolo and Wajir. In Samburu County and Isiolo County, ethnic violence in the form of cattle raiding and indiscriminate killing is present between communities. In Samburu, livestock rustling occurs between the Turkana, Pokot, Rendile and the Samburu (Pkalya et al, 2003; Khisa et al., 2016). In Isiolo County, recent conflict is primarily between the Turkana and Borana communities (Saferworld 2015).

In the counties of Lamu and Garissa, conflict is exacerbated by the presence of Al-Shabaab militants, who maintain a base of operations in the Boni Forest. The militants have made numerous attacks in the two counties that began to escalate in intensity in 2014. Terrorist cells will often pick targets in Kenya to inflame pre-existing grievances and tensions. In Lamu County, migration of pre-dominantly Christian 'upcountry' tribes has been reported to be widely resented by the pre-dominantly Muslim coastal populations. Attacks are frequently designed to provoke a major crackdown which draws new recruits, supporters and sympathisers to their cause and de-legitimises the state security apparatus in key areas. The divisions crossed by the Project in Lamu County (Hindi, Mpeketoni and Witu) are still reeling from the aftermath of terrorist attacks from 2014 (Social Baseline, Annex II). The towns have not recovered socio-economically, and some residents are fearful of staying out after dark in the evenings. Investors who lost property in the attacks claim they have not been compensated which has de-incentivised re-building in these areas. Even though the area has been calmer lately, these areas retain the stigma of being prone to terrorist attacks.

Security is a challenge given the limited physical infrastructure and communication infrastructure of the counties. Where present, police and the judiciary are under resourced and unable to carry out its functions. The police and judiciary in north-western Kenya have had a difficult time reigning in raiding parties. Additional support in the communities therefore often comes from the voluntary Kenya Police Reserve (KPR) who protect enclosures and cattle caravans (Mkutu and Wandera, 2013), though reservists in AoI counties have been temporarily disarmed by the Government in order for a comprehensive vetting and retraining initiative to take place.

Insecurity and conflicts are also contributing to migration and re-settling in safer areas, often near security installations. Some pastoralists are also settling down into more permanent stockades. However, these emerging ASAL trade centres are not well enough planned or resourced to absorb a high number of immigrants without negative social and environmental consequences, which may ultimately degrade security as well.

Table 6.11-2 summarises the criminal activity by county between 2016 and 2019. Turkana has the highest number of reported incidents in the six counties and is driven by inter-communal violence and highway banditry. Meru County also has relatively high levels of reported criminal activity.

Table 6.11-2:Criminal activity by county (Between 2016 and 24 March 2019)

Type of Criminal Activity	Turkana	Samburu	Meru	Isiolo	Garissa	Lamu
Civil Disobedience	14	8	17	9	15	16
Criminal Violence	2	8	22	5	3	3
Highway Banditry	32	11	1	10	2	0
Inter-communal Conflict	61	18	18	31	9	4
Kidnap	0	0	3	1	2	0
Others	3	8	26	15	12	18
Robbery/Theft	1	4	16	3	4	3
Fraud/Extortions	2	2	2	1	0	0
Sexual Violence	0	1	4	2	0	1
Total	**115**	**60**	**109**	**77**	**47**	**45**

Source: *Castor Vali Africa, 2019*

6.12 Economics and Employment

6.12.1 Introduction

A baseline study was undertaken to describe the socio-economic and health conditions in the LLCOP AoI. This section (Economics and Employment) and sections 6.10 Physical and Social Infrastructure, 6.11 Community Health, Safety and Security and 6.13 Livelihoods, provide summaries of the complete social baseline and health baseline report (Annex II) upon which changes from the Project on the social environment are measured.

The Economics and Employment section begins with a description of population and demographics and county administration and leadership for overall context, and then describes revenue sharing and general economic, employment and labour force characteristics.

6.12.2 Area of Influence

The Social AoI is a 25 km buffer around the proposed pipeline route and is presented in Figure 6.10-1.

6.12.3 Methodology

6.12.3.1 Approach

Socio-economic baseline characterisation involved the following steps:

- Identify the AoI within which the effects of the Project on socio-economic conditions will be evaluated, in this case communities within a 25 km buffer around the proposed pipeline route;
- Identify parameters used to characterise socio-economic conditions in AoI communities, including from review of Scoping Consultations held in June 2018 and detailed in the Scoping Report (Annex I); and
- Design and carry out a literature review and data collection programs to characterise existing socio-economic conditions and collect information to support assessing the effects of the Project on socio-economic conditions:
  - Literature review and secondary data collection – government reports, academic literature and information from civil society groups; and
  - Primary data collection – interviews with key individuals, focus group discussions, seasonal calendars and land use mapping.

6.12.3.2 Parameters

The potential effects of the Project on socio-economics were described using the following parameters and organised by subcomponent:

- National economy: gross domestic product (GDP), foreign direct investment, export earnings, household income, national employment, infrastructure, health and social wellbeing (Human Development Index (HDI));
- Population demographics, ethnicity and language, economic base and employment;
- Social infrastructure including education, health, housing and security;
- Physical infrastructure including water, sanitation and waste, energy sources, roads and communication; and
- Land and natural resources.

6.12.4 Population Demographics

The Project will traverse six counties from northwest to southeast Kenya, beginning in Turkana and cutting across the counties of Samburu, Isiolo, Meru, Garissa and ending in Lamu, specifically the Lamu Port at Manda Bay. The counties of Turkana, Samburu, Isiolo and Garissa are classified as arid counties (i.e. 85-100% aridity) and the counties of Meru and Lamu are classified as semi-arid (i.e. 30-84% aridity) (Government of Kenya, 2019a; PRISE, 2016). The arid counties are predominantly pastoral with limited crop farming while the semi-arid counties are primarily agro-pastoral with integrated crop and livestock production systems (PRISE 2016). The arid and semi-arid (ASAL) counties are endowed with rich natural resources such as forests and wildlife, minerals, and unique cultural characteristics.

In relation to socio-economic development, the ASAL counties are generally characterised by low human development (e.g. high poverty levels, low literacy, low employment), high growth rates, and poor infrastructure (PRISE, 2016). These characteristics increase vulnerability and when climate shocks and stresses such as drought occur, the effects are more acute (e.g. food shortages). The ASAL counties are also characterised by the shifting demographic patterns where people settle in towns as a result of the loss of livestock-based livelihoods and conflict from resource-induced competition.

Various development changes are occurring in the ASALs. While pastoralists have used mobility as a key coping strategy, they have become increasingly sedentary in response to food insecurity (PRISE, 2016). Natural population increases combined with in-migration exerts pressure on natural resources (e.g. land and water) as well as social infrastructure (e.g. housing). Land fragmentation from the subdivision of communal land has also become common in the ASALs, which has led to changes that are inconsistent with sustainable land use.

Current population projections were based on the most recent census, conducted in 2009. In 2009, the counties had youthful populations, with approximately 40% of the total population in the six counties under the age of 14 (KNBS, 2009). The counties of Meru and Turkana are the most populous counties and the counties of Lamu and Isiolo are the least populous. Table 6.12-1 presents the counties overlapped by the Project and their projected current populations.

Table 6.12-1: Demographics and administrative units for the Project counties

County	Area (km^2)	Administrative Units	Census Population (2009)	2017 Population (Projected based on 2009 Census)
Turkana	68,680.3	▪ 7 sub-counties ▪ 17 divisions ▪ 56 locations ▪ 156 sub-locations	855,399	~1,000,000
Samburu	21,022.1	▪ 3 sub-counties ▪ 7 divisions ▪ 39 locations ▪ 108 sub-locations	223,947	319,708
Isiolo	25,700.0	▪ 3 sub-counties ▪ 10 wards ▪ 43 sub-locations	143,294	191,627

County	Area (km²)	Administrative Units	Census Population (2009)	2017 Population (Projected based on 2009 Census)
Meru	6,936.2	■ 9 sub-counties	1,356,301	1,601,629
Garissa	44,174.1	■ 6 sub-counties ■ 23 divisions	699,534	849,457
Lamu	6,273.1	■ 2 sub-counties ■ 7 divisions	101,539	137,180

Source: Turkana County Government, 2013; 2018; Samburu County Government, 2013; Isiolo County Government, 2013; Meru County Government, 2013; Garissa County Government, 2013; Lamu County Government, 2013.

A diverse mix of ethnic groups reside in the six counties. While the majority of the ethnic groups in the six counties are domestic pastoralists, the groups have distinct languages, religions and cultural practices. In the counties of Turkana, Samburu and Isiolo, the dominant ethnic groups are the Turkana, Samburu and Borana people (Fratkin and Roth, 2015). In Meru County, the Ameru are the dominant ethnic group. In Garissa County and Lamu County, the dominant ethnic groups are the Somali and Bajuni, respectively. Lamu County is also home to the Aweer community who live in the area known as the Boni-Lungi Forest. Golder and ESF carried out focus groups meetings, one-on-one meeting and desktop studies to find out if there is potential for the LLCOP to affect the livelihoods of the Aweer community. The outputs of this report is appended to Annex II Social Baseline (Additional Aweer Social Baseline Data Collection, ref. 1772867.551.7). A full list of Vulnerable and Marginalised groups as per the new Kenyan Constitution is presented in the SEP – Annex III.

The official national language. Kiswahili is spoken in all counties. The Turkana and Samburu people are Nilotic people, people that share common linguistic features but not necessarily share social or political bonds. In Isiolo, the Borana people speak Borana, a dialect of the Oromo language. In Meru County, the dominant ethnic group, the Ameru, is of Bantu linguistic origin. In Garissa County and Lamu County, the primary languages spoken by the dominant ethnic groups are Kiswahili and Somali.

In the counties of Isiolo, Garissa, and Lamu, the majority of people practice Islam (Kenya Information Guide, 2018; Pulse, 2017; Journey Kenya, 2013). While in Turkana and Samburu, the majority of people are either Christians or animists (traditional spiritualism) (Future Agricultures, 2014). In Meru County, Christianity is the primary religion.

6.12.5 County Administration and Local Leadership

County governments are divided into sub-counties that are further divided into divisions, locations and subdivisions. Counties are led by elected governors for a period of five years and a maximum of two terms. Sub-counties were created to ease service delivery in health, agriculture, urban services and local infrastructure (World Bank Group, 2018a). County governments consist of the County Assembly and the County Executive. The County assembly is made up of members of county assembly (MCAs) elected from different assembly wards in the county and nominated MCAs who represent special interests such as persons with disabilities and youth and the speaker.

The relationship between national, county and traditional leadership is still evolving as county governments implement changes towards more devolved government under the 2010 Constitution. Location and sub-location leadership, Chiefs[1] and Assistant Chiefs are aided by Elders who assist the Chief in his or her duties. Elders may carry out the Chief's functions when they are absent and are considered part of traditional governance structures. Traditional, county and national governance systems are interdependent. Elders serve the communities by acting as decision makers, mediators, environmental and cultural conservators, and disseminators of information to and from the community and county government. Elders also take a central role in pastoralist issues such as controlling grazing patterns and seasonal calendars. The role of Elders has changed slightly as they follow newly introduced structures from the county. Roles on decision making are influenced by more educated people who advise elders, especially in community projects that involve them as stakeholders.

6.12.6 Revenue Allocation

Following devolution in 2010, county governments were charged with overseeing some functions such as the provision of health care, pre-primary education and maintenance of local roads in return for a share of national revenues (Brookings, 2013). Kenya's Commission on Revenue Allocation (CRA) provides a revenue formula to the National Assembly for the allocation of funds to county governments. The formula is a point of contention for some counties due to the fact that it relies upon population statistics from the 2009 National Census. Some argue that using these outdated numbers disadvantages regions that have experienced rapid population change since the 2009 census (Daily Nation, 2019a). In 2019, county politicians requested that the CRA formula be reviewed after the upcoming 2019 census (Daily Nation, 2019a). For the July 2019/June 2020 fiscal year, the government announced that Turkana County will receive 10 billion Kenyan Shillings (Ksh), the most out of all six counties crossed by the Project, while Lamu will receive the least at 2.5 billion Ksh (Business Daily Africa 2019).

6.12.7 Economic Activities and Employment

Economic activities in the six counties are predominantly in the informal sector[2], which is also seen at the national level, and is characteristic of lower-middle income economies (World Bank 2017a, World Bank 2018b). Formal sector employment is employment with legal and social protection. In the AoI communities, formal sector employment plays a minor role in economic activities given that the vast majority of communities are centred on subsistence activities (i.e. pastoralism and agriculture). Formal employment is more commonly found in urban and peri-urban AoI communities such as Isiolo Town and in sectors such as education, government, tourism, domestic and humanitarian organisations. Fishing is a prominent industry in Lamu County and conducted on a smaller scale in the counties of Garissa and Turkana. Tourism is a growing industry in all counties and is most developed in Lamu County.

Turkana, Samburu, Garissa, and Isiolo are also characterised by very high poverty rates. These counties are included in the top ten poorest counties[3] in the country, with Turkana County having the highest rate of poverty (Development Initiatives 2018a; Standard Media 2018d). Turkana has shown signs of improvement however, with poverty rates declining from a rate of 92.6% in 2005/2006 to 79.4% to 2015/2016 (Development Initiatives 2018b). Of the counties traversed by the Project, Meru has the lowest rate of poverty at 19.4% followed by Lamu at 28.5% (Development Initiatives 2018a). Due to a combination of factors such as historical marginalisation, the communal land tenure system, and poor infrastructure (both physical and social), the development of industries and wage/salaried employment in the counties of Turkana, Samburu, Garissa and Isiolo has been extremely limited. In addition, the low levels of educational attainment and literacy rates serve

[1] Chiefs are government appointed positions.

[2] The informal sector refers to the production and employment that takes place in unincorporated small or unregistered enterprises. Informal employment refers to employment without legal and social protection (Chen 2012 via ODI 2018).

[3] Turkana is ranked first with 79.4%, Samburu is third with 75.8%, Garissa is fifth with 65.5%, and Isiolo is tenth with 51.9% (Development Initiatives 2018a; Standard Digital, 2018).

as barriers to obtaining the limited number of formal employment positions that exist. Additional difficulties to the development of formal sector employment can be attributed to insecurity caused by raiding, cattle rustling in the pastoral communities and extremist activity in Garissa and Lamu. Unemployment is therefore high in the six counties, especially in Turkana and Isiolo (around 70% unemployment). Waged employment is found on a limited scale in all six counties with Isiolo County having the highest proportion of waged employment at 14.5%. Employment data on the individual AoI communities is not available.

In Turkana County the economy is focused primarily on nomadic pastoralism and livestock herding (TCG, 2013). Nearly 60% of the population derive their livelihood from livestock-based activities (TCH, 2018a). The remainder of the county's livelihoods are categorised as 20% agro pastoral, 12% fisher folks and 8% in the urban/peri-urban formal and informal employment (TCH, 2018a). In the sub-counties that overlap the Project (Turkana East and Turkana South), reliance on firewood/charcoal and petty trade have become more prevalent, surpassing livestock herding as the main occupation between 2015 to 2017 (TCH, 2018a). Employed and waged labour, as a category, have declined noticeably during this same period while selling firewood/charcoal have risen to compensate. In 2009, the county had an unemployment rate around 70%, significantly higher than the national unemployment rate of 42% (TCG, 2013). Waged earners in the county are employed in sectors ranging from education, government, domestic to humanitarian organisations.

Like Turkana County, economic activity in Samburu is also centred around nomadic pastoralism. In the Samburu AoI communities, the main economic activities are focused on livestock rearing, conservancy management, small-scale farming and irrigation, quarry activities and sand harvesting. The communities are also involved in small business initiatives which generate income, such as greenhouses, bee keeping, beading and tree planting, poultry farming and aloe vera harvesting. The labour force (aged 15-64) of Samburu County was 103,987 in 2009, representing 46.4% of the total population (SCG, 2018). The labour force was projected to rise to 185,446 by 2022. In 2009 there were 4,215 wage earners in the public service, approximately 3,000 wage earners in the private sector, and another 5,000 wage earners were estimated to be working for civil society organisations (FBOs, NGOs and INGOs) (SCG, 2018). There were approximately 3,000 self-employed persons in Samburu County engaged in business activities such as livestock marketing, poultry farming, clothing and textile, apiary, horticulture and crop farming (SCG, 2018). More recent employment data for Samburu County was not available.

Livestock rearing forms the economic backbone of Isiolo County with over 80% of the population relying on livestock for their livelihoods (ICG, 2018). Wage-earners account for 14.5% of the county population and are found in the public sector and hotel industry, mainly in Isiolo Town (ICG 2018). The majority of the population is not engaged in formal employment due to the lack of industry, technical skills and literacy. Approximately 60% of the county is engaged in rural self-employment and 15% engaged in urban self-employment such as trade of commodities like *Miraa*[4] and livestock (ICG, 2018). High levels of unemployment are found in Isiolo County with over 70% of the labour force not formally employed. The total labour force is 52.1% (82,691) of the total population (ICG, 2018).

Agriculture is the main economic activity in Meru County. A variety of food (wheat, barley, potatoes) and cash crops (tea, banana, *Miraa*) are grown (MCG, 2018). Livestock such as dairy and beef cattle, goats, sheep, poultry and honey bees are kept for subsistence and commercial purposes. Waged employment and self-employment are limited, each contributing approximately 10% of total household income (MCG 2018). Wage earners are found primarily in the public and private sectors as well as civil society organisations.

[4] Miraa, also known as Khat, is a flowering plant that is commonly chewed.

Self-employment is focused mainly in the agricultural sector, *Jua Kali*[5] and trade sectors. The total labour force is 55.9% (915,083) of the total population (MCG, 2018).

Livestock also forms the economic backbone of Garissa County's economy. Self-employment is more common than wage employment, with 28% of the total labour force as self-employed and 7% wage earners (GCG, 2018). The self-employed in Garissa are mainly engaged in activities related to agriculture such as milk vending, *Jua Kali*, *miraa* selling, hawking and livestock selling and are found primarily in urban centers. Wage earners are formally employed by government departments, NGOs, donor agencies and business organisations. Unemployment in the county is around 28% (GCG, 2018). Youth in the AoI communities in Garissa are employed in a variety of activities such as farming and animal herding, burning and selling charcoal, and other small-scale businesses.

In Lamu County, agriculture and agricultural related activities[6] are the largest contributors to the rural household income, at 90%. Other sources of household income for the county include tourism (5%), wage employment (2%), urban self-employment (1.5%) and rural self-employment (1.5%). Agriculture and livestock farming occurs in the mainland while fishing occurs around the county islands. Lamu County's fishing industry is worth an estimated 180 million Ksh, employing around 3,500 artisan fishermen for marine in-shore and fresh-water fishing in approximately 40 fishing grounds (MoALF 2018b). Fishing is the main livelihood activity in the AoI communities of Mokowe, Kiliana, Bargoni and Pate. In recent years, the construction of the Lamu port has disrupted access for many fishermen in the AoI community of Kiliana.

While there are some vocational training facilities in the counties, they are mostly located in the more urban AoI communities (e.g. Lokichar, Maralal, Mokowe, Wamba, Meru Town) and not in the rural AoI communities. Garissa and Lamu have the greatest number of training institutions with multiple colleges, universities and vocational training centres (GCG, 2018; LCG, 2018). The remaining counties each have a handful of facilities (ICG, 2018; SCG, 2018). These facilities lack sufficient funding and their distances from communities often serve as access barriers, especially for girls[7] (Glennerster et al. 2011). The youth in the rural AoI communities aspire to obtain formal employment, often moving to urban centres in or outside their counties. However even after moving, obtaining formal employment is difficult. Overall, youth unemployment is high in the AoI communities which follows the trend of high youth unemployment seen at the national level. In Swari, youth stated that many of them have used illicit or unethical means to generate income due to the lack of employment opportunities. Many of those who are educated view employment opportunities which involve manual labour (e.g. construction) unfavourably.

Economic activities in the six counties are predominantly in the informal sector due to the lack of industry and waged employment which can be attributed to historical marginalisation, the communal land tenure system, and poor infrastructure development. Obtaining the limited number of wage employment positions in government and NGOs is also difficult due to the low levels of educational attainment and literacy rates in the counties. Unemployment is therefore high in all six counties, especially in the counties with higher levels of poverty such as Turkana. Youth unemployment is also high. While the youth in the six counties are eager for formal employment, it can be difficult due to the lack of opportunity in the rural AoI communities and the lack of physical access to the vocational training centres. Given these factors, the labour market in the AoI communities across the six counties are centred primarily around nomadic pastoralism and subsistence agriculture with the exception of Lamu County which also has a prominent fishing sub-sector. Livestock, small-scale agriculture, and agricultural activities are also the main sources of household incomes in the AoI communities.

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[5] Jua Kali refers to the Informal Sector

[6] The agricultural sector includes livestock production and fishing subsectors.

[7] Research has shown that girls schooling in Kenya is more sensitive to distance than boys schooling (Glennerster et al. 2011)

6.12.8 Tourism

Tourism is an emerging industry in the six counties with the exception of Lamu, where it is established and has become an important contributor to the county's economy. Current attractions are associated primarily with natural attractions and game conservancies, with some heritage, culture and community-based tourism, eco-tourism and sport attractions. National parks are located in the counties of Turkana, Meru and UNESCO sites are found in Turkana and Lamu. Several game reserves with a wide range of wildlife species are found in the counties of Lamu, Isiolo, Samburu and Turkana. Wildlife conservancies are also prominent tourist attractions in the counties of Samburu, Meru, and Lamu. Game conservation has also been slowly adopted by pastoralists as an alternative land use as it can provide better returns when it is linked up to the tourist market (Repcon Associates, 2017).

Private ranches are found in Lamu and Meru which double as wildlife conservancies and a place where cattle and sheep rearing occur (MCG, 2018; LCG, 2018). In Samburu, group ranches are land set aside for public use and individual ownership (SCG, 2018). No ranches are found in Isiolo, Garissa, and Turkana. Meru County offers additional activities relating to outdoor activities such as mountain climbing, competitive sports, camping, trekking, waterfall diving and bird watching. Lamu County has several archaeological and cultural attractions. Tourism is a major economic activity in Lamu county but has underperformed in the past five years due to travel advisories issued by Western countries (Daily Nation, 2018a).

As part of Vision 2030, Isiolo Town is identified as a resort city to be developed to optimise tourism potential with the creation of multi-use facilities such as amusement parks, water sport facilities, art exhibits, theatres, and ski and golf courses (Vision 2030, 2018). This development is expected to also bring visitors to neighbouring county attractions, such as the upcoming Nyambene Conservancy in Meru County.

The range and capacity of tourist accommodations varies in each of the counties in the AoI. Samburu County has twenty tourist class hotels, mainly located within reserves and other conservation areas (SCG, 2018). Isiolo County, specifically Isiolo North, has several hotels and restaurants (ICG, 2018). Garissa County has five tourist class hotel facilities and three unclassified facilities (GCG, 2018). The AoI community, Garissa Town, has a highly developed hospitality industry. In other counties however, very limited tourist accommodations are found and additional investment in tourism infrastructure is needed. Counties require investment in building additional visitor accommodations to expand capacity. In Turkana County the entire county only has one tourist class hotel while Meru County has two tourist class hotels (TCG, 2013; MCG, 2018). Additional marketing is also required as some of the counties are not popular destinations for regional or international tourism despite their tourism potential. In recent years, insecurity issues have impacted tourism in Lamu and Samburu. Attacks on Lamu's archipelago by Al Shabaab and raids on the Lamu-Garsen road, Ishakani, Pandanguo, Maleli, have negatively impacted the tourism sector. Tourism may also be affected by other external factors such as poaching, livestock intrusion into wildlife conservation areas, and drought.

6.13 Livelihoods

6.13.1 Introduction

A baseline study was undertaken to describe the socio-economic conditions in the LLCOP AoI. This section (Livelihoods) provides a largely qualitative summary of the complete social baseline report (Annex II) upon which changes from the Project on the social environment are measured.

The Livelihoods section focuses on pastoralism, agriculture, fishing, other livelihood activities as well as a brief summary on land tenure and livelihoods.

6.13.2 Area of Influence

As described in Section 6.10.2, the Social AoI is a 25 km buffer around the proposed pipeline route and is presented in Figure 6.10-1.

6.13.3 Methodology

6.13.3.1 Approach

Socio-economic baseline characterisation involved the following steps:

- Identify the AoI within which the effects of the Project on socio-economic conditions will be evaluated, in this case communities within a 25 km buffer around the proposed pipeline route;
- Identify parameters used to characterise socio-economic conditions in AoI communities, including from review of Scoping Consultations held in June 2018 and detailed in the Scoping Report (Annex I); and
- Design and carry out literature review and data collection programs to characterise existing socio-economic conditions, including dominant livelihoods, and collect information to support assessing the effects of the Project on socio-economic conditions.

6.13.3.2 Parameters

The potential effects of the Project on socio-economics in this sub-section were described for livelihoods and land tenure.

6.13.3.3 Data Collection

Socio-economic data was collected, analysed and reported on using the following sources:

- The Stakeholder Engagement Report (Annex III of the ESIA) – summary of consultations during the ESIA process that includes a discussion of key concerns; Literature review and secondary data collection – government reports, academic literature and information from civil society groups;
- Primary data collection – interviews with key individuals and focus group discussions.

6.13.4 Pastoralism

Nomadic pastoralism is practiced in all six counties and is the main economic activity in Turkana, Samburu and Isiolo and is maintained due to the aridity of the lands and challenges with agriculture. In Turkana and Samburu, pastoralism is the main livelihood for over half the population. Cattle, camels, sheep and goats are the typical livestock reared for both subsistence and commercial purposes. Livestock ownership serves multiple functions, as a form of pastoral capital, a means of production, storage, transport, and transfer of food and wealth[1]

[1] Livestock provides a regular food source for household members and provides cash income to pay for services such as education and healthcare. Socially, livestock acts as payment of dowry, compensation of injured parties after raids, represents prosperity and is a store of wealth during drought and disease.

(Schilling et al., 2012). Livestock is typically owned by individuals and herding activities are carried out by the men while young men provide security against cattle rustling.

Livestock requires large quantities of water which are in short supply in the ASAL counties, especially during the dry seasons. Due to the challenges of limited pasture and water, pastoralists travel throughout the year from one area to another in search of these resources in the dry season. Movement is also determined by security concerns regarding livestock raiding. Pastoralists in all counties follow herding calendars and experience seasonal changes due to rainfall irregularity. Over time, the timing of the different seasons has changed, and pastoral movements have become irregular, making grazing patterns difficult to determine.

Pastoralists will often have semi-permanent homes like the pastoralists in Barsaloi, Samburu County, who return to Barsaloi in the rainy season and migrate during the long dry season. Others have permanent homesteads like the pastoralists in Suyian who live in large homesteads as a security measure against threats from other hostile communities (e.g. the Turkana). Typically, herders migrate in family groups comprised of multiple families or lineages. In Meru, pastoralists travel in groups of 50 families while in the other counties the groups are smaller with five to ten families. Pastoralists often travel in large groups armed with guns to protect their livestock from predation and livestock raiding.

Conflict can arise between competing resource users, leading to conflict and violence in the form of cattle rustling, ethnic violence and displacement (Sharamo, 2014). Additional pressures of drought and erratic rainfall have resulted in decreased pastures and pastoral movement from neighbouring counties[2] into Isiolo County's Ewaso Ng'iro riverbed where they compete with local livestock for grazing resources. Pastoralists from Garissa also travel into Lamu County in times of extended drought as Lamu County provides grazing land. While migrating pastoralists are aware of negotiated rules of access, many choose to ignore them which results in conflict. The situation is aggravated by the presence of small arms and light weapons and competing uses of land for commercial ranching and wildlife conservation (Saferworld, 2015). Due to large-scale livestock movements and the risk of violent conflict with incursions by heavily armed herders, the rangelands team in Isiolo County is moving away from supporting individual conservancy grazing plans and looking at regional and county-level land-use planning (NRT, 2017).

Challenges from erratic rainfall and water scarcity is common for all pastoralists who live in AoI communities. Additional pressure is found in Samburu County, primarily due to institutional changes regulating access to land. Historically, land use was managed communally, and any member of the community was able to access the land for grazing and living. Today, livestock mobility involves longer periods and more complex distances due to a shrinking resource base and new rules of access. In some areas, there is increased enforcement of boundaries by private land owners and group ranches. Some group ranches have begun to challenge the right of non-members to settle semi-permanently on group ranch land. Community-based wildlife conservancies also limit livestock access to large areas of pasture and institute new grazing rules with implications for livestock mobility. Insecurity is also an issue, preventing several grazing areas from use. In addition, human population growth, increased sedentarisation and the growth of towns and settlements have influenced the landscape for herding. Furthermore, the younger, more educated Samburu are less committed to pastoralism as a way of life (Lesorogoi, 2017). This is seen in other counties as well.

In most AoI communities, Elders manage the grazing and seasonal calendars, and resolve disputes related to pasture or grazing lands within the community and between communities. In many of the counties, pastoralists are represented by groups who facilitate interactions with the government and provide assistance in procuring resources. In Isiolo, pastoralists are represented by pasture management committees, the Council of Elders, youth leaders and traditional decision-makers. In Kandebene, Meru County, pastoral groups are mainly

[2] Including counties overlapping the Project (Samburu and Garissa) and other counties (Wajir, Marsabit, Tana River) (Saferworld, 2015).

supported by the county government with no representative groups. Pastoralist groups are found in and around the AoI communities of Mokowe and Hindi, staying in non-permanent homesteads. These groups assist with communicating their issues with the local government and resource fundraising. No pastoralist groups are found in the AoI communities in Garissa except in Kamuthe, where youth groups provide security.

6.13.5 Agriculture

Small-scale agriculture is the main economic activity in Meru, Garissa, and an important economic activity in Lamu. Farmers are typically unable to farm on a large scale as they do not own enough land and the rainfall is erratic. In many areas, soil quality is also poor and can only support certain types of crops. Subsistence farming (e.g. beans, cow peas, maize, sorghum, watermelon) is the primary type of farming practiced in the AoI communities in these counties with some cash crops (e.g. Miraa, mangoes, coconut, cotton, and *Bixa Orellana* ('annatto'). Farmers in these counties typically practice mixed farming where they grow many types of crops and keep livestock on the same piece of land. In Isiolo, livestock production is more common than crop production, with over 80% of inhabitants relying on livestock for their livelihoods.

In Meru, common crops grown in the Project area are beans, maize, peas as well as a variety of other crops. Miraa is a highly lucrative cash crop grown in the Project area in Mutuati and Laare Town. Products are sold or exchanged for children's school fees at the local schools. There are no agricultural processing facilities near Kaichuru Village. The average household income in the AoI communities in Meru ranges from 2,000 to 20,000 Ksh per month. Produce storage is inadequate and insufficient in Meru County as produce is usually stored at the individual farm level, resulting in farmers selling produce immediately after harvest at a time when prices are low due to oversupply (MCG, 2018).

Vast farming potential exists in Garissa County. Currently about 12% (2,072 hectares (ha)) of land along the Tana River Basin is under irrigation, out of a potential total of 17,847 ha of land. The average farm size in Garissa County is 1.5 ha for a small-scale farm and 20 ha for a large-scale farm, individual group farms are mainly found along the Tana River. Farmers in the AoI communities of Kamuthe and Bouralgy consume and sell their agricultural products while farmers in Saka only engage in subsistence farming. Only farmers in Kamuthe have access to tractors for cultivation and ploughing and are supported by the Red Cross through the provision of watermelon seeds.

Almost three-quarters of the population in Lamu County is involved in the agricultural sector[3], primarily in crop production. Approximately 85% of Lamu County is arable. Of the 56,923 ha currently being utilised, 39.5% are used for cash crops, 37.4% for food crops, and 23.1% for farm forests. Farming is predominantly rain-fed with only 1% of households practicing irrigation farming. The primary agricultural areas in the county are in the Mpeketoni, Witu and Hindi divisions, which overlap with the Project. The average farm size per household is 1.6 ha. Food crops such as maize, cowpeas, cassava are grown for consumption while mangoes, coconut, and cotton are produced for commercial sales. Cotton production is the highest source of income for households in Lamu County, contributing 42% of household income. Lamu County is Kenya's largest producer of cotton, simsim and bixa, producing approximately 40% of cotton, 50% of *simsim*[4] and 40% of *bixa*[5] grown in the country overall (LCG, 2018). Food crops and cash crops are grown in the AoI communities of Kiliana and Jipe. Livestock production is the main source of livelihood for approximately 30% of the population and is primarily small-scale (MoALF, 2018). Cattle and goat rearing are mostly found in Hindi and Witu. Dairy cattle are also reared in Mpeketoni and parts of Hindi and Witu. Market access is critical to the development of agriculture in Lamu County (LCG, 2018). Currently there are only two physical markets for farm produce in communities outside the AoI including Amu and Mpeketoni. Markets in other areas are in the form of vegetable kiosks in

[3] The agricultural sector includes the livestock subsector and fishing subsector.

[4] Simsim is also known as sesame.

[5] Bixa is also known as Achiote, a type of tree known as the source of annatto, a natural orange-red condiment.

town centres and along major roads. Agricultural processing facilities are also inadequate and constrain marketability of perishable goods such as fruits and vegetables (LCG 2018).

The Aweer in Lamu County are traditionally hunter-gatherers and well known for traditional honey harvesting (refer to the Aweer Briefing Report – attached to the full Social Baseline Report included in Annex II). They also practice small-scale subsistence farming using slash-and-burn and shifting cultivation methods (Annex II). Since colonial times, the Aweer have been encouraged to shift from hunting towards agriculture. This has resulted in the clearing of large tracks of land in the Boni Forest, their traditional hunting and foraging grounds, to make way for agriculture; however practicing agriculture is challenging for the community as most of the land inhabited by the Aweer is not fertile and receives little rainfall (Annex II). Agriculture by the Aweer are practiced more in Pandanguo. Farming also occurs in the arid lands of Turkana, Samburu, and Isiolo but is challenging due to the erratic and unreliable rainfall. In Turkana, farming occurs along the Turkwel and Kerio Rivers where irrigation schemes facilitate the growing of food (e.g. fruit (bananas, pawpaws, oranges), vegetables (kales, green grams)) and cash crops (e.g. sorghum). Crop farming occurs along the Katilu Irrigation Scheme (an irrigation scheme along the Turkwel River in Turkana), a 809.4 ha project that has allowed around 1,800 farmers to move from the traditional over-reliance on livestock keeping to sustainable farming (Business Daily Africa, 2017b). Farming also occurs in Samburu County but primarily in areas not crossed by the Project. Food crops are grown in the AoI communities in Samburu on a small-scale with two planting seasons in April and November. Large-scale farming also occurs and maize and beans are the most commonly grown crops. No agricultural products are grown in most of the AoI communities near the Project in Isiolo County except near Isiolo Central and Ngare Mara, where small-scale farming occurs close to homesteads. Irrigation farming is practiced along the Ewaso Ng'iro River, which is crossed by the Project pipeline, and in Isiolo Central and Kinna. Crops are grown for both subsistence and commercial purposes. Common crops grown are maize, sorghum, beans, vegetables, and fruits such pawpaw, avocadoes and citrus. A farmers training centre is located in Isiolo Central. Although livestock production is the main source of livelihood, the county lacks markets for its products. Livestock markets are found in Ngare Mara and in an area near Garba Tula town.

Challenges to the agricultural sector include erratic and unreliable rainfall, poor soil quality which can only support certain types of crops and limited farming land due to the lack of communal land available in the Lamu AoI communities (i.e. Pate, Jipe, and Kiliana). Without title deeds for legal ownership, farmers are also limited in investment options, and coupled with low financial means, they face barriers in adopting new technologies that increase productivity and enhance market access.

6.13.6 Fishing

Fishing is most prominent in Lamu County and is conducted only on a small scale in the counties of Turkana and Garissa. Fishing is the economic backbone in Lamu County (LCG, 2018). Lamu County's fishing industry is worth an estimated 180 million Ksh, employing around 3,500 artisan fishermen for marine in-shore and fresh-water fishing in approximately 40 fishing grounds. Freshwater fishing in Lamu is concentrated in channels, ox-bow lakes of Tana River and other inland water bodies. Marine in-shore fishing is carried out in 3,100 km^2 of territorial marine water and extending 144 km from Dar-es-salaam in Kiunga to Ras Teweni. Fishers in Lamu County currently fish in Beach Management Units[6]. There are 39 villages in Lamu that have BMU sites, two of which are located in two AoI communities, Mokowe and Pate. Fishing is the main livelihood activity in the AoI communities of Mokowe, Kiliana, Barigoni and Pate. The fishing grounds within 5 nautical miles offshore are mainly utilised by the artisanal fishers, while industrial fishers with seine and long line boats fish beyond 5 nautical miles (MOT, 2013). Fishing is more intensive during the Northeast monsoon season (September to February). Most small-scale fishing occurs during the North East monsoon season (November to February) when sea conditions are calm. During the South East monsoon season (March to October), the rough currents

[6] Beach Management Units are co-management structures between the fishing community in Lamu County, NGOs and the private sector that are found at fish landing sites (Republic of Kenya 2015). Fishers pay a registration fee for their fishing vessels as well as a fisherman's licence to access specific areas of the coast.

from the strong winds make the sea inaccessible to local fishing craft, rendering 80% of the population destitute (Repcon Associates, 2017).

Approximately 40% of the fish in the district is exported to outside the county. Fishing is the main livelihood activity in the AoI communities of Mokowe, Kiliana, Barigoni and Pate. In recent years, destructive over-fishing and fishing techniques have resulted in dwindling inshore fish stocks (MoLF, 2018, LCG, 2019). In-shore fishing continues as fishers do not have the equipment (e.g. boats, engines, nets) and means (e.g. ability to preserve and process products and infrastructure to market the resources to international markets) to pursue the vast offshore marine resources (Rodden, 2014; Heddon, 2006). Marine fishery yields are constrained by several factors. The majority of fishing crafts used in 2014 were for shallow waters, with non-motorised sail boats, constituting 80.1% of all craft types. Another 8% of crafts had outboard engines, 2.1% had inboard engines, and the remaining fishing crafts used poles or paddles. Pressure on this industry is due in part to the lack of alternative livelihoods for the fishing communities and an inability to harness offshore fisheries (LCG, 2017). The national fishing industry remains extremely underdeveloped and Kenya's offshore coastal marine resources have been vastly untapped.

Access to fishing grounds in Lamu West, where AoI communities are located, is currently affected by construction of the Lamu Port. As part of the LAPSSET project, the 32-berth port is under construction in the Lamu marine area with the first three berths scheduled to open by the end of 2019 (Construction Kenya, 2019). Many of the artisanal fisherman in Lamu West have abandoned the trade due to the ongoing dredging activities for the port project which resulted in the closure of the majority of fishing channels in the Lamu port site in Kiliana. Approximately 4,600 fishermen are affected and displaced (Daily Nation, 2018b; Business Daily Africa, 2018a). As the boats employed by artisanal fishermen are not equipped for deep waters, moving out of the port area is not an option (Rodden, 2014). The displaced fishermen sought compensation for the port's impact on their livelihoods and while they won 1.76 billion Ksh in 2018, this was later appealed (Daily Nation 2018c). Affected fishermen have called for the Kenya Marine Fisheries Research Institute (KMFRI) to provide specialised training that would allow them to pursue alternative ventures such as seaweed farming (Business Daily 2018a).

Fishing also occurs in the counties of Turkana and Garissa. In Turkana County fishing occurs along the western shores of Lake Turkana, and pastoralists from the AoI communities also indicated that fishing occurs along the Kerio River and Suguta River, both of which cross the Project footprint. Fishing is conducted in Garissa County on a small scale along the Tana River (which the proposed pipeline follows the route of but does not cross), including by AoI community members from Saka, and in five fish ponds. The Tana River is perennial (flows all year round) while the Kerio and Suguta are largely perennial and are semi-permanent; the lower courses of these rivers are seasonal.

6.13.7 Other Livelihood Activities

Changes in pastoral household mobility have encouraged participation in non-pastoral income activities. The growth of pastoral settlements around service centres and water points has encouraged additional income activities in Turkana, Isiolo and Garissa. These activities include petty trading, casual non-livestock labour, and firewood collection and charcoal production (TCH, 2018a; Ashiba, 2018). Mining exploration occurs in all six counties but in areas that do not overlap with the Project.

Bee keeping is practiced in Laare Town (Meru County) and Masalani (Garissa County). In Laare Town, beehives are owned individually or as a group, and generally between two and ten hives are owned. Each hive yields an average of 10 kg, with one kg of honey selling for 1,000 Ksh. In Masalani, an individual on average owns two bee hives, which can yield an average of 24 litres and is sold for approximately 3,000 Ksh per litre. Bee keeping activities in Garissa County have been identified as having potential for further expansion (GCG, 2018). Beekeeping is also practiced in Samburu County where farmers organise themselves into beekeeping groups across sub-counties and sell their crude honey to Samburu Bee Keeping Cooperative for processing. The Aweer people in Lamu County are major honey producers who depend on it as the main source of their livelihood. They practice individual bee farming[7], group bee farming[8] and traditional bee farming[9]. Due to ongoing security operations in the Boni Forest and associated restrictions, the Aweer were not able to access the forest since security operations began in 2015 (Daily Nation, 2019b). Many lost their market share and have quit the trade due to the lack of market for their honey. Due to these restrictions, the Aweer have become more dependent on bee farming in the Lungi Forests. A honey cooperative and honey processing center are located in Hindi.

Conservancy management is also an important economic activity in some AoI communities, serving as wildlife corridors, migration routes and tourist attractions. In Samburu County, the Project traverses through three newly established County supported conservancies in Samburu North (Baragoi, Ndoto, and Kirisia-Nkoteiya), and three Northern Rangelands Trust (NRT) supported conservancies in Samburu East (Meibae, Namunyak and Kalama) (SCG 2018). Of these conservancies, three are designated as protected areas under IUCN, including Meibae Community Conservancy, Namunyak Wildlife Conservation Trust, and Kalama Community Wildlife Conservancy (UNEP-WCMC 2019). In Isiolo, the Project traverses through Nakuprat-Gotu conservancy, which supports pastoralism. In Meru, the Project traverses the Nyambene National Reserve. The Project does not overlap any protected areas in Garissa and Lamu. Turkana does not have conservancies. Figure 6.13-2 presents the protected areas crossed by the Project.

[7] Individual bee farming is where individual families own bee hives in their own home compound or within their farms.

[8] Group bee farming is through registered groups where farms are owned as a group and profits are shared.

[9] Traditional bee farming is a traditional method of honey harvesting by searching bee hives or bee holes in the forest.

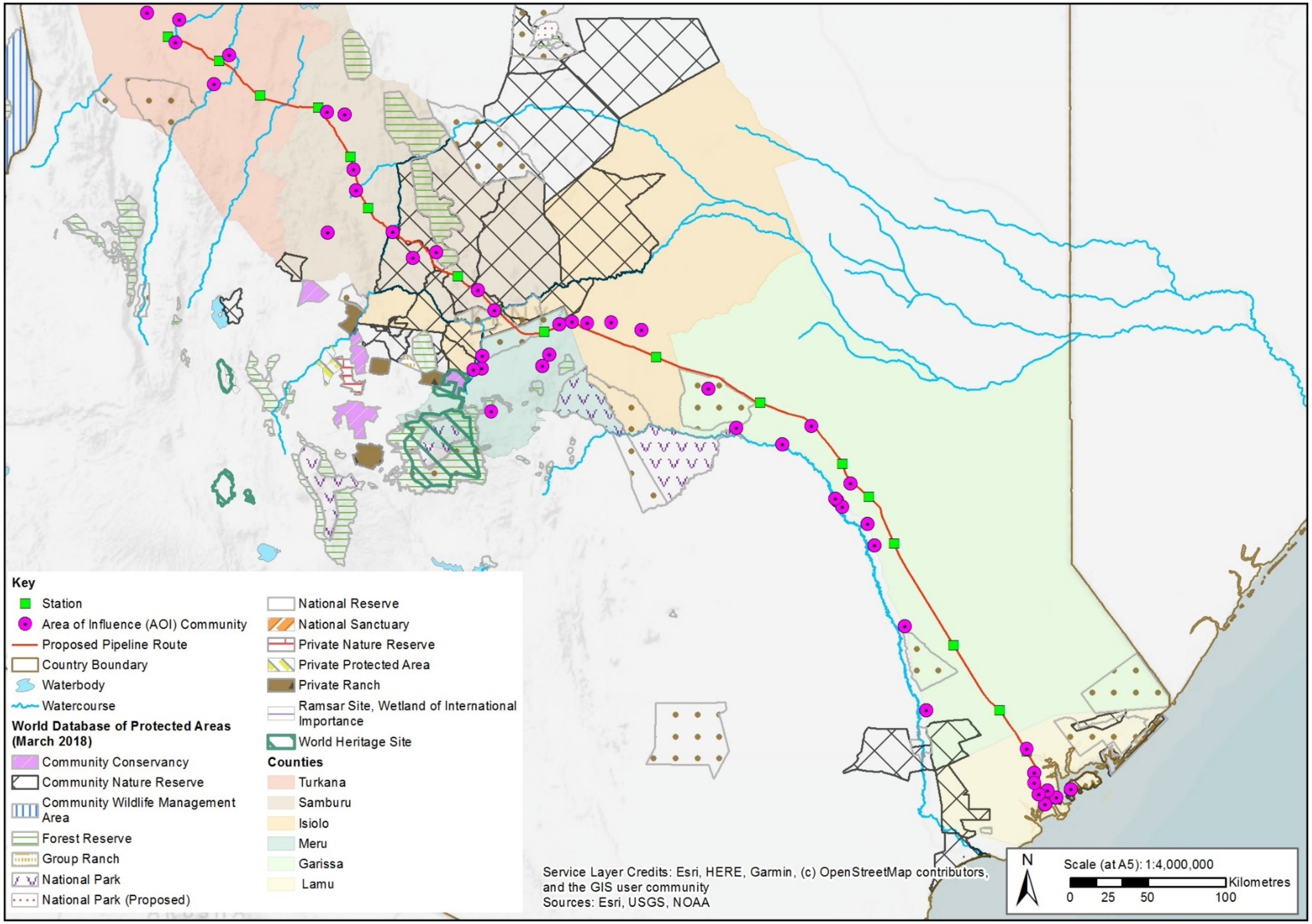

Figure 6.13-1: Protected areas in the vicinity of the Project

Hunting and gathering is the main livelihood for the Aweer people. The Aweer depend on the resources in the forested lands between Dodori and Boni National Reserve in Lamu County for collecting natural fruits, honey, plants for traditional medicine and building materials (Annex II). Woven mats and honey from the forest or NGO supported beekeeping projects are sold for cash. In addition, it is likely that the Aweer supplement their diet with small quantities of game meat which is occasionally hunted (Annex II).

6.13.8 Land Tenure and Livelihoods

Land ownership and customary tenure in the six counties is a barrier to land use practices and other issues that could positively affect livelihoods. Lack of land ownership have inhibited the development of small-scale agriculture in terms of investment. In addition, insecure land rights and unequal access to land and resources have been a source of conflict in some counties.

Land ownership in the AoI communities can be categorised in three types: communal, public and private. Land is predominantly communally owned in the majority of the six counties with the exception of Meru County and Lamu County, where larger proportions of land (approximately 60% and 42%, respectively) are privately held. Small proportions of land in the counties of Samburu, Isiolo and Meru are categorised as public land, and includes land for public institutions such as schools, health facilities and game reserves.

Under the communal land tenure system, individual rights are not guaranteed and are a major disincentive for communities to embrace best land use practices. This has led to unsustainable land use practices such as overgrazing, in many of the counties. Development of small-scale agriculture and investment capacity have also been hindered as the absence of title deeds prevent farmers from accessing credit facilities as they lack collateral. The County Development Plans identify the need for faster land adjudication and registration in the land tenure system to assist in the development of these counties and encourage investment. In Samburu County, private land is owned under a freehold tenure system or under leasehold system. Leasehold land in Samburu are mostly within the urban areas where private land has been allocated to private entities or individuals.

Landlessness is not an issue in the counties of Turkana, Samburu and Garissa as the land is held in trust by the county governments. Although land ownership in Isiolo County is also low, low title registration has been a source of resource-based conflicts (ICG, 2013). In Meru County and Lamu County, where private ownership is more prominent, landlessness is a major issue of concern as it is a source of continuous conflict between farmers and livestock herders. In Meru County, most households have small parcels of land and large-scale farmers hold large tracks of land. Inadequate land has fueled rural to urban migration, increasing informal settlements in urban areas (MCG, 2013). Similarly, in Lamu County, most county residents without title deeds live on ancestral lands as squatters. Rapid population growth and poverty have also caused inequalities in land sub-divisions, preventing land acquisition and leading to landlessness.

The LLCOP traverses land that is classified as community or communal lands. The Ministry of Land and National Land Commission published their intention to acquire land for the LAPSSET Corridor, on behalf of the LAPSSET Corridor Development Authority (LCDA) through two notices, one in October 2016 and more recently on 15 February 2019 in the Kenya Gazette. The proposed pipeline is routed in its entirety inside the Corridor and will lease land from the LCDA. LAPSSET and NLC representatives commenced consultations in counties that the LAPSSET Corridor travels through in July of 2019.

Communities have been able to legally register their lands since the enactment of the Community Lands Act in 2016, which gives communities the opportunity to collectively use and manage land communally owned by forming Community Land Management Committees. The Land Management Committees are to include women and youth. There have been challenges with implementation and few communities have applied to have their land rights legally recognised in any parts of Kenya. Communities affected by the LAPSSET Corridor and (including the pipeline within it) will need to register their community lands (communal lands) in order to receive compensation. The issue of land rights and land acquisition was raised in all counties that were consulted on the LLCOP and is a particularly charged issue in Turkana, Isiolo and Lamu.

6.14 Ecosystem Services

6.14.1 The Concept of Ecosystem Services

Ecosystem services consist of all the natural products and processes that contribute to human well-being, and the personal and social enjoyment derived from nature (Landsberg, *et al*., 2014). They are the benefits that people and/or a project (the beneficiaries) obtain from ecosystems. The benefits gained can be either physical or psychological, and can be obtained actively or passively, directly or indirectly. The local scale ecosystem services may be the basis for rural livelihoods and subsistence; for example, grasses and shrubland in an otherwise arid landscape are an important grazing resource for livestock, which provides both cash income and food for low-income families. Ecosystem services whose beneficiaries are at the global or regional scale are not covered by this assessment.

Ideally, the Project should maintain the value and functionality of priority ecosystem services[1] to those beneficiaries directly dependent upon them, through direct management control.

6.14.2 Area of Influence

The LLCOP spans six counties across Kenya. The AoI for ecosystem services will adopt the AoI identified for the social assessments, in Section 6.10 (Figure 6.10-1). The communities identified within the AoI are also shown on Figure 6.10-1 and are identified as potentially affected by virtue of their proximity to the Project.

6.14.3 Method

Kenyan legislation and policies pertaining to biodiversity conservation and wildlife management do not specifically define what constitutes an ecosystem service; however, ecosystem services are mentioned in the national Wildlife Policy in the context of sustainable economic development of the country (Ministry of Forestry and Wildlife, 2012). Ecosystem services are also recognised as features of protected areas that should be conserved (Wildlife Conservation and Management Act, 2013). The National Biodiversity Strategy and Action Plan (NBSAP) (Ministry of Environment and Natural Resources, 2000) provides for the conservation and sustainable use of natural resources that provide the basic sources of livelihoods for an estimated 80% of the country's population. These include food, firewood, construction materials, medicines and aesthetics; all of which are ecosystem services.

For the purposes of this assessment, the definitions of ecosystem services are based on those developed by the Millennium Ecosystem Assessment (MA, 2005) (Table 6.14-1).

Table 6.14-1:Ecosystem services categories (MA, 2005)

Broad categories	Definition
Provisioning services	Supporting human needs e.g. traditional hunting grounds, medicinal plants and minerals, water sources, wild foods, fire wood, construction materials.
Cultural services	Aesthetic, spiritual, recreational and other cultural values e.g. sacred sites, traditional meeting areas, traditional knowledge, sense of place.
Regulating services	Control of the natural environment e.g. maintenance of key ecological processes, groundwater recharge, erosion control, water quality.
Supporting services	Natural processes essential to resilience and functioning of ecosystems. e.g. primary production, soil formation and conservation, nutrient cycling.

[1] Type I priority ecosystem services are those services upon which the local beneficiaries (including the Project) depend for their livelihoods, health, safety, and/or culture, and which project impacts are most likely to impact; Type II priority ecosystem services are those services upon which the Project is directly dependent or that could prevent the Project from achieving planned operational performance.

The baseline aims to describe the ecosystem services supplied in the Area of Influence (AoI), and the benefits that people get from those services (that is, a qualitative appraisal of demand for the services). It also identifies the services on which the Project will depend for its operational performance. Provisioning and Cultural services are listed County by County whilst supporting and regulating are considered at the Project level.

6.14.3.1 Data Collection

Consistent with good practice in ecosystems services assessment, primary data was largely sourced from the social baseline studies presented in Sections 6.10, 6.12, and 6.13, as well as the full social baseline (Annex II), together with a review of the ecosystem services baseline prepared for the Upstream Project (Golder, 2018a). Secondary data were gathered from relevant available literature.

Primary data for these baselines were obtained from a variety of biophysical and social surveys and assessments, including Focus Groups and KIIs in all six countries. In addition to data gathered as part of the social baseline, one KII held with Elders on 18 May 2017 was specifically focused on identifying ecosystem services in the Upstream Project AoI (Turkana). During this KII, the attendees were asked to help populate a detailed inventory of key ecosystem services. Given the location of the Upstream Project, these data primarily focus on Turkana.

Spatial data was derived from assisted land use mapping, where people identified the spatial distribution of resource use, village infrastructure, travel routes and other valued village attributes relative to the Project alignment. Using base maps developed from satellite imagery, village representatives worked together to map land uses in the area of the Project.

6.14.4 Results

6.14.4.1 Turkana County

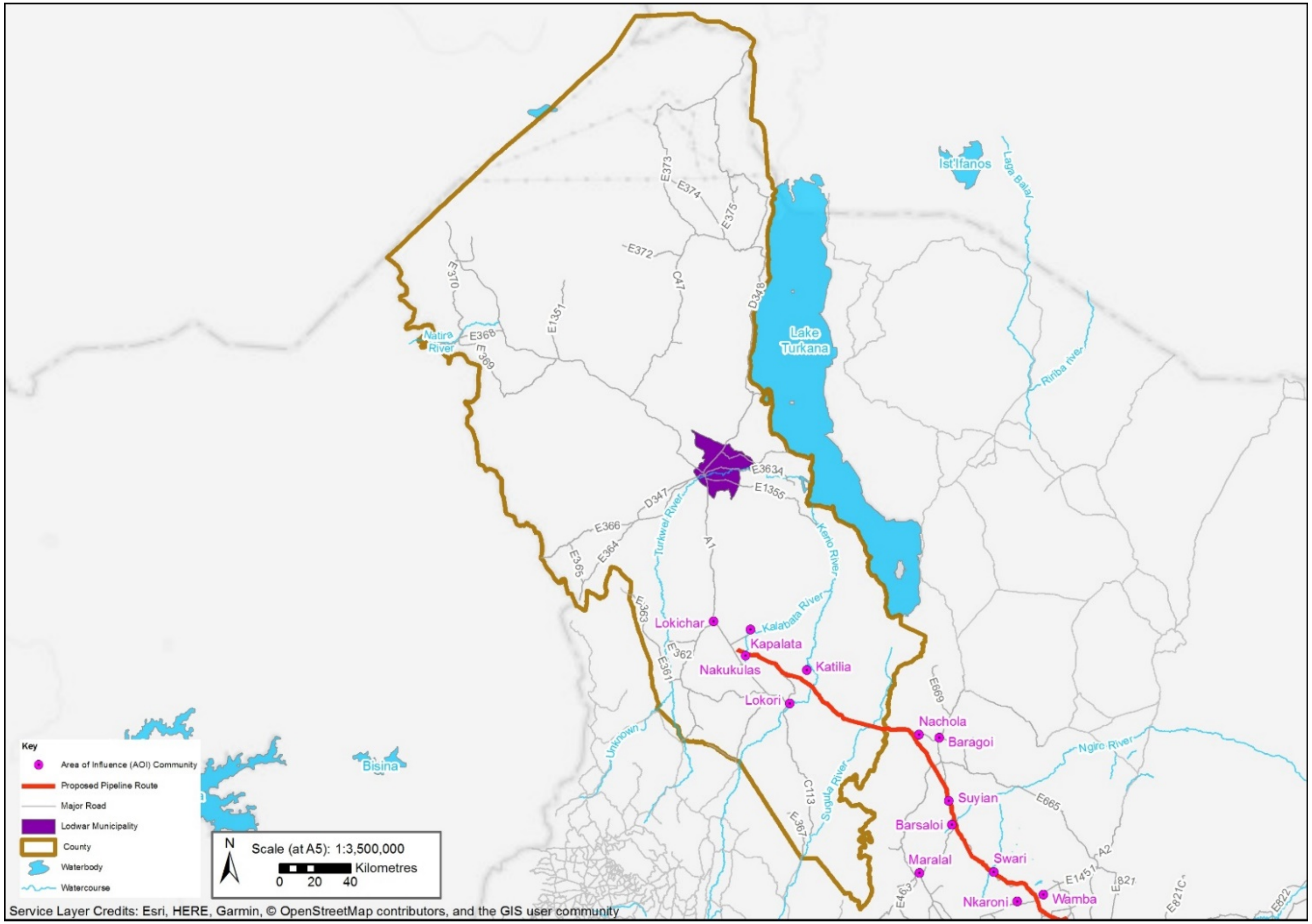

Figure 6.14-1: Turkana County

Provisioning Ecosystem Services

Browsing/grazing resources for livestock

In the Project area, herds include large numbers of drought-resistant livestock species such as camels and goats, with relatively few cattle (Dyson-Hudson and McCabe, 1983). The maintenance of livestock is reliant on there being a supply of freshwater and browsing/grazing resources. Average livestock herd size in the Project AoI communities varies and this influences water consumptions requirements, whilst limited availability of water in the dry season reduces the water consumption of livestock. The daily water consumed by livestock varies greatly depending on the species, and the season, varying from approximately 4 litres per day consumed by goats and sheep in the dry season, to 150 litres per day consumed by donkeys (Focus Groups, Pastoralists: Lokori, Kalapata, Katilia, January 2019).

Pasture and water resources in the county are characterised by changes in availability from year to year in response to the uncertain rainfall timing and distribution, and so patchy vegetation productivity. As a result, the extent of pastoralists' movement between areas of pastures varies.

Soils, water, pollinators and other services supporting arable, fruit, and vegetable production

Agro-pastoralists keep livestock as well as practising small-scale crop farming. The agro-pastoral zone is located along the Turkwel and Kerio Rivers where irrigation schemes allow cultivation of a mix of subsistence crops and small quantities of cash crops (e.g. sorghum, maize, green gram, cowpeas, and vegetables) (FEG, 2016). The maintenance of these crops is reliant on the supply of freshwater, maintenance of suitable soil conditions, and pollinators.

Fishing

Fishing of tir, loruk, tilapia (Epokot), and catfish (Kopito) occurs along the Kerio River (Focus Group, Pastoralists: Lokori, 15 January 2019; Katilia, 17 January 2019). Fishing also occurs along the Suguta River with fishing of akiragiragiot (no common name), koopito (Nile perch), etiir (Tilapia), naliba (Ningu), loruk (King Fish) and losali (Carpus).

Water

Turkana County is a water-scarce county that has experienced a general decline in the quantity and quality of water for domestic and productive use. Rainfall ranges from 120 to 500 mm per year and is highest at higher altitude in South Turkana. They are, however, erratic and rain sparsely distributed throughout the county, which results in droughts and floods (TCG, 2017).

With the exception of Lake Turkana, few naturally occurring surface water bodies are found in the county (TCG, 2017). The main rivers in the county are the Kalapata, Kerio, Malimalite, Tarach, and Turkwel rivers, of which only the Turkwel and Kerio are semi-permanent (UNICEF 2017; Schilling et al. 2012). A network of ephemeral rivers (*luggas* or *laghas)* occurs, and springs are also found across the county, especially in parts of the lake zones and Turkana East.

The county Government has constructed man-made water bodies across the county such as dams, water pans[2], and sub surface dams (TCG, 2017). The man-made structures are mainly used for domestic and livestock and are especially important during the dry season for livestock. Other water supplies for livestock come from traditional wells, natural water pans, boreholes, and oases (Focus Group, Pastoralists: Lokori; Kalapata; Katilia; Lokichar, 2019).

Excessive grazing pressure in the county can have a deleterious effect on soils, stripping them of the capacity to hold any water as well as increasing rates of erosion and sedimentation (TCG, 2017).

[2] A water pan is a small reservoir created by excavating open ground, to collect and store surface runoff from uncultivated grounds, from hillsides, roads, rocky areas and open rangelands

Other

Other land and resource uses focus on forest products, including charcoal, wood carvings, fencing posts, firewood, aloe vera and herbal medicines[3] (TCG, 2013). Although charcoal production is illegal in Turkana County, it offers small returns to those that produce it and is practised along the Turkwel and Kerio Rivers. Wild fruits are sold throughout the county, including Doum Palm, and other fruits known locally as Ngakalalio, Edong, Edapal, and Ebei (Muchoki, 2015). Trade in Prosopis pods around Lodwar and Kakuma is also emerging as an important source of income.

Honey production is a commercially viable enterprise especially along the Turkwel and Kerio Rivers. Beehives are made from logs cut from special types of trees such as the 'Echoke' (locally known as a sycamore) and the 'Edurukoit' (a type of Acacia).

Cultural Ecosystem Services

Cultural heritage sites are found in the Turkana region in different sedimentary basins and environments such as open woodland plains, small dry water channels/luggas, river flood plains and rocky and hilly areas. The Lokichar area is especially notable for the dense distribution of sites/occurrences of sites and features.

Ekalale Loa Lotimaan is a site with sacred trees where people conduct their rites of passage. Other culturally important sites are also present where trees are important and should not be cut down, whilst at *Longaada* red ochre found here is harvested for cultural events (Focus Group, Elders: Kalapata; Lokichar; Katilia, 2019).

3 Some of the local herbs used for medicinal purposes include Kutikuti, Ekabonyo, Eogong, and Siir (Focus Group, Lokori Elders, 15 January 2019). Herbs are mostly found in the forested and hilly areas. Some of the herbs used for medicinal purposes by traditional healers in Lokichar are Echuchuka (Aloe Vera), Emus (traditional herb), Eogong (medicinal herb), Emoronyit (medicinal herb), Esekon (Salrodora Persica), and Eregis (medicinal herb) (Focus Group, Lokichar Elders, 19 January 2019).

6.14.4.2 Samburu County

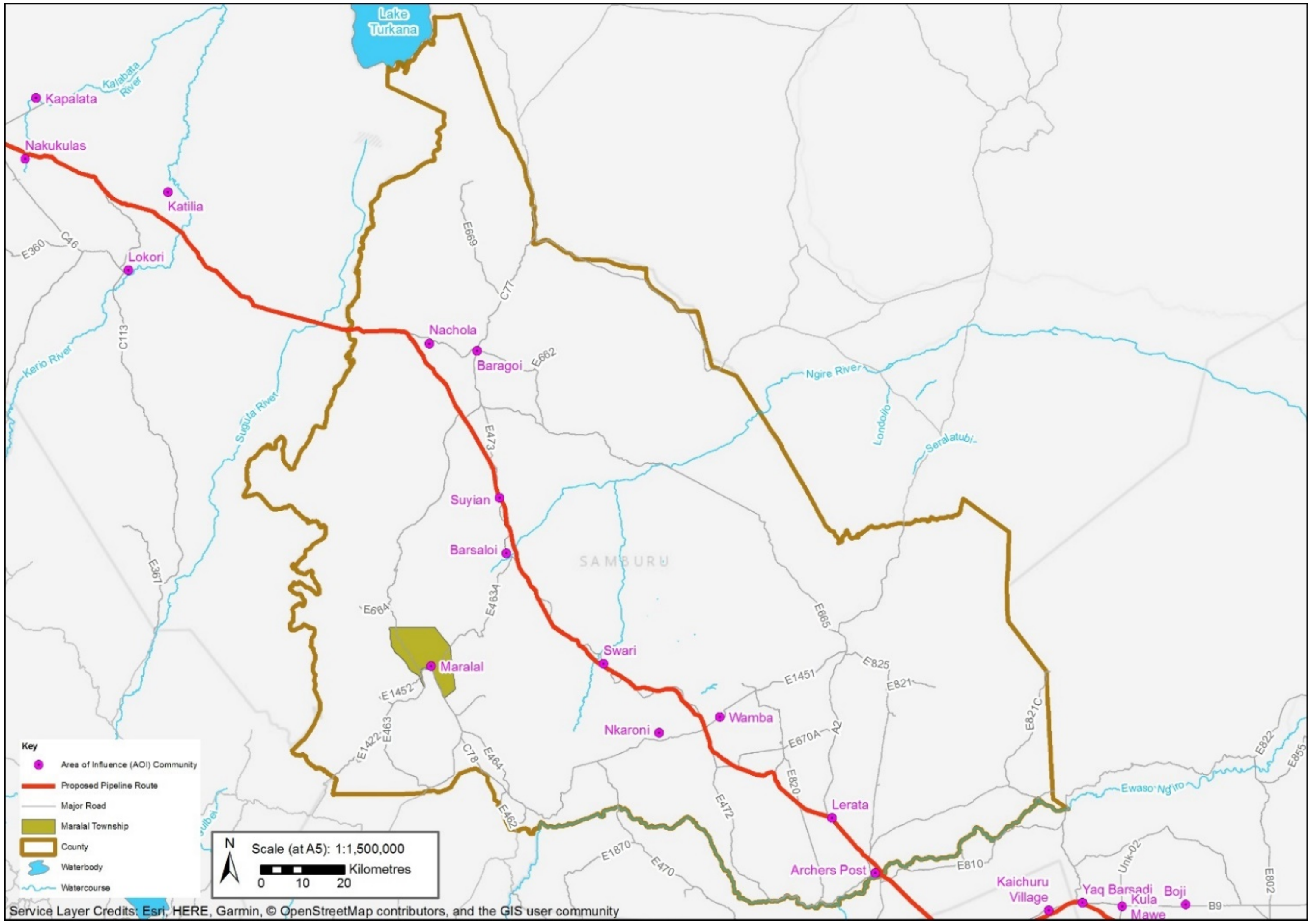

Figure 6.14-2: Samburu County

Provisioning Ecosystem Services

Browsing/grazing resources for livestock

Ninety-two percent of the County land is rangeland suitable for livestock production and supports 202,700 cattle; 622,000 sheep; 714,000 goats; 36,100 camels and 10,000 donkeys (SCG, 2018). The Elders manage the harvesting of *Acacia tortilis* pods and leaves which are used as animal feed.

The average herd size varies based on climate, but in most communities, herd size averages 30 to 40 animals per herder, and up to 100 or more animals for the wealthy. The pastoralists migrate in groups moving with their livestock in search of pasture or water depending on the seasons. The main water sources utilised are Barsaloi river, Nachola river, Suyian river, and Seyia river.

The livelihoods of pastoralists are under increasing pressure in Samburu County, due to institutional change regulating access to land and a shrinking resource base (Lesorogol, 2017; Pas, 2018).

Agriculture

Approximately 139,000 ha (8%) of the County is classified as arable land with adequate moisture to support crop farming, of which 28,500 ha is recorded as being under cultivation. Most commercial and subsidence crops in the County are grown in the highland areas of Poro in Kirisia Division due to the fertile soils and adequate rainfall (SCG, 2018; Office of the Controller of Budget, 2018). Rotational planting is practiced allowing manure to accumulate and for soils to become more fertile in between planting. Farming is challenging in lowland areas where soil quality is poor, there is low rainfall and a shortage of land for farming. Agricultural activities are also constrained by wildlife predation on crops, security concerns, shortages of water, and a lack of agricultural materials (i.e. tanks and troughs).

Other

More than half of households use fuel wood as the main source of lighting (61%). The majority of households also use firewood for cooking (81%), followed by charcoal (17%) (KNBS, 2009). Wood is sourced from red cedar and *Acacia tortilis*, whilst charcoal is produced by these trees. Over-reliance on wood for fuel is considered a health and environmental concern, and the government intends to make efforts to promote sustainable and modern charcoal production technologies, including the use of charcoal kilns and adoption of renewal energy (SCG, 2018).

Beekeeping, fish farming and sand harvesting are also being practiced in the county (SCG, 2018). The famers keep bees mainly for crude honey production for use as food and a source of household income.

Plants, traditional herbs, or other materials that are gathered include salt, *Lekeel siet, Sagaram* and *Sitet* (used for healing), Sukuroi (aloe), and Nkuuk (for charcoal). *Acacia tortilis* (umbrella thorn) is gathered and is highly valued for its pods and herbal properties, and is also used for fencing, shades, ropes and timber.

The county is often affected by cyclical droughts, which occur every 1 to 3 years. The frequency is reported to have increased recently because of increasingly erratic weather patterns.

Cultural Ecosystem Services

Cultural sites near the Project alignment were reported by informants close to Baragoi, including Loonyeyok, a cultural site where gum is collected from the *Acacia senegal* tree and mixed with honey and hay, this is fed to dairy cows to enhance milk production, as such a cultural and provisioning service. Ltepes trees (*Acacia tortilis)* are considered sacred, as the “father” tree in the area; they should not be protected. Just to the east of Wamba there is a sacred site called Kurdop, situated in a river at the foot of a mountain, as well as a site where warriors celebrate *Lmuget,* a traditional ceremony for boys’ coming of age.

6.14.4.3 Isiolo County

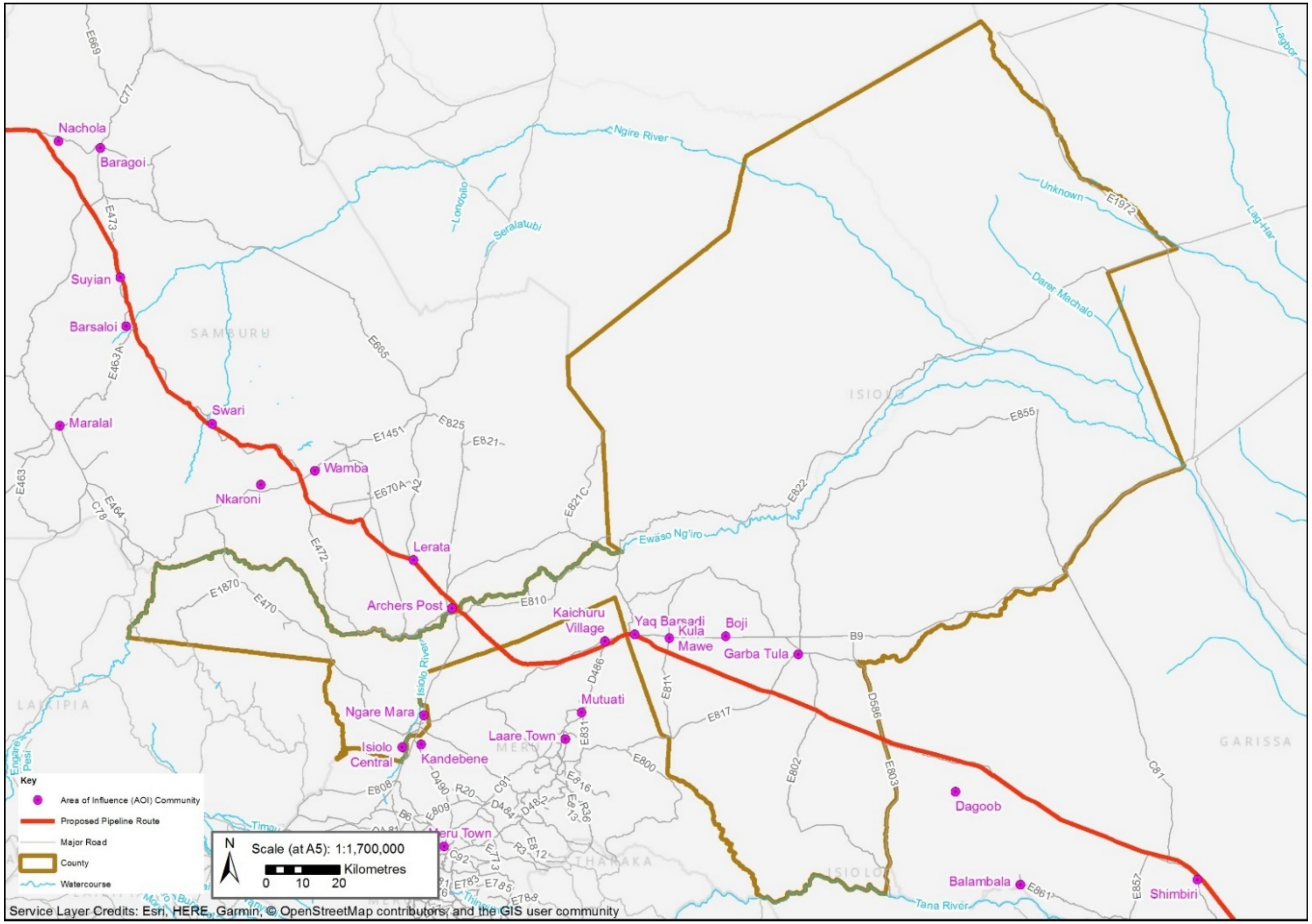

Figure 6.14-3: Isiolo County

Provisioning Ecosystem Services

Browsing/grazing resources for livestock

Over 80% of the land in Isiolo County is non-arable, accounting for 22,000 km^2, and is used for grazing by pastoralists (GOK, 2014). Over 80% of inhabitants rely on livestock for their livelihoods, with less than a third (26%) practising agro-pastoralism. In a study of the economic contribution of the pastoral meat trade in Isiolo County, 66% of respondents from Oldonyiro and Garba Tula towns were employed in the live animal trade (Iruata et al., 2015). Isiolo County Council also receives revenue from pastoral meat businesses (Iruata *et al*., 2015).

Variability in the amounts and timing of rainfall contribute to food insecurity (GOK, 2018b), and livestock numbers have reduced recently because of drought and the reoccurrence of dry seasons. Herders migrate between grazing areas depending on availability of water. A cow requires an average of 30 to 40 litres of water per day, while goats need approximately 10 to 15 litres a day.

Inadequate rainfall and drought in the surrounding counties have resulted in decreased pasture and the subsequent movement of livestock from the counties of Wajir, Marsabit, Tana River, Samburu, and Garissa into Isiolo County, where they compete with local livestock for grazing resources (Saferworld, 2015). Adaptation to climate change in Isiolo County has included pasture establishment and conservation, construction and maintenance of boreholes and watering points for livestock and rearing of drought-tolerant livestock types (MoALF, 2018).

Rangeland management remains one of the greatest challenges in conservancies where there is high levels of range degradation and soil erosion, especially due to large-scale livestock movements and during the 2016-2017 drought (NRT, 2018).

Agriculture

Agriculture production has varied over the years because of erratic and unreliable rainfall (GOK, 2014). The majority of Isiolo County is arid and cannot support rain fed crop farming, so agricultural activities largely depend on irrigation, with the Bisan Adhi, Kinna and Ewaso Ng'iro rivers supporting irrigation. There are currently 20 irrigation schemes in the county (GOK, 2018). Only 1,497 hectares are under food crops production, but this is expected to increase to 3,000 hectares because of planned irrigations schemes (GOK, 2018). Fruit trees are grown with the crops for subsistence and commercial purposes, and they also act as wind breaks and improve soil quality. Rice is consumed daily in all communities.

The agricultural sector faces several challenges, there has been low productivity of land because of prolonged drought and poor land management practices including overgrazing and charcoal burning (GOK, 2014).

Water

In general, access to water in Isiolo County comes from four major sources, including direct use of natural water sources such as rivers, streams and springs; developed surface water sources, such as earth dams, sand/subsurface dams, tanks and pans; developed groundwater such as wells, waterholes and boreholes; and emergency water supply by the government using tankers (Mati et al., 2005).

Isiolo County has three main rivers, including Ewaso Ng'iro, Isiolo and Bisanadhi (GOK, 2018). Most of the irrigation shemes are found along these rivers (GOK, 2018). The Ewaso Ng'iro River is the most important source of water in Isiolo District, especially for livestock watering, and herders and their livestock often come to the river from the north during dry periods. Surface water availability in Isiolo County varies with seasons of the year, and sources include rivers, streams, springs and runoff from the Isiolo sub-catchment of the Middle Ewaso Ng'iro catchment (GOK, 2018). Surface water abstraction points are mainly along rivers and streams of the three sub catchments. All the rivers from each sub-catchment drain into the Ewaso Ng'iro North River which is the main drainage system in the area. Most of the springs are situated within game reserves and are not accessible to local people. Many springs that were previously located along the major rivers are no longer available because of environmental degradation (Mati et al., 2005).

The main aquifers in Isiolo County are the Isiolo-Nyambeni-Mount Kenya aquifer that has high ground water potential, Merti aquifer, Garbatula-Modagashe aquifer that has very low ground water potential and Kachuru-Kulamawe-Boji aquifer which has fairly low ground water recharge in the aquifer (GOK, 2018).

Developed water sources are poorly distributed, consisting of 123 water sources/points of which 59% are operational during the rainy season and only 36% are operational during the dry season (Mati et al., 2005). There is no piped/tap water in the rural areas and the district relies mostly on boreholes, accounting for 58% of all developed water sources. There is an over reliance on groundwater, yet only 20% of the county has good groundwater potential. Merti, Garbatula and Sericho Divisions are especially lacking water sources, particularly during the dry season. The reliance on shallow wells for water is 17% in the county, most being traditional hand-scooped holes.

Under suitable conditions, floodwater harvesting is practiced through the excavation of shallow pans or ponds, both of which rely on surface runoff, but ponds also rely on some groundwater (Mati et al., 2005). Water harvesting in Isiolo County is limited to one subsurface dam and five operational pans during the rainy season, and one operational pan during the dry season. Isiolo County is overlapped by several sand rivers whose potential for floodwater harvesting and storage has not been fully tapped (Mati et al., 2005).

During the dry seasons, most people rely on piped water (39%) followed by bore hole (34%) and river (10%) (GOK, 2018). During the rainy season, 37% of people rely on piped water, followed by boreholes (25%) and river (11%). The reliance on rain water harvesting increases during the rainy season to 10%.

Following the rains in the high elevation areas, water flows down through the catchment along riverbeds and aquifers into the Ewaso Ng'iro North river that runs through the centre of Isiolo County (Jarso *et al*., 2017). People and livestock from surrounding counties and other countries migrate towards the Ewaso Ng'iro riverbed in search of water and pasture, particularly during the dry season or droughts. The increased population during these times has placed pressure on the water service infrastructure and what it is able to support. Further, the natural flows through the catchment that used to transfer water from upstream are continuing to decrease due to increasing upstream extractions for irrigation and other uses (Jarso et al., 2017). As a result, according to the NDMA, vulnerable households in Isiolo County have been surviving on as little as eight litres per person per day (GOK, 2016).

Other

Fish is only consumed in Isiolo Central, but rarely. Wood is used in households for cooking, with the majority (65.2%) of households relying on fire wood for cooking, while 29.1% rely on charcoal.

Another source of income is harvested honey, which is bought and sold at market honey is also used to treat ailments, including malaria, along with medicinal roots and leaves.

Wild plants are also consumed in some of the communities when they are in season.

Cultural Ecosystem Services

Community members reported several sacred sites along the Project alignment, including cleansing sites and traditional initiation sites. Again, and in congruence with other counties, some species of acacia trees were reported as sacred and used during ceremonies and community members indicated that they should not be destroyed.

6.14.4.4 Meru County

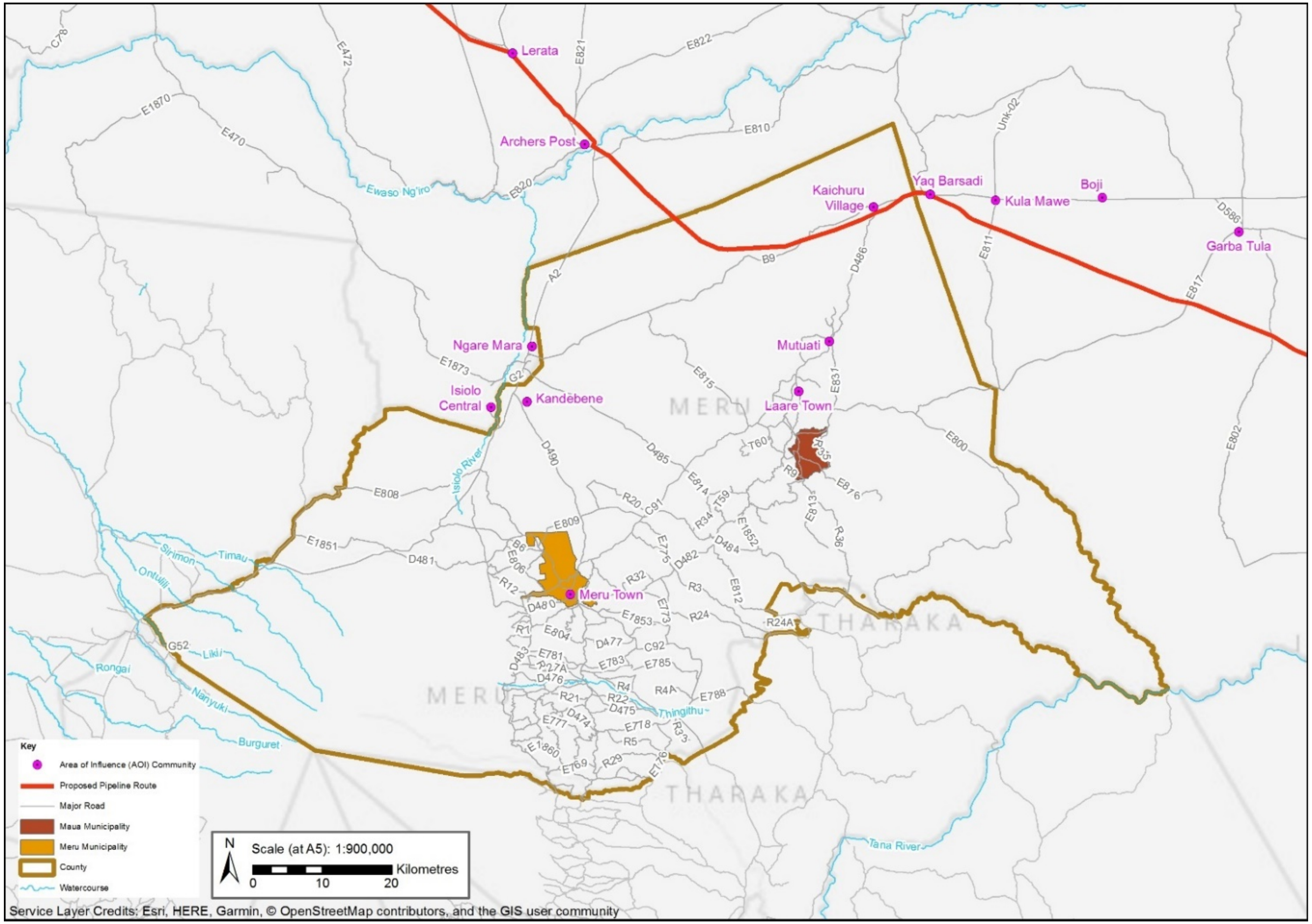

Figure 6.14-4: Meru County

Provisioning Ecosystem Services

Pastoralism

In Kaichuru Village, the land use near the proposed Project area is predominantly free grazing. The main determinant of animal movements is the availability of water and security concerns from occasional livestock raiders. The main sources of water in the grazing areas near Kaichuru Village are the Barajadi and Gachuru boreholes and Magado, Waso and Chapa springs. In Kandebene the Lanyiru stream, Rikindu River and Wasonara River are commonly used by herders. The Lobua and Chokaa swamps, which are no longer protected areas, are used to feed livestock.

The Meru County farmers keep livestock both for subsistence and commercial purposes. These include dairy and beef cattle, goats, sheep and poultry.

Agriculture

Agriculture is the main economic activity in the proposed Project area. However, the size of land for farming has been decreasing in size over time increasing the pressure on land. Farmers practice mixed farming where they grow many types of crops and keep livestock on the same piece of land. Miraa[4] is a highly lucrative cash crop grown in the project area, other crops grown include beans, peas, maize, bananas, sorghum, millet, tomatoes, onions, and sunflower (Focus group, women, Kaichuru, 31 October 2018).

Water

The county has 11 permanent rivers. The main river is the Kathita which is a tributary to the Tana River.

The main water sources for both households and livestock are boreholes, rivers, water pans, water vendors and piped water from community-based projects. Boreholes account for the highest number of users at 53.8% compared to 25% during the dry season. Rivers and water pans are used equally. The majority of water pans in the grazing areas of the agro-pastoral livelihood zone such as Kachiuru, Ithata, and Njaruine have completely dried up. Boreholes in Kandebene, Inono, Ndumuru, and Mariara are currently the main water sources for both livestock and households.

The main sources of water for livestock herders in Kaichuru Village are the Barajadi and Gachuru boreholes and Magado, Waso and Chapa springs. Households in Kandebene depend on the Kandebene borehole, and in the rainy seasons they also draw water from the Matabithi borehole and the Batalo, Kungu, Karuya and Kandebene dams. The Lanyiru stream flows throughout the year, and the Rikindu River and Wasonara River are seasonal. The Rikindu River flows through the Kandebene community, while the Wasonara River is nearby.

The main water supply in Laare Town is from the diocese of Meru, springs at Laare, Kitawaa, Atununu and Kithingangu, and boreholes in Laare, Ntunene and Kiridora. Spring water is free, and residents pay between KSh 5 to KSh 10 for water from the boreholes.

Other

In Laare Town, beekeeping is a livelihood and economic activity near the proposed Project area. The beekeepers use their Indigenous Knowledge and locally available materials to keep honeybees in Ndumuru or their homesteads. The honey is used domestically and can be used to brew alcohol and is also sold.

The majority of people are dependent on traditional fuels (wood-charcoal, crop residue maize stalks and cobs). Firewood is the major household fuel in the county with over 86.1% of the total population relying on it for their daily energy needs (KNBS, 2009; MCG, 2018).

4 Miraa, also known as khat, is a flowering plant native to the Horn of Africa and the Arabian Peninsula. The addictive herb is chewed for its stimulative effect.

Cultural Ecosystem Services

Near Kaichuru Village, Igembe is a sacred site surrounded by trees and large stones where natural minerals are found, and it is located near the Project.

Sacred sites near Mutuati that are located near the proposed Project include Buru shrines and Ndumuru sacred sites. The sites are surrounded by natural salts (*mwonyo*) and herbs and are used by pregnant women and animals to feed on.

Sacred places near Laare Town include the Igombe salt lick and Kimeru where white ash is found and used for rituals. Other sacred places reported include those where traditional healers go to collect herbs, such as Migombe, Luma and Mea hills.

Natural resources that are considered sacred or of spiritual importance near Kandebene include the Lobua swamp and Chokaa, where particular plants grow that are used to feed livestock (Focus Groups, Elders: Kaichuru, 31 October 2018; Kandebene, 3 November 2018; Laare Town, 2 November 2018; Mutuati, 1 November 2018). The animals also drink *mwonyo* from the swamps, which is from natural salt water springs and full of nutritional supplements.

6.14.4.5 Garissa County

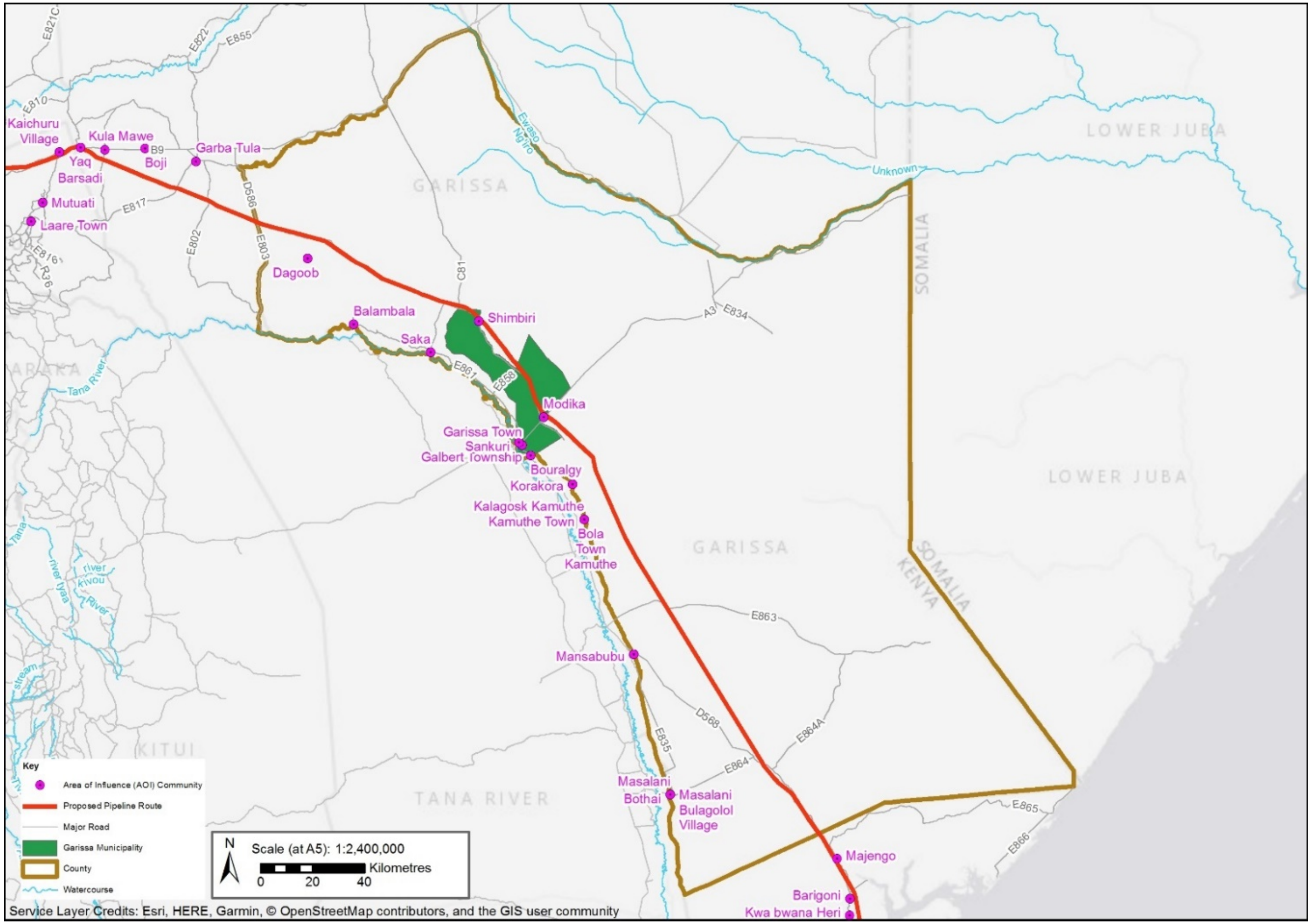

Figure 6.14-5: Garissa County

Provisioning Ecosystem Services

Pastoralism

The main livestock bred are cattle (Boran), goats (Galla), sheep (black headed Persian) and camel (dromedary one-humped) and livestock products include meat, milk, hides and skins (Focus Groups, Women: Modika, 13 October 2018; Shimbiri, 15 October 2018; Mansabubu, 16 October 2018; Balambala, 17 October 2018; Masalani, 17 October 2018; Appendix B, Social Baseline, Annex II).

Livestock herd sizes vary greatly among livestock herders. Camel herds range from 80 to 100 head, while cows are typically kept in groups of 20 to 100. Goat herds range in size dramatically, from 20 to 700 (Focus Groups, Pastoralists: Korakora, 14 October 2018; Masalani, 17 October 2018; Appendix B, Social Baseline, Annex 2).

There are several challenges associated with the herding of livestock. Drought is a problem during the dry season, particularly given the high water requirements of livestock. Water is required in large quantities for livestock, with Camels requiring up to 100 litres every ten days, and cows requiring 50 litres every three days. However, water for pastoral use is scarce, and is often sourced from water pans and boreholes (Focus Group, Pastoralists: Korakora, 14 October 2018; Appendix B, Social Baseline, Annex II).

Agriculture

Garissa County is principally a semi-arid area and receives an average rainfall of 275 mm per year (GCG, 2018). There are two rainy seasons, the short rains from October to December and the long rains from March to May. Balambala and Fafi Sub-counties practice rain-fed agriculture on a small scale.

It is estimated that Garissa has 44,100 acres of land along the Tana River Basin which can be used for irrigation. Currently, only 5,121 acres of land (12%) along the basin is under irrigation. The main crops grown in the county are watermelons and sweet melon, mangoes, vegetables, tomatoes, paw paws, bananas, cowpeas, simsim, rice, sorghum, lentils, peas, chiles maize and green grams (Focus Group, Agriculture: Saka, 16 October 2018; Bouralgy, 13 October 2018; Sankuri, 14 October 2018; Kamuthe, 15 October 2018; Appendix B, Social Baseline, Annex II). These are usually produced on a small scale under irrigation along the River Tana. *Miraa* is also sold, a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulative effect (Focus Groups, Women: Modika 13 October 2018; Shimbiri, 15 October 2018; Mansabubu 16 October 2018; Balambala 17 October 2018; Masalani 17 October 2018).

There are a number of challenges faced by those practicing agriculture. Floods during the rainy season can wash away crops, particularly vegetables. Temporary burst floods from the release of water by the Kenya Electricity Generating Company also poses a risk of washing away crops adjacent to rivers.

Fishing

Fish farming in Garissa County is done on a small scale along the Tana River and in fish ponds. There are five fish ponds with a total area of 1,200 m^2 and mud fish, cat fish, bone fish, tilapia and eel are the types typically caught. There are six landing beaches along the Tana River in Garissa, Fafi, Balambala and Masalani.

There is limited artisanal fishing in Garissa County, and it was reported that community members prefer goat, cow or camel meat to fish. However, oil from fish is used for medicinal purposes.

Water

Garissa County has one permanent river (Tana River), 25 shallow wells, 109 boreholes, 195 water pans and one dam (GCG, 2018). The county is generally water-scarce with acute water shortages experienced during the dry season.

Approximately 24% of the population in Garissa County have access to safe water (GCG, 2018). Access to piped water is limited to the sub-county headquarters where approximately 27,725 households have a connection to piped water. The remaining population make use of unsafe water directly from the river, luggas, boreholes, shallow wells and pans.

Other

Fire wood is used as a source of energy for cooking by approximately 84% of the county's population, and 25% use wood for lighting (GCG, 2018). Charcoal is used for cooking by 40% of the population (GCG, 2018).

Beekeeping is practiced by some residents of Garissa Town, Balambala, and Masalani (Focus Group, Women: Garissa Town, 12 October 2018; Local Government: Balambala, 17 October 2018; Bee Keeper: Masalani, 17 October 2018). The Gares tree is used to construct beehives traditionally, though beekeepers are increasingly using timber to construct hives. The harvested honey is used for household food, and traditional medicine, and is sold at a cost of about 3,000 KSh per three litres (Focus Group, Beekeepers: Masalani 17 October 2018).

Cultural Ecosystem Services

There is a sacred tree in Kamuthe which is used by the villagers for traditional ceremonies. Sacred trees also exist in Masalani, some of which also provide fruit.

6.14.4.6 Lamu County

Background and Economic Base

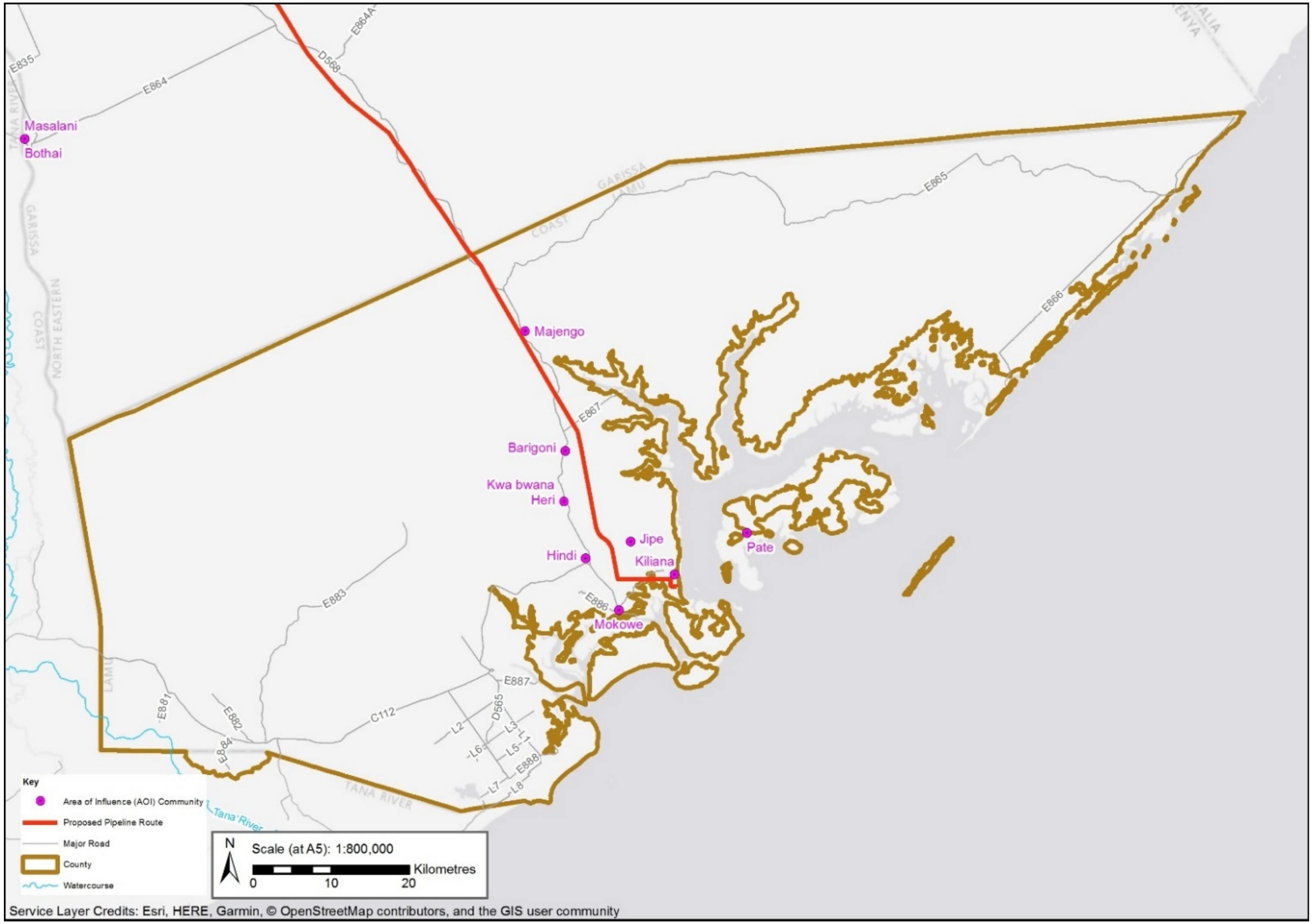

Figure 6.14-6: Lamu County

Provisioning Ecosystem Services

Pastoralism

Livestock production is an important livelihood for approximately 30% of the population (MoALF, 2018b). The main livestock reared are cattle, sheep, goat, donkeys and poultry.

There are 20 ranches in the county that act as grazing reserves and are used by pastoral farmers from Lamu County as well as from the neighbouring Garissa County (MoALF, 2018b). Most of the farming in Lamu County is rain-fed, and only 1% of households practice irrigation farming (MoALF, 2018b).

Herd size is influenced by the seasons and availability of pasture and water. Scarcity of land and water is a major challenge for herders in Lamu County. During the dry season, the herders travel from one area to another in search of pasture and water. Livestock herders from Hindi obtain their water from seasonal dams which only impound water during the rainy season. Herders from Mokowe obtain water for their animals from boreholes, seasonal dams and ponds.

Agriculture

Of the arable land, 56,923 ha is being utilised; 37.4% is under food crops, 39.5% is under cash crops and 23.1% is under forestry use. The primary crops grown in the county are maize, cowpeas, dolichos, cassava, pigeon peas and green grams (LCG, 2016). The county also produces mangoes, coconut, cotton, bixa and simsim as cash crops. Cotton production remains the highest source of income for households, contributing 42% to household incomes, followed by banana (14%), maize (8%), cassava (7%), bixa (6%) and mangrove (5%). Those living in the Lamu peri-urban areas practice subsistence farming (LCG, 2016).

Decreasing and unpredictable rainfall has resulted in reduced production, and crop failure. Irrigation practice is limited in the county because of the prevalence of saline groundwater, relatively flat topography, and drying of lakes and rivers.

Unlike Counties inland, In Lamu there is only one rainy season and one dry season per year. During the rainy season cashew nut and mango crops are grown in Kiliana, and other seasonal crops include maize, sunflowers, cowpeas, and simsim (sesame seeds). In Jipe, the main cash crops are *Bixa orellana* ('annatto') and cotton, and the main food crops are maize, cowpeas and green grams. The seasonal crops are rotated consecutively with one season left fallow to allow the land to generate nutrients.

Fishing

Fishing is an important economic activity, providing food and employment, and there are 3,500 artisanal fishermen (MoALF, 2018b). The County produces over 1,500 metric tons of fish annually valued at KSh 111.8 million, of which 85% is from marine and 15% from fresh water fishing (LCG, 2016).

The fishing industry is the economic backbone of Lamu County, with 75% of communities depending on fishing for their livelihoods either directly or indirectly (LCG, 2019). Fishing is practiced for subsistence and commercial purposes. The annual fish production for the county is estimated as 2,500 metric tonnes valued at KSh 180 million.

Fishing in the county consists of marine in-shore and fresh water fishing (LCG, 2016). Marine in-shore fishing is carried out in 3,100 km^2 of territorial marine water and extending 144 km from Dar-es-salaam in Kiunga to Ras Teweni. Freshwater fishing is concentrated in channels, ox-bow lakes of Tana River and other inland water bodies.

Fish landing sites are important infrastructure that supports the fishermen and other fisher community operations at the beach (MoALF, 2014). In 2014, there were 28 landing sites recorded in Lamu County, 15 of which were located on islands. There are approximately 40 fishing grounds in Lamu County with a diversity of fish species (LCG, 2016). Figure 6.14-4 shows the major fishing grounds in Lamu County.

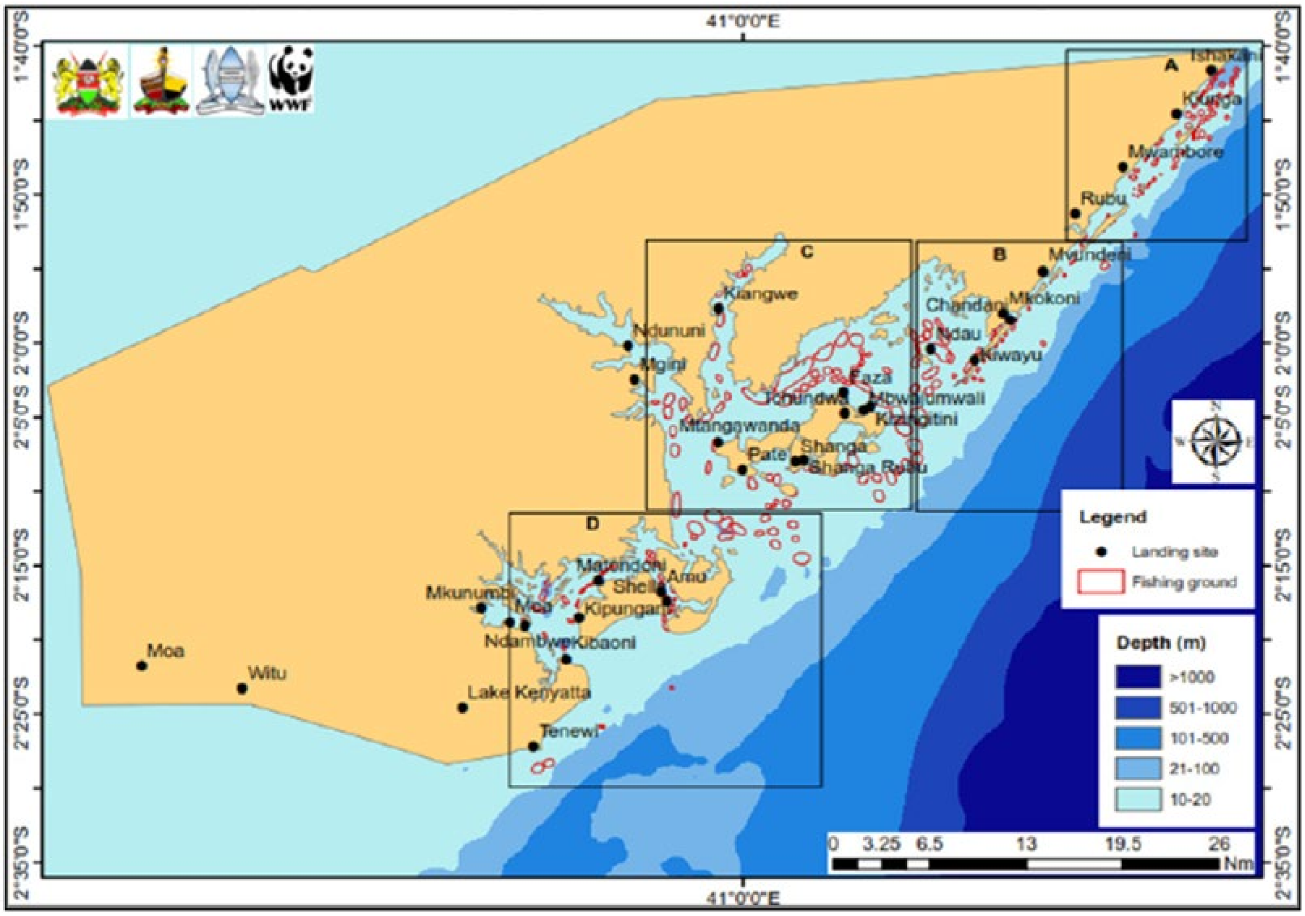

Figure 6.14-7: Fishing grounds in Lamu County (Kurrent Technologies, 2016)

Types of seafood harvested in Lamu include tasi, lobster and crabs, prawns, tewa, red snapper, tafi, tuku, bluespot mullet (Focus Groups, Fishers: Mokowe; Kiliana; Barigoni; Pate, 2018).

According to fishers from Mokowe and Pate, tourism in the area has opened markets for fishers to sell their produce. The fishers also benefit tourists who hire boats for deep sea touring and fishing. Fish prices fluctuate significantly during the year depending upon supply, being highest during the dry season. Collectively, the Bandari Salam Fisheries group can catch up to 3 tonnes of fish per day, and each individual can make up to KSh 2000 per day (Focus Group, Fishers: Mokowe, 24 October 2018).

Destructive over-fishing and fishing techniques have resulted in dwindling inshore fish stocks (MoALF, 2018b; LCG, 2019).

Water

The county has four major catchment areas, including Dodori, Coastal zone, Duldul, the Lamu Bay drainage and Tana River catchments (LCG, 2016). There are no permanent rivers in the county, but only a few seasonal streams which flow from the west towards the south eastern part of the county. The only permanent open water site in the county is Lake Kenyatta in Mpeketoni which at times dries up during exceptionally dry years. The county also has several swamp areas which are supplied by rain water.

The main sources of water in the county are groundwater, surface water, rainfall and desalination of sea water (LCG, 2016). Ground water is used for most water supplies in Lamu County, but most areas have saline groundwater. Surface water sources include the sea, lakes, pans, dams and seasonal rivers. The county is experiencing rising demand for water because of rapid population growth and urbanisation.

Other

Firewood (70.9%) and charcoal (22.8%) remain the main source of energy used for cooking purposes (KNBS, 2009).

Mangroves provide ecosystem service functions that are exploited by local communities, including other foods, fuelwood, building poles, charcoal, shoreline protection, medicines and cultural services (e.g. sacred sites) (Ministry of Transport, 2013; Murage, undated; Government of Kenya, 2017). Some communities in Lamu, such as the Bajuni, depend on mangrove harvesting as their main source of income (GoK, 2017). Mangrove poles are used in construction of houses and boats.

Beekeeping in carried out by individuals or on group farms. Both man-made hives and natural hives consisting of holes in trees are used. The harvested honey is used for food, herbal medicine, and to brew alcohol. Generally, more honey is harvested during the rainy season because of increased availability of water and production of flowers. In Barigoni, bee keepers sell 100% of their harvest since it is their only economic activity.

Cultural Ecosystem Services

Sacred sites in Barigoni includes Kwa Mwalimu, Jadha, Gela, Komuri and Araseli (Focus Group, Elders, Barigoni 2018; Appendix B Social Baseline, Annex II). Community ancestors are buried at some of these sites, and visitors are not permitted to visit them. In addition, mangroves hold some cultural value.

6.14.4.7 Regulating Ecosystem Services

Regulating ecosystem services are provided on a landscape scale, and unlike provisioning and cultural ecosystem services, are not specifically linked to a particular vegetation community or habitat type. Regulating ecosystem services provided in the AoI include regulation of local climate via surface reflectance and evaporation; regulation of soil stability and erosion control; maintenance of the natural hydrological regime through regulation of water timing and flows, and groundwater recharge; and evaporation rates (Havstad *et al*., 2007; Safriel *et al.,* 2005). In particular, mangroves provide coastal protection from erosion and sea inundation (UNEP-WCMC, 2006).

Pollination is recognised as a Type I priority ecosystem service for local beneficiaries because of people's reliance on wild fruits and seed pods as a source of food for themselves and livestock; whilst regulation of water flows and timing, and soil stability and erosion control are considered Type II priority ecosystem services for the Project, playing an important role in maintaining operational performance (e.g. prevention of floods and erosion reduces the amount of maintenance required for infrastructure like roads).

6.14.4.8 Supporting Ecosystem Services

Supporting services are the natural processes, such as nutrient cycling and primary production that maintain the other services. Some of the primary ecological functions of the AoI include the provision of habitat for climax vegetation communities and maintenance of fauna species populations; nutrient cycling and support of primary production and plant growth, thereby forming the base of the food chain; and water cycling. The support of primary production, such as fruits used as food by people, is considered to represent a Type I priority ecosystem service within the AoI. In particular, mangrove habitats along the Lamu marine coast provide complex ecosystem functions for fish (e.g. spawning, nursery and foraging). Furthermore, sustainable water cycling is considered to be a Type II priority ecosystem service upon which the Project is dependent. These ecosystem services are not tied to specific habitat types or vegetation communities but are supplied at an ecosystem/landscape scale.

6.14.4.9 Summary of Priority and Non-Priority Ecosystem Services

A summary of the Ecosystem services provided in the AoI are presented in Table 6.14-2. The ecosystem services have been colour coded as per the following definitions (Landsberg *et al.,* 2014):

- Priority ecosystem services on which project impacts may affect the livelihoods, health, safety, or culture of the ecosystem service beneficiaries (Type I; highlighted in red text);
- Priority ecosystem services that could prevent the project from achieving planned operational performance e.g. water supply, regulation of flow and erosion control (Type II; highlighted in italicised *green* text); and
- Non-priority services (black text).

Table 6.14-2: Summary of Ecosystem Services Within the AoI

Provisioning	
Browsing/grazing resources for livestock	■ Livestock raised for meat, milk, and as wealth rely on grazing/browsing resources.
Soils, water, pollinators and other services supporting honey production by bees	■ Honey is produced for a food source, and in small-scale sales/trade.
Soils, water, pollinators and other services supporting arable, fruit, and vegetable production	■ Local communities grow crops, vegetables and fruit.
Fish	■ Fish are captured and used as a source of food and income.
Wild foods	■ Bushmeat and edible plant species are gathered in the wild.
Trees	■ Trees are a source of shade for livestock; ■ Seedpods are used as animal fodder; and ■ Bark and sap may be used for medicinal purposes.
Biomass fuel and timber	■ Firewood is gathered for personal and commercial benefit; and ■ Timber may be harvested for building and furniture making.
Freshwater	■ Water is required for human and animal consumption, together with irrigation, washing, and recreational uses.
Freshwater	■ Freshwater is obtained from local rivers (including Turkwel, Kerio, Barsaloi, Tana, Suyian, Seyia, and Nachola). Other water sources include streams, luggas, traditional wells, natural water pans, bore holes, and rainwater collection.
Medicinal plants	■ Loonyeyok (gum from the Acacia Senegal tree) and honey is used as herbal medicine, and to enhance milk production in dairy cows; ■ A number of species of medicinal herb are available within the AoI, including aloe which is used to treat disease; and ■ Miraa, chewed for its stimulative effect.
Mangroves	■ Mangroves provide fuelwood, building poles, charcoal, and medicines.

Regulating	
Regulating water flows and timing	The AoI sits within a number of river catchments. These hydrological systems will regulate water run-off, influence ground water recharge and maintain the water storage potential of the landscape. The natural landscape is also likely to regulate flooding during intense rainfall events.
Mangroves	Mangroves provide coastal protection from erosion and sea inundation.
Erosion control (prevention of soil loss)	Current vegetative cover plays an important part in soil retention on steep slopes and managing scour and soil erosion throughout the year.
Regulating the water cycle	Water systems provide drinking and irrigation water to local villages. Current vegetative establishment controls suspended sediments and regulates the water cycle.
The role of ecosystems in pollination	There are abundant wildflowers growing within the AoI which are used by local bee colonies and which are likely to support crop pollination, for example pollination of fruit trees.
Cultural	
Recreational pleasure people derive from natural or cultivated ecosystems	Habitat within the AoI includes arable, standing/running water, forestry and grasslands. All of these ecosystem features have provided intrinsic recreational pleasure for users over a number of generations.
Educational and inspirational values	Generations of people will learn how to hunt, fish and forage within the AoI.
Ethical and Spiritual Values	Sacred sites and intangible cultural heritage, evident within the AoI, are intrinsically linked with natural ecosystems such as wetlands, rivers, lakes and forests. Some species of acacia trees are regarded as sacred and used during ceremonies and community members indicated that they should not be destroyed.
Supporting	
Mangroves	Mangrove habitats along the Lamu marine coast provide complex ecosystem functions for fish (e.g. spawning, nursery and foraging).
Supplying habitat	The AoI plays an important part in providing habitat for a large number of species, including some which are nationally protected or endangered at the e.g. Grevy's Zebra and hirola.
Primary production	Timber production is supported by the climate and appropriate growing conditions.
Water cycling	The AoI plays a part in sustainable water cycling.

7.0 POTENTIAL IMPACTS AND MITIGATION

Section 7.0 presents the analysis of impacts for the Project, considering incorporated environmental measures that are either inherent in the design or are Good International Industry Practice (GIIP).

In addition to these incorporated measures and following the classification of impacts, further mitigation measures are identified if required to manage or reduce unacceptable adverse impacts. Residual impacts are those that remain following the implementation of the proposed mitigation measures.

The following sections present the potential impacts and mitigations for each ESIA technical discipline.

7.1 Air Quality

7.1.1 Introduction

The potential effects on air quality because of the Project have been determined using a qualitative assessment methodology. The qualitative method takes a staged approach as follows:

1) Establish baseline conditions – determine baseline conditions through review of existing published and available site-specific information (summary in Section 6.2). For the full baseline refer to Annex II;

2) Establish the key receptors and their importance – determined through baseline studies;

3) Characterise the magnitude of the impact to the receptor – determine the potential changes to receptors brought about by the Project (including inherent mitigation) and assign a magnitude of impact;

4) Assess the impact significance – determined by the nature and magnitude of impact, combined with the importance of receptor; and

5) Consider the need for monitoring and management.

7.1.2 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.1-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.1-1: Criteria for determining importance/sensitivity of receptors

Receptor Importance	Example Receptor Types
Very high	■ International importance. ■ Receptor with a high quality and rarity, regional or national scale and limited potential for substitution/replacement.
High	■ National importance. ■ Human health permanent residential receptor. ■ Receptor with a high quality, local scale and limited potential for substitution/replacement. ■ Receptor with a medium quality and rarity, regional or national scale and limited potential for substitution/replacement.

Receptor Importance	Example Receptor Types
Medium	■ Regional importance. ■ Human health transient receptor. ■ Receptor with a medium quality and rarity, local scale and limited potential for substitution/replacement. ■ Receptor with a low quality and rarity, regional or national scale and limited potential for substitution/replacement.
Low	■ Local, limited or no known importance. ■ Human amenity receptor. ■ Receptor with a low quality and rarity, local scale. ■ Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character.

7.1.3 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.1-2.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 38 months (the maximum anticipated construction period);
- A medium-term impact is defined as between 3 and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s).

Table 7.1-2: Criteria for assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	**Beneficial**
High	Change in air emission concentrations or deposited dust predicted to exceed AQS at indicative sensitive receptors with process contribution greater than 25% of AQS.	Large scale or major improvement predicted in Air Quality at resource/receptor.
Medium	Change in air emission concentrations or deposited dust predicted to exceed AQS at indicative sensitive receptors with process contribution less than 25% of AQS; OR Change in air emission concentrations or deposited dust predicted to exceed AQS at non-sensitive receptors, with process contribution greater than 25% of AQS.	Some benefit or improvement predicted in Air Quality at resource/receptor.
Low	Change in air emission concentrations or deposited dust predicted to exceed baseline, but not exceed AQS at indicative sensitive receptors; OR Change in air emission concentrations or deposited dust predicted to exceed AQS at non-sensitive receptors, with process contribution less than 25%* of AQS.	Minor benefit or improvement predicted in Air Quality at resource/receptor.
Negligible	No expected detectable change in measurable air emission concentrations or deposited dust to ground at sensitive or non-sensitive receptors.	

** In alignment with IFC EHS Guideline: Air Emissions and Ambient Air Quality*

7.1.4 Key Guidance and Standards

The guidance and standards that are relevant to the protection of Air Quality to which the Project will be expected to conform are as follows:

- Kenyan Government Environmental Management and Coordination Act (EMCA) (1999) and Amendments, 2018;
- Kenyan Government, 2014. The Environmental Management and Co-ordination (Air Quality) Regulations, 2014;
- World Health Organisation (WHO). Air Quality Guidelines Global, 2005;
- International Finance Corporation Performance Standards; and
- World Bank Group Environmental, Health, and Safety General Guidelines, 2007

The project standards are detailed in Table 7.1-3.

Table 7.1-3: Summary of AQS adopted for human health[1]

Emission	Time weighted average	Concentration ($\mu g/m^3$, unless stated)
SO_2	Annual	50
	24-hour	20
	10-minute	500
NO_2	Annual	40
	24-hour	188
	1-hour	200
NO_x	Annual	60
	24-hour	80
PM_{10}	Annual	20
	Annual IFC Interim Target 2	50
	24-hour	50
	24-hour IFC Interim Target 2	100
$PM_{2.5}$	Annual	10
	Annual IFC Interim Target 2	25
	24-hour	25
	24-hour IFC Interim Target 2	50
Deposited Dust	24-hour	200 mg/m^2/day

Abbreviations: $\mu g/m^3$ = micrograms per cubic metre; mg / m^2 / day = milligrams per square metre per day; NO_2 = nitrogen dioxide; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns; PM_{10} = particulate matter less than or equal to 10 microns; SO_2 = sulphur dioxide.

Results of the baseline monitoring and how the monitoring results compare to the AQS at each location are presented and discussed in the full baseline in Annex II and included in the baseline summary in Section 6.2.

7.1.5 Receptors of Interest and Importance

Air quality receptors within the AoI have been identified and the sensitivity of the receptor has been defined. Higher sensitivity receptors are considered to be any specific locations where people reside or spend long periods of time, whilst lower sensitivity receptors are areas where people have access (for example, for the purposes of grazing) but do not spend long periods of time.

[1] A comparison of the IFC and Kenyan AQS are presented in the Project Standards report (ref. 1772867.576), Annex I where the project standards are defined.

Receptors included in the assessment, where present, are as follows:

- Permanent human receptors – residential settlements;
- Transient human receptors - due to the prevalence of nomadic pastoralism in the region and the associated transience of settlement, sensitive receptors cannot be easily defined. All areas where transient receptors could be present have been included in the operational assessment. These receptors have been screened out of the construction assessment; and
- Ecological receptors - where areas of protected and sensitive ecological receptors are present and screened into the assessment.

Table 7.1-4 presents the assigned importance for these receptors following the criteria presented in Table 7.1-1

Table 7.1-4: Receptors and importance

Receptor	Importance	Comment
Permanent Human Receptors	High	Human health impact on people resident at a receptor
Transient Human Receptors	Medium	Defined as being medium sensitivity due to the period of time which people are likely to be present there (less than one year), if at all.
Amenity receptors	Low	Not a human health impact but an impact relating to the loss of amenity and nuisance, therefore the sensitivity of the receptors is defined as low.

7.1.5.1 Construction Phase

Transient receptors have the potential to be located within 250 m of the source, but they will not be present for prolonged periods (greater than one year). There is the potential for transient receptors to be present in the vicinity of the pipeline route but they will be present for short durations and not within the LAPSSET corridor during the construction works. Therefore, transient receptors have been screened out of the construction impacts assessment.

As far as possible, LLCOP has been routed to minimise the impact to settlements and sensitive areas of biodiversity and cultural importance. Within the AoI there are potential residential receptors outside of the LAPSSET corridor but within the 250 m AoI near Archer's Post (approximately 50 m west of the pipeline route) and Lamu Port (approximately 200 m east of the pipeline route).

There are key areas inhabited by the critically endangered Grevy's Zebra, but these are outside of the 250 m AoI and have also been screened out of the assessment. Dust emissions may impact flora and fauna and restrict growth of sensitive habits by soiling the leaf surface. It is therefore important to consider the impact on sensitive protected sites that exist in close proximity to the Site. The pipeline runs between Shaba and Samburu National Reserves, two important designated national reserves, however their distance from the pipeline (greater than 250 m) screens them out of this assessment. Where community conservancies are encountered, effort has been made to route adjacent to existing infrastructure to minimise impact. The assessment has determined that no such sites are within 250 m of the Site boundary and impacts on nature conservation sites are therefore not considered further as Not Significant.

7.1.5.2 Operational Phase

Due to the length of the operational period, it is assumed that transient receptors can be present in any location and access up to the fenceline of the stations, for any period of time less than one year. Due to the transient nature of the receptors, the impact of annual air quality on these receptors is not- significant and are screened out of this assessment. Only the short-term AQS (24-hour, 1-hour and 10-minute) will be applicable. An approximate 2 x 2 km^2 area surrounding each of the power generating stations (see Figure 7.1-1) has been included in the assessment, which has used Air Quality Dispersion Modelling (AERMOD), and it is assumed that transient receptors could be present anywhere in this area. Results for air quality within the station fence lines will be considered separately in the context of occupational health and managed through the occupational health management plan (worker health and safety plan).

7.1.6 Potential Sources of Impact

Potential atmospheric emissions, considered in this impact assessment, from activities during groundworks, installation, and operations can be categorised into two groups:

7.1.6.1 Construction Phase

Based on the project description and the understanding of the baseline air quality conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to air quality during the construction phase. The potential sources of impact and routes by which they could impact air quality are as follows:

- Dust generated during construction of the pipeline; and
- Emissions from vehicle movements during construction.

7.1.6.2 Operation Phase

Based on the project description the following aspects of the Project have been identified as presenting potential sources of impact to air quality during the operational phase:

- Emissions during operation from generators located along the pipeline route;
- Dust from operation for example, traffic on roads; and
- Emissions from vehicle movements during operation.

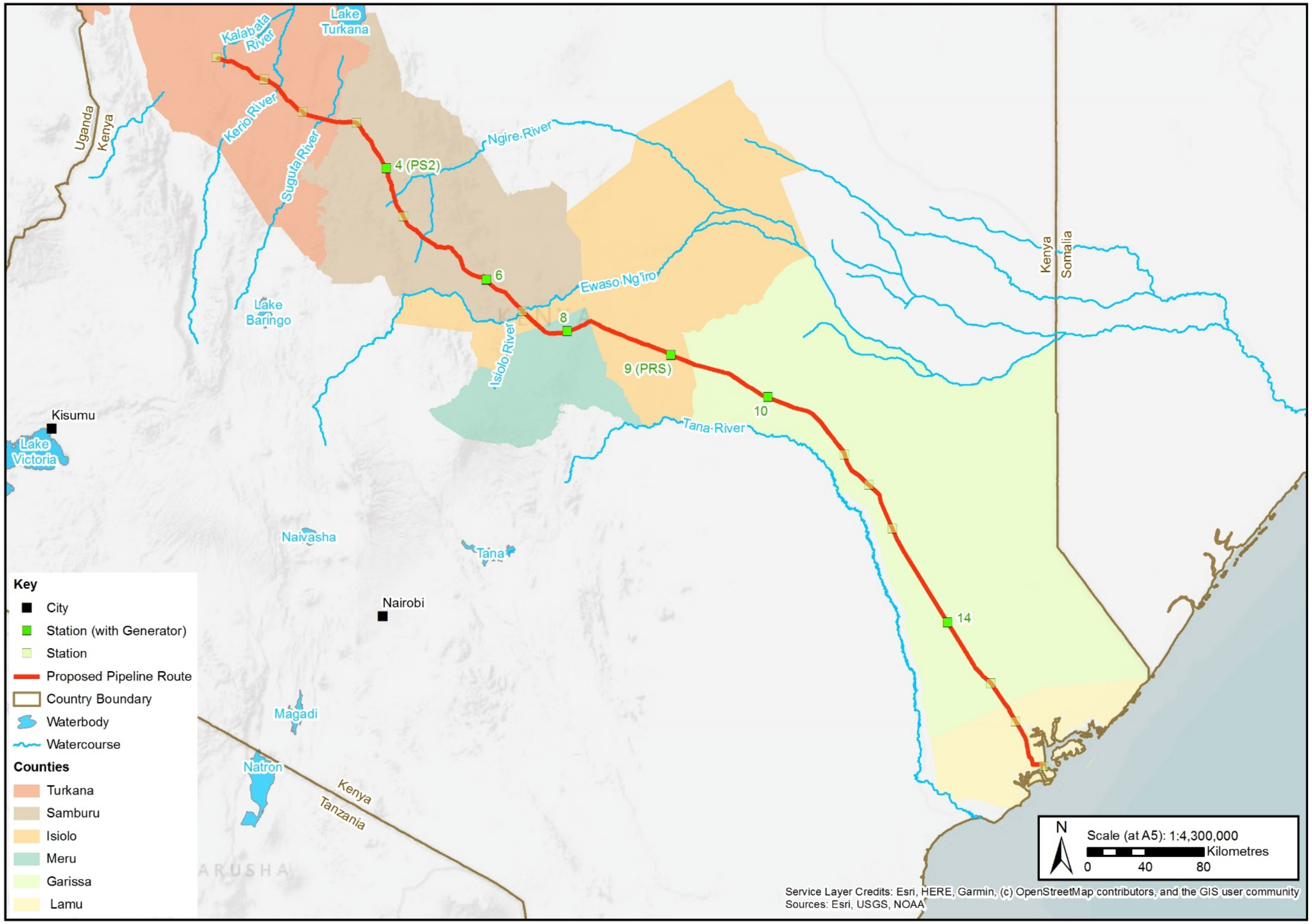

Figure 7.1-1: Stations where power generators will be present

7.1.7 Incorporated Environmental Measures

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are Good International Industry Practice (GIIP). The following incorporated environmental measures are specifically relevant to air quality.

7.1.7.1 Inherent Design Measures

There are no inherent mitigation measures specifically for construction.

During operations, the following inherent design measures, defined by air dispersion modelling, have been incorporated. Following a review of stack requirements at stations along the pipeline route during the FEED process, generator stacks have been designed to meet the required emission standards.

7.1.7.2 Good International Industry Practice

The following widely followed good practice measures are applicable to <u>all phases</u> of the Project and will be applied/followed in order to manage the magnitude of impacts on air quality:

- Regular schedule of vehicle and generator maintenance to ensure optimal emissions performance;
- All equipment and infrastructure will be operated and maintained in line with manufacturer's recommendations and using the appropriate fuel and will be monitored with periodic inspection and audits;
- All personnel will be appropriately trained to use relevant equipment; and
- Applicable national and Project speed limits will be adhered to by Project vehicles on all roads.

The following measures are applicable to the <u>construction</u> phase of the Project:

- Stored materials that have the potential to produce dust (including spoil) will be covered or promptly removed, unless being re-used on site.;
- Where practical, trucks transporting dusty material associated with the project will be covered to prevent escape of materials during transport;
- Daily site inspections will be undertaken by the PipeCo Site Representative when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions; Where reasonable and practical, vehicles and equipment will be turned off when not in use, leaving vehicles idling for extended periods will be avoided unless weather and/or safety conditions dictate the need for them to remain turned on; If dust is either observed or is considered likely to cause a nuisance to adjacent settlements, dust suppression will be undertaken using recycled grey water as a first preference. Where this is not available, water from other sources may be used provided abstraction of the water is appropriately permitted; and Uncontrolled burning of waste materials will be prohibited.

7.1.8 Impact Classification

Taking into account the baseline air quality setting (Section 6.2), the relevant incorporated environmental measures (Section 7.1.7), and the potential sources of impact (Section 7.1.6) determined from the project description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant incorporated mitigation applicable to each receptor are summarised. The magnitude and significance of each impact linkage is assigned.

7.1.8.1 Construction Phase

7.1.8.1.1 Deposited Dust

Dust typically comprises particles ranging between 1-75 micrometres (μm) in aerodynamic diameter, which are formed through a mixture of crushing and abrasive forces on materials. Due to the relatively large particle size of dust, dust particles are airborne for short durations following initial release to the atmosphere. The larger dust particles generally fall out of suspension rapidly and in relatively close proximity to the emission source (usually within 250 m).

Dust particles, therefore, are unlikely to cause long-term or widespread changes to local air quality and have little effect to human health; however, the deposition of dust particles can result in the local soiling of surfaces which may result in complaints due to amenity loss or perceived damage caused. During construction, the potential for dust impacts are likely to be transient and sporadic. During site operations dust impacts may be intermittent at nearby receptors if emissions are not adequately mitigated and managed.

For the purpose of this assessment, potential dust impacts are considered to be significant where sensitive human and ecological receptors are located within 250 m from the proposed LLCOP and International air quality guidelines for dust have been adopted as the working air quality standard (in the absence of a relevant Kenyan standard) to determine current air quality compliance.

The transport of dust emissions is determined primarily by the following local meteorological conditions surrounding the development Site:

- The wind speed determines the likely entrainment and deposition of dust and the distance of travel from the Site;
- The wind direction controls the area over which the dust particles carried; and
- Moisture/precipitation influences adhesion (i.e. less likely to be entrained) and deposition (via rainfall) of particles in the air.

In the qualitative assessment of construction impacts, data has been used from the meteorological stations at Meru and Garissa. Precipitation will suppress dust and prevent it from becoming airborne, as well as increasing the rate at which dust is deposited onto ground surfaces (i.e. no longer airborne) due to surface wetting. Precipitation levels of in excess of 6 mm/month are considered sufficient to effectively suppress any potential airborne dusts for most of the year. According to the 3-year average, the greatest amount of rainfall occurs between October and December at both stations. The driest periods, according to the 3-year average, are between June and September at Meru, and between January and February, June and July, and in September at Garissa. On average for the 3-year datasets, the 6mm threshold is met or exceeded for eight months at Meru and five months at Garissa.

The wind roses provided in Figure 7.1-2 indicate the prevailing wind direction for the datasets. They indicate a southerly to south/south easterly prevailing wind at both meteorological stations. With a dominant southerly wind direction, it is considered likely that any dust sensitive receptors located to the north of the proposed LLCOP are most likely to be affected by deposited dust emissions associated with the construction and operation of the Site. The permanent residential receptor location at Archer's Post and Lamu considered in this assessment, are located to the west, south and east of the pipeline route and therefore upwind. Dust particles will therefore not be predominantly dispersed to and deposited at these receptor locations.

Details of specific construction work and timescales are not available at this time although construction of the pipeline will be phased over six spreads and there will not be prolonged construction activities in each location. The potential for impacts from dust emissions to air are likely to be generated predominantly by land clearance activities, trenching and backfilling and on-site transport vehicle movements. The activities will potentially be of a medium magnitude occurring for a short- duration and they will be temporary resulting in a minor impact significance. Additional mitigation measures are proposed for the control of dust emissions, which will reduce the magnitude to low and the resulting impact significance to Negligible.

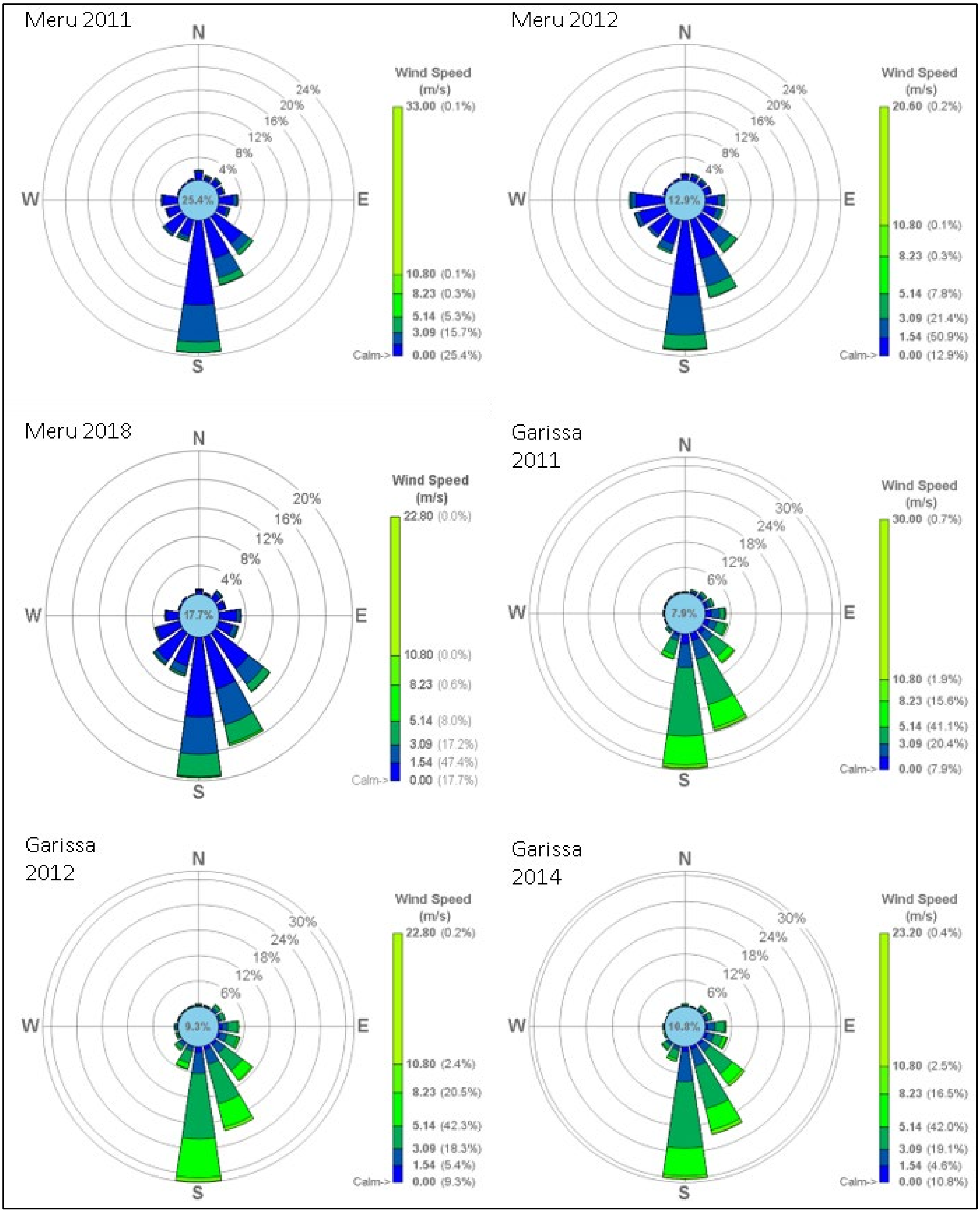

Figure 7.1-2: Windroses for Meru and Garissa Meteorological Stations

7.1.8.1.2 Vehicle Emissions

In the absence of any International or Kenyan guidance, the UK Design Manual for Roads and bridges (DMRB) screening criteria would be used to determine the level of assessment required based on the projected additional traffic flows associated with the development. The additional traffic flows are assessed against the following assessment screening criteria:

- Existing road alignment will change by 5 m or more;
- Daily LGV traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more;
- Heavy Goods Vehicle (HGV) flows will change by 200 AADT or more;
- Daily average speed will change by 10 km/hr or more; or
- Peak hour speed will change by 20 km/hr.

AADT is the total traffic flow for the year (2 way) divided by 365 and is the industry specific way of comparing or describing traffic flows on roads. If none of the above screening criteria are met, then a detailed assessment is not required.

The total number of anticipated truck journeys over the construction period is 30,138 and the construction period is approximately 38 months long. In reality, the vehicle movements will be dispersed over six pipeline construction spreads and therefore all of the traffic movements will not occur in the same location. This equates to an AADT of 26 for the construction phase, which is below the screening criteria. Therefore, a further detailed assessment is not required and this has been scoped out of the assessment as Not Significant.

Table 7.1-5: Construction phase impact classification and impact significance

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Receptors potentially impacted by loss of amenity, residential properties in Archers Post and Lamu which are located outside of the LAPSSET corridor but within 250m of the pipeline construction. (low)	Loss of amenity through deposited dust emissions associated with the construction phase	Medium – Short term – Temporary – Direct	Minor (adverse)	No additional mitigation in addition to those described in Section 7.1.7 Specific measures associated with dust mitigation will be detailed further in the Construction Environmental Management Plan (CEMP).	Low – Short term – Temporary – Direct	Negligible

7.1.8.2 Operational Phase

The results of the impact assessment for the operational phase of the project with respect to air quality is presented in Table 7.1-6.

7.1.8.2.1 Emissions from Crude Oil-Fired Generators

For the assessment of operational emissions from the generators located at stations 4, 6, 8, 9,10 and 14 (shown in Figure 7.1-1) along the pipeline route, a quantitative Air Dispersion Modelling Assessment has been undertaken using the AERMOD modelling software (version 8.1.0.15). Modelled emissions from the station generators associated with the project include gases (nitrogen oxides (NO_x), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and fine particulates (PM_{10} and $PM_{2.5}$). A "normal operating scenario" has been considered simulating the generators at each station operating continuously through the year, fuelled by the crude oil transported by the pipeline. Although the generators can be fuelled by diesel, the emissions for crude oil would be higher and therefore this assessment considered the most conservative scenario. No down-time is included in the ADM which is also the most conservative assumption.

Emissions data were sourced from a combination of PPMT data, manufacturer's model, equipment specification and Kenyan and IFC Emission Limit Values (ELVs). Standard ADM assumptions have also been adopted in the assessment, including the assumption that 70% of NO_x is converted to NO_2 in the long-term and 35% in the short-term and assessing particulate emissions in two stages, the first assuming 100% of particulate emissions are PM_{10} and the second assuming 100% of particulate emissions are $PM_{2.5}$.

Meteorological data used in the assessment are from Meru and Garissa and the windroses are detailed in Figure 7.1-2. Three years of data is used to account for inter-annual variability in the data and the years were selected based on completeness and availability of the annual data sets with 2011 and 2012 being used for both stations, along with the most recent year available for each station, which is 2018 for Meru and 2014 for Garissa. Terrain data has been incorporated into this assessment using 12 m digital elevation model (DEM) data for an approximate 2 x 2 km square surrounding each station. The surface roughness values were based on land use within a 1 km radius of each station and the albedo/bowen ratios consider a 10 km^2 area centring on each station, following the model classification methodology.

The ADM uses the emissions source data and the meteorological data to predict the potential effect of emissions on air quality across the modelled domain. As the assessment is considering transient receptors, which could be present anywhere outside of the station fenceline, a receptor grid has been included, centred on each station. This allows for contour plots of predicted concentrations to be generated.

The ADM predicts the contribution from the site, known as the Process Contribution (PC), to ambient air quality as a ground level concentration attributable to the modelled project source. For the assessment of each pollutant considered, the PC is added to the existing background concentration (detailed in the full baseline in Annex II and summarised in Section 6.2), to calculate the Predicted Environmental Concentration (PEC), which is the contribution from the site plus the existing air quality environment. The PEC is then compared to the adopted AQS for the Project. The AQS indicates the degree of environmental effect that can be considered acceptable for the pollutant of concern at a receptor.

For the assessment of emissions from the generators located at stations 4, 6, 8, 9,10 and 14 along the pipeline route, all short- term PCs (excluding station 6 1-hour NO_2) combined with the existing background concentrations are below the relevant AQS, as detailed in Table 7.1-3. As discussed in section 7.1.5.2 only the short term AQS have been considered relevant due to the transient nature of the receptors. The magnitude of the impact is identified as being low, which combined with the transient receptor sensitivity of medium results in a minor adverse predicted impact.

7.1.8.2.1.1 NO_2 Concentrations at Station 6

There is a predicted exceedance of the 1-hour Project AQS for NO_2, which is based on the International standard, in a very limited area on the hill side opposite station 6. The predicted concentration is below the 1-hour Kenyan AQS for NO_2. This predicted concentration is most likely to be an overestimate due to the terrain surrounding this station and the way in which the AERMOD model conservatively simulates dispersion on local hill sides. Based on the discussion above, it is unlikely that this exceedance will, in reality, occur. The magnitude of the impact post mitigation is therefore identified as being low, which combined with the receptor sensitivity of medium (transient receptors) results in a moderate adverse predicted impact.

Contour plots of the 1-hour NO_2 PEC (PC plus baseline) is included as Figure 7-1.3. They present the result in the area surrounding the stations including the location of where the plume grounds, which represents the highest concentrations. The contour plot incorporates the project (International) AQS, which is lower than the Kenyan standard. Predicted concentrations outside of the station boundary are below the Kenyan AQS.

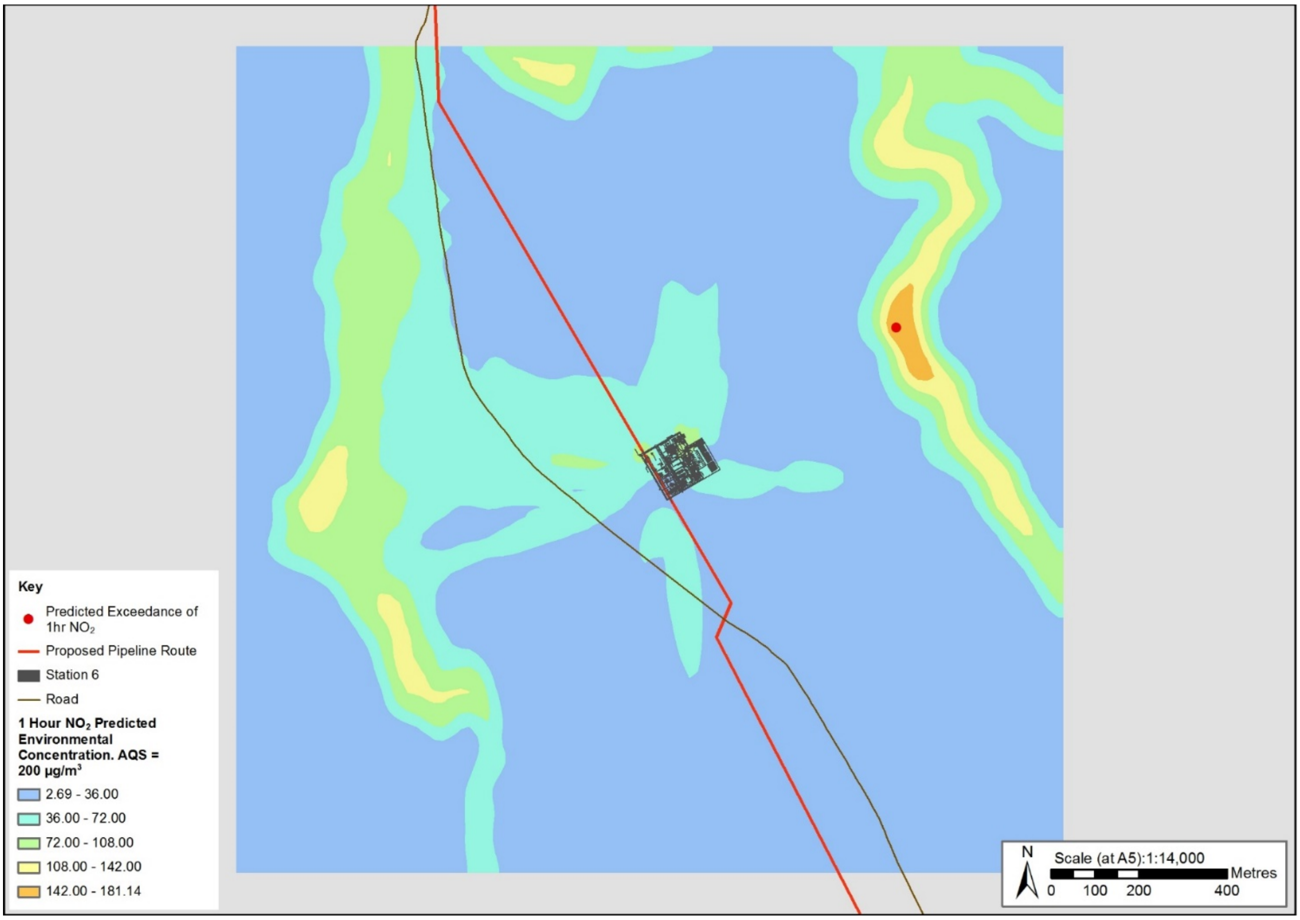

Figure 7.1-3: Station 6 1-hour NO_2 Contour Plot and comparison with the Project (International) AQS

7.1.8.2.2 Deposited Dust

A 6 m permanent easement is proposed, 3m either side of the pipeline centreline, which allows a right of access for maintenance. Work within the easement is expected to be intermittent, sporadic and any vehicle access will be limited. No elevated levels of dust emissions are anticipated during the operation of the pipeline and the associated stations; therefore, this has been scoped out of the assessment as Not Significant.

7.1.8.2.3 Exhaust Emissions from Operational Vehicles

For the assessment of operational vehicles, it is anticipated that the operational vehicle movements will be less than the screening criteria defined in Section 7.1.8.1.2 and therefore this has been scoped out of this assessment as Not Significant.

Table 7.1-6: Operational phase impact classification and impact significance

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Transient Human Receptors (medium)	Combustion emissions of all short-term emissions from the generators located at the stations	Medium – Medium Term – Temporary – Direct	Minor (adverse)	No additional mitigation in addition to those described in Section 7.1.7. Specific measures associated with dust mitigation will be detailed further in the Operational Environmental Management Plan (OEMP).	Medium – Medium Term – Temporary – Direct	Minor (adverse)

7.1.8.3 Decommissioning

The pipeline has a design life of 25 years. At this stage it is not possible to anticipate the situation at that time. However, should any ground disturbance or demolition of stations be required which will result in deposited dust the mitigation measures implemented during the construction phase will be applied during decommissioning. No additional sources of emissions to air are anticipated in addition to those already assessed.

7.1.9 Summary of Mitigation

7.1.9.1.1 Construction

No additional mitigation measures beyond those detailed in Section 7.1.7 are required for the construction phase. Specific measures regarding dust will be detailed further in the Construction Environmental Management Plan.

7.1.9.1.2 Operation

No additional mitigation measures beyond those detailed in detailed in Section 7.1.7 are required for the operations phase. Specific measures regarding dust will be detailed further in the Operational Environmental Management Plan.

Annual stack emissions monitoring will be undertaken for NO_x, SO_2 and PM_{10} for all engines to demonstrate compliance with the IFC and Kenyan ELVs. If the monitored concentrations are consistently (over 3 consecutive years) significantly (less than 75%) better than the required levels, the emissions monitoring frequency will be reduced to once every 3 years.

7.1.10 Summary of Residual Impacts

The Project has the potential to impact the air environment in the following ways:

- Through the generation of dust and increased deposited dust concentrations relating to the construction phase;
- By changing the local air quality concentrations through the emissions to air produced by the generators located at the stations along the pipeline route.

The impact significance that results from the combination of receptor importance and predicted impact magnitude is classified as minor adverse to negligible.

7.2 Noise and Vibration

7.2.1 Introduction

This section considers the potential impacts within the noise and vibration Area of Influence arising from noise and vibration sources associated with the Project. Specifically, environmental noise and vibration effects relevant to human receptors are assessed. Assessment of the effects of the Project on ecological and social receptors related to sensory disturbance from noise and vibration, is carried out in other sections of this ESIA.

7.2.2 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.2-1 has been used with reference to the information collated in the baseline to classify the selected human receptors in the assessment of potential noise and vibration effects.

Table 7.2-1: Criteria for determining importance/sensitivity of receptors

Receptor Importance	Example Receptor Types
Very high	■ International importance; and/or ■ Receptor with a high quality and rarity, regional or national scale and limited potential for substitution/replacement.
High	■ National importance; ■ Permanent human noise and vibration sensitive receptor; ■ Receptor with a high quality, local scale and limited potential for substitution/replacement; and/or ■ Receptor with a medium quality and rarity, regional or national scale and limited potential for substitution/replacement.
Medium	■ Regional importance; ■ Receptor with a medium quality and rarity, local scale and limited potential for substitution/replacement; and/or ■ Receptor with a low quality and rarity, regional or national scale and limited potential for substitution/replacement.
Low	■ Local, limited or no known importance; ■ Receptor with a low quality and rarity, local scale; and/or ■ Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character.

7.2.3 Magnitude of Impact

The characterisation of the potential overall impact of the Project considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude effects criteria for potential noise and vibration effects has then been classified between 'negligible' and 'high', as described in Table 7.2-2. The magnitude effects criteria have been developed in accordance with the key guidelines discussed in Section 7.2.4, as well as general guidance provided from various directives for noise assessments[1]. The following are other criteria considered when assessing the potential overall impact of the Project on noise and vibration.

Each potential overall impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 38 months (the maximum anticipated construction period);
- A medium-term impact is defined as between 3 and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

It should be noted that although short-term impacts are defined up to 38 months, due to the rate at which the pipeline is to be constructed (approximately 1 km per day), a receptor will only be potentially affected for up to two weeks due to the planned duration of pipeline construction in any one location.

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Frequency is also considered when determining the nature of a potential impact. Infrequent effects occur intermittently but not continuously over an assessment period, while frequent effects occur repeatedly or continuously.

Potential overall impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s). Indirect impacts are likely to occur away from the Project.

Impacts as they relate to noise and vibration in this assessment are considered to be adverse and direct.

Table 7.2-2: Criteria for assessing magnitude of impact

Magnitude of Impact	Description Criteria	
	Noise [a]	Vibration
High	Project related change in daytime and/or night-time equivalent noise level >10 dB above baseline or exceeds applicable noise limit at sensitive receptors	Project related vibration level of > 10.0 mm/s for ground vibration (level of human perception) and 150 dBL at sensitive receptors. May influence related design decisions regardless of any possible mitigation.
Moderate	Project related change in daytime and/or night-time equivalent noise level > 5 dB and ≤ 10 dB and meets applicable noise limit at sensitive receptors	Project related ground vibration level of 5 – 10 mm/s and air overpressure of 117 – 150 dBL at sensitive receptors. Should influence decisions on project design unless mitigated. An impact or benefit which is sufficiently important to require management.

[1] The 3dB, 5dB and 10dB intervals are informed by Bies and Hansen (2009)

Magnitude of Impact	Description Criteria	
	Noise [a]	Vibration
Low	Project related change in daytime and/or night-time equivalent noise level > 3 dB and ≤ 5 dB and meets applicable noise limit at sensitive receptors	Project related ground vibration level of 1 – 5 mm/s and air overpressure of 90 – 117 dBL at sensitive receptors and meets the project guidelines. Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation.
Negligible	Project related change in daytime and/or night-time equivalent noise level ≤ 3 dB and meets applicable noise limit at sensitive receptors	Project related vibration level of < 1.0 mm/s for ground vibration (level of human perception) and 90 dBL at sensitive receptors.

[a] *Applicable noise limits further discussed in Section 7.2.4*

7.2.4 Key Guidelines and Standards

7.2.4.1 Noise

The *International Finance Corporation Environmental, Health and Safety (EHS) Guidelines - Noise Management* dated April 30, 2007 (IFC Noise Guideline) and *Kenya Environmental Management and Coordination (Noise and Excessive Vibration Pollution Control) Regulations* dated 2009 (Kenya Noise Regulations) are relevant documents to the Project that provide guidance in managing sound levels at specific locations. Golder previously carried out a review of the IFC Noise Guideline and Kenya Noise Regulations for the Upstream project, recommending the use of the IFC Noise Guideline for Project operation (Project Standards, ref 1772867.568). This was subsequently confirmed with NEMA in a meeting that the IFC Noise Guideline could be used as Project standards for the Upstream EOPS Phase II ESIA and has been adopted for the LLCOP Project ESIA also; minutes of the meeting were recorded and a Technical Memorandum compiled by Golder on the findings of the meeting.

Noise-sensitive receptors identified for the noise impact assessment are best categorised as "*residential; institutional; educational*" under the IFC Noise Guideline, with noise level limits as presented in Table 7.2-3.

Table 7.2-3: IFC Noise guideline noise limits for operation

Receptor Type	Noise Limit (dBA; $L_{Aeq,1r}$) [a]	Reference Period
Residential; institutional; educational	55	Daytime (07:00 – 22:00)
	45	Night-time (22:00 – 07:00)

[a] *IFC Noise Guideline allows for either the sound level limits presented here or a maximum increase in background levels of 3 dB at the nearest receptor location off-site.*

The Project standards adopt the noise level limits presented in Table 7.2-3 at off-site receptor locations during Project operations and considers these as the applicable noise level limits for the magnitude effects criteria for the impact assessment presented in Section 7.2.3.

The IFC Noise Guideline does not provide construction noise level limits and therefore the conservative approach to use construction limits provided in the Kenya Noise Regulations (Table 7.2-4) has been taken to assess the construction phase. It is acknowledged that there may be an opportunity to allow Project construction to operate above these limits under specific conditions, in discussion with NEMA. Nevertheless, for the purposes of this assessment, the IFC limits have been used to define the impact assessment criteria presented in Section 7.2.3.

Table 7.2-4: Kenya noise regulations noise limits for construction

Receptor Type	Noise Limit (dBA; $L_{Aeq,daytime/night-time}$)	Reference Period
Health facilities, educational institutions, residential	60	Daytime (06:00 – 18:00)
	35	Night-time (18:00 – 06:00)

Note that the definition of daytime and night-time for the construction limits in the Kenya Noise Regulations differs from the daytime and nighttime definition in the IFC Noise Guideline.

7.2.4.2 Vibration

The Kenya Noise Regulations is the relevant document to the Project that provides guidance in managing ground vibration levels at specific locations. Peak component particle velocity (PPV) is considered the best measure of the impact of vibrations on residential structures.

The receptors identified for the vibration impact assessment are best categorised as "*residential*". There are numerous documents which are used to provide guidance in managing air vibrations at specific locations. However, most address the potential impact on residential structures using modern techniques and materials. The Ghanaian "*Minerals and Mining (Explosives) Regulations, 2012 (Section 199)",* were developed to mitigate the potential impact of blasting operations on the type of more sensitive residential structures which are likely to be encountered near the pipeline blasting operations for the Project. The proposed ground and air vibration level limits are presented in Table 7.2-5.

Table 7.2-5: Vibration guidelines for blasting vibration limits

Receptor Type	Ground Vibration Limit (mm/s) (a)	Air Vibration Limit (dBL)
Residential	5 mm/s	117

(a) The Kenya Noise Regulations require that vibration levels do not exceed 0.5 centimetres per second beyond any source property boundary or 30 metres from any moving source.

An introduction to a few of the key concepts with regard to ground and air vibrations is provided below:

- Ground vibration is an elastic effect measured in units of peak particle velocity and is defined as the speed of excitation of particles within the ground resulting from vibratory motion. For the purposes of this report, ground vibration is measured in mm/s.
- Air vibration is a pressure wave travelling through the air, produced by the direct action of an explosive on air or the indirect action of a confining material subjected to explosive loading. For the purposes of this report, air vibration is expressed in a logarithmic scale as decibels in the Linear or Unweighted mode (dBL).
- Air vibrations from surface blasting operations differ from noise in that they consist primarily of acoustic energy below a frequency of 20 Hz, where human hearing is less acute (Siskind et al., 1980). Noise, on the other hand, consists primarily of acoustic energy within the audible range from 20 to 20000 Hz.

The Project Standards (Annex I) adopt the vibration limits presented in Table 7.2-5 at the off-site receptor locations. The magnitude criteria for the impact assessment presented in Section 7.2.3 consider these vibration limits for the impact analysis.

It is important to note that humans perceive vibrations below the levels required to impact residential structures. The level of human perception for impulsive vibration, such as blasting, is 1.0 mm/s.

7.2.5 Receptors of Interest and Importance

Area of Influence

The noise and vibration Area of Influence comprised the areas within 1.5 km of the pipeline RoW and 5 km from the station fencelines, which incorporates the areas beyond where it is expected that noise and vibration from Project sources will attenuate to a level below the ambient noise level or below a detectable vibration level. A desktop review of publicly readily available satellite imagery was completed by the Project team to identify potential receptors where human activity is expected to occur and to characterise the respective existing conditions.

Receptors

Noise and vibration receptors have been identified and the sensitivity of the receptor has been defined using the criteria outlined in Table 7.2-1. Higher sensitivity receptors are considered to be noise and vibration sensitive locations where people live or spend long periods of time (i.e. permanent), whilst medium or lower sensitivity receptors are areas where people have access (for example, for the purposes of grazing) but do not spend long periods of time (i.e. transient). Due to the uncertainty of the location of transient receptors, the assessment of the potential noise and vibration effects of the Project considered permanent human noise-sensitive land use receptors only, and they are considered to be of high importance.

Table 7.2-6 presents the identified nearest communities where permanent human receptors have been identified and have the potential to be impacted by noise and vibration from the Project. Baseline noise levels were measured within some of the communities, as described in Section 6.3. Table 7.2-6 presents the approximate minimum distances from identified permanent receptor locations within the communities to the pipeline and to the nearest station associated with the Project. If additional permanent receptors are identified at distances less than those presented in Table 7.2-6, the effects of noise and vibration due to the Project may need to be considered at these locations.

Any permanent receptors (as presented in Table 7.2-6) located within the 500 m LAPSSET corridor, which includes the 26 m pipeline RoW, will undergo a process of compulsory purchase by LAPSSET. Note that the pipeline corridor generally follows the edge of the LAPSSET corridor, which results in potential permanent receptors, who will not undergo compulsory purchase, located as close as 50 m from the pipeline.

Table 7.2-6: Selected receptors of interest

Community	Nearest Project Station	Approximate Minimum Distance between Community Receptor and Nearest Project Station (m)	Approximate Minimum Distance between Community Receptor and Project Pipeline (m)
Barsaloi [a]	S4/PS2	> 5000	1000
Lengusaka [a]	S6	> 5000	700
Archer's Post [a]	S7	200	50
Garba Tula [a]	S9	> 5000	n/a – Outside of Area of Interest
Ohio Village [a]	S10	1600	n/a - Community within LAPSSET corridor
Lamu Port [a]	Lamu Marine Terminal	300	200
Nakukulas	LEF/PS1	900	1000
Lerata	S6	> 5000	n/a - Community within LAPSSET corridor
Suyian	S4/PS2	> 5000	n/a - Community within LAPSSET corridor
Yaq Barsadi	S8	> 5000	n/a - Community within LAPSSET corridor
Kaichuru	S8	> 5000	900
Shimbiri	S11	> 5000	1000
Modika	S11	> 5000	1100
Kiliana	Lamu Marine Terminal	1700	700
Majengo	S16	1500	800
Swari	S5	> 5000	400

[a] *Proxy receptors for monitoring field locations and stations*

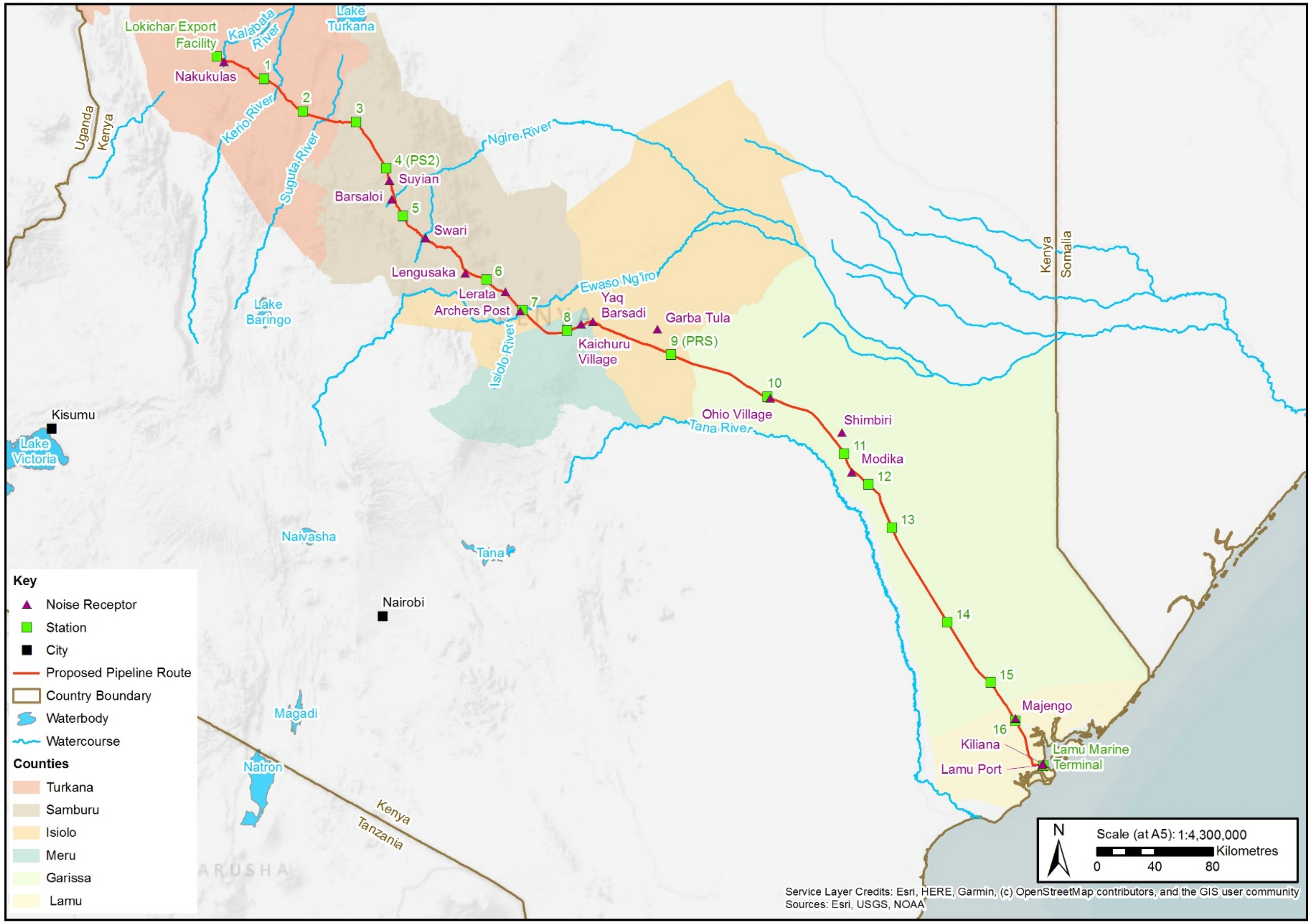

Figure 7.2-1: Noise receptors

7.2.6 Potential Sources of Impact

7.2.6.1 Noise

As Project noise emissions and potential effects on the environment differ between pipeline and station activities, the noise assessment considers the pipeline and stations separately for both Project construction and operation.

7.2.6.1.1 Construction Phase

Noise levels are expected to increase at times due to activities associated with construction of the pipeline and the stations. Potential effects on noise levels during construction are expected to be greatest during the following key activities:

- Pipeline construction:
  - Clearing and grading;
  - Trenching; and
  - Lowering pipe and backfilling.
- Station construction:
  - Clearing and grading;
  - Trenching;
  - Foundation construction;
  - Onsite fabrication of tanks and piping; and
  - Building construction.

7.2.6.1.2 Operation Phase

Noise emissions associated with pipeline operation are expected to be minimal, as noise emitted from the buried pipeline is expected to be imperceptible in the environment over baseline conditions, therefore this is scoped out of the assessment and is not evaluated any further. With the exception of periodic maintenance and inspection activities, no additional significant noise sources are expected as a result of pipeline operation.

The stations associated with the Project include export facilities, pump stations, block valves, pig launchers/receivers, pressure reduction, and a load out facility. The stations that are considered the most significant are those that include the following sources of noise:

- Generators (and associated air coolers); and
- Pumps.

7.2.6.2 Vibration

7.2.6.2.1 Construction Phase

Continuous vibration (produced by road traffic, construction activities and industrial sources) propagates over comparatively small distances. Other than at locations immediately adjacent to the roadside, the existing vibration levels in the study area were therefore assumed to be zero.

As blasting operations for grade and ditch excavation during the construction phase will be the source of vibrations beyond those small distances, this report will focus on blast-induced vibrations. Some rock blasting may be required within Turkana County, though this method is an exception rather than the rule on construction. Vibration, as a potential source of impact, consists of two components: ground vibration and air vibration[2].

7.2.6.2.2 Operation Phase

Blasting will cease at the end of the construction phase. No impacts are expected during the operation phase.

7.2.7 Incorporated Environmental Measures (Inherent Mitigation)

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are Good International Industry Practice (GIIP). The following incorporated environmental measures are specifically relevant to noise.

7.2.7.1 Inherent Design Measures

The following measures are applicable to the construction phase of the Project:

- Construction activities will usually occur during the daytime period only, with occasional nighttime work for testing and inspections. If additional unexpected conditions occur that require nighttime construction, receptors that may be impacted will be notified and if approvals are required by the Kenya Noise Guidelines, they will be obtained; and
- Construction activities will be undertaken on a sequential basis and therefore will not take place concurrently at the same location.

The following measures are applicable to the operational phase of the Project:

- The pipeline will be buried, therefore mitigating operational noise; and
- All combustion air intakes and exhausts of Project generators will be installed with silencers.

7.2.7.2 Good International Industry Practice

The following widely followed good practice measures are applicable to all phases of the Project and will be applied/followed in order to manage the magnitude of impacts on noise:

- Where reasonable and practical, vehicles and equipment will be turned off when not in use, leaving vehicles idling for extended periods will be avoided unless weather and/or safety conditions dictate the need for them to remain turned on;
- All equipment will be operated and maintained in line with manufacturer's recommendations and using the appropriate fuel and will be monitored with periodic inspection and audits; and
- Applicable national and Project speed limits will be adhered to by Project vehicles on all roads.

7.2.8 Impact Analysis Methods

7.2.8.1 Noise

For the purposes of the noise assessment, a semi-quantitative noise assessment was conducted for the Project activities associated with the construction of the pipeline and stations. A full quantitative noise assessment was carried out for the operation of the stations but was not considered necessary for pipeline operation.

[2] The term "ground vibration" is used in this document to describe vibrations that travel through the ground produced by blasting operations at the Project Site. The term "air vibration" is used in this document to describe the vibrations that travel through the air produced by the blasting operations at the Project Site.

7.2.8.1.1 Construction

Detailed construction information, such as a list of planned equipment and schedule, was not available at the time of this assessment. Therefore, a semi-quantitative assessment based on assumptions was conducted. Predictions were undertaken to assess the potential noise levels resulting from the operation of typical construction equipment within a 12-hour daytime construction period. The noise prediction modelling was carried out with Computer Aided Noise Attenuation (CadnaA), with modelling algorithms based on *ISO 9613 Acoustics: Attenuation of Sound during Propagation Outdoors (International Organization for Standardization 1993 and 1996)* [ISO 1993 and 1996].

The following key assumptions were applied for construction of the pipeline[3]:

1) The sound pressure level considered to represent a single unit of typical construction equipment was 85 dBA at 15 m when operating at full power; this is representative of large off-road equipment such as dozers, excavators, graders, cranes, or generators.
2) An acoustical usage factor of 40% was considered. This is representative of equipment operating for 24 minutes per hour at full power with noise levels for the remaining time considered insignificant, or acoustically equivalent.
3) The predictions assumed that the construction equipment travels along a 1 km straight segment of pipeline over a 12-hour period at a constant rate.
4) It was assumed that three distinct construction activities (i.e. those discussed in Section 7.2.6), each comprised of five units of construction equipment, would be operating over the 1 km spread in a given day.

The following key assumptions were applied for construction of the stations[3];

1) The sound pressure level considered to represent a single unit of typical construction equipment was 85 dBA at 15 m when operating at full power.
2) An acoustical usage factor of 40% (i.e. Similar to pipeline construction, 24 minutes per hour) was considered.
3) It was assumed that five units of construction equipment would be operating at a single location within a station fenceline in a given 12-hour period.

7.2.8.1.2 Operation

For the quantitative assessment of station operation, three different station configurations, which represent a total of seven stations along the pipeline, were considered to contain significant noise sources. The primary noise sources associated with the operation of each of these station configurations are expected to be the following:

- LEF/Station PS1:
  - Two operating crude oil pipeline pumps.
- Station S4/PS2:
  - Two operating crude oil pipeline pumps;
  - Two operating 4.6 MW generators; and
  - Two operating remote coolers for the generators.

[3] Prior to construction, once detailed construction information is available, the appropriateness of the assumptions outlined above should be confirmed

- Stations S6, S8, S9, S10, S14:
  - One operating 3.2 MW generator; and
  - One operating remote cooler for the generator.

The quantitative analysis was completed through analytical numerical modelling to predict the potential noise levels in the Area of Influence as a result of Project noise emissions. The noise prediction modelling was carried out with CadnaA and with the modelling algorithm ISO 9613.

Noise sources were characterised by entering the sound power octave band spectrum associated with each source. Ground cover, atmospheric absorption, and source utilisation also defined the nature of noise emissions. The ISO 9613 prediction method is conservative as it assumes that all receptors are downwind from the noise source or that a moderate ground-based temperature inversion exists. Note that station-specific parameters such as the terrain surrounding each station were not considered.

Table 7.2-7 summarises the list of equipment, quantity, and sound power level that was provided by the PPMT and used to characterise sources in the noise model. The equipment was assumed to operate continuously for 24 hours per day. When required, source noise data were supplemented from published manufacturer sources and measured levels of similar equipment. The list of equipment is considered to be representative of the significant noise sources that are proposed for the Project. All other equipment associated with the stations will be designed and operated such that they are acoustically insignificant. The location and dimensions of each piece of equipment within the stations' fencelines were determined based on site layouts provided by the PPMT.

Noise controls will be incorporated into the inherent design of the Project. These controls include silencers on the generator combustion air intake and exhaust. According to the PPMT, it is expected that the exhaust silencer will provide a minimum attenuation of 30 dB and the combustion air intake silencer will provide a minimum attenuation of 40 dB. The performance of these silencers is included in the sound power levels provided in Table 7.2-7.

S4/PS2 is expected to have the highest noise levels when compared to the other stations, based on the list of equipment provided. The generators at S4/PS2 will therefore be housed in an acoustic shelter as an additional mitigation measure to further reduce overall noise levels. The conceptual design of the generator enclosure assessed included the combination of a steel structure, a steel door, and two acoustical louvers located on the walls. Each of these enclosure components are considered to be individual noise sources, with sound power levels presented in Table 7.2-7. Other acoustically equivalent designs and materials could be considered during detailed design. At Station 4 an acoustical enclosure is proposed for the generator which will comprise a steel structure, a concrete floor and steel doors. The noise mitigation of the enclosure is included in this assessment. The information was obtained from manufacturer's data and acoustics and noise control literature.

The generators are expected to operate at a maximum load of 75%. The sound power levels provided by the manufacturer reflected a 100% load; therefore, it was assumed that when operating at 75% load, the acoustical energy for each of the generator components is 75% of the acoustical energy emitted during 100% load. The sound power levels presented in Table 7.2-7 reflect the reduced sound power levels expected when the generators operate at 75% load.

Table 7.2-7: Station operation noise emissions

Station	Source Description	Quantity	Sound Power Level (dBA)
LEF/PS1	Crude Oil Pipeline Pumps	2	107
S4/PS2	Generator – Mechanical Casing	2	124 [a]
	Generator – Exhaust	2	113 [b]
	Generator – Combustion Air Intake	2	100 [b]
	Remote Cooler for Generator	2	106
	Crude Oil Pipeline Pumps	2	105
	Generator Enclosure Door	1	82
	Generator Enclosure Louver	2	101
	Generator Enclosure North Wall	1	97
	Generator Enclosure East Wall	1	99
	Generator Enclosure South Wall	1	97
	Generator Enclosure West Wall	1	102
	Generator Enclosure Roof	1	103
S6, S8, S9, S10, S14	Generator – Mechanical Casing	1 (per station)	122
	Generator – Exhaust	1 (per station)	111 [b]
	Generator – Combustion Air Intake	1 (per station)	105 [b]
	Remote Cooler for Generator	1 (per station)	106

Note: For this study, a 4.6 MW CAT 9CM32E generator was used at S4/PS2 and a 3.2 MW CAT 8CM32C generator was used at S6, S8, S9, S10 and S14.
[a] The CAT 9CM32E generator mechanical casing was modelled inside of the generator steel enclosure; this sound power level was used as an input into the calculations of the emissions of the noise sources associated with the generator enclosure.
[b] Sound power levels for exhausts and combustion air intakes include the expected attenuations due to inherent design silencers

7.2.8.2 Vibration

A quantitative modelling of vibration impacts was undertaken at the nearest receptors. The exact location of where the blasting will be developed at detailed design. Nevertheless, blast vibration impact assessment comprised the following tasks:

- Development of a blast vibration attenuation model based on the proposed blast parameters as well as vibration monitoring conducted during previous blasting operations;
- Prediction maximum explosive charge weights for a range of set-back distances in order to maintain compliance with the stated limits; and
- Identification of proposed mitigation measures, where appropriate.

7.2.8.2.1 Predictive Modelling of Blast Vibrations

The rate at which ground and air vibrations attenuate from a source is site specific. The rate at which these effects attenuate or dissipate from a particular site are dependent on geologic and environmental conditions, topography and the particulars of the blast design. The intensity of ground and air vibration effects from any construction blasting operation are primarily governed by the distance between the receptor and the blast and the maximum weight of explosive detonated per delay period within the blast.

Predictive modelling to determine the attenuation characteristics of ground and air vibration levels from blasting operations at individual receptor points would typically involve monitoring a number of site blasts at specific locations. Where no site-specific data is available, the model parameters can be estimated based on similar conditions. For this vibration impact assessment, the appropriate published models have been used.

The proposed Upper Bound model for ground vibrations presented by the International Society of Explosive Engineers (ISEE) is considered appropriate and is shown in the following equation and presented graphically in Figure 7.2-2:

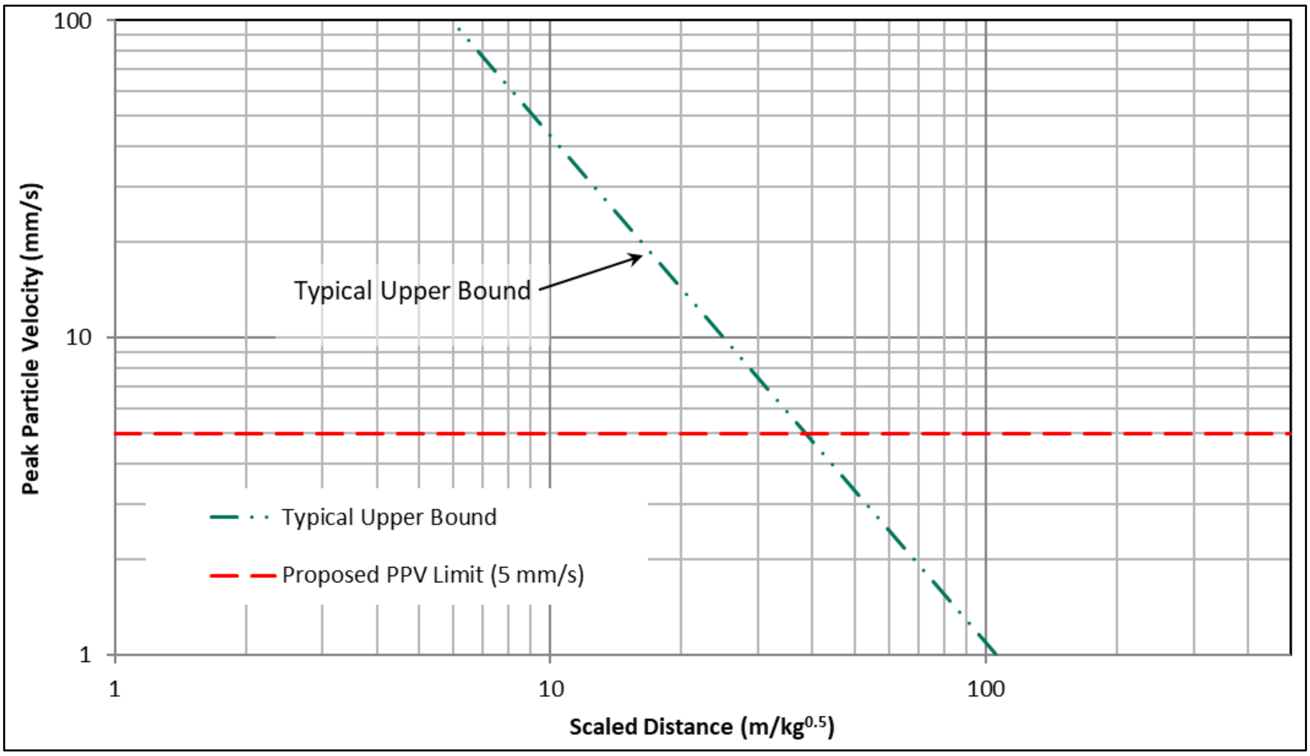

Figure 7.2-2: Ground vibration attenuation model

Air vibrations attenuate from a blast site at a slower rate than that of ground vibrations. The distribution of air vibration energy from a blast is also strongly influenced by the prevailing weather conditions during the blast. For example, wind can increase down-wind levels by 10 to 15 dBL above that which would otherwise be measured (Dowding, 1985). Low cloud ceilings and temperature inversions also contribute to air vibrations propagating further than would typically be the case. Other factors influencing air vibration distribution from a blast include the length of collar and type of stemming material, differences in explosive types and variations in burden distance. Air vibrations can also be represented dBL as presented on Figure 7.2-3.

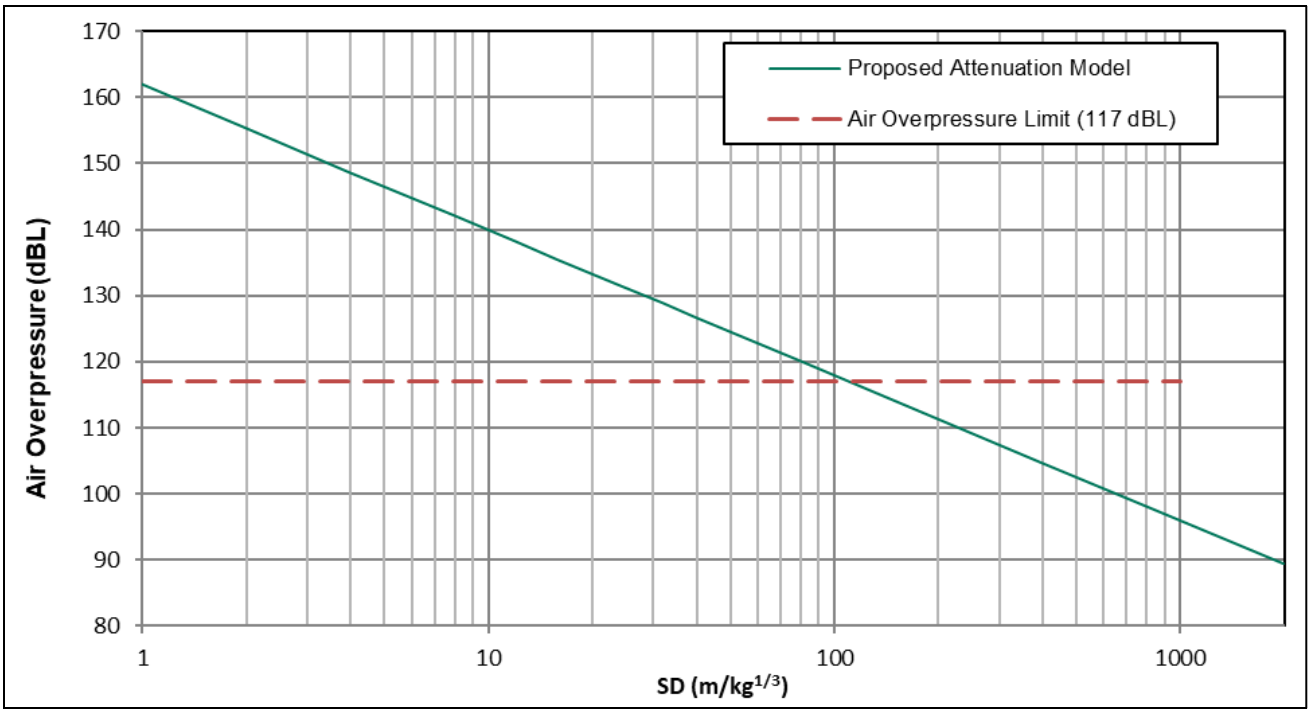

Figure 7.2-3: Air vibration attenuation model

7.2.9 Impact Classification

Taking into account the baseline setting (Section 6.3), the relevant incorporated environmental measures (Section 7.2.7), and the potential sources of impact (Section 7.2.9) determined from the project description, the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant incorporated mitigation applicable to each receptor are summarised. The magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Section 7.2.3.

7.2.9.1 Construction

7.2.9.1.1 Noise

Noise levels are expected to increase, on occasion, due to construction activities, but construction noise will be temporary, intermittent, and limited to the vicinity of construction activities, within the defined Area of Influence. The range in increased noise levels associated with construction activities will depend primarily on the number and type of noise sources and their proximity to receptors (i.e. the Project noise levels in the environment generally decrease as the distance between the receptor and construction activities increases). Potential effects on noise levels during construction will vary based on type of construction activities, but for a typical pipeline construction operation, noise effects are expected to be greatest during clearing and grading, trenching, and lowering pipe and backfilling. For station construction, the potential effects are expected to be greatest during ground clearing, grading, trenching, foundation construction and building construction. The primary noise sources associated with typical pipeline construction activities are large off-road equipment such as dozers, backhoes, excavators, graders, side boom tractors, cranes, and ancillary equipment such as generators, pumps, air compressors and welders.

The Kenya Noise Regulations set out a construction daytime average noise level limit of 60 dBA at health facilities, educational institutions, and residential type receptors. As discussed in Section 7.2.4, Project construction activities will meet this noise level limit at identified permanent receptors.

As discussed in Section 7.2.8.1.1, predictions of a pipeline construction scenario were carried out based on the assumption that three groups of five units of equipment, with each unit producing a sound pressure level of 85 dBA at 15 m, will travel along a straight 1 km segment of pipeline in a given 12-hour daytime period. Modelling of a station construction scenario was carried out based on the assumption that five units of equipment operate in one location within a station fence-line in a 12-hour daytime period. The calculations include a 40% acoustical usage factor, which estimates the amount of time a unit of equipment is operating at full power, when noise levels are expected to be highest and noise levels for the remaining time considered insignificant, or acoustically equivalent. Table 7.2-8 and

Table 7.2-9 summarize the predicted noise levels, and the resulting magnitude ratings at the identified community receptors discussed in Section 7.2.5 for pipeline and station construction, respectively.

Table 7.2-8: Predicted noise levels and resulting magnitude ratings for pipeline construction

Community	Approximate Minimum Distance between Community Receptor and Project Pipeline (m)	Daytime Indicative Baseline Noise Level (dBA)	Predicted Project Noise Level (dBA)	Cumulative Noise Level (Baseline + Project) (dBA)	Change from Baseline Noise Level (dBA)	Mitigation Measure to Meet Kenya Noise Regulations Limit (60 dBA)	Magnitude Rating
Barsaloi	1000	45.9	47.4	49.7	3.8	None	Low[(b)]
Lengusaka	700	49.2	51.1	53.3	4.1	None	Low[(b)]
Archer's Post	50	53.7	62.0	60.8	8.3	A NEMA licence will be applied for to allow the construction noise limit to be temporarily exceeded, subject to consultation and agreement with nearby residents. Receptor may be considered for compensation under a Livelihood Restoration Plan.	Moderate[(b)]
Garba Tula	> 5000	49.6	< 30	49.6	0.0	None	Negligible
Ohio Village	Community within LAPSSET corridor	53.5	n/a	n/a	n/a	n/a	n/a
Lamu Port	200	50.6	58.4	59.1	8.5	A NEMA licence will be applied for to allow the construction noise limit to be temporarily exceeded, subject to consultation and agreement with nearby residents. Receptor may be considered for compensation under a Livelihood Restoration Plan.	Moderate[(b)]
Nakukulas	1000	44.1 [a]	47.4	49.1	5.0	None	Low[(b)]
Lerata	Community within LAPSSET corridor	44.1[a]	n/a	n/a	n/a	n/a	n/a
Suyian	Community within LAPSSET corridor	44.1 [a]	n/a	n/a	n/a	n/a	n/a

Community	Approximate Minimum Distance between Community Receptor and Project Pipeline (m)	Daytime Indicative Baseline Noise Level (dBA)	Predicted Project Noise Level (dBA)	Cumulative Noise Level (Baseline + Project) (dBA)	Change from Baseline Noise Level (dBA)	Mitigation Measure to Meet Kenya Noise Regulations Limit (60 dBA)	Magnitude Rating
Yaq Barsadi	Community within LAPSSET corridor	44.1 [a]	n/a	n/a	n/a	n/a	n/a
Kaichuru	900	44.1 [a]	48.5	49.8	5.7	None	Moderate[(b)]
Shimbiri	1000	44.1 [a]	47.4	49.1	5.0	None	Low[(b)]
Modika	1100	44.1 [a]	46.3	48.3	4.2	None	Low[(b)]
Kiliana	700	44.1 [a]	51.1	51.9	7.8	None	Moderate[(b)]
Majengo	800	44.1 [a]	49.7	50.8	6.7	None	Moderate[(b)]
Swari[(c)]	400	50.6	58.4	59.1	8.5	A NEMA licence will be applied for to allow the construction noise limit to be temporarily exceeded, subject to consultation and agreement with nearby residents. Receptor may be considered for compensation under a Livelihood Restoration Plan.	Moderate[(b)]

(a) *Minimum monitored baseline average one hour daytime value discussed in Section 6.3, applied to communities where baseline noise levels were not measured*

(b) *Magnitude rating is driven by the change in predicted noise level compared to baseline. Predicted noise levels (post mitigation, if mitigation is required) are predicted to be below the project noise limits.*

(c) *Results have been inferred qualitatively based on the nearest receptor (Lamu Port), as the location was identified post modelling. This is assumed to be conservative as Swari is located at a greater distance from the pipeline than Lamu Port*

Table 7.2-9: Predicted Noise Levels and Resulting Magnitude Ratings for Station Construction

Community	Nearest Project Station	Approximate Minimum Distance between Community Receptor and Nearest Project Station (m)	Daytime Baseline Noise Level (dBA)	Predicted Project Noise Level (dBA)	Cumulative Noise Level (Baseline + Project) (dBA)	Change from Baseline Noise Level (dBA)	Mitigation Measure to Meet Kenya Noise Regulations Limit (60 dBA)	Magnitude Rating
Barsaloi	S4/PS2	> 5000	45.9	< 30	45.9	0.0	None	Negligible
Lengusaka	S6	> 5000	49.2	< 30	49.2	0.0	None	Negligible
Archer's Post	S7	200	53.7	57.7	59.2	5.5	A NEMA licence will be applied for to allow the construction noise limit to be temporarily exceeded, subject to consultation and agreement with nearby residents. Receptor may be considered for compensation under a Livelihood Restoration Plan.	Moderate[b]
Garba Tula	S9	> 5000	49.6	< 30	49.6	0.0	None	Negligible
Ohio Village	S10	1600	53.5	37.7	53.6	0.1	None	Negligible
Lamu Port	Lamu Marine Terminal	300	50.6	56.5	57.5	6.9	None	Moderate
Nakukulas	LEF/PS1	900	44.1 [a]	44.8	47.5	3.4	None	Low[b]
Lerata	S6	> 5000	44.1[a]	< 30	44.1	n/a	None	Negligible
Suyian	S4	> 5000	44.1 [a]	< 30	44.1	n/a	None	Negligible
Yaq Barsadi	S8	> 5000	44.1 [a]	< 30	44.1	n/a	None	Negligible

Community	Nearest Project Station	Approximate Minimum Distance between Community Receptor and Nearest Project Station (m)	Daytime Baseline Noise Level (dBA)	Predicted Project Noise Level (dBA)	Cumulative Noise Level (Baseline + Project) (dBA)	Change from Baseline Noise Level (dBA)	Mitigation Measure to Meet Kenya Noise Regulations Limit (60 dBA)	Magnitude Rating
Kaichuru	S8	> 5000	44.1 [a]	< 30	44.1	0.0	None	Negligible
Shimbiri	S11	> 5000	44.1 [a]	< 30	44.1	0.0	None	Negligible
Modika	S11	> 5000	44.1 [a]	< 30	44.1	0.0	None	Negligible
Kiliana	Lamu Marine Terminal	1700	44.1 [a]	36.9	44.9	0.8	None	Negligible
Majengo	S16	1500	44.1 [a]	38.6	45.2	1.1	None	Negligible
Swari [(c)]	S5	> 5000	44.1 [a]	< 30	44.1	0.0	None	Negligible

(a) Minimum monitored baseline average one-hour daytime value discussed in Section 6.3, applied to communities where baseline noise levels were not measured
(b) Magnitude rating is driven by the change in predicted noise level compared to baseline. Predicted noise levels (post mitigation, if mitigation is required) are predicted to be below the project noise limits.
(c) Results have been inferred qualitatively based on an equivalent receptor, as the location was identified post modelling.

Noise levels associated with Project pipeline and station construction activities have the potential to result in high magnitude ratings if no mitigation is considered beyond the inherent mitigation presented in Section 7.2.7. Project pipeline and station construction noise levels are expected to result in negligible to moderate magnitude ratings for high importance receptors, based on the methodology described in Section 7.2.8.1.1.

Table 7.2-8 and Table 7.2 9 indicate that during pipeline and station construction in Archer's Post and pipeline construction at the Lamu Port, mitigation is required to meet the Kenya Noise Regulations limit of 60 dBA. Noise barriers were considered but not deemed practical. PipeCo will need to discuss with NEMA temporary exceedances of the regulatory standards and also discuss with the local community timing and phasing of construction activities

Permanent receptors where the Kenya Noise Regulations limits are exceeded will need to be considered in a Livelihood Restoration Plan. The duration of the effect at any one location along the Project is expected to be short-term, temporary and intermittent. Where the magnitude rating is high, the assessed impact of the predicted effect is moderate. For a moderate magnitude rating, the assessed impact of this predicted residual effect is low. The construction phase impact assessment with respect to noise is presented in Table 7.2-10.

Once detailed construction information is available, if construction conditions differ from those considered in the modelling, including factors such as the use of louder or quieter equipment or a different quantity of equipment operating at a given time appropriate mitigation will need to be revaluated.

Table 7.2-10: Construction phase impact classification and impact significance related to noise

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Permanent Human Receptor (high)	Noise associated with pipeline construction	High – Short-Term – Temporary (Archers Post and Lamu only)	Moderate (adverse)	Construction at Archer's Post or when a permanent receptor is 50 m from the construction corridor, construction noise limit to be temporarily exceeded. Construction at Lamu Port or when a permanent receptor is 200 m from the construction corridor, construction noise limit to be temporarily exceeded. At locations where construction noise will temporarily exceed statutory limits, NEMA will be notified. The EPC Contractor will liaise with local residents and will implement appropriate measures (such as work times and phasing of work etc) to limit the impact of noise. Monitoring will be carried out prior to and during construction to confirm baseline levels and maintain impacts as acceptable during construction. Receptor may be considered for compensation under a Livelihood Restoration Plan.	Moderate – Short-Term – Temporary	Minor[(a)] (adverse)
	Noise associated with station construction	High – Short-Term – Temporary (Archer's post only)	Moderate (adverse)	Construction at Archer's Post or when a permanent receptor is 200 m from station construction, construction noise limit to be temporarily exceeded a NEMA licence will be applied for to allow the construction noise limit to be temporarily exceeded. At locations where construction noise will temporarily exceed statutory limits, NEMA will be notified. The EPC Contractor will liaise with local residents and will implement appropriate measures (such as work times and phasing of work etc) to limit the impact of noise.	Moderate – Short-Term – Temporary	Minor[(a)] (adverse)

				Monitoring will be carried out prior to and during construction to confirm baseline levels and maintain impacts as acceptable during construction. Receptor may be considered for compensation under a Livelihood Restoration Plan.		

(a) *Magnitude rating is driven by the change in predicted noise level compared to baseline. Predicted noise levels (post mitigation, if mitigation is required) are predicted to be below the project noise limits.*

7.2.9.1.2 Vibration

Site-specific SD plots are commonly used as a blast design tool since maximum peak ground vibration levels can reasonably be predicted at specific distances from a blast. Based on the regression models developed in Section 7.2.8.2.1, Table 7.2-11 shows the maximum suggested explosive loads for various distances from the construction blasting operation based on the proposed guideline limits of 5 mm/s and 117 dBL respectively. This is shown graphically in Figure 7.2-4.

Table 7.2-11: Maximum explosive loads to comply with NPC-119 ground and air vibration limits

Distance 1) (m)	Max. Explosive Charge Weight (kg) 2)	
	PPV = 5 mm/s SD = 38.7 m/kg$^{1/2}$	PSPL = 117 dBL SD = 110.0 m/kg$^{1/3}$
200	27	6
300	60	20
400	107	48
500	167	94
600	240	162
700	327	258
800	427	385
900	541	548
1000	668	751

1) Distance between the blast and the sensitive receptor.
2) Assuming the attenuation models proposed above.

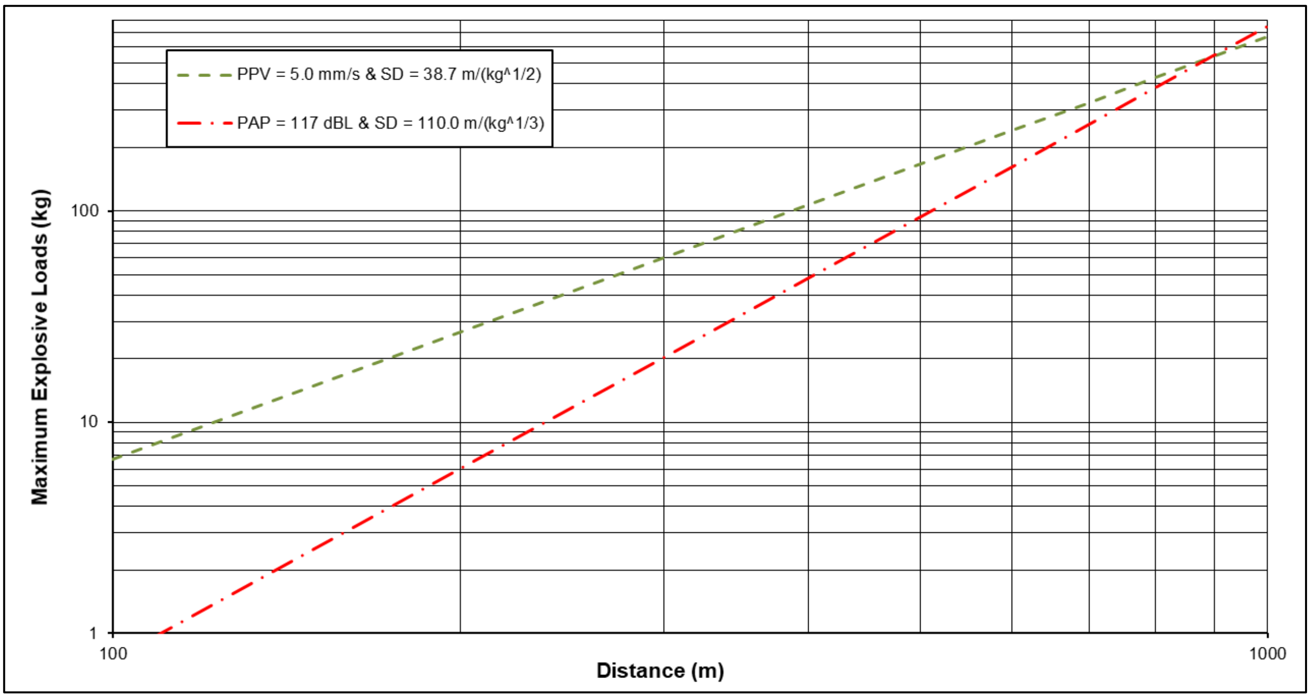

Figure 7.2-4: Maximum explosive charge weights to comply with ground and air vibration limits

The results demonstrate that the air vibration limit of 117 dBL is the more restrictive guideline when determining the maximum explosive loads for the construction blasting operations.

Vibration levels within the Area of Influence are expected to increase, on occasion, due to construction activities, but construction vibration will be temporary, intermittent, and limited to the vicinity of the required blasting for the Project, within the defined Area of Influence. The range in increased vibration levels associated with construction activities will depend primarily on the number and size of the blasting sources and their proximity to receptors (i.e. the Project vibration levels in the environment generally decreases as the distance between the receptor and blasting activities increases). For a typical pipeline construction operation, blast operations are primarily limited to grading and trenching. Potential effects on vibration levels during blasting will vary based on blast design parameters. For the stations, the potential effects are expected to be similar to those during the pipeline construction. They will be primarily limited to the grading and trenching, and the effects will vary based on the blast design parameters.

As the Project is expected to be generally linear and construction activities are planned sequentially, the duration of construction blasting activity at any one location along the Project will be limited and intermittent, thereby reducing the amount of time a given receptor would be exposed to Project-related construction blast vibrations. The variability of blast vibrations due to the depth and volume of rock to be blasted, location of blasts and the distance of receptors from the construction blasting activity, will result in a range of Project vibration levels at receptors, generally decreasing with distance from the Project blasts.

The vibration mitigation necessary to minimise the potential vibration effects during Project construction will be designed inherently into the Project. This mitigation includes reducing the explosive charge weight detonated at a given instant within the blast. Such mitigation strategies will be outlined specifically within the blast plan.

The potential impact will depend on of blast-induced vibrations which will depend on the depth of rock to be blasted, the maximum explosive charge weight detonated per millisecond time interval within the blast (delay period) and the separation distance between the blast and the receptor. As the specific locations of the required rock blasting have yet to be determined, we have assumed that the blast will comply with the vibration limits discussed in Section 7.2.4.2 and the vibration attenuation models described in Section 7.2.8.2.1.1.

Blast vibrations are local, short-term and infrequent. The receptor importance is considered high (permanent human receptors within communities). If the vibrations remain compliant with the vibration limits, the significance is considered minor. If the setback distance and/or the blast design results in vibrations levels below 1.0 mm/s and 90 dBL, the magnitude is negligible, and the significance is considered negligible.

The following potential impacts during construction have been evaluated but are categorised as negligible and therefore need no further analysis:

- Vibration associated with pipeline construction; and
- Vibration associated with station construction.

7.2.9.2 Operation

7.2.9.2.1 Noise

Noise emissions associated with pipeline operation are expected to be minimal, as noise emitted from the buried pipeline is expected to be imperceptible in the environment over ambient conditions and is therefore not evaluated any further.

Noise effects associated with pig launching and receiving, pipeline maintenance and inspection activities during operation will be variable, short in duration, and will only occur periodically over the life of the Project and therefore are not evaluated any further.

A 6 m access route is proposed within the pipeline corridor. The use of the access track is expected to be intermittent, sporadic and subject to a speed limit less than 40 kph and is therefore not evaluated any further.

Noise levels from stations during operations have been calculated as a function of distance from the station, in the event that additional permanent receptors are subsequently identified. Noise prediction results (with incorporated and additional mitigation applied) for the three station configurations, are presented as a function of distance from the station fence-lines in Figure 7.2-5. The IFC Noise Guideline daytime and night-time limits are also presented. Noise levels at all identified community receptors are below the IFC Noise Guideline limits.

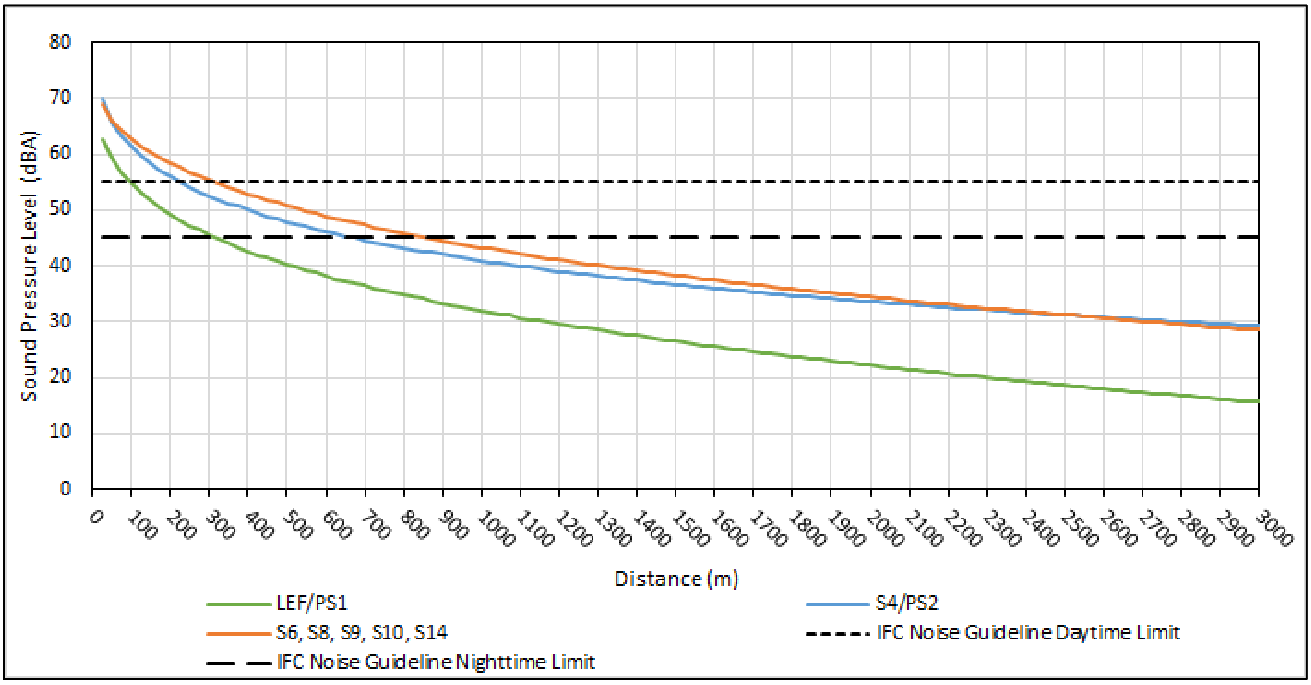

Figure 7.2-5: Predicted noise results from station operations

The Station at LEF/PS1 will be located in the Upstream Central Processing Facility (CPF). It will ultimately be considered as part of the cumulative impacts in the Upstream Foundation Stage Development ESIA. Nevertheless, for completeness, the noise assessment of the LEF/PS1 has been considered here in isolation for information purposes only. Figure 7.2-5 indicates that during the operation of LEF/PS1, the distance to the IFC Noise Guideline daytime limit of 55 dBA is approximately 100 m and to the IFC Noise Guideline night-time limit of 45 dBA is approximately 325 m, when not considered alongside the Upstream infrastructure. There are no known receptors within this area of exceedance of the project standards, therefore all receptors in the vicinity of LEF/PS1 are below the project noise standard limits.

During operation of S4/PS2 the distance to the IFC Noise Guideline daytime limit is approximately 225 m and to the IFC Noise Guideline night-time limit is approximately 675 m. During operation of S6, S8, S9, S10, and S14, the distance to the IFC Noise Guideline daytime limit is approximately 300 m and to the IFC Noise Guideline night-time limit is approximately 850 m. There are no known permanent human receptors within these distances of the stations.

Noise emissions associated with station operation have the potential to increase ambient noise levels at receptors in the vicinity of the stations. Magnitudes have been defined as a function of distance from the station fence-lines for LEF/PS1 (functioning in isolation from Upstream infrastructure) and S10. These stations have the most significant noise generating equipment (Section 7.2.8.1.2) and are located within 5 km of communities identified in Section 7.2.5. Predicted Project operation noise levels, measured baseline noise levels and impact magnitudes are presented for LEF/PS1 and S10 in Figures 7.2-6 and 7.2-7, respectively.

Communities (Section 7.2.5) not discussed here are located more than 5 km from any stations with significant noise generating equipment. As operations are expected to be continuous for 24 hours per day, the figures below focus on the night-time period when the baseline noise levels are lower and the IFC Noise Guideline limit is more stringent.

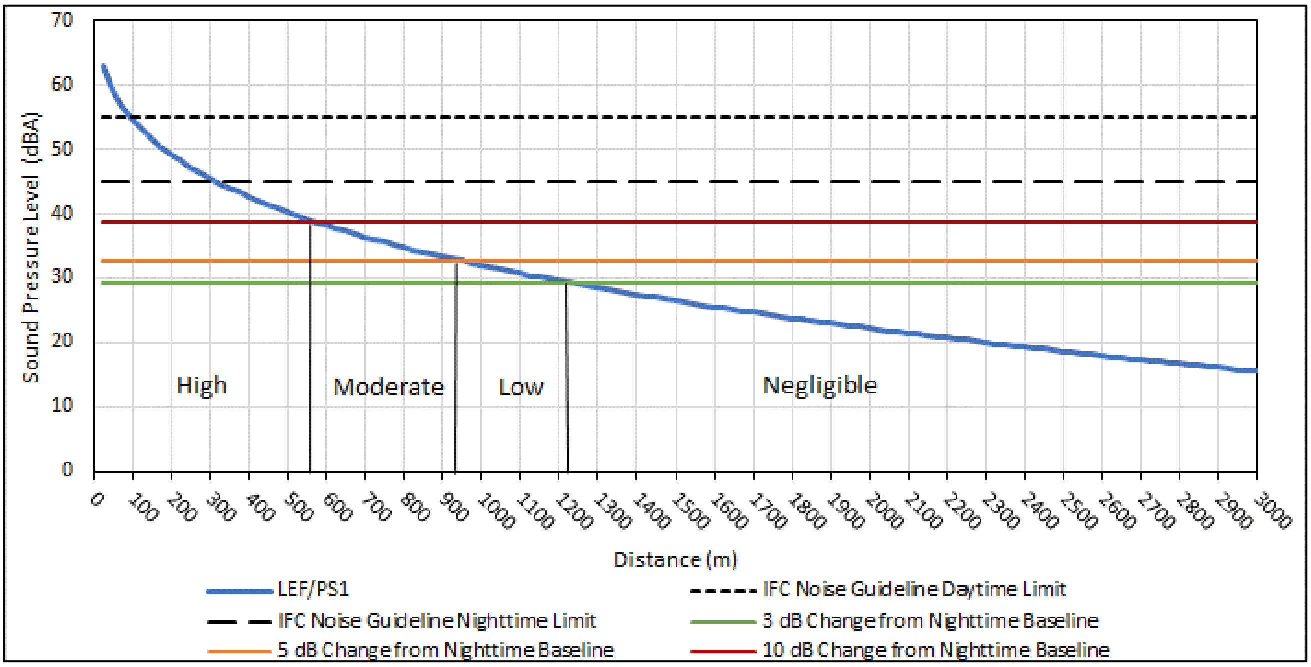

Figure 7.2-6: Project operations phase predicted noise levels and associated magnitude Ratings from LEF/PS1

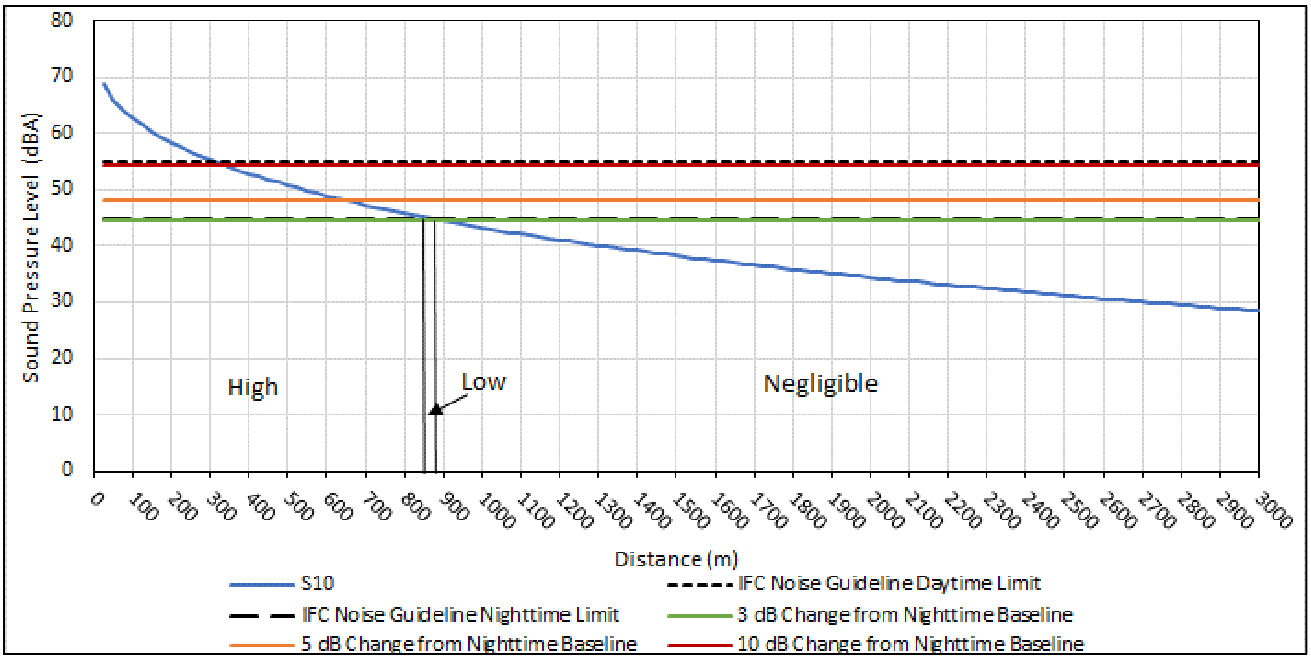

Figure 7.2-7: Project operations phase predicted noise levels and associated magnitude ratings from S10

Figure 7.2-6 indicates the following, based on average night-time baseline noise levels of 29 dBA at the community near LEF/PS1 (functioning in isolation for upstream infrastructure):

- At distances greater than approximately 1225 m from the LEF/PS1 fence-line the predicted change from night-time baseline noise levels is less than or equal to a 3 dB;
- At distances from approximately 925 m to 1225 m the predicted change from night-time baseline noise levels is less than or equal to a 5 dB;
- At distances from approximately 575 m to 925 m the predicted change from night-time baseline noise levels is less than or equal to a 10 dB; and
- At distances less than approximately 575 m to the fence-line of LEF/PS1.

However, the predicted noise levels are respectively below the Project daytime and night-time standard. There are no predicted exceedances of the Project noise limits at any of the identified receptors in the vicinity of the station. Moreover, LEF/PS1 will be located within the Upstream CPF, which is located within the Central Facilities Area (CFA), which will contain numerous sources of noise. Mitigation of noise from LEF/PS1 will be addressed within the Upstream ESIA and therefore the noise impacts due to LEF/PS1 have not been carried forward to the impact classification.

Figure 7.2-7 indicates the following, based on average night-time baseline noise levels of 44.7 dBA at the community near S10:

- At distances greater than approximately 875 m from the S10 fence-line the predicted change from night-time baseline noise levels is less than or equal to a 3 dB;
- At distances from approximately 850 m to 875 m the predicted change from night-time baseline noise levels is less than or equal to a 5 dB; and
- At distances less than approximately 850 m, the predicted noise level is greater than the IFC Noise Guideline night-time limit of 45 dBA.

Note that the distance between S10 and the nearest identified community receptor within Ohio Village is 1600 m and therefore the magnitude rating is expected to be **negligible** at this community.

The following potential impacts during operation have been evaluated but are categorised as negligible and therefore require no further analysis:

- Noise associated with station operation (S6, S8, S9, S10, and S14); and
- Noise associated with station operation (S4/PS2).

7.2.9.2.2 Vibration

Blasting will cease at the end of the construction phase. No impacts are expected during the operation phase.

7.2.9.3 Decommissioning

Assuming that some of the types of vehicles and equipment used during construction are also used for decommissioning and abandonment, changes to ambient sound levels from the Project during decommissioning and abandonment are expected to be similar to those during construction.

7.2.10 Summary of Mitigation

7.2.10.1 Noise

For Project construction, the following additional mitigation was identified:

- For pipeline construction:
  - At Archer's Post or when a permanent receptor is 50 m from the construction corridor:
    - At locations where construction noise will temporarily exceed statutory limits, NEMA will be notified. The EPC Contractor will liaise with local residents and will implement appropriate measures (such as work times and phasing of work etc) to limit the impact of noise. Monitoring will be carried out prior to and during construction to confirm baseline levels and maintain impacts as acceptable during construction. Receptor may be considered for compensation under a Livelihood Restoration Framework; and
    - An acoustical usage factor of 25% (i.e. reduce the time at which the equipment is emitting the considered sound pressure level by 9 minutes in a given hour).
  - At Lamu Port or when a permanent receptor is 200 m from the construction corridor, at locations where construction noise will temporarily exceed statutory limits, NEMA will be notified. The EPC Contractor will liaise with local residents and will implement appropriate measures (such as work times and phasing of work etc) to limit the impact of noise. Monitoring will be carried out prior to and during construction to confirm baseline levels and maintain impacts as acceptable during construction. Receptor may be considered for compensation under a Livelihood Restoration Framework.
- For station construction:
  - At locations where construction noise will temporarily exceed statutory limits, NEMA will be notified. The EPC Contractor will liaise with local residents and will implement appropriate measures (such as work times and phasing of work etc) to limit the impact of noise. Monitoring will be carried out prior to and during construction to confirm baseline levels and maintain impacts as acceptable during construction. Receptor may be considered for compensation under a Livelihood Restoration Framework.

These mitigation measures presented above may need to be confirmed once detailed construction information is available, if construction conditions differ from those considered in the modelling, including factors such as the use of louder or quieter equipment or a different quantity of equipment operating at a given time. If this mitigation is not feasible, receptors at which the Kenya Noise Regulations are exceeded may need to be considered under a Livelihood Restoration Framework.

The following additional mitigation / management measures will be included in the Environmental Management Plans:

- Where reasonable and practical, vehicles and equipment will be turned off when not in use, leaving vehicles idling for extended periods will be avoided unless weather and/or safety conditions dictate the need for them to remain turned on.
- Applicable national and Project speed limits will be adhered to by Project vehicles on all roads.
- All equipment will be operated and maintained in line with manufacturer's recommendations, using appropriate fuel and will be monitored with periodic inspection and audits.

For Project operation, the following additional mitigation was identified:

- The shelters designed to house the generators located at S4/PS2 will have provision for acoustic barriers to meet applicable standards.

7.2.10.2 Vibration

No mitigation is required for the Project to have a minor impact significance on vibration. However, the following is recommended during construction. The intensity of blast vibrations is primarily influenced by the maximum explosive weight detonated per delay period within a blast and the distance between the blast and the receptor. Thus, two primary means of reducing the impact by the blast-induced ground vibrations during the construction phase are by:

1) Increasing the distance to these receptors; and

2) Reducing the weight of explosive charge detonated per delay period.

It is not anticipated that a reduction in the maximum explosive weight detonated per delay period within the blast would be required to comply with the regulatory limit for the vibration during the construction phase. Obviously, this will be dependent on the depth of rock required to be excavated and the monitoring results. For construction blasting, reducing the explosive charge weight is often the most common means of lowering the vibration level at the nearby sensitive receptors. The common approaches to reducing the explosive charge weights are as follows:

1) Reducing the borehole diameter with a corresponding reduction in the blast drill pattern.

2) Introducing decked charges within each borehole within a blast. A process called “decking” entails dividing the borehole into multiple smaller charges, decks, which are separated by stemming or an air cushion. This allows the two separated charges to be initiated on different time delays.

Blast-induced ground and air vibrations shall be monitored where the separation distance between the blast and the nearest sensitive receptor is less than 400 m to ensure compliance with the limits shown in Table 7.2-5 in Section 7.2.4.2. The mitigation recommendations for compliance with those limits shall be addressed where necessary.

7.2.11 Summary of Residual Impacts

7.2.11.1 Noise

The Project has the potential to impact noise levels in the following ways:

- During station and pipeline construction; and
- During station operations.

With inherent mitigation that has been incorporated into the design and the mitigation discussed in Section 7.2.10, there will be residual impacts relating to construction of the pipeline and stations. This will potentially occur in a limited duration when specific construction activities are in close proximity to permanent receptors. A Construction Environmental Management Plan will be implemented once more information regarding construction activities is available to reduce construction noise impacts at these receptors.

The impact significance that results from the combination of receptor importance and predicted impact magnitude is classified as minor to negligible.

7.2.11.2 Vibration

If the monitored blasting vibrations are maintained below the regulatory limits, no residual impacts are anticipated.

7.3 Water Resources (Surface Water and Groundwater)

7.3.1 Introduction

This section provides an assessment of the potential effects of the Project on surface and groundwater resources. Potential effects have been determined using a qualitative assessment methodology. Where potential effects have been identified, these are considered in turn and mitigations are set out where these are considered necessary to ensure that any potential effects are considered acceptable.

7.3.2 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.3-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.3-1: Criteria for Determining Importance of Receptors

Receptor Importance	Example Receptor Types
Very high	■ International importance; ■ Human health; and/or ■ Receptor with a high quality and rarity, regional or national scale and limited potential for substitution/replacement.
High	■ National importance; ■ Receptor with a high quality, local scale and limited potential for substitution/replacement; and/or ■ Receptor with a medium quality and rarity, regional or national scale and limited potential for substitution/replacement.
Medium	■ Regional importance; ■ Receptor with a medium quality and rarity, local scale and limited potential for substitution/replacement; and/or ■ Receptor with a low quality and rarity, regional or national scale and limited potential for substitution/replacement.
Low	■ Local, limited or no known importance; ■ Receptor with a low quality and rarity, local scale; and/or ■ Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character.

7.3.3 Magnitude of Impact and Impact Significance

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. In the case of the water environment, the potential for the water environment to cause a change to the project facilities is also considered. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.3-2. Using the impact magnitude and the receptor importance classification, the matrix presented in ESIA Section 3.4 has been used to determine impact significance.

7.3.3.1 Impact Duration

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 38 months (the maximum anticipated construction period);
- A medium-term impact is defined as between 3 and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

7.3.3.2 Impact Reversibility

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

7.3.3.3 Direct and Indirect Impacts

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s). Indirect impacts are likely to occur away from the Project, which in the case of this assessment applies to downstream surface watercourses or water bodies and floodplains.

7.3.3.4 Impact Magnitude and Significance

The assignment of impact magnitude is supported by the findings of the Wood Group fluvial dynamic and hazard study (Wood Group, 2018), work undertaken to understand flood, erosion and scouring risks (Wood Group, 2019), and calculations undertaken by Tullow relating to the lateral extent of heating impacts.

Table 7.3-2: Criteria for assessing magnitude of impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Loss of resource/receptor, loss of quality and integrity of the resource/receptor, severe damage to key characteristics, features or elements (e.g. to water flows, water levels, or the availability of a water resource or flood risk). With respect to water quality, concentrations exceed baseline concentrations and water quality standards for parameters that could affect human health.	Large scale or major improvement to resource/ receptor quality, extensive restoration or enhancement.
Medium	Partial loss of resource/receptor, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements (e.g. to water flows, water levels, or the availability of a water resource or flood risk). With respect to water quality, concentrations are likely to exceed baseline concentrations and water quality standards for parameters that are unlikely to affect human health.	Some benefit to key characteristics, features or parameters describing resource/ receptor quality.

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
Low	Some measurable change in/damage to attributes, quality or vulnerability (e.g. to water flows, water levels, or the availability of a water resource or flood risk). Minor loss of, or alteration to, key characteristics, features or elements. With respect to water quality, concentrations are unlikely to exceed baseline concentrations and water quality standards.	Minor benefit to, or addition of, one or more key characteristics, features or parameters describing resource/ receptor quality.
Negligible	No, or very minor (immeasurable), change to characteristics, features or parameters describing resource/receptor quality (e.g. water flows, water levels, water quality, or the availability of a water resource or flood risk).	

7.3.4 Key Guidance and Standards

The guidance and standards that are relevant to the protection of the water environment to which the Project will be required to conform, in addition to the Project Standards presented in Annex I (ref. 1772867.568) are as follows:

- Kenyan policy and legislation, including:
  - The National Water Master Plan (2030);
  - Kenyan Government, 2006. Environmental Management and Coordination Act (Water Quality) Regulation Schedule 1: Quality Standards for Sources of Domestic Water;
  - Kenyan Government, 2006. The EMCA (Water Quality) Regulations (2006) Schedule 3: Standards for Effluent Discharge into the Environment;
  - Kenyan Government Environmental Management and Coordination Act (EMCA) (1999) and Amendments (2018); and
  - The Kenya Water Act (2016);
- Kenya Standard KS 459-1: 2007 (ISC 13.060.20). Drinking Water – Specification. Part 1: The requirements for drinking water. Third Edition;
- International Finance Corporation Performance Standards, 2012; and
- World Bank Group Environmental, Health, and Safety General Guidelines, 2007.

7.3.5 Receptors of Interest and Importance

The focus of this assessment is on the quality and availability of water within the Area of Influence (AoI) (i.e. the pipeline RoW and the footprint of the Lamu Port infrastructure). Baseline environmental information indicates the importance and scarcity of water in the AoI. This emphasis is reflected in the relevant legislation[1].

[1] The objective of the Environmental Management and Co-Ordination (Water Quality) Regulations is to prevent pollution of water, prohibit the discharge of effluent to the environment that has a quality that contravenes the standards, and prevent abstraction without an environmental impact assessment license. The Kenya Water Act also enforces the requirement to have permission to construct boreholes and wells, that abstraction amounts need to be reasonable, to reduce the potential for water losses, and to prevent contamination/pollution of water.

7.3.5.1 Primary Receptors

Using the LLCOP project description and the baseline water environment information presented in full in the baseline report (in Annex II), and summarised in Section 6.4 of this ESIA, the following general types of primary receptors have been identified as being susceptible to changes in quantity (levels and flows) and quality:

- Surface water the marine and coastal water environment, permanent rivers, seasonal rivers and the extensive network of ephemeral streams and drainage luggas[2] (see Figure 7.3-1); and
- Groundwater in aquifers across which the pipeline crosses divided into shallow aquifers predominantly located along river valleys and the edge of the volcanic deposits, important regional aquifers (such as the Merti Aquifer) and deeper aquifers.

Specific primary receptors that fall within these general categories and will be considered in this assessment have been identified from the baseline work and are presented in Table 7.3-3.

7.3.5.2 Secondary Receptors

Secondary receptors that could be impacted because of changes in surface water or groundwater quality and quantity/availability of the primary receptors, include:

- Lake Turkana – the lake is assessed as a secondary receptor to any changes that could impact the Kerio River or luggas that form part of the drainage network that flows into Lake Turkana.
- Existing water users – livestock and humans that use local community water supplies (including surface water (including dams, springs, water pans, shallow hand dug wells in luggas, hand pumped wells, and boreholes). Note that an additional more detailed discussion and assessment of water users is presented in the livelihoods impact assessment (Section 7.11).
- Existing water users – non-human biota (i.e. ecological/aquatic habitats), which are considered separately in Sections 7.5 and 7.6.

In addition to the receptors that could be impacted by changes in water quality and quantity/availability, this assessment also considers that humans and infrastructure that could be at risk of erosion and/or from changes to flood regimes.

Table 7.3-3 presents the specific primary and secondary receptors considered in this assessment that have been identified from the baseline, and the assigned importance for the primary and secondary receptors following the criteria presented in Section 7.3.1.

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[2] For the purposes of this work, and as defined in the water resources baseline (see Section 6.4), permanent/perennial rivers are those where water is present above ground level all year round. Seasonal/ephemeral watercourses include seasonal rivers, seasonal streams and luggas. Seasonal rivers are the larger watercourses that have temporary flow above the ground surface only during the wet seasons. Seasonal streams also only have flow during the wet seasons, however are more minor watercourses. Lugga is the term for the transitory network of drainage channels that direct surface water run-off during intense rainfall events towards the more defined channels. These are typically shallow, migratory and form a wide dendritic network. Seasonal rivers, seasonal stream and luggas may have water below the ground surface in the river beds in the dry season that can be exploited as water resources through dug wells in or adjacent to the riverbeds.

Table 7.3-3: Water receptors and importance

Receptor	Importance	Commentary on Importance as Determined from Baseline Information
Primary Receptors		
Main, largely permanent/perennial, rivers (Kerio, Suguta and Ewaso Ng'iro)	High	Used as a water supply throughout the region with limited potential for substitution due to limited water resources in Kenya. The Ewaso Ng'iro River may provide recharge to the Merti Aquifer (special aquifer). The Kerio River flows into Lake Turkana that is of importance for water use for those farming along the lake shore.
Seasonal rivers and ephemeral streams/drainage luggas (as identified in the baseline)	Medium	Used for water supplies throughout the region (e.g. through water pans, dams and dug wells). Limited potential for substitution due to limited water resources in Kenya.
Coastal water features (e.g. tidal creeks and the marine environment)	Low	Little or no water resource importance. Water is saline. For ecological importance see Section 7.6.
Shallow groundwater aquifers (alluvial/colluvial aquifers and volcanics)	High	Used as a water supply throughout the region with limited potential for substitution due to limited water resources in Kenya. Proximity to the surface and the potential for recharge through sandy soils and superficial deposits means there are likely to be pathways between activities at the surface and these receptors.
Merti and Lodwar aquifer systems	High	Nationally classified as special aquifers. Limited potential for substitution due to limited water resources in Kenya. Some recharge from the surface, so there is potential for pathways between activities at the surface and these receptors.
Deep groundwater	Low	Potential for importance as a water supply, but likely to have low quality due to high salinity and yields can be poor. Limited recharge potential from the surface within the Project area.
Secondary Receptors		
Humans	Very High	Humans. Water users dependent on quality and availability of water in periodically water-stressed environments. For further consideration of the impact on livelihoods see Section 7.13. Humans may also be impacted if flood regimes are altered by the Project.
Lake Turkana	High	Important regional waterbody with limited potential for substitution due to limited water resources in Kenya.
Infrastructure	Low	Project structures (e.g. pipeline, stations, camps) under construction or completed. Local replaceable receptors.

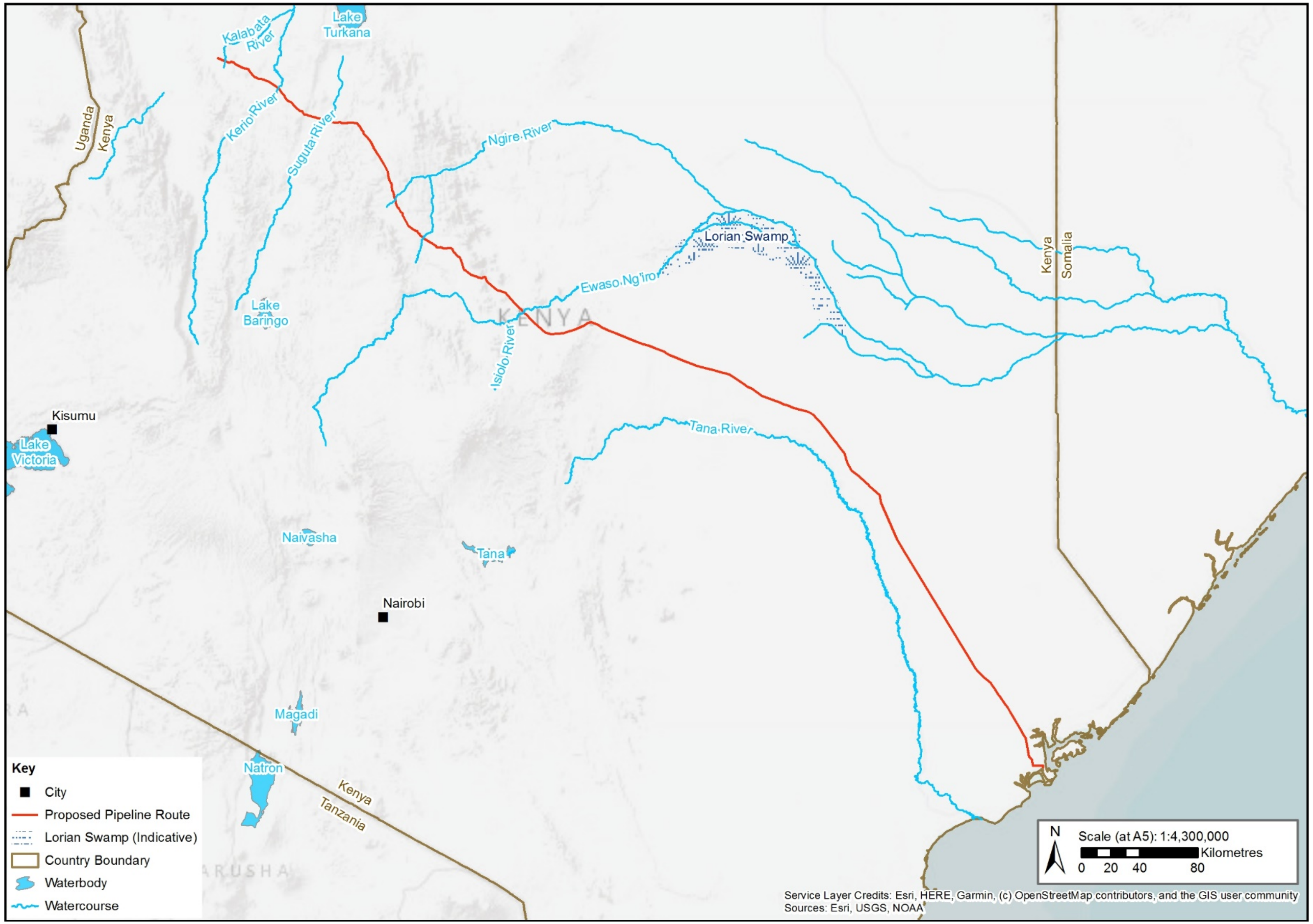

Figure 7.3-1: Primary receptors – key surface water features

7.3.6 Potential Sources of Impact

Potential sources of impact will occur throughout the life of the Project (construction, operations, decommissioning). These are set out below by Project phase.

7.3.6.1 Construction Phase

Based on the project description and the understanding of the baseline water conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to either water quality or availability during the construction phase. The potential sources of impact and routes by which they could impact water quality and/or quality during the construction phase are as follows:

- Construction activities near or within watercourses – including vehicle movements and activities such as vegetation clearing; topsoil stripping; excavating and storage of excavated materials, which may result in ground disturbance leading to increased suspended solids being washed into the surface water environment, thereby changing water quality. Changes to drainage patterns, which could alter run-off regimes a reduction in recharge to aquifers. Pipeline construction activities in watercourses themselves also have the potential to alter existing river flows, erosion patterns and flood risk through temporary diversion or damming.
- Construction activities in coastal areas – such activities can lead to silt disturbance that could increase the concentration of suspended solids and mobilise existing contamination[3], thereby changing water quality. These issues are already likely to be manifest while the new Lamu Port is under construction.
- Construction of subsurface features (e.g. trench, pipeline, foundations) – excavation of trenches or pits can result in passive dewatering of saturated ground around them while they are open. Excavations can lead to changes in the subsurface hydraulic properties, which could change local groundwater levels and flow patterns.
- Storage, transport and use of chemicals and fuel – leaks or spills of substances needed in construction activities (e.g. fuel in generators, additives, lubricants and cleaning agents) or of fuel/lubricants associated with machinery at any stage of their storage, transport, maintenance, refuelling or use could lead to changes in water quality.
- Pipeline flushing and hydraulic testing – Sourcing the water for this process has the potential to impact water availability for existing users. Additional water abstraction licenses would be required if more water needs to be abstracted than is currently permitted. The discharge of used cleaning and hydrotesting water has the potential to introduce to the receiving surface water or groundwater environment chemicals such as biocides and corrosion inhibitors, or other potential contaminants such as rocks/fines, metal/plastic fragments welding residue or manufacturing lubricants. Discharge of the water also has the potential to change baseline flows, erosion rates and downstream flood risk.
- Water abstraction (for other construction needs) – Other than the water required for hydrotesting, water needs during construction could be required for dust suppression, concrete production, construction camp water supplies, and water for cleaning equipment and vehicles. Sourcing the water for this process has the potential to impact water availability for existing users. Additional water abstraction licenses would be required if more water needs to be abstracted than is currently permitted.
- Construction waste – this could include soils, general waste from camps, waste oils and filters from mobile plant and equipment and generators, oily rags, waste solvents and used chemical drums. Leaching from

[3] The presence of existing contamination is unknown. Existing contamination will be unlikely in previously undeveloped areas but possible if development takes place in area of historical port activities.

stored construction waste, or inappropriate disposal of the waste, could lead to a change in water quality in receiving waterbody through direct disposal into the water environment. Impacts on groundwater quality are also possible through the infiltration of precipitation through waste, through the ground and into groundwater. Surface water could also be indirectly impacted through contaminated run-off.

- Sanitation leaks and wastewater discharge (including discharges from construction camps) – temporary construction compounds will have sanitation facilities. Leaks or inappropriate discharges from such facilities have the potential to change water quality in receiving watercourse or change groundwater quality through infiltration.

In addition, the potential hazard that current river flows and flooding could present to construction phase workers, vehicles and infrastructure is also considered.

7.3.6.2 Operations Phase

Based on the project description the following aspects of the Project have been identified as presenting potential sources of impact to either water quality or availability during the operational phase:

- Presence of the backfilled pipeline trench - the pipework and associated backfill materials that will be installed within the trench will have different hydraulic properties to the original soils/rock that are excavated. This could also lead to localised changes in flow patterns and levels.
- Oil leaks and/or spills (from pipeline, station facilities, tanks, or during transfer between facilities such as port to offshore) – natural damage could be caused by failures of pipework; corrosion of pipework or joints could lead to breaks[4]. Spills or leaks of oil could impact surface water or groundwater quality.
- Leaching from pipeline materials – the materials involved in the construction and burial of the pipeline are likely to include concrete, steal, welding materials, the fusion bonded epoxy used in the anti-corrosion coating, the PUF insulation layer and the HDPE outer layer. The outer HDPE layer will limit the potential for the pipe materials to leach into groundwater.
- Sanitation leaks and wastewater/effluent discharge – the operational facilities will have sanitation facilities. Common wastewater contaminants include total suspended solids and faecal coliforms. Leaks or inappropriate discharges (including from stations and staff accommodation) from such facilities have the potential to change water quality in receiving watercourse or groundwater through infiltration.
- Storage and use of chemicals, fuel and machinery – leaks of substances such as chemical additives to oil, maintenance and cleaning chemicals, fuel/lubricants from operational machinery and substances used at the electricity generating stations could lead to changes in water quality.
- Water abstraction requirements – permanent operational facilities (including stations and staff accommodation facilities) will have some water requirements for welfare and maintenance. Extraction of surface water or groundwater could have an impact on water availability for existing users.
- Storage and disposal of waste materials – depending on the source of the waste it has the potential to contain crude oil 'wax' from pigging, free-phase and dissolved petroleum hydrocarbons (such as benzene, toluene, ethylbenzene, and xylene (BTEX)), oxygenates (e.g. methyl tertiary-butyl ether (MTBE)), metals, and phenols. Leakage from stored waste materials, or inappropriate disposal, could lead to a change in water quality in receiving watercourse, or groundwater through infiltration.

[4] Emergency, Accidental and non-routine events such as erosion leading to pipeline exposure and damage; earthquakes, landslides, vandalism, or accidental damage through later groundworks could lead to pipeline damage, which are addressed in Section 7.14.

- River flows and flooding (either from rivers or the sea) could present a hazard to infrastructure, operational phase workers and humans located in the flood plains. The Project could have the potential to alter existing river flows and downstream flood risk if the construction across watercourses changes the morphology of the riverbed.

7.3.6.3 Decommissioning Phase

The pipeline has a design life of 25 years and the technologies and GIIP techniques for pipeline decommissioning cannot be predicted so far in the future. Nevertheless, when decommissioning does take place it is likely that some activities will take place that are similar to those that will have occurred at the construction phase, plus some activities specific to decommissioning. The following aspects have been identified as presenting potential sources of impact to either water quality or availability during the operational phase:

7.3.6.4 Climate Change

Climate change predictions with respect to rainfall, evaporation and flooding can be highly variable. The uncertainty in precipitation projections for Kenya arises from the wide disagreement of different climate models in the projected change in amplitude of future El Nino events. Most climate predictions suggest there will be an increase in temperature and rainfall, and of extreme weather events (i.e. rainfall intensity and droughts).

Temperature increases of up to 2.5^{o}C are predicted by 2060 (Ministry of Foreign Affairs of the Netherlands, 2018). Predicted precipitation changes in East Africa for the period 2080 to 2099 range between -3% and +25% precipitation (mean +7%) (World Bank, 2011). Projections presented in the UNPD Climate Change Country Profile for Kenya consistently indicate an increase in total annual rainfall over Kenya. In addition, the proportion of rain falling in heavy rainfall events is predicted to increase (McSweeney et al. 2010a). However other studies predict a potential decrease in future rainfall in Kenya. Funk et al. (2010), for example, predict that large parts of Kenya will experience more than a 100 mm decline in long rains by 2025, linking the reduction in precipitation to changes in circulation patterns over the warming Indian Ocean. Generally, a wetter climate is predicted with more intense wet seasons, and increase in the number of extreme wet days, and less severe droughts during October-November-December and March-April-May.

It is likely that increased rainfall volumes and intensity will result in increased run-off, river flows, erosion and flooding. The greatest Project water needs will be during the construction phase. In the short term, climate change is likely to be less significant. However, climate change during operations has the potential to contribute to impacts on the buried pipeline through exposing and damaging it if the design has not considered climate change within the Project lifetime. This also has the potential for changes in run-off, erosion and flooding to impact facilities located near surface watercourses through erosion damage or inundation by flood waters.

There is uncertainty over predicted changes to river flows as a result of changes in weather patterns link to forecast climate change. Some climate change models predict a 20% increase in Kenya's river flows by 2030 resulting from extreme runoff during intense rainfall events (Avery, 2013). Increases in runoff rates would lead to more erosion and flooding. Different groundwater systems are likely to react in different ways to climate change. Shallow aquifers recharged by rainfall and with short residence times will react more quickly to changes in recharge and are likely to be those most affected. Changes in rainfall and run-off patterns could reduce recharge to such aquifer and lead to reduced resource availability. Deep fossil groundwater is unlikely to be impacted by climate change directly because recharge is already negligible, but increased demand for water may result in people exploiting such resources where previously they had been less favourable.

The Intergovernmental Panel on Climate Change (IPPC) Fifth Assessment Report (2014) presents the prediction that there is very likely to be a significant increase in the occurrence of future sea level extremes by 2050 and 2100. Projections of regional changes in sea level reach values of between 10% to 20% above the global mean value in equatorial regions. Under all modelled scenarios, the rate of sea level rise is predicted to very likely exceed the observed rate of 2.0 [1.7 to 2.3] mm/yr during 1971 to 2010 (IPPC, 2014). Based on this range of predicted sea level rise, and a Project lifetime to 2047 (28 years), sea levels could increase between approximately 22 cm and 45 cm. This should be considered in the project design.

7.3.7 Incorporated Environmental Measures

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are GIIP. The following incorporated environmental measures are specifically relevant to water resources.

7.3.7.1 Inherent Design Measures

The measures that have been incorporated into the Project design to reduce impacts or avoid creating them are as follows:

- The pipeline route has been selected to avoid wetland areas where possible and to reduce the number of permanent river crossings (see Section 4: Project Description and Analysis of Alternatives).
- The pipeline will be buried to reduce the possibility of damage at the surface (deliberate or accidental) that could otherwise lead to water contamination. The pipeline will be buried at least 0.9 m below the surface (or 0.6 m in areas of rock). The burial depth will be deeper where it passes under watercourses to offer additional protection from erosion. At watercourse crossings, the pipe installation depth will be informed by the erosion assessment recommendations (Wood Group, 2019) for each watercourse crossing. For seasonal rivers, the minimum depth of cover will be 2 m below the lowest point of the riverbed.
- The Project will incorporate an early leak detection system and isolation valves to identify and limit spill volumes.
- The pipeline and associated facilities will be designed to appropriate earthquake standards to reduce the risk that seismic events could result in damage and leaks that could otherwise lead to water contamination.
- Use of high durability, resistant concrete that is suitable for the environment it is being used in. This will include consideration of the concrete most suitable for use in coastal areas where it is likely to come into contact with seawater, and concrete that is most suitable for sulphate rich ground conditions.
- The pipe will have a greater wall thickness and be surrounded by concrete (or other selected buoyancy control method) where it passes through temporary and permanent river crossings.
- There will be thermal insulation on pipe to maximise heat retention and reduce the potential impact on water temperatures from oil heating.
- The internal corrosion of the pipework will be limited by the oil itself, so there will be no need for added chemicals that could present a source of impact to water quality.
- There will be a protective coating on the outside of the pipe to reduce corrosion and, therefore, damage leading to leaks, which could otherwise lead to water contamination.
- Manual isolation values will be placed either side of the permanent river crossings to allow isolation of the pipeline in the crossing area in the event of an incident that could result in pollution of the watercourse.
- Where applicable, Project facilities will be designed using closed drain systems that will collect discharge from pipework and equipment within stations during routine operations and maintenance and direct any discharges to a dedicated storage vessel to prevent discharge to the water environment.

- The Project will be designed so that all construction and operation related emissions and discharges meet project environmental standards as defined in Annex I.
- The export facilities at Lamu will be within the existing Lamu Port. No new berth construction will be undertaken in the marine environment.
- Areas of high-risk flooding, such as land south-west of the River Tana, have been avoided to reduce the potential for damage to the pipeline and to reduce the potential for changes to existing flow and flood regimes.
- Areas of high scouring have been avoided where possible (for example, between KP110 and KP300 in Samburu County) and routing the pipeline along the highest point of scour.
- Narrow sections of rivers have been selected for the pipeline crossing to reduce the distance of trenching in the base of rivers that will be required.
- Installation of the pipeline at river crossings will be timed to be coincident with periods of very low flow during the dry season.

7.3.7.2 Good International Industry Practice

The following widely followed good practice measures are relevant to <u>all phases</u> of the Project and will be applied/followed in order to manage the magnitude of impacts on the water environment:

- The pipeline and its facilities will be designed to comply with all applicable Kenyan Laws and Regulations, and applicable international design codes and HSE standards, as well as international good practice – specifically the Work Bank Group EHS Guidelines and IFC Performance Standards. These include, but are not limited to, the following:
  - Works in, or within watercourses shall not take place without consent from NEMA (as per the EMCA (Water Quality) Regulations, 2006).
  - Defects in the pipeline will be identified and rectified through use of QA/QC procedure and testing to reduce the potential for leaks, in line with the guidelines provided in IFC[5].
  - The pipeline hydrostatic testing will be completed in accordance with Project specifications and the guidelines provided in IFC EHS Guidelines for Onshore Oil and Gas Development (April 2017).
- Water will be reused where possible to reduce demand on resources.
- Water management and drainage will be incorporated in the design to ensure discharges will meet applicable environmental standards (including from temporary and permanent sanitation facilities) to reduce the potential impact to water quality. These measures will be details in a CEMP for the construction phase and in an OEMP and/or WMP for the operations phase.
- Waste will be disposed of to an appropriate NEMA licenced facility.
- Handling, storage, treatment and disposal of hazardous substances will be in line with appropriate standards to reduce contamination of water resources. The procedures for all stages of hazardous substance handling, storage, use and disposal will be defined in the CEMP.

[5] International Finance Corporation, 2007. Environmental, Health and Safety Guidelines for Onshore Oil and Gas development

- The Emergency Preparedness and Response Plan will identify procedures (including for protecting the water environment from pollution) in the event of emergencies such as leaks, fires and ruptures. They will include how to manage and dispose of firefighting chemicals to reduce contamination potential.
- The Project will apply effective spill prevention, control and response procedures for non-emergencies to control releases that could pollute the water environment. Provision, and training in use, of spill containment equipment will be implemented where they are required.
- When selecting chemicals and materials this will, where practicable, aim minimise the use of hazardous materials. Consideration will be given to selecting the items with the least potential for harm / lowest toxicity to the water environment without loss of effectiveness.
- Appropriate secondary containment structures (to hold at least 110% of the maximum volume of storage) will be used where there is storage of hazardous materials. Hazardous materials will be stored inside roofed buildings and on impervious surfaces to reduce potential contamination of water resources.
- Regular management, inspection and maintenance regimes for all operating equipment, vehicles and machinery will be followed to limit the potential of wear, damage or corrosion leading to leaks or spills which could enter the water environment. All operators will receive adequate and appropriate training. Oil water separators and grease traps will be installed and maintained as appropriate at refuelling facilities, workshops, parking areas, fuel storage and containment areas to reduce potential contamination risk to water resources.
- For any Project phase, abstractions will not exceed the permitted abstraction rates. If new abstractions are required from any water source, the Project will apply for an abstraction permit for which potential impacts to environment will be assessed and presented in the application. Monitoring will be undertaken in accordance with permit conditions. Should boreholes be required for monitoring or water supply, drilling of boreholes will be undertaken following good practice methods:
  - Boreholes will, where possible, be located away from areas of potential contamination (e.g. areas used for storage of waste or hazardous substances, or near septic tanks or effluent discharge points).
  - Drilling techniques (including drilling fluids) and grouting methods will be selected to limit the potential for introducing contamination or allowing cross-contamination. The material used for casing and screening will be made from steel or well-grade plastic. The top sections will be lined to seal off possible contamination at the near surface.
  - Headworks/covers will, where possible, be raised above the ground surface to avoid surface contamination collecting around the top of the borehole and will be clearly marked and be located away from high traffic areas to limit the potential for damage. Headworks will be secured.
  - Abandoned/decommissioned boreholes will be securely sealed or backfilled with non-polluting materials.
- Wastewater from welfare facilities (e.g. toilets) will be discharged to an appropriately permitted wastewater treatment facility or septic tank prior to transport for treatment. If wastewater is collected in a septic tank system, the tanks will be properly designed, installed and maintained to prevent contamination of groundwater.
- No discharge of any effluent into the water environment will take place without a valid effluent discharge license issued by NEMA (as per the Environmental Management and Co-ordination (Water Quality) Regulations).

- As with the construction phase, good site works practices will be followed by decommissioning/demolition workers.

The following measures are applicable to the construction phase of the Project:

- Existing infrastructure has been identified for use where possible (e.g. existing roads instead of new ones) to reduce the need for creation of new infrastructure - the construction of which could have led to increased suspended solid and changes to infiltration.
- Works will be to applicable design codes and health and safety standards.
- Works in periods of extreme rainfall and rainy seasons will be managed, as far is it is practicable, to limit the generation and mobilisation of suspended solids into the water environment and to manage safety of workers.
- Temporary erosion control measures will be installed prior to earth-moving activities, to limit the likelihood of sediment mobilisation to the water environment. Suspended solid management techniques will be used. The procedures being followed will be audited and monitored throughout construction.
- The amount of time the trenches will be open will be minimised, reducing the time per location when excavated soils are exposed to limit the likelihood of sediment mobilisation to the water environment. Any materials, which could lead to contamination, placed in trenches by third parties or otherwise, will be removed before trenches are backfilled to remove potential sources of contamination.
- Construction activities in perennial rivers and wetland areas will take place during the dry seasons when watercourse flows and levels are low. Construction activities in perennial rivers and wetland areas will take place during the dry seasons when watercourse flows and levels are low – timings of construction activities will be selected based on when the watercourse is at its lowest anticipated level to limit the potential for sediment mobilisation.
- Construction activities in seasonal rivers and smaller streams/luggas will be scheduled for dry season periods when no flow is anticipated.
- All construction waste, which could be a source of water contamination, will be handled, stored and managed as outlined in the Waste Management section of the CEMP.
- Hydrostatic test water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures.
- The pipeline hydrostatic testing procedure will aim to store and reuse water to reduce volume required from water abstractions.
- The use of biocides and corrosion inhibitors in hydrostatic test water will be minimised and avoided where possible, to limit potential sources of contamination.

The following measures are applicable to the operational phase of the Project:

- Oil volume monitoring and management in the pipeline will be used to identify losses as soon as is practicable. The leak detection system will be used to determine if an emergency response team needs to be mobilised. Action plans will be followed if leaks are detected to reduce the potential for water contamination. Details of the leak monitoring procedure, monitoring locations, monitoring frequency and action plans will be included in the Operational Environmental Management Plan (OEMP).
- The pipeline will be regularly inspected, and maintenance programmes will be followed to maintain pipeline integrity to reduce the potential for leaks that could otherwise lead to water contamination.

- Operational waste will be handled in a way that follows environmental legislative requirements and reduces pollution potential, in line with the Waste Management section of the OEMP.

The following measures are applicable to the decommissioning phase of the Project:

- Five years prior to the planned 'End of Project', a Decommissioning Plan will be developed for agreement with the appropriate authorities. When the pipeline is decommissioned, the following decommissioning philosophy will be adopted:
  - All underground equipment (pipeline) will be emptied of oil product, left in a clean state (hydrocarbon-free"), plugged and left *in situ*;
  - All above ground infrastructure will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with Affected Communities and County Government to identify any facilities than can be safely handed over for community use;
  - All marine facilities will be emptied of oil product and removed for safe disposal;
  - All construction waste will be handled, stored and managed through good practice; and
  - All decommissioning waste will be handled, stored and managed through the good practice.

7.3.8 Impact Classification

Taking into account the baseline water environment setting (Section 6.4), the relevant incorporated environmental measures (Section 7.3.7), and the potential sources of impact (Section 7.3.6) determined from the project description, the potential source-pathway-receptor impact linkages for the construction, operational and the decommissioning phases are presented in this section.

A discussion regarding the key sources of impact during each of the Project phases to the key receptors is presented in each of the sub-sections below. Each discussion section is followed by a table where all impact linkages are identified and assessed. The potential sources of impact to each receptor are summarised. The initial magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Section 7.3.3. This initial assessment takes into account the incorporated mitigation detailed in Section 7.3.7. Additional mitigation required to reduce the impact magnitude and significance further is summarised in the tables and detailed in Section 7.3.8.4. The residual impact classification and significance takes into account both the incorporated and additional mitigation commitments.

7.3.8.1 Construction Phase

Construction Activities near or within Watercourses or in Coastal Areas

Work near water courses could lead to an increase in suspended solids and impact water quality in any surface watercourses by material being transported by run-off. Work in watercourses will disturb the riverbed material and lead to an increase in suspended solids. Surface water flows could also be blocked to allow in-channel construction. The inherent design mitigation includes keeping crossing distances as short as possible, and the incorporated mitigation includes the requirement for all works in or near water to be undertaken under NEMA consent. One of the incorporated environmental measures designed to reduce the potential impact of construction works on watercourses is to undertake the work in the dry season where the flow and depth of permanent rivers are at their lowest and disturbance in the riverbed can be limited. Working in the dry seasons, limiting the length of time the trenches are open for, and employing temporary erosion control measures will also reduce the potential for the transport of material via run-off. However, when flow is lowest, baseline suspended solids content may be higher and dilution potential reduced, so impacts associated with discharges of suspended solids or other contaminants could be greater. Therefore, it is important to incorporate a combination on mitigation measures that limit the potential for suspended solids generation or the possibility of unlicensed discharges to occur. The initial predicted impact to water quality in all types of watercourse and associated water users from this source is **medium (adverse)**. Due to the likely dilution over the distance to Lake Turkana and in the sea, the initial predicted impact to Lake Turkana and to coastal waters is **low (adverse).** The potential impacts to in-watercourse or flood plain construction infrastructure due to changes in flows is predicted to be **low (adverse)**.

Changes to drainage patterns could alter run-off regimes a reduction in recharge to aquifers because of reduced infiltration rates, which watercourses receive the run-off, and the volumes of run-off to watercourses. Changes to riverbed morphology could change surface water flow regimes, erosion and downstream flow risk, which could impact surface watercourses and Project infrastructure under construction. Works will be limited to a narrow corridor, but without additional mitigation the initial predicted impact to all types of watercourse from this source is **medium (adverse)**. Due to the distance to Lake Turkana, and the other water inputs to the Kerio River along this distance, the initial predicted impact to Lake Turkana is **low (adverse**). Changes to shallow aquifer recharge due to compaction are also predicted to be **negligible** because they will be localised, and existing infrastructure will be used where possible.

If construction activities disturb ground in previously developed areas this could mobilise existing contamination. Existing marine berth facilities will be used. Most of the construction works will be undertaken in previously undeveloped areas, so the potential for encountering historical contamination and this impacting the water environment is unlikely, so impacts to surface watercourses, groundwater and human water users is not considered. If works for the Lamu Marine Terminal are undertaken on previously developed land this could mobilise contamination into the marine environment. The predicted impact magnitude is considered to be **low (adverse).**

Trench backfilling with non-inert material could impact water quality though leaching of contaminants to groundwater and surface water. No foreign materials will be allowed in the trench. Any materials, which could lead to contamination, placed in trenches by third parties or otherwise, will be removed before trenches are backfilled. The potential initial impacts to groundwater and surface water are predicted to be **negligible**.

Storage, Transport and Use of Chemicals and Fuel

Leaks during the storage, transport or use of chemicals or fuel could lead to changes in water quality that could exceed baseline water quality and Project water quality standards. The use, and therefore requirement for, hazardous substances will be avoided where possible. Handling, storage, treatment and disposal will be undertaken as per the CEMP. There will be control and response procedures for non-emergencies releases. The predicted initial impact magnitude to all surface watercourses and shallow aquifers (and associated human users) is **negligible.**

Lake Turkana receives less than 10% of its inflows from the Kerio and Turkwel rivers combined, so any water inputs from the River Kerio will be small in comparison to other inputs. Dilution along the River Kerio will also occur. A large amount of dilution would also occur in the marine environment, and there is limited pathway potential between the surface and deep aquifers. Therefore, the predicted initial impact magnitude to these receptors is also **negligible.**

This assessment does not consider large-scale emergency situations and non-routine events, which are addressed in Section 7.14.

Leaks and Spills Associated with Machinery

Leaks of fuel/lubricants from machinery could lead to changes in water quality. Volumes are likely to be small but could result in exceedances of baseline quality and water quality standard. Effective spill prevention, control and response procedures for non-emergencies to control releases. Training, inspection and maintenance of vehicles and machinery will be used to reduce potential for leaks. The predicted initial impact magnitude to all receptors is **negligible.**

Pipeline Flushing and Hydraulic Testing

The source (or sources) of water for commissioning (hydrotesting) activities and the water demand is currently unconfirmed. Water could be taken from surface watercourses and it could therefore directly impact flows. If water is taken from the ground, this could impact existing water levels. The incorporated mitigation means that hydrostatic test water will be obtained in accordance with applicable regulations and abstraction and discharge will occur in the same catchment, where possible. Water demand will also be reduced by water reuse where possible. Existing water users are considered to be secondary receptors that could be indirectly impacted by changes to water availability because both groundwater and surface water along the route of the pipeline is used at present. However, further characterisation of the water environment and local users at the selected abstraction location(s) would be required, so the initial predicted impact magnitude from abstractions to groundwater, surface watercourses and associated human water user receptors is **medium (adverse).**

Discharge of the used water could impact the quality of the receiving waterbody. The incorporated mitigation means that hydrostatic test water will be discharged in accordance with applicable regulations. The use of biocides and corrosion inhibitors will be avoided where possible. Discharge of the used water could also lead to increased erosion and impact flows/flood risk in surface watercourses. The incorporated mitigation means that hydrostatic test water will be discharged in the same catchment as it was abstracted. The initial predicted impact magnitude to the smaller watercourses where the discharge could be a large proportion of flows is **high (adverse)**, to large watercourses, shallow groundwater and water users is **medium (adverse)** and **low (adverse)** to the marine environment and Lake Turkana.

Construction Water Abstractions

Abstracting water for other construction needs (other than hydraulic testing) could result in changes to surface water flows and groundwater levels, and therefore, water availability. It is predicted to result in smaller impact than the hydrostatic test water abstraction as less water will be required and in not such a concentrated period of time. Abstractions will be sourced under existing licences or under new licences applied for via the Regulator. If deep boreholes are required, these will be constructed following good practice methods. However, further characterisation of the water environment and local users at the selected abstraction location(s) would be required, so the initial predicted impact magnitude from abstractions to groundwater, surface watercourses and associated human water user receptors is **medium (adverse).**

Construction Waste

Waste will be managed flowing the methods detailed in the CEMP and will be disposed of to an appropriate waste facility. Therefore, the predicted initial impact on all receptors is **negligible**.

Sanitation Leaks and Wastewater Discharge

These sources of impact have the potential to affect water quality. The incorporated mitigation means wastewater discharge will be managed and no discharges of effluent will take place unless under a valid effluent discharge license. Therefore, the predicted initial impact on all receptors is **negligible**.

Pathway Types

Many pathways are considered to be direct (e.g. discharging a substance into surface water would have a direct impact on surface water quality or taking groundwater from a borehole would have a direct impact on groundwater availability). However, the baseline information indicates that there are some indirect impacts. For example, indirect impacts on water quality could result from discharges, leaching, leaks or spills to ground that are then conveyed to surface water or groundwater through transport in the unsaturated zone. Changes to surface water flow and quality could result in indirect impacts to shallow groundwater recharge and quality. Conversely impacts on shallow groundwater levels could indirectly impact surface water baseflows.

Humans are secondary receptors to changes in water quality and availability, so all such impacts to humans are considered to be indirect. This assessment presents an initial assessment of the potential impacts to humans as a result of changes to the water environment, but additional detail and in-combination impacts are addressed in the Social Impact Assessments.

Impact Duration

Because most of the sources of impact that could occur at the construction phase will only be present during the construction phase, the impacts are considered to be short-term in their timescale. Only permeant changes to ground conditions that could impact the water environment (e.g. subsurface features and changes to drainage patterns) are considered to be long-term.

The construction phase impact assessment with respect to water resources is presented in Table 7.3-4. Further details of the summary mitigation include in the table are presented in Section 7.3.9.

The following construction related impacts have been evaluated but are considered of negligible significance pre-mitigation and therefore require no further analysis:

- Construction of subsurface features.

Table 7.3-4: Construction phase impact classification and impact significance

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
Main Rivers (high)	Ground disturbance leading to increased suspended solids – direct impact on quality	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Appropriate management of excavated materials will be implemented. Suspended solid management techniques will be used for run-off. Temporary erosion control measures will be installed prior to earth-moving activities to limit the likelihood of sediment mobilisation to the water environment. Suspended solid management techniques will be used. The procedures being followed will be inspected and monitored throughout construction.	Low – short-term – temporary	Minor (adverse)
	Changes to drainage and flow patterns - direct or indirect impact on drainage, flows, erosion and flood risk	Medium – long-term – permanent	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Post construction, monitoring of riverbed morphology and sediment transport will continue until at least the end of the first complete wet season after construction, with further inspections following any extreme event rainfall/flood events.	Negligible – long-term – permanent	Negligible
	Discharge of pipeline testing water – direct impact on quality, flows, erosion and flood risk (indirect impact if discharge to ground)	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP and WMP. A hydrotest plan will be developed for each spread. Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures. Hydrotest water abstraction and disposal will be planned so as to avoid/minimise impacts to local water users. The pipeline hydrotesting will be completed in accordance with Project specifications and the guidelines provided in IFC EHS Guidelines for Onshore Oil and Gas Development (April 2017).	Low – short-term – temporary	Minor (adverse)
	Abstraction for pipeline hydrotesting water - direct or indirect impact	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed WMP. A pre-construction hydro-census will be undertaken specific to the area where abstractions are	Low – short-term – temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
	on flows erosion and flood risk			proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates. The testing procedures and controls will be detailed in a hydrotesting plan per spread.		
	Abstraction for construction water needs (including construction camp requirements) - direct or indirect impact on flows erosion and flood risk	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed WMP. Pre-construction hydro-census work specific to the area where abstractions are proposed to fully understand likely receptors.	Low – short-term – temporary	Minor (adverse)
	Trench backfilling with non-inert materials – indirect impact on quality	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. The amount of time the trenches will be open will be minimised, reducing the time per location when excavated soils are exposed to limit the likelihood of sediment mobilisation to the water environment. Any materials, which could lead to contamination, placed in trenches by third parties or otherwise, will be removed before trenches are backfilled to remove potential sources of contamination.	Negligible – short-term – temporary	Negligible
Lake Turkana (high)	Ground disturbance leading to increased suspended solids – indirect impact on quality	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Management of excavated materials. Suspended solid management techniques will be used. The procedures being followed will be inspected and monitored throughout construction.	Negligible – short-term – temporary	Negligible

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
	Changes in discharge regime into the lake – indirect impact on water levels	Low – long-term – permanent	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Post construction, monitoring of riverbed morphology and sediment transport	Negligible – long-term – permanent	Negligible
	Discharge of pipeline testing water – indirect impact on quality	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP and WMP. A hydrotest plan will be developed for each spread. Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator.	Negligible – short-term – temporary	Negligible
	Trench backfilling with non-inert materials – indirect impact on quality	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Any materials, which could lead to contamination, placed in trenches will be removed before trenches are backfilled.	Negligible – short-term – temporary	Negligible
Seasonal rivers and luggas (medium)	Ground disturbance leading to increased suspended solids – direct impact on quality	Medium – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Management of excavated materials. Suspended solid management will be used. The procedures being followed will be inspected and monitored throughout construction.	Low – short-term – temporary	Minor (adverse)
	Changes to drainage and flow patterns leading to changes in the flow regime, erosion rates, and flood risk downstream - direct or indirect impact on drainage, flows, erosion and flood risk	Medium – long-term – permanent	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Post construction, monitoring of riverbed morphology and sediment transport.	Negligible – long-term – permanent	Negligible

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
	Discharge of pipeline testing water – direct impact on quality, flows, erosion and flood risk (indirect impact if discharge to ground)	High – short-term – temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP and WMP. A hydrostatic test plan will be developed for each spread. Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator.	Medium – short-term – temporary	Minor (adverse)
	Abstraction for pipeline hydro testing water - indirect impact on baseflows from groundwater abstraction	Medium – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed WMP. A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed. The testing procedures and controls will be detailed in a hydrostatic testing plan.	Low – short-term – temporary	Minor (adverse)
	Abstraction for construction water needs (including construction camp water) - indirect impact on baseflows from groundwater abstraction	Medium – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed WMP. Pre-construction hydro-census work specific to the area where abstractions are proposed.	Low – short-term – temporary	Minor (adverse)
	Trench backfilling with non-inert materials – indirect impact on quality	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Any materials, which could lead to contamination, placed in trenches will be removed before trenches are backfilled.	Negligible – short-term – temporary	Negligible
Coastal water features and the marine environment (low)	Discharge of pipeline testing water – direct impact on quality	Low – short-term – temporary	Minor (Adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP and WMP. A hydrostatic test plan will be developed for each spread. Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator.	Negligible – short-term – temporary	Negligible

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
Shallow groundwater aquifers (high)	Discharge of pipeline testing water – indirect impact on quality	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP and WMP. A hydrostatic test plan will be developed for each spread. Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator.	Negligible – short-term – temporary	Negligible
	Abstraction for pipeline hydrotesting water – direct impact on water levels	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed WMP. Pre-construction hydro-census work specific to the area where abstractions are proposed to fully understand likely receptors. The pipeline hydrotesting will be completed in accordance with Project specifications and the guidelines provided in IFC EHS Guidelines for Onshore Oil and Gas Development (April 2017). The testing procedures and controls will be detained in a hydrotest plan.	Low – short-term – temporary	Minor (adverse)
	Abstraction for construction water needs (including construction camp water) – direct impact on water levels	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.3.7. Specific regard must be made for the following: Detailed WMP. Pre-construction hydro-census work specific to the area where abstractions are proposed.	Low – short-term – temporary	Minor (adverse)
	Trench backfilling with non-inert materials – indirect impact on quality	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Any materials, which could lead to contamination, placed in trenches will be removed before trenches are backfilled.	Negligible – short-term – temporary	Negligible
Merti and Lodwar aquifer systems (high)	Discharge of pipeline testing water – indirect impact on quality	Medium – short-term - temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP and WMP. A hydrostatic test plan will be developed for each spread. Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator.	Negligible – short-term - temporary	Negligible

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
	Abstraction for pipeline hydrotesting water – direct impact on water levels	Medium – short-term - temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed WMP. Pre-construction hydro-census work specific to the area where abstractions are proposed to fully understand likely receptors. The pipeline hydrotesting will be completed in accordance with Project specifications and the guidelines provided in IFC EHS Guidelines for Onshore Oil and Gas Development (April 2017). The testing procedures and controls will be detained in a hydrostatic testing plan.	Low – short-term - temporary	Minor (adverse)
	Abstraction for construction water needs (including construction camp water) – direct impact on water levels	Medium – short-term - temporary	Moderate (adverse)	Measures described in Section 7.3.7. Specific regard must be made for the following: Detailed WMP. Pre-construction hydro-census work specific to the area where abstractions are proposed to fully understand likely receptors	Low – short-term - temporary	Minor (adverse)
	Trench backfilling with non-inert materials – indirect impact on quality	Low – short-term - temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Any imported backfill materials will be uncontaminated.	Negligible – short-term - temporary	Negligible
Deep groundwater (low)	Abstraction for pipeline hydrotesting water – direct impact on water levels	Medium – short-term - temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed WMP. Pre-construction hydro-census work specific to the area where abstractions are proposed. The pipeline hydrotesting will be completed in accordance with Project specifications and the guidelines provided in IFC EHS Guidelines for Onshore Oil and Gas Development. (April 2017). The testing procedures and controls will be detained in a hydrostatic testing plan.	Low – short-term - temporary	Negligible
	Abstraction for construction water needs (including construction	Medium – short-term - temporary	Minor (adverse)	Measures described in Section 7.3.7. Detailed WMP. Specific regard must be made for the following: Pre-construction hydro-census work specific to the area where abstractions are proposed.	Negligible – short-term - temporary	Negligible

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
	camp water) – direct impact on water levels					
Humans (very high)	Ground disturbance leading to increased suspended solids — impact on quality leading to indirect impact on water usability and the user	Medium – short-term - temporary	Major (Adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Management of excavated materials. Suspended solid management techniques will be used. The procedures being followed will be inspected and monitored throughout construction.	Negligible – short-term - temporary	Minor (adverse)
	Trench installation and backfilling leading to localised changes in groundwater flow and levels – indirect impact on shallow groundwater availability	Negligible – long-term - temporary	Minor (adverse)	No additional measures beyond those described in Section 7.3.7.	Negligible – long-term - temporary	Minor (adverse)
	Leaks during storage, transport or use of substances – indirect impact on quality	Negligible – short-term - temporary	Minor (adverse)	No additional measures beyond those described in Section 7.3.7.	Negligible – short-term - temporary	Minor (adverse)
	Leaks of fuel/lubricants from machinery - impact on quality leading to indirect impact on water usability and the user	Negligible – short-term - temporary	Minor (adverse)	No additional measures beyond those described in Section 7.3.7.	Negligible – short-term - temporary	Minor (adverse)
	Discharge of pipeline testing water - impact on quality leading to indirect	Medium – short-term - temporary	Major (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP and WMP. A hydrostatic test plan will be developed for each spread. Hydrotest water will be	Negligible – short-term - temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
	impact on water usability and the user			obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator.		
	Abstraction for pipeline hydrotesting water – impact on water flows or levels leading to indirect impact on water availability and the user	Medium – short-term - temporary	Major (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed WMP. Pre-construction hydro-census work specific to the area where abstractions are proposed. The pipeline hydrotesting will be completed in accordance with Project specifications and the guidelines provided in IFC EHS Guidelines for Onshore Oil and Gas Development. (April 2017). The testing procedures and controls will be detailed in a hydrostatic testing plan.	Negligible – short-term - temporary	Minor (adverse)
	Abstraction for construction water needs (including construction camp water) – impact on water flows or levels leading to indirect impact on water availability and the user	Medium – short-term - temporary	Major (adverse)	Measures described in Section 7.3.7. Detailed WMP. Specific regard must be made for the following: Pre-construction hydro-census work specific to the area where abstractions are proposed.	Negligible – short-term - temporary	Minor (adverse)
	Leaching from stored waste/inappropriate waste disposal - impact on quality leading to indirect impact on water usability and the user	Negligible – short-term - temporary	Minor (adverse)	No additional measures beyond those described in Section 7.3.7. Operational waste will be handled in a way that follows environmental legislative requirements and reduces water contamination potential, in line with the Waste Management section of the OEMP.	Negligible – short-term - temporary	Minor (adverse)
	Sanitation leaks/inappropriate discharges (including construction camp	Negligible – short-term - temporary	Minor (adverse)	No additional measures beyond those described in Section 7.3.7.	Negligible – short-term - temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding additional mitigation)	Impact Significance (excluding additional mitigation)	Additional Mitigation	Residual Impact Classification (including all mitigation)	Impact Significance
	discharges) - impact on quality leading to indirect impact on water usability and the user					
	Trench backfilling with non-inert materials - impact on quality leading to indirect impact on water usability and the user	Low – short-term - temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Any materials, which could lead to contamination, placed in trenches will be removed before trenches are backfilled.	Negligible – short-term - temporary	Minor (adverse)
	Work in watercourses, or discharges of large volumes, leading to changes in the flow regime and flooding – indirect impact on humans	Low – short-term - temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Post construction, excavated areas will be reinstated to reflect the original riverbed geomorphology. Any maintenance or operational activities will not take place in ephemeral rivers or watercourses without relevant permissions. Analyses will be completed before the design is finalised and construction starts, to assess the scale of potential changes to sediment flow and flood risk	Negligible – short-term - temporary	Minor (adverse)
Construction infrastructure (low)	Work in watercourses, or discharges of large volumes, leading to changes in the flow regime and flooding – indirect impact on equipment	Low – short-term - temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional mitigation required: Detailed CEMP. Analyses to assess the scale of potential changes to sediment flow and flood risk. Post construction, excavated areas will be reinstated to reflect the original riverbed geomorphology.	Negligible – short-term - temporary	Negligible

7.3.8.2 Operational Phase

Oil Leaks and/or Spills

Minor (non-emergency) oil leaks and/or spills from the pipeline, station facilities, tanks, or during transfer between facilities such as port to offshore could lead to water quality changes. The pipeline route is designed to avoid areas of high flood risk and scouring, and, therefore, erosion potential. It will be buried, have a protective coating, be tested before use, and will have a leak detection system and inspection regime with associate procedures and actions plans that will be detailed in the OEMP. All oil transport and storage facilities, including tanks, will be designed to appropriate earthquake standards. Oil volume monitoring will take place and all oil storage tanks will have secondary containment. All transfer of oil will take place in areas of hardstanding with appropriate segregated drainage systems. The predicted impact to surface watercourses, shallow aquifers, that marine environment and human water users is **low (adverse).** The predicted impact to Lake Turkana and deep groundwater is **negligible**.

This assessment does not consider large-scale emergency situations and non-routine events, which are addressed in Section 7.14.

Storage and Use of Chemicals and Fuel

Leaks during the storage, transport or use of chemicals or fuel could lead to changes in water quality that could exceed baseline water quality and Project water quality standards. The use, and therefore requirement for, hazardous substances will be avoided where possible. Handling, storage, treatment and disposal will be undertaken as per the OEMP and the Waste Management Plan (WMP). There will be control and response procedures for non-emergencies releases. The predicted initial impact magnitude to all surface watercourses and shallow aquifers (and associated human users) is **low (adverse).**

Dilution along the River Kerio, the large amount of dilution that would also occur in the marine environment, and the limited pathway potential between the surface and deep aquifers means the predicted initial impact magnitude to Lake Turkana and the marine environment is also **negligible.**

This assessment does not consider large-scale emergency situations and non-routine events, which are addressed in Section 7.14.

Water Abstraction

Abstracting water for operational needs could result in changes to surface water flows and groundwater levels, and therefore, water availability. It is predicted to result in smaller impact than the construction phase abstraction as less water will be required. It is also possible that the abstractions used during the construction phase will remain in use, so no additional new abstractions will be required. Abstractions will be sourced under existing licences or under new licences applied for via the Regulator. If deep boreholes are required, these will be constructed following good practice methods. However, the water demand will extend throughout the length of the operational period into the future where climate change predictions suggest that water scarcity and demand will increase. Further characterisation of the water environment and local users at the selected abstraction location(s) would be required, so the initial predicted impact magnitude from abstractions to groundwater, surface watercourses and associated human water user receptors is **medium (adverse).**

Discharge of Water

Discharge of captured/intercepted and redirected water, or any other non-effluent water, at inappropriate locations, quality and rates has the potential to cause pollution and erosion. The incorporated mitigation means wastewater discharge locations, rates and quality will be managed and no discharges will take place unless under a valid discharge license. Without pre-discharge management of captured water, and strategic decisions about catchment management, the predicted initial impact on surface watercourses, shallow groundwater, and water users is considered to be **medium (adverse).** The predicted impact magnitude on all other receptors is **negligible.**

Flood Risk and Erosion Predictions

The water environment (i.e. river flows and flooding from rivers or the sea) is considered to be a potential source of impact to the Project because of 1) the potential to expose the buried pipeline and put it at greater risk of damage, and/or 2) the potential for coastal or river-side infrastructure (e.g. port facilities and stations) to be impacted by flooding. The presence of the Project itself also has the potential to change current flood flows and flood plain storage areas and, therefore, the existing downstream erosion patterns and flood risk.

The pipeline design has been informed by modelling of the existing flood risk (i.e. flood extent and the depth of flooding) and the predicted erosion at the watercourse crossings. The pipeline will be buried at least 0.9 m below the surface and deeper where it passes under watercourses and the floodplain. In rocky areas this may be reduced to 0.6 m. The pipeline will also be protected through all watercourse crossings in its channel by a greater pipe wall thickness and concrete. This will reduce the potential for erosion damage to the pipeline; thereby reducing the potential impact to the pipeline and associated secondary impacts to the water environment should the pipeline be breached and oil escape.

Working in riverbeds has the potential to change riverbed morphology, flow patterns and associated erosion rates and flood risk. Climate change also has the potential to alter existing watercourse flow regimes and flood risk. Although the design of the Project is informed by the existing flood and erosion modelling, additional work relating to climate change predictions and changes to flood risk is considered necessary. The initial impact assessment of the Project on downstream flood risk and erosion potential is **medium (adverse).**

Pathway Types

As with the construction phase, some operational impact pathways are considered to be direct (i.e. discharging a substance into surface water would have a direct impact on surface water quality or taking groundwater from a borehole would have a direct impact on groundwater availability). However, as described in Section 7.3.8.1, the baseline information indicates that there are some indirect impacts and secondary receptors as well.

Impact Duration

Because most of the sources of impact that could occur at the operational phase will only be present during the operational phase, the impacts are considered to be medium-term in their timescale. Once a source of impact to either water quality or quantity (flows or levels) has been removed at the end of the operational phase, baseline conditions can return, so the impacts are temporary.

The operational phase impact assessment with respect to water resources is presented in Table 7.3-5. Further details of the summary mitigation include in the table are presented in Section 7.3.9. The following operational related impacts have been evaluated but are considered of negligible significance pre-mitigation and therefore require no further analysis:

- Heating from oil in the pipeline having a direct impact on water quality;
- Presence of the backfilled pipeline trench;
- Leaching of materials used in construction having a direct or indirect impact on water quality;
- Sanitation leaks/inappropriate discharges having a direct or indirect impact on water quality;
- Leaks of fuel/lubricants from operational machinery having a direct or indirect impact on water quality; and
- Leaching from waste/inappropriate waste disposal having a direct or indirect impact on water quality.

Table 7.3-5: Operational phase impact classification and impact significance

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
Main Rivers (high)	Oil leaks and/or spills from pipeline, stations or other facilities – direct or indirect impact on quality	Low – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP. Use of underground storage tanks for fuels and lubricants will be avoided to reduce the potential for leaks that are harder to identify, which could lead to contamination of the water environment.	Negligible – medium-term - temporary	Negligible
	Leaks or spills during storage, transfer, transport or use of substances – indirect impact on quality	Low – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP. Use of underground storage tanks will be avoided	Negligible – medium-term - temporary	Negligible
	Abstraction for operational water needs - direct or indirect impact on flows, erosion and flood risk	Medium – medium-term – temporary	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed WMP. Hydro-census to inform receptors and impacts of any new abstraction. Water will be reused where possible to reduce demand on resources.	Negligible – medium-term – temporary	Negligible
	Discharges of wastewater - direct impact on quality, flows, erosion and flood risk (indirect impact if discharge to ground)	Medium – medium-term - temporary	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP.	Negligible – medium-term - temporary	Negligible
	Changes in riverbed morphology – direct change to river flows	Medium – short term - temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP. Post construction, excavated areas will be reinstated to reflect the original riverbed geomorphology. Monitoring of riverbed morphology and	Low – short term - temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
				sediment transport will continue until at least the end of the first complete wet season after construction, with further inspections following any extreme event rainfall/flood events. Any maintenance or operational activities will not take place in ephemeral rivers or watercourses without relevant permissions (works within watercourses shall not take place without consent from NEMA (as per the EMCA (Water Quality) Regulations, 2006)).		
	Changes in sedimentation in watercourses due to unnatural scouring at pipeline locations – direct change to river flows	Medium – short term - temporary	Moderate (adverse)	Measures described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP. Riverbed reinstated to reflect original geomorphology. Monitoring of riverbed morphology and sediment transport. Operational activities will not take place in the water environment without relevant permissions.	Low – short term - temporary	Minor (adverse)
Seasonal rivers and luggas (medium)	Oil leaks and/or spills from pipeline, stations or other facilities – direct or indirect impact on quality	Low – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP. Use of underground storage tanks will be avoided	Negligible – medium-term - temporary	Negligible
	Leaks or spills during storage, transfer, transport or use of substances – indirect impact on quality	Low – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP. Use of underground storage tanks will be avoided.	Negligible – medium-term - temporary	Negligible
	Abstraction for operational water needs - direct or indirect	Medium – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed WMP. Hydro-census to	Negligible – medium-term - temporary	Negligible

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
	impact on flows erosion and flood risk			inform receptors and impacts of any new abstraction. Water reuse where possible.		
	Discharges of wastewater - direct impact on quality, flows, erosion and flood risk (indirect impact if discharge to ground)	Medium – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP.	Negligible – medium-term - temporary	Negligible
	Changes in riverbed morphology – direct change to river flows	Medium – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP. Riverbed reinstated to reflect original geomorphology. Monitoring of riverbed morphology and sediment transport. Operational activities will not take place in the water environment without relevant permissions.	Low – long-term - permanent	Minor (adverse)
	Changes in sedimentation in watercourses due to unnatural scouring at pipeline locations – direct change to river flows	Medium – short term - temporary	Minor (adverse)	Measures described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP. Riverbed reinstated to reflect original geomorphology. Monitoring of riverbed morphology and sediment transport. Operational activities will not take place in the water environment without relevant permissions.	Low – short term - temporary	Minor (adverse)
Shallow groundwater aquifers (high)	Oil leaks and/or spills from pipeline, stations or other facilities – direct or indirect impact on quality	Low – medium-term - temporary	Minor (Adverse)	Measures as described in Section 7.3.7. Additional measures required as described in Section 7.3.8.4: Detailed OEMP. Use of underground storage tanks will be avoided.	Negligible – medium-term - temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
	Leaks or spills during storage, transfer, transport or use of substances – indirect impact on quality	Low – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP. Use of underground storage tanks will be avoided.	Negligible – medium-term - temporary	Negligible
	Abstraction for operational water needs - direct impact on water levels	Medium – medium-term - temporary	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed WMP. Hydro-census to inform receptors and impacts of any new abstraction. Water reuse where possible.	Negligible – medium-term – temporary	Negligible
	Discharges of wastewater - indirect impact on quality	Medium – medium-term - temporary	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP.	Negligible – medium-term – temporary	Negligible
Merti and Lodwar aquifer systems (high)	Oil leaks and/or spills from pipeline, stations or other facilities – direct or indirect impact on quality	Low – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP. Use of underground storage tanks will be avoided.	Negligible – medium-term - temporary	Negligible
	Leaks or spills during storage, transfer, transport or use of substances – indirect impact on quality	Low – medium-term - temporary	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP. Use of underground storage tanks will be avoided.	Negligible – medium-term - temporary	Negligible
	Abstraction for operational water needs - direct impact on water levels	Medium – medium-term - temporary	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed WMP. Hydro-census to inform receptors and impacts of any new abstraction. Water reuse where possible.	Negligible – medium-term – temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
	Discharges of wastewater - indirect impact on quality	Medium – medium-term - temporary	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed WMP and OEMP.	Negligible – medium-term - temporary	Negligible
Deep groundwater (low)	Abstraction for operational water needs - direct impact on water levels	Medium – medium-term – temporary (permanent if taken from fossil sources or from sources are not recharged at the rate of abstraction)	Minor (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed WMP. Hydro-census to inform receptors and impacts of any new abstraction. Findings incorporated into licence application. Water reuse where possible.	Negligible – medium-term – temporary (permanent if taken from fossil sources or from sources are not recharged at the rate of abstraction)	Negligible
Human (very high)	Oil leaks and/or spills from pipeline, stations or other facilities – indirect impact on water usability due to changes in quality	Low – medium-term - temporary	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP. Use of underground storage tanks will be avoided	Negligible – medium-term - temporary	Minor (adverse)
	Leaks or spills during storage, transfer, transport or use of substances – indirect impact on water usability due to changes in quality	Low – medium-term - temporary	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP. Use of underground storage tanks will be avoided.	Negligible – medium-term - temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
	Abstraction for operational water needs - indirect impact on water availability due to changes in water levels	Medium – medium-term – temporary (permanent if taken from fossil sources or from sources are not recharged at the rate of abstraction)	Major (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed WMP. Hydro-census to inform receptors and impacts of any new abstraction. Findings incorporated into licence application. Water reuse where possible.	Negligible – medium-term – temporary (permanent if taken from fossil sources or from sources are not recharged at the rate of abstraction)	Minor (adverse)
	Discharges of wastewater - indirect impact on water usability due to changes in quality	Medium – medium-term - temporary	Major (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP. Drainage and storm waters will be managed through separate drainage systems. Discharges within the same catchment as abstraction where possible. Wastewater collection pits will be lined. Monitoring of receiving waters.	Negligible – medium-term - temporary	Minor (adverse)
	Changes in riverbed morphology leading to change to river flows and flood risk – indirect impact on human health due to changes in flood risk	Low – long-term - permanent	Moderate (adverse)	Measures as described in Section 7.3.7. Additional measures required: Detailed OEMP and WMP. Post construction, the original riverbed form will be returned and retained throughout operations. Monitoring of riverbed erosion. Operational activities will not take place in the water environment.	Negligible – long-term - permanent	Minor (adverse)

7.3.8.3 Decommissioning

As the operational phase of the project nears its end (no less than five years prior to end of pipeline design life), a decommissioning plan will be developed that will include measures to protect water resources and mitigate any impacts identified. In particular, it is predicted that impacts that may need mitigation and specific protocols in place will include site clearance activities and water supply and discharge, for which similar mitigation to that adopted during construction will be required relating to sediment management, permitting, waste management.

7.3.9 Summary of Mitigation and of Monitoring

In addition to the incorporated mitigation that will be put in place during construction, operations and decommissioning to avoid impacts or reduce their magnitude (Section 7.3.7), additional mitigation is required to reduce the residual impact of the Project. These are already specified in Tables 7.3-4 and 7.3-5. This section collates and presents further detail relating to those mitigation commitments, which will be expanded upon in one of the following management plans:

- Construction Environment Management Plan;
- Operation Environment Management Plan; or
- Water Management Plan.

The pre-construction and construction additional mitigation measures that will be undertaken pre-construction to limit the magnitude of Project impacts at any phase, and those that will be used to reduce construction impact magnitudes, or reduce the potential for creating the impact, are as follows:

- A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates. Prior to construction, and based on final water requirements, appropriate local hydro-census work will be undertaken to identify and characterise local water users. The details of this will be presented in the WMP, but will include the locations of the water sources, the source of the water, details of how the water is collected, how many people rely on the water, the depth to groundwater sources, when the water is used and what the water is used for. If impact on local water supplies could occur, an alternative, equivalent water supply will be provided to users throughout the construction period.
- Appropriate management of excavated materials will be implemented. Suspended solid management techniques will be used for run-off. The procedures being followed will be audited and monitored throughout construction.
- Analyses will be completed before the design is finalised and construction starts, to assess the scale of potential changes to sediment flow and flood risk (hydraulic and scour analysis).
- Where construction work occurs adjacent to, or in water courses which may be flowing during the construction period, procedures for inspection and monitoring will be implemented throughout the construction period, including upstream and downstream water quality monitoring pre and post construction, where applicable. Post construction, monitoring of riverbed morphology and sediment transport will continue until at least the end of the first complete wet season after construction, with further inspections following any extreme event rainfall/flood events. The purpose of this will be to confirm that sediment transport and erosion patterns have not been adversely altered by the in-channel construction works.
- Drainage channels and ditches will be designed to limit changes to natural flows and reduce the potential for flood risk.

- Hydrotest water abstraction and disposal will be planned so as to avoid/minimise impacts to local water users. A hydrotest plan will be developed for each spread. This will include details of the permitted sources of water, licensed abstraction rates (if applicable), required source water quality, required discharge water quality and rates, the discharge locations, treatment methods (if required), monitoring.

Most measures that will be used to avoid or reduce the potential for impacts to the water environment are incorporated at the design stage. Other operational mitigation measures that will be used to reduce operational impact magnitudes, or reduce the potential for creating the impact, are as follows:

- Post construction, excavated areas will be reinstated to reflect the original riverbed geomorphology. Any maintenance or operational activities will not take place in ephemeral rivers or watercourses without relevant permissions.
- Materials, including water, will be reused where possible to reduce demand on resources.
- Use of underground storage tanks for fuels and lubricants will be avoided to reduce the potential for leaks that are harder to identify, which could lead to contamination of the water environment.
- Operational waste will be handled in a way that follows environmental legislative requirements and reduces water contamination potential, in line with the Waste Management section of the OEMP.

Decommissioning mitigation measures include:

- A Decommissioning Plan, produced no less than 5 years prior to end of the pipeline operations, will provide details of mitigation and commitments for the protection of environment and water users during decommissioning and beyond.

Summary of Monitoring Commitments

Monitoring will be undertaken as part of some of the above mitigation to allow assessment of the water environment and track the effectiveness of the mitigation. Some monitoring is also incorporated into the Project either through the design or through the project description. The points below draw out the monitoring aspects of the mitigation:

- Compliance of discharged water with applicable standards, at discharge location and monitoring locations downstream of septic tanks and monitoring of identified water use (from hydro-census) potentially affected by discharges.
- Volumes of water abstracted during construction and operations.
- Compliance with water abstraction permit requirements.
- Monitoring associated with construction suspended solids management techniques – pre-construction suspended solid monitoring in the water environment upstream and downstream of intended working areas, followed by on-going monitoring during construction to confirm the effectiveness of the suspended solids management techniques. Assessment of results will take place against appropriate environmental limits. All monitoring locations, frequencies, methods and limits will be set out in the Management Plan for that phase of work.
- Monitoring of riverbed morphology at and immediately downstream of the watercourse crossing locations before and after construction (to continue until at least the end of the first complete wet season after construction, with further inspections following the first extreme event (1 in 30-year return period flows) to confirm the effectiveness of the design against predictions. Details will be set out in the Management Plan for that phase of work.

- Water quality monitoring in receiving waterbodies/courses associated with discharges. Monitoring will be undertaken when flow is present at locations upstream and downstream of the discharge point. Parameters will be selected based on activities being undertaken and the associated potential contaminants. Assessment will take place against appropriate environmental limits. All monitoring locations, frequencies, methods and limits will be set out in the Management Plan for that phase of work.
- Monitoring of the quality of hydrostatic test water to inform treatment and disposal requirements. Hydrostatic test water quality will be monitored before use and before discharge to enable identification of changes in water quality. If the water for discharge does not meet the required discharge standards, the water will be treated. Hydrostatic testing water quality and discharge rate monitoring will be defined in a CEMP.
- Oil volume monitoring forms part of the incorporated mitigation. Along with the inherent design leak detection system, this will be used to determine if leaks have occurred that could impact the water environment. The locations and frequency of oil volume monitoring, and the method of recording, will be detailed in the Operational Management Plan.
- It is good practice for details of the types and volumes of hazardous substances stored to be recorded during all Project Phases. This will be used to understand the sources of potential impacts, allow appropriate storage and handling methods to be undertaken, and to allow for leak/loss detection. The type of monitoring, frequency and record keeping will be detailed in the appropriate management plan for the phase of works.
- Water Supply Abstraction monitoring - All abstraction, whether surface water or groundwater, will be undertaken under licence. The licence will detail the location of the abstraction and any monitoring requirements. These will be set by the Regulator (e.g. NEMA) and will include abstraction volumes within specific timeframes and may also include water quality parameters.
- Discharge of water and treated effluent monitoring – All discharges, whether surface water or ground, will be undertaken under consents. The consent will detail the location of the discharge and any monitoring requirements. These will be set by the Regulator (e.g. NEMA) and will include the permitted discharge locations, rates, water quality parameters, and water quality limits.

7.3.10 Summary of Residual Impacts

The Project has the potential to impact the water environment in three main ways:

- By using existing water resources and changing the current availability of water to existing human and non-human users;
- By changing the quality of the water, principally through sediment transport; and by changing flows/flood risk at locations where the pipeline crosses permanent or seasonal rivers; and
- The Project itself could also be impacted by the water environment through flooding.

With mitigation that has been incorporated into the design, or will take place as incorporated mitigation during pre-construction, construction, operational or decommissioning phases, it is considered that most of the sources of potential impacts to and from the water environment are manageable and either minor or negligible. Most impacts are also considered to be temporary, except where they are associated with physical changes to drainage, recharge or riverbed morphology, or with features constructed in the subsurface.

The initial impacts that are moderate (adverse) to one or more receptors and require additional mitigation are associated with the management of suspended solids, maintaining baseline drainage regimes, managing abstractions sustainably in a water stressed environment and changing climate, and controlling the discharge of the hydrostatic testing water. After additional mitigation is applied, the associated residual impact significance to the water environment is classified as minor or negligible, and therefore is considered not significant.

7.4 Soils Geology and Geohazards

7.4.1 Introduction

This section provides an assessment of the potential effects of the Project on, or to the Project from, soils, geology and geohazards. Potential effects have been determined using a qualitative assessment methodology. Where potential effects have been identified, these are considered in turn and mitigations are set out where these are considered necessary to ensure that any potential effects are considered acceptable.

As geology and geohazards do not include environmental receptors, this impact assessment focuses exclusively on potential soils impacts.

7.4.2 Receptor Importance

In order to identify the importance of soil quality to human activities on the land (i.e. agricultural land use), the scale of relative importance presented in Table 7.4-1 has been used, with reference to the information collated in the baseline, to classify the types of impacts and their importance/sensitivity to impacts on soil quality.

Table 7.4-1:Criteria for determining importance/sensitivity to impacts on soil quality

Importance	Soil Quality Impact Types
Very high	■ International importance ■ Human health ■ Soil has a high quality for agricultural land use, regional or national scale and limited potential for substitution/replacement
High	■ National importance ■ Soil has a high quality for agricultural land use, local scale and limited potential for substitution/replacement ■ Soil has a medium quality for agricultural land use, regional or national scale and limited potential for substitution/replacement
Medium	■ Regional importance ■ Soil has a medium quality for agricultural land use, local scale and limited potential for substitution/replacement ■ Soil with a low quality for agricultural land use, regional or national scale and limited potential for substitution/replacement
Low	■ Local, limited or no known importance ■ Soil has a low quality for agricultural land use, local scale ■ Environmental equilibrium is stable and is resilient to impacts that are greater than natural fluctuations, without detriment to its present character

7.4.3 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change in soil quality. The potential for an impact to occur to soil quality has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact. The magnitude of the potential impact has then been classified between ‘negligible’ and ‘high’, as described in Table 7.4-2.

Duration of Impact

Each potential impact can be either adverse or beneficial to soil quality and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 38 months (the maximum anticipated construction period);
- A medium-term impact is defined as between 3 and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

Reversibility of Impact

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Direct and Indirect Impacts

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on soil quality has another knock-on impact on one or more other related soil types. Indirect impacts are likely to occur away from the Project, which in the case of this assessment applies to downwind landscapes due to dust deposition.

Table 7.4-2: Criteria for assessing magnitude of impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Loss of resource, loss of quality and integrity of the resource, severe damage to key characteristics, features or elements. Concentrations of contaminant in soils exceeding baseline concentrations and standards for parameters that could affect human health.	Large scale or major improvement to resource quality, extensive restoration or enhancement.
Medium	Partial loss of resource, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements. Concentrations of contaminant in soils are likely to exceed baseline concentrations and standards for parameters that are unlikely to affect human health.	Some benefit to key characteristics, features or parameters describing resource quality.
Low	Some measurable change in/damage to attributes, quality or vulnerability. Minor loss of, or alteration to, key characteristics, features or elements. With respect to soil quality, concentrations are unlikely to exceed baseline concentrations and standards (e.g. soil organic matter, salinity, pH/fertility, metal concentrations).	Minor benefit to, or addition of, one or more key characteristics, features or parameters describing resource quality.
Negligible	No, or very minor (immeasurable), change to characteristics, features or parameters describing resource quality (e.g. soil organic matter, salinity, pH/fertility, metal concentrations).	

7.4.4 Key Guidance and Standards

The guidance and standards that are relevant to the protection of geology and soils to which the Project will be required to conform are as follows:

- Kenyan policy and legislation, including:
  - Kenyan Government Environmental Management and Coordination Act (EMCA) (1999) and Amendments (2018); and
  - Republic of Kenya National Environment Policy, 2013;
- National Soil and Water Conservation Project (Machakos District) (FAO UN 1989);
- International Finance Corporation Performance Standards, 2012; and
- World Bank Group Environmental, Health, and Safety General Guidelines, 2007.

The impact assessment mitigations were developed by applying international industry standards for pipeline construction on undisturbed native ground, including considerations for topsoil salvage, storage and replacement. These soil conservation and reclamation principles are ubiquitous in the pipeline construction industry worldwide but are consistent with Food and Agriculture Organisation of the United Nations (FAO UN) standards.

7.4.5 Soil Types of Interest and Importance

The focus of this assessment is on the quality of soil. Baseline environmental information indicates the importance and types of soil that occur in the Area of Influence.

Using the LLCOP project description and the baseline soil environment information presented in full in the baseline report (Annex II), and summarised in Section 6.5, the following primary soil resources have been identified as being susceptible to changes in soil quality:

- High importance agricultural land potential: disturbance of Chernozems, Cambisols and Phaeozems, which are understood to occur intermittently throughout the pipeline route, due to pipeline construction, resulting in loss of organic matter and soil fertility; and
- Medium importance agricultural land potential: disturbance of Fluvisols, Calcisols, Luvisols, Lixisols, Gleysols, and Vertisols due to pipeline construction, resulting in a loss of soil fertility or change in soil water content/drainage.

In addition to the receptors that could be impacted by changes in soil quality, this assessment also considers changes to soil quantity through the risk of erosion. Figure 7.4-1 illustrates the soil resources along the LLCOP route and Table 7.4-3 presents the assigned importance for these resources following the criteria presented in Section 7.4.1.

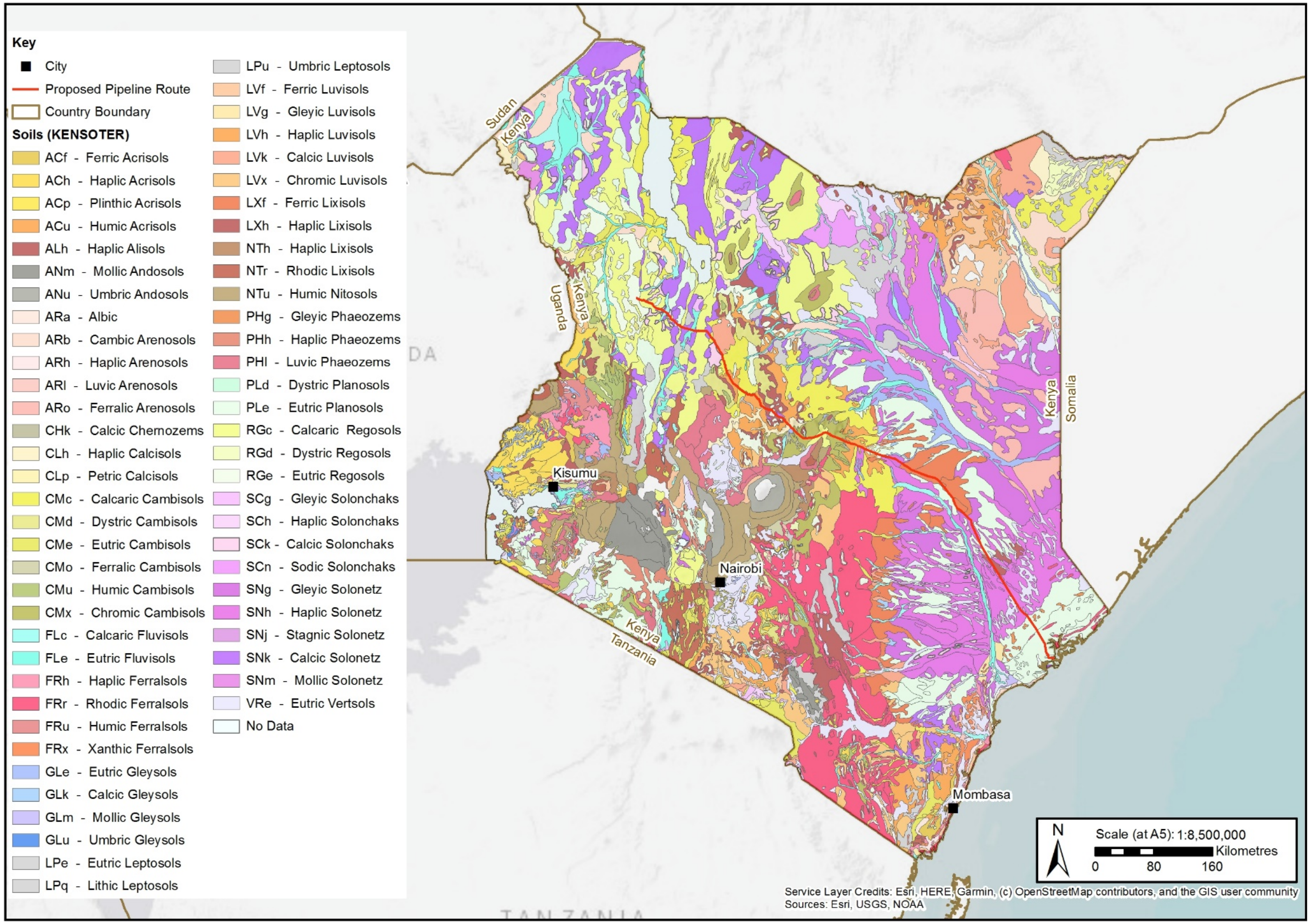

Figure 7.4-1: Soil Resources that are potentially susceptible to changes in soil quality along the LCCOP route

Table 7.4-3: Soil resources and importance

Soil Resource	Importance	Comment
Fluvisols	Medium	Important soils with cropland potential that require periodic flooding/high available water (e.g. rice). Main concern is alteration of water holding capacity.
Planosols	Low	Poor agricultural land potential, limited potential for degradation of land use capability due to project construction/operation.
Regosols		
Solonchaks		
Solonetz		
Calcisols	Medium	Viable agricultural land potential, however cropping variety diversity would be limited due to pH/fertility.
Cambisols	High	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Sensitive to soil organic carbon loss.
Arenosols	High	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Sensitive to soil organic carbon loss and are highly erodible.
Luvisols	Medium	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Generally resilient to soil quality degradation from short duration impacts due to strong moisture holding capacity.
Lixisols		
Chernozems	High	Optimal agricultural land potential. Highly sensitive to soil organic matter loss due to disturbance/soil storage.
Gleysols	Medium	Important soils/ agricultural land potential for crops that require periodic flooding/high available water (e.g. rice). Main concern is alteration of water holding capacity.
Phaeozems	High	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Sensitive to soil organic carbon loss.
Vertisols	Medium	Important soils/land potential for agriculture, however of lower quality than soil types with high importance.

Table 7.4-4: Soil erosion and importance

Soil Resource	Importance	Comment
Fluvisols	High	High risk of soil loss due to disruption of water flows during pipeline construction.
Planosols	Low	Poor quality agricultural land potential, limited potential for degradation of land use capability due to wind/water erosion during project construction/operation.
Regosols		
Solonchaks		
Solonetz		
Calcisols	Medium	Viable agricultural land potential, however cropping varieties are limited due to pH/fertility, and limited potential for degradation of land use capability due to wind/water erosion during project construction/operation.
Cambisols	High	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Sensitive to soil organic carbon loss.
Arenosols	High	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Sensitive to soil organic carbon loss and are highly erodible.
Luvisols	Medium	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Generally resilient to soil quality degradation from short duration impacts due to relatively low erodibility.
Lixisols		
Chernozems	High	Optimal agricultural land potential for the region. Highly sensitive to land degradation from vegetation removal.
Gleysols	Low	Important soils with agricultural land potential that require periodic flooding/high available water (e.g. rice). Low potential for degradation of land use capability due to wind/water erosion during project construction/operation.
Phaeozems	Medium	Viable agricultural land potential but are not as enriched with organic matter as the optimal soil types. Generally resilient to soil quality degradation from short duration impacts due to relatively low erodibility.
Vertisols	Low	Important soils/lands for agriculture, however of lower quality than soil types with high importance. Generally resilient to soil quality degradation from short duration impacts due to relatively low erodibility.

7.4.6 Potential Sources of Impact

There is no linkage between the project activity and environmental receptors for geology or geohazards *per se*. Geohazards and Geology are considered in the project design with respect to human safety and project construction feasibility/engineering design, however they are not addressed in this impact assessment section. Geohazards and landslips are included in risk analysis in the unplanned events and accidents section (Section 7.14).

7.4.6.1 Construction Phase

Based on the project description and the understanding of the baseline soil conditions that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to either soil quality or soil loss due to erosion during the construction phase. The potential sources of impact and routes by which they could impact soil resources are as follows:

- Localised loss of topsoil due to erosion (wind and/or water);
- Localised degradation of soil quality due to the admixing of saline subsoil into the topsoil and dilution of organic matter;
- Localised degradation of soil quality due to compaction of medium and fine-textured topsoil (rutting) and subsoil;
- Storage, transport and use of chemicals and fuel – leaks or spills of substances needed in construction activities (e.g. fuel in generators, additives, lubricants and cleaning agents) at any stage of their storage, transport or use could lead to changes in soil quality;
- Pipeline construction activities associated with the physical disturbance of soil resources, their handling, storage, and replacement could lead to a change in soil quality and expose soil resources to elevated risk of soil erosion while soil is in stockpile and the landscape is altered (i.e. trench excavation); and
- Leaks and/or spills of fuel/lubricants associated with machinery – leaks from machinery pipework or tanks, or spills during maintenance and/or refuelling could lead to changes in soil quality.

Operation Phase

Based on the project description the following aspects of the Project have been identified as presenting potential sources of impact to soil resources during the operational phase:

- Presence of the backfilled pipeline trench – the pipework and associated backfill materials that will be installed within the trench will have different hydraulic properties to the original soils/rock that are excavated. This could also lead to localised changes in soil drainage and soil water availability;
- Replaced topsoil/surface soil on pipeline RoW – the replaced soils will have been in storage and may have degraded due to organic matter loss, soil biodiversity loss, and/or erosion. This could result in changes to soil quality;
- Oil leaks and/or spills (from pipeline, station facilities, tanks, or during transfer between facilities such as port to offshore) – natural damage could be caused by failures of pipework; corrosion of pipework or joints could lead to breaks. Spills or leaks of oil could impact soil quality;
- Leaks of fuel/lubricants from operational machinery – this could lead to changes in soil quality, and
- Storage and use of chemicals and fuel – leaks of substances such as chemical additives to oil, maintenance and cleaning chemicals, and substances used at the electricity generating stations could lead to changes in soil quality.

7.4.7 Incorporated Environmental Measures

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are GIIP. The following incorporated environmental measures are specifically relevant to soils, geology and geohazards.

7.4.7.1 Inherent Design Measures

The measures that have been incorporated into the Project design to reduce impacts or avoid creating them are as follows:

- The pipeline will be buried to reduce the possibility of damage at the surface (deliberate or accidental) that could otherwise lead to soil contamination;
- The Project will incorporate an early leak detection system and isolation valves. Oil volume monitoring and management in storage facilities will be used to identify losses as soon as is practicable. Action plans will be followed if leaks are detected to reduce the potential for soil contamination;
- The pipeline and associated facilities will be designed to appropriate earthquake standards to reduce the risk that seismic events could result in damage and leaks that could otherwise lead to soil contamination;
- There will be thermal insulation on pipe to maximise heat retention and which will reduce the potential impact on soil temperatures from oil heating;
- The internal corrosion of the pipework will be limited by the oil itself, so there will be no need for added chemicals that could present a source of impact to soil quality; and
- There will be a protective coating on the outside of the pipe to reduce corrosion and, therefore, damage leading to leaks, which could otherwise lead to soil contamination.

Further measures planned and incorporated into the Project to reduce impacts include:

- Existing infrastructure has been identified for use where possible (e.g. existing roads instead of new ones) to reduce the need for creation of new infrastructure - the construction of which could have led to increased suspended solid and changes to infiltration;
- The routing of the pipeline was completed such that it avoids communities. As the active agricultural land is nearby these communities, the pipeline route avoids active agricultural lands to the extent possible;
- The length of the pipeline route is minimised to the extent possible to take the most direct route possible;
- Areas of high-risk flooding, such as land south-west of the River Tana, have been avoided; and
- Areas of high scouring have been avoided where possible (for example, between KP110 and KP300 in Samburu County) and routing the pipeline along the highest point of scour.

7.4.7.2 Good International Industry Practice

The following measures are applicable to all phases of the Project and will be implemented in order to reduce impacts on soil resources:

- Handling, storage, treatment and disposal of hazardous substances will be in line with appropriate standards to reduce the potential of soil contamination. The procedures for all stages of hazardous substance handling, storage, use and disposal will be defined in the CEMP;
- Waste disposal will be to a NEMA-licensed facility to reduce potential for soil contamination. Transportation of such wastes will be by a NEMA-licenced contractor;
- The Emergency Preparedness and Response Plan will identify procedures (including for protecting soil resources from contamination) in the event of emergencies such as leaks, fires and ruptures. They will include how to manage and dispose of firefighting chemicals to reduce potential for contamination;
- The Project will apply effective spill prevention, control and response procedures for non-emergencies to control releases that could pollute the soil environment. Provision of, and training in use of spill containment equipment will be implemented where they are required;

- When selecting chemicals and materials this will, where practicable, aim to avoid or minimise the use of hazardous materials. Consideration will be given to selecting the items with the least potential for harm/lowest toxicity to the soil and water environment without loss of effectiveness;
- Appropriate secondary containment structures (to hold at least 110% of the maximum volume of storage) will be used where there is storage of hazardous materials. Hazardous materials will be stored inside roofed buildings and on impervious surfaces to reduce potential contamination of soils;
- Transfer of hazardous materials from tanks to storage facilities will take place in areas with surfaces sufficiently impervious to avoid loss to the environment. The surface will be sloped to a collection or a containment structure not connected to municipal wastewater/storm water collection system;
- The Project will limit the volume of hazardous substances stored at any one site to only what is required to reduce potential contamination risk to soil;
- Regular management, inspection and maintenance regimes for all operating equipment, vehicles and machinery will be followed to limit the potential of wear, damage or corrosion leading to leaks or spills which could contaminate soils. All operators will receive adequate and appropriate training.;
- Oil water separators and grease traps will be installed and maintained as appropriate at refuelling facilities, workshops, parking areas, fuel storage and containment areas to reduce potential contamination risk to soil; and
- Use of underground storage tanks for fuels and lubricants will be avoided to reduce the potential for leaks that are harder to identify, which could lead to contamination of soil.

The following measures are applicable to the construction phase of the Project:

- The pipeline will be constructed to comply with relevant laws/regulations and with environmental permits in place to reduce likelihood of contamination risk to soils;
- Temporary erosion control measures will be installed prior to earth-moving activities to minimise movements of soils;
- The amount of time the trenches are open will be minimised, reducing the time per location when excavated soils are exposed. Any materials, which could lead to contamination, placed in trenches by third parties or otherwise, will be removed before trenches are backfilled to remove any source of potential soil contamination. Construction activities in perennial rivers and wetland areas will take place during the dry seasons when flows and levels in watercourses are low; timings of constructions activities will be selected based on when the watercourse is at its lowest anticipated level to limit the potential for sediment mobilisation.
- There will be no construction in small streams and seasonal rivers/luggas when there is flow. Construction activities in small streams and seasonal rivers/luggas will be scheduled for dry season periods when no flow is anticipated. Works in periods of extreme rainfall will be limited, as far is it is practicable, to limit soil loss due to erosion;
- Topsoil will be salvaged along the length of the pipeline trench, stored separately and replaced following pipeline installation and trench backfilling. In identified agricultural areas, the duration of topsoil storage will be minimised to reduce degradation of soil quality; and
- All construction waste will be handled, stored and managed in accordance with the Waste Management section of the CEMP to reduce potential sources of soil contamination;

The following measures are applicable to the operational phase of the Project:

- The pipeline will be regularly inspected, and maintenance programmes will be followed to maintain pipeline integrity to reduce the potential to leaks that could otherwise lead to soil contamination;
- Operational waste will be handled in a way that follows environmental legislative requirements and reduces soil contamination potential, in line with the Waste Management section of the OEMP;
- The pipeline will be inspected on an ongoing basis throughout its operational life to identify any areas of erosion and subsidence; and
- Drainage water from process areas that could be contaminated with oil (closed drains) and drainage water from non-process areas (open drains) will be separated to the extent practical from storm water drainage to limit potential to contaminate soil.

The following measures are applicable to the decommissioning phase of the Project:

Five years prior to the planned 'End of Project', a Decommissioning Plan will be developed for agreement with the appropriate authorities.

When the pipeline is decommissioned, the following decommissioning philosophy will be adopted:

- All underground equipment (pipeline) will be emptied of oil product, left in a clean state and left in situ;
- All above ground infrastructure will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with Affected Communities and County Government to identify any facilities than can be safely handed over for community use;
- All marine facilities will be emptied of oil product and removed for safe disposal;
- All construction waste will be handled, stored and managed through the good practice outlined in the Waste Management section of the CEMP; and
- All decommissioning waste will be handled, stored and managed through the good practice outlined in the Waste Management section of the Decommissioning Plan.

7.4.8 Impact Classification

Taking into account the baseline soil setting (Section 6.5), the relevant incorporated environmental measures (Section 7.4.5) and the potential sources of impact (Section 7.4.4) determined from the project description, the potential source-pathway-resources impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant incorporated mitigation applicable to each soil resource type are summarised. The magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Section 7.4.1.

7.4.8.1 Construction Phase

The construction phase impact assessment with respect to soil resources is presented in Table 7.4-6.

Many pathways are considered to be direct (e.g. admixing topsoil with trench spoil resulting in a degradation in soil quality). However, the baseline information indicates that there are some indirect impacts as well. For example, indirect impacts on soil quality could result from discharges, leaching, leaks or spills to ground that are then conveyed to the ground surface through transport in the unsaturated zone.

Soil Quality

One measure to reduce the potential impact of construction works on soil quality could be to undertake the work in the dry season where the opportunity for soil erosion (e.g. water and sedimentation) can be limited. However, during the dry season, soils are more prone to wind erosion (and dust deposition), so impacts associated with soil disturbance during construction could be greater. Therefore, it is important to incorporate a combination on mitigation measures that limit the potential for erosion generally to occur.

The exact locations of where soil resources are used for agriculture along the pipeline route is not currently fully understood, so it is considered that impacts on soil quality could affect existing farmers anywhere along the Project. Further engagement with potential agricultural land users will be required during stakeholder engagement and any further analyses prior to construction.

The two key impacts on soil quality during construction will be, firstly the temporary loss of high importance agricultural land, which will have a **low** magnitude on soil, which will be managed using a soil management procedure, which could lead to compensation in line with the livelihood restoration strategy.

Secondly, the topsoil handling and storage will have a low impact on soil quality. Proposed mitigation is that topsoil will be salvaged along the length of the Right of Way, stored separately in windrows in accordance with the soils erosion management/control in the CEMP and replaced following pipeline installation and trench backfilling. Prior to Construction, through mapping and engagement with local land users, high value agricultural land will be identified. In identified areas of high value land, the duration of topsoil storage will be minimised to reduce degradation of soil quality.

Soil Erosion Potential

The Wood Geohazard report (Wood, 2018a) includes information about the soil types present along pipeline and a qualitative erosion risk assessment. Based on common practice in the oil and gas industry, the report used a threshold of 10 t/ha/year as acceptable upper limit, which was reduced to 5 t/ha/year for sensitive sites (e.g. slopes along rivers). Most of the soils encountered were classified as medium or high erosion potential. Those classified as low had higher erosion potential when present on slopes. The erosion risk presented in the Wood report for each soil type is summarised in Figure 7.4-2 and Table 7.4-3. Where the report identifies locations along the pipeline that are of highest erosion risk for a soil type, these locations are also presented.

The primary mitigation for soil erosion is to minimise the duration that soils are exposed in windrow and unvegetated. The duration of topsoil storage will be minimised to reduce degradation of soil quality. Other mitigations minimising the amount of construction that occurs during intense rainfall events or extended drought periods where high winds can erode topsoil in windrows will also help minimise erosive losses. Once the trench is backfilled and topsoil is replaced on the RoW, the land should be restored to pre-disturbance land use as quickly as practicable to minimise topsoil erosion post-construction. Soil type specific mitigations are included below on Table 7.4-5.

Given that the design of the Project will be informed by the existing flood and erosion modelling, and by the additional work relating to climate change predictions and changes to flood risk that will be undertaken before the design and construction methods are finalised, it is considered that the impacts to soil resources due to erosion are a **medium** impact, but can be managed.

Table 7.4-5: Soil erosion risk for each soil reference group

Soil Reference Group	Risk Rating	Rationale	Specific Mitigation	Locations identified as having potential for specific soils
Arenosols	High	Prone to wind erosion and easily turned to dunes.	Duration of topsoil storage will be minimised to reduce degradation of soil quality.	0.0 km to 6.3 km
Calcisols	Medium/ High	Lack of vegetation makes prone to wind and water erosion.	Duration of topsoil storage will be minimised to reduce degradation of soil quality.	110.5 km to 121.6 km 292.3 km to 300.4 km 414.4 km to 440.3 km
Cambisols	Medium/ High	Erosion likely on slopes when surface is bare.	Duration of topsoil storage will be minimised to reduce degradation of soil quality.	121.6 km to 128.4 km 150.9 km to 181.7 km 202.1 km to 215.0 km 301.7 km to 335.4 km 358.2 km to 391.0 km
Chernozems	Low	High organic matter content reduces the overall risk of erosion, and these soils typically occur on low relief terrain.	Duration of topsoil storage will be minimised to reduce degradation of soil quality.	
Vertisols	Low	Wind erosion possible if soils allowed to dry out.	Duration of topsoil storage will be minimised to reduce degradation of soil quality.	
Fluvisols	Medium	Erosion potential in vicinity of rivers.	Duration of topsoil storage will be minimised to reduce degradation of soil quality.	43.7 km to 49.8 km 88.8 km to 95.2 km
Lixisols	High	Crust can develop leading to low rain infiltration, presenting an erosion risk from sudden overland flows and wind.	Duration of topsoil storage will be minimised to reduce degradation of soil quality.	253.5 km to 262.7 km 269.0 km to 274.1 km 279.3 km to 287.1 km 468.2 km to 522.0 km 655.2 km to 677.9 km
Luvisols	Low / Medium	Typically low, but erosion prone on slopes.	Duration of topsoil storage will be minimised to reduce degradation of soil quality.	128.4 km to 150.9 km 181.7 km to 202.1 km 215.0 km to 253.5 km 287.1 km to 292.3 km 391.0 km to 414.4 km
Phaeozems	Low	Erosion by wind may occur after prolonged droughts.	. Duration of topsoil storage will be minimised to reduce degradation of soil quality.	811.2 km to 814.7 km
Planosols	Low	Wind erosion possible if soils allowed to dry out.	None. Limited value for agricultural land.	63.2 km to 75.4 km 631.0 km to 655.2 km 749.7 km to 811.2 km

Soil Reference Group	Risk Rating	Rationale	Specific Mitigation	Locations identified as having potential for specific soils
				814.7 km to 816.0 km
Regosols	High	Weakly developed soil structure and horizons makes these soils prone to erosion.	None. Limited value for agricultural land.	6.3 km to 36.0 km 56.9 km to 60.5 km 75.4 km to 77.9 km 97.8 km to 110.5 km 262.6 km to 269.0 km 281.6 km to 284.9 km 335.4 km to 358.2 km
Solonchaks	Medium	Erosion due to wind.	None. Limited value for agricultural land.	49.8 km to 56.9 km
Solonetz	Medium	Erosion due to wind.	None. Limited value for agricultural land.	36.0 km to 43.7 km 60.5 km to 63.8 km 77.9 km to 88.8 km 95.2 km to 97.0 km 97.0 km to 97.8 km 274.1 km to 279.3 km 440.3 km to 468.2 km 587.3 km to 631.0 km 677.9 km to 749.7 km

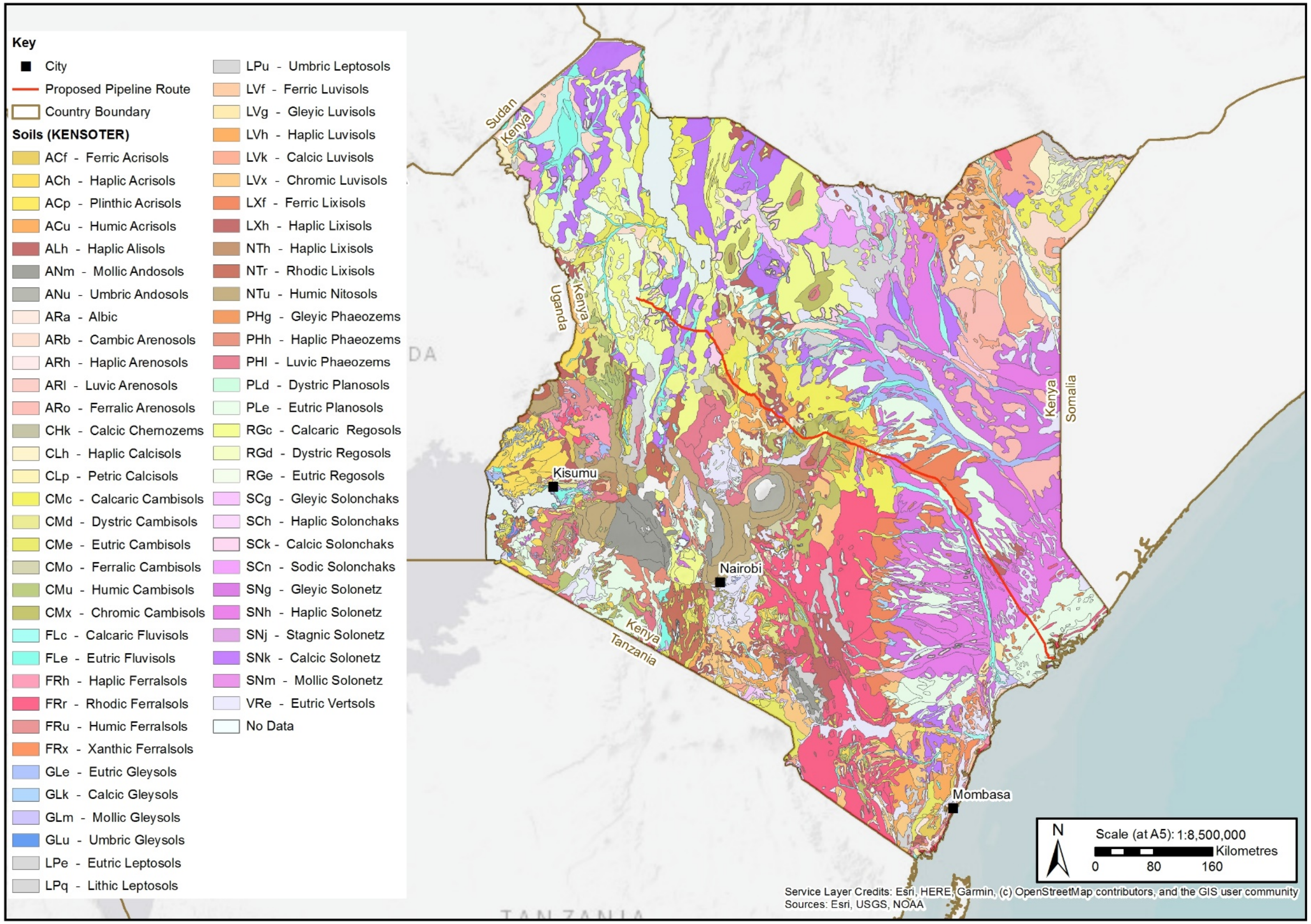

Figure 7.4-2: Soils that are potentially at risk from soil erosion along the LCCOP route

The following construction related impacts are considered of negligible significance pre-mitigation and have therefore been scoped out of the impact tables:

- Storage, transport and use of chemicals and fuel – leaks or spills of substances needed in construction activities (e.g. fuel in generators, additives, lubricants and cleaning agents) at any stage of their storage, transport or use could lead to changes in soil quality;
- Leaks and/or spills of fuel/lubricants associated with machinery – leaks from machinery pipework or tanks, or spills during maintenance and/or refuelling could lead to changes in soil quality;
- Heavy equipment traffic leading to compaction and rutting – can result in compaction and rutting of soil along the pipeline RoW, reducing its porosity and negatively impacting soil structure and water permeability in the rooting zone.

Table 7.4-6: Construction Phase Impact Classification and Impact Significance

Soil Resource (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
High importance agricultural land potential: Chernozems, Cambisols and Phaeozems (high)	Ground disturbance leading to increased exposure to erosion risk	Medium– short-term - temporary	Moderate (adverse)	In addition to measures described in Section7.4.7: Identification of high value agricultural land prior to construction through mapping and engagement with local land users. Topsoil to be left in windrows, in line with soils erosion management/control in the CEMP.	Low– short-term – temporary	Minor (adverse)
	Ground disturbance leading to a short-term loss of agricultural land capability	Medium– short-term – temporary	Moderate (adverse)	In addition to measures described in Section 7.4.7: Site-specific erosion control plans will be prepared for construction work mountainous/high relief areas.	Low– short-term – temporary	Minor (adverse)
	Topsoil handling and storage (admixing, organic carbon loss, salinity changes) – direct impact on quality	Low– short-term – temporary	Minor (adverse)	No additional measures beyond those described in Section 7.4.7.	Low– short-term – temporary	Minor (adverse)

Soil Resource (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Medium importance agricultural land potential: Fluvisols, Calcisols, Luvisols, Lixisols, Gleysols, and Vertisols (medium)	Ground disturbance leading to increased exposure to erosion risk	Medium– short-term – temporary	Minor (adverse)	In addition to measures described in Section 7.4.7: Topsoil will be left in windrows, in line with soils erosion management/control in the CEMP.	Low– short-term – temporary	Minor (adverse)
	Ground disturbance leading to a short-term loss of agricultural land capability	Low– short-term – temporary	Minor (adverse)	No additional measures beyond those described in Section 7.4.7.	Low– short-term – temporary	Minor (adverse)
	Topsoil handling and storage (admixing, organic carbon loss, salinity changes) – direct impact on quality	Low– short-term – temporary	Minor (adverse)	In addition to measures described in Section 7.4.7: Site-specific erosion control plans will be prepared for construction work mountainous/high relief areas.	Low– short-term – temporary	Minor (adverse)

7.4.8.2 Operational Phase

For the operational phase soil resources impact assessment, the following has been taken into account:

- No further direct soil disturbance will take place beyond the construction phase. Impacts have been assessed under the construction phase; and
- As with the construction phase, some operational impact pathways are considered to be direct (i.e. topsoil quality degradation due to disturbance, storage and replacement).

Sources of impact that could occur at the operational phase will be short-term in their timescale as operational activities that may affect soils could only occur in isolated events and are not continuous. Once a source of impact to soil quality has been removed at the end of the operational phase, baseline conditions can return, so the impacts are temporary. During the operational phase there will negligible to low magnitude of impacts on soils as events that may impact the receptor will be limited in extent and would be expected to recover over a short period of time following the application of mitigations.

The operational phase impact assessment with respect to soil resources is presented in Table 7.4-7.

The following operation related impacts are considered of negligible significance pre-mitigation and have therefore been scoped out of the impact tables:

- Oil leaks and/or spills (from pipeline, station facilities, tanks, or during transfer between facilities such as port to offshore) – natural damage could be caused by failures of pipework; corrosion of pipework or joints could lead to breaks. Spills or leaks of oil could impact soil quality;
- Leaks of fuel/lubricants from operational machinery – this could lead to changes in soil quality, and
- Storage and use of chemicals and fuel – leaks of substances such as chemical additives to oil, maintenance and cleaning chemicals, and substances used at the electricity generating stations could lead to changes in soil quality.

Table 7.4-7: Operational phase impact classification and impact significance

Soil Resource (Importance)	Source of Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
High importance agricultural lands: Chernozems, Cambisols and Phaeozems (high)	Ground disturbance leading to increased exposure to erosion risk	Low– short-term – temporary	Minor (adverse)	No additional measures beyond those described in Section 7.4.7.	Low– short-term – temporary	Minor (adverse)
Medium importance agricultural lands: Fluvisols, Calcisols, Luvisols, Lixisols, Gleysols, and Vertisols (medium)	Ground disturbance leading to increased exposure to erosion risk	Low– short-term – temporary	Minor (adverse)	No additional measures beyond those described in Section 7.4.7.	Low– short-term – temporary	Minor (adverse)
Low importance agricultural lands: Planosols, Regosols, Solonchaks, Solonetz (low)	Ground disturbance leading to increased exposure to erosion risk	Low– short-term – temporary	Negligible	No additional measures beyond those described in Section 7.4.7.	Low– short-term – temporary	Negligible

7.4.9 Decommissioning

As the operational phase of the project nears its end (five years prior to end of pipeline design life), a decommissioning plan will be developed that will include measures to protect soil resources and mitigate the loss of agricultural land potential along the pipeline route. The decommissioning plan will include general and specific mitigation measures for erosion and sediment control, topsoil conservation, and the preservation of soil quality.

7.4.10 Summary of Monitoring and Mitigation

In addition to the design mitigation measures that will be put in place during construction and operation to avoid impacts or reduce their magnitude, the additional mitigation or monitoring will be applied. This section collates and presents further detail relating to those mitigation commitments, which will be expanded upon in one of the following management plans:

- Construction Environment Management Plan; and
- Operation Environment Management Plan.

Specific additional mitigation and monitoring commitments comprise the following:

- Identification of high value agricultural land prior to construction through mapping and engagement with local land users. Topsoil will be left in windrows, in line with soils erosion management/control in the CEMP. Site-specific erosion control plans will be prepared for construction work in mountainous / high relief areas;
- Topsoil will be salvaged along the length of the pipeline trench, stored separately and replaced following pipeline installation and trench backfilling. In identified agricultural areas, the duration of topsoil storage will be minimised to reduce degradation of soil quality; and
- The pipeline will be inspected on an ongoing basis throughout its operational life to identify any areas of erosion or subsidence.

7.4.11 Summary of Residual Impacts

The Project has the potential to impact soil resources in four main ways:

- By disturbing soils on high and medium importance agricultural land and degrading the quality of soil resources during the construction phase of the project;
- By changing the erosion potential of the soil to water and wind erosion during construction and operation due to soil disturbance;
- By affecting the soil drainage patterns on high and medium importance agricultural land through alteration of the soil surface and physical changes to soil structure.

With mitigation that has been incorporated into the design, or will take place during pre-construction, construction or operational phases, it is considered that the sources of potential impacts to soil resources are manageable. Most impacts are also considered to be temporary, except where they are associated with physical changes to drainage, which need to be monitoring and rectified.

The associated impact significance that results from the combination of resource importance and predicted impact magnitude, post mitigation, is mainly classified as minor, negligible or not significant.

7.5 Ecological Impacts - Terrestrial and Aquatic Biodiversity

7.5.1 Introduction and Area of Influence

The Project aims to ensure that biodiversity and ecosystem functions are not degraded or lost from the landscape as a result of the Project's construction, operation, and decommissioning. Key to this commitment is supporting the long-term survival of species and habitats that occur in the Project's Area of Influence (AoI). In essence, these species, and habitats should have the same chances of long-term survival with, or without, the Project.

The AoI for the biodiversity assessment (Figure 7.5-1), within which data has been gathered for the baseline, comprises the areas of potential direct and indirect effects during operations and construction of the Project based on analysis completed within the ESIA. It includes a 25 km buffer along the entire pipeline, plus wherever the buffered route intersected a defined protected area or area of biological importance, that area is incorporated into AoI (Golder, 2018b).

Potential direct impacts such as changes in habitat availability, composition and quality caused by land take, sensory disturbance (light, noise, vibration), air emissions and dust from the project operation or construction may include direct and indirect disturbances to biota, which could extend beyond a confined area and hence the establishment of the buffer.

Primary data sources used to support this assessment included land cover mapping and classification for the AoI and a seasonal field sampling programme. The field sampling programme occurred from June to November 2018 to encompass the long and short wet seasons and covered vegetation and flora, invertebrates, herpetofauna, birds and mammals in representative locations. The full baseline report is presented in Annex II of the ESIA. A summary of the full baseline report is set out in Section 6.6 of this ESIA.

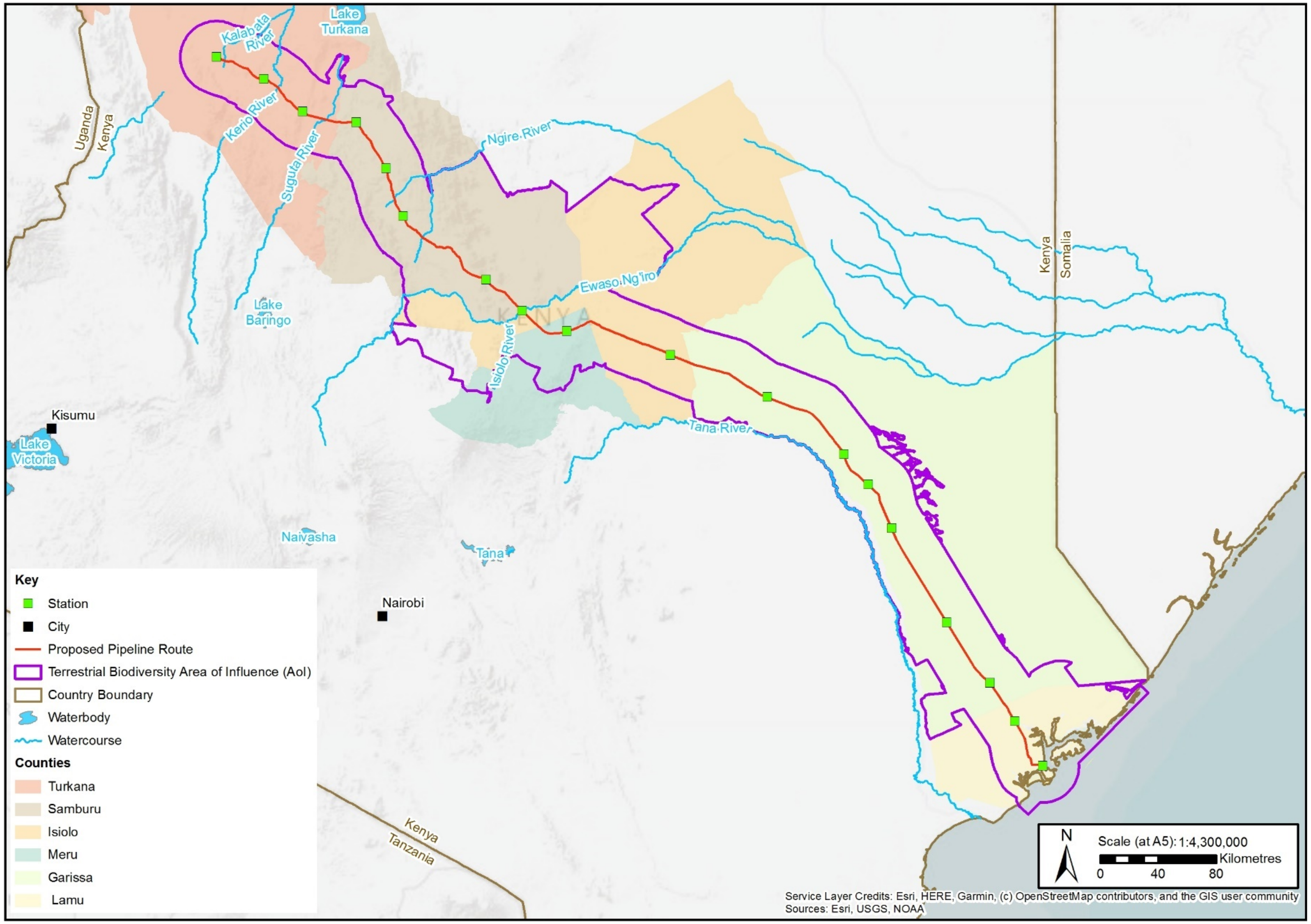

Figure 7.5-1: Terrestrial biodiversity Area of Influence (AoI)

7.5.2 Receptor Importance

Sensitivity and Importance of Receptors

The sensitivity and importance of species and habitat receptors and the sensitivity/importance rating for each receptor group is provided in Table 7.5-1. For species receptor groups, the individual species in that group with the highest sensitivity determined the overall group's sensitivity. For the purposes of this assessment, Protected sites (National reserves and IUCN II/VI reserves) and flora and fauna species of conservation concern (SoCC) are considered to have a '*high sensitivity/importance'* because of the presence of species protected under the Kenyan WCMA (2013) and their identified IUCN threat category[1].

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.5-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.5-1: Criteria for determining importance and sensitivity of receptors

Receptor Importance	Example Receptor Types
Very high	Designated Areas: Internationally protected sites where the receptor and Project site share habitat or species synergies. Habitats: supporting a set of Nationally unique species in comparison to other examples of the habitat; habitats already threatened within the region; habitats with a limited global extent or a significant proportion of the total extent of that habitat type will be affected. Also includes habitats used by high importance species as important feeding or breeding areas (or potentially migration routes), including those alongside watercourses. Plant and Animal Species: Critically Endangered (CR) or Endangered (EN) species (IUCN 2009), and species listed in the WCMA, 2013) dependent on a case by case basis using expert opinion. Species and taxa having a particularly Restricted Range (i.e. endemic to a site or found globally at fewer than 10 sites or animal species having a distribution range less than 50 000 km^2 or restricted-range bird species (those with a global breeding range less than 50 000 km^2). Following a precautionary principle, IUCN VU species are also included if they meet the following: Restricted Range criteria, particular vulnerability to certain threats, are of high stakeholder interest or considered in expert opinion to be of high importance, have been classed as being of high importance.
High	Designated Areas: areas not included in the criteria for very high importance. Habitats: locally rare, small or scattered; vegetation communities or sub-communities; habitats which include set of species uncommon in Kenya; habitats supporting species which have specific adaptations to that habitat; habitats with significant richness in biodiversity. Includes any low importance habitats used by moderate or high importance species as important breeding, feeding areas or migration routes, including those alongside watercourses. Plant and Animal Species: Endangered (EN) Vulnerable (VU), Near Threatened (NT) LC or Data Deficient (DD) species (IUCN 2009), some species from WCMA were assessed on a case by case basis using expert opinion. Not included in the criteria for very high importance species.
Medium	Designated Areas: areas not included in the criteria for high importance. Habitats: not globally regionally or nationally protected or listed and which are common or abundant and which are not critical to other ecosystem functions. Habitats which are very common and widespread in the East African region or habitats generally modified[2] or

[1] Critically Endangered (CR), Endangered (EN), Vulnerable (VU) Near threatened (NT) Least concern (LC) Data deficient (DD) Not evaluated (NE)
[2] Modified habitat is defined as areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition.

Receptor Importance	Example Receptor Types
	degraded by anthropogenic activities, or land with no real conservation significance in expert opinion. Plant and Animal Species: not protected or listed, common or abundant and is not critical to other ecosystem functions and is not included in the criteria for high or moderate importance.
Low	Designated Areas: areas not included in the criteria for medium importance. Habitats: which are common, abundant, robust and which are not critical to other ecosystem functions. Habitats which are very common and widespread in the East African region or habitats generally modified or degraded by anthropogenic activities, or land with no real conservation significance in expert opinion. Plant and Animal Species: not protected or listed, common or abundant and are not critical to other ecosystem functions and is not included in the criteria for medium, high or very high importance and sensitivity. Plant and animal species are ubiquitous and tolerant of anthropogenic impact.

7.5.3 Magnitude of Impact

Table 7.5-2 details the magnitude of impact criteria used for the qualitative assessment of potential impacts on biodiversity.

Table 7.5-2: Magnitude assessment parameters for biodiversity

Magnitude	Geographical Extent	Duration	Frequency
Negligible Individuals will not be affected; disturbance to habitat integrity (area, quality, composition, configuration, processes, and functions) will be absent, or transient. **Low** Impacts could affect individuals; that is, in the case of fauna receptors, individuals may become disturbed, but not injured, with some minor reversible disturbance to habitat receptor integrity (area, quality, composition, configuration, processes, and functions). For flora receptors, individual plants may be destroyed. **Medium** Impacts would affect individuals detrimentally, with injury or death of individuals. The local population may be affected through the loss of individuals, but not the local population and/or species as a whole. The integrity of habitat receptor's integrity may be affected detrimentally and possible permanently. **High** Impacts will affect the viability of the local habitat or local population of a receptor and/or the species as a whole	**Project Footprint** **Broader Area of Influence**	**Short-term** Impact is reversible at end of construction **Medium-term** Impact is reversible at end of operational life **Permanent** Impact is not reversible	**Infrequent** Impact occurs intermittently during construction, but not continuously, over the assessment period **Frequent** Impact occurs repeatedly or continuously over the assessment period

7.5.4 Key Guidance and Standards

The biodiversity impact assessment has been completed in accordance with Kenyan legislation and to align with international guidance and good practice such as those define by the International Petroleum Industry Environmental Conservation Association (IPIECA).

7.5.5 Receptors of Interest and Importance

Indicators used to assess impacts to habitat receptors were changes in:

- Extent;
- Condition;
- Regional representativeness; and
- Landscape connectivity.

Table 7.5-3 presents the assigned importance for these receptors following the criteria presented in Section 7.5.2, which are also presented on Figure 7.5-2 to Figure 7.5-5.

Table 7.5-3: Receptors and importance

Receptor	Importance	Comment
Rahole and Nyambene National Reserves shown in the following figures.	High	Designated protected area meeting the criteria for High importance, where the Project is located within the protected area.
Shaba, Samburu, Kiunga, Dodori, Buffalo Springs, Arawale National Reserves shown in the following figures.	High	Designated protected area meeting the criteria for High importance, where Project impinges the protected area.
Community Reserves/Conservancies - West Gate, Sera, Ol Lentille Conservancy, Ngare Ndare Community Conservancy, Matthews Range, Nasuulu, Nakuprat-Gotu, Mpus Kutuk, Meibae, Lewa, Leparua, Lekurruki, Kalama, Ishaqbini Hirola Community Conservancy, Il Ngwesi Community Trust, Biliqo-Bulesa, Namunyak and Awer Community Conservancy.	High	Designated protected area within the AoI meeting the criteria for High importance where the Project crosses a protected area and stations may be present in a protected area (Kalama (bordering Namunyak) and Awer)
Acacia-Commiphora stunted bushland, Somalia-Masai Acacia-Commiphora deciduous bushland and thicket, Somalia-Masai semi-desert grassland and shrubland.	Medium	Habitats are common or abundant and which are not critical to other ecosystem functions. Habitats which are very common and widespread in the East African region or habitats generally modified or degraded by anthropogenic activities, or land with no real conservation significance in expert opinion.
Riverine wooded vegetation, Desert, Dry combretum wooded grassland and Edaphic grassland on drainage-impeded or seasonally flooded soils.	High	Locally infrequent, small or scattered; vegetation communities or sub-communities; habitats which include set of species uncommon in Kenya; habitats supporting species which have specific adaptations to that habitat; habitats with significant richness in biodiversity.

Receptor	Importance	Comment
Large and medium Mammals	High	Animal Species: Critically Endangered (CR) individuals rather than CR populations. Endangered (EN) Vulnerable (VU), Near Threatened (NT) LC or Data Deficient (DD) species (IUCN 2009), some species from WCMA were assessed on a case by case basis using expert opinion. Not included in the criteria for very high importance species.
Small mammals and bats	High	Animal Species: Critically Endangered (CR) individuals rather than CR populations. Endangered (EN) Vulnerable (VU), Near Threatened (NT) LC or Data Deficient (DD) species (IUCN 2009), some species from WCMA were assessed on a case by case basis using expert opinion. Not included in the criteria for very high importance species.
Herpetofauna	High	Animal Species: Critically Endangered (CR) individuals rather than CR populations. Endangered (EN) Vulnerable (VU), Near Threatened (NT) LC or Data Deficient (DD) species (IUCN 2009), some species from WCMA were assessed on a case by case basis using expert opinion. Not included in the criteria for very high importance species.
Avifauna	High	Animal Species: Critically Endangered (CR) individuals rather than CR populations. Endangered (EN) Vulnerable (VU), Near Threatened (NT) LC or Data Deficient (DD) species (IUCN 2009), some species from WCMA were assessed on a case by case basis using expert opinion. Not included in the criteria for very high importance species.
Invertebrates	Medium	Plant and Animal Species: not protected or listed, common or abundant and is not critical to other ecosystem functions and is not included in the criteria for high or moderate importance.
Fish	High	Animal Species: Critically Endangered (CR) individuals rather than CR populations. Endangered (EN) Vulnerable (VU), Near Threatened (NT) LC or Data Deficient (DD) species (IUCN 2009), some species from WCMA were assessed on a case by case basis using expert opinion. Not included in the criteria for very high importance species.

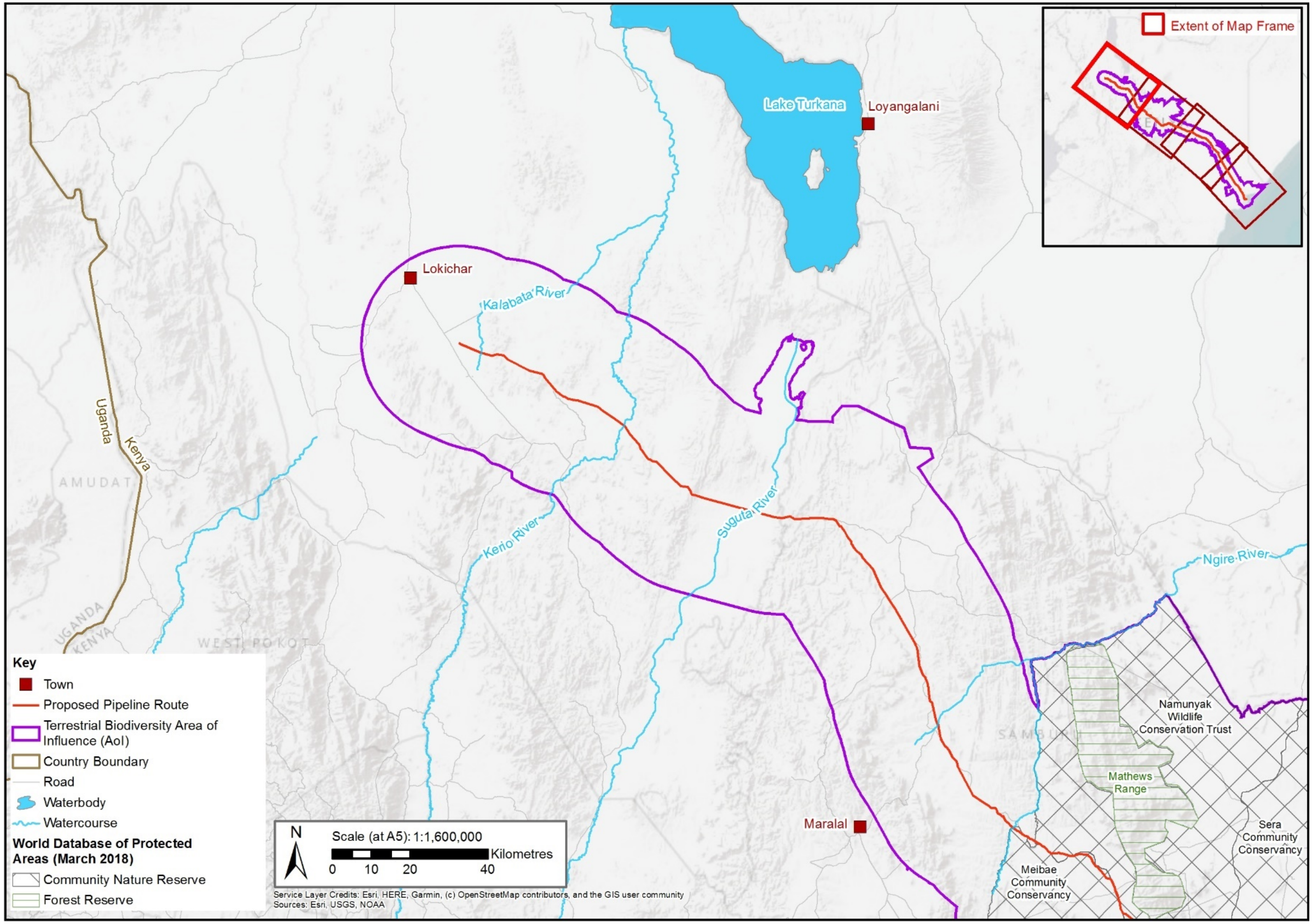

Figure 7.5-2: Protected areas within the AoI (1)

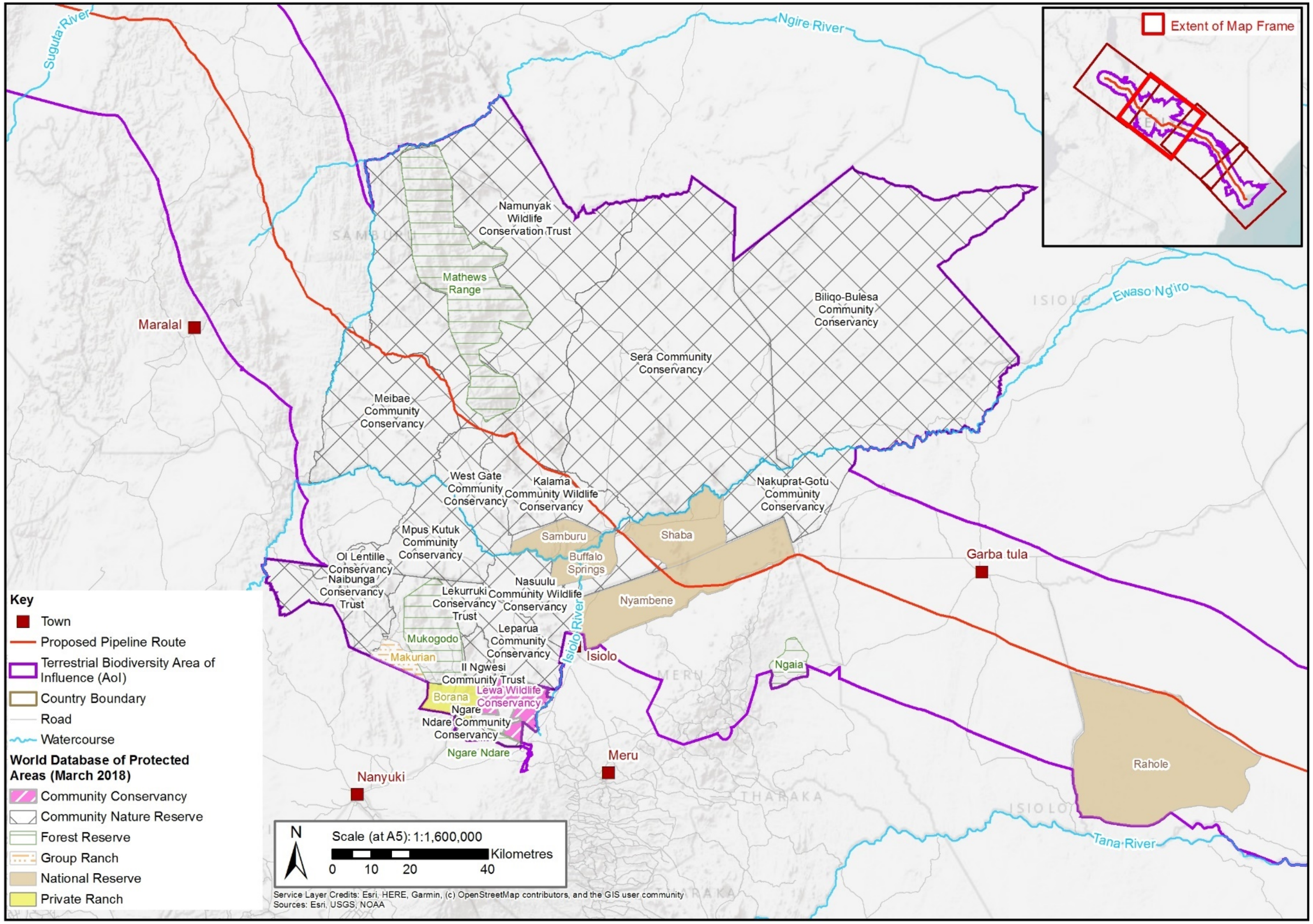

Figure 7.5-3: Protected areas within the AoI (2)

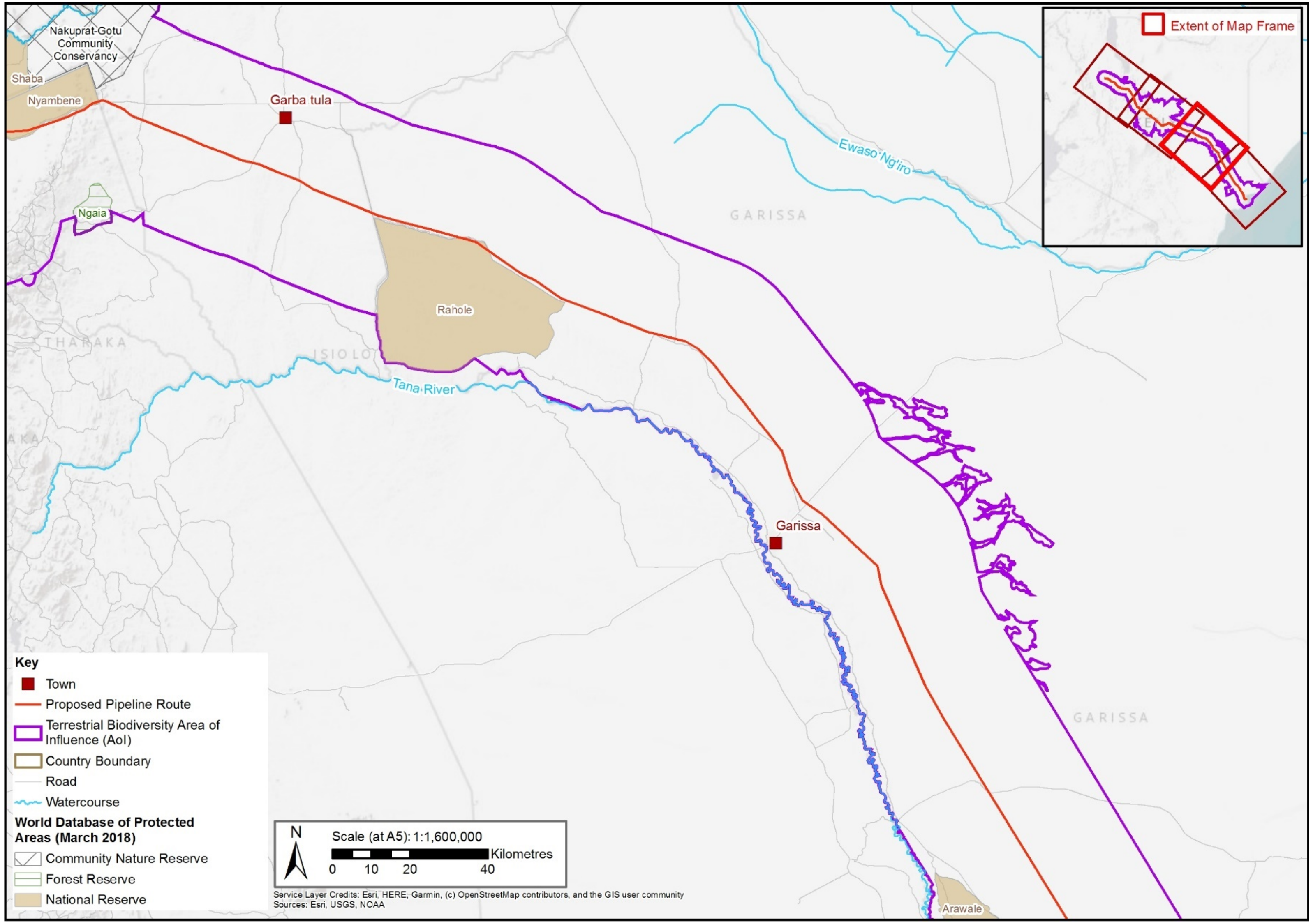

Figure 7.5-4: Protected Areas within the AoI (3)

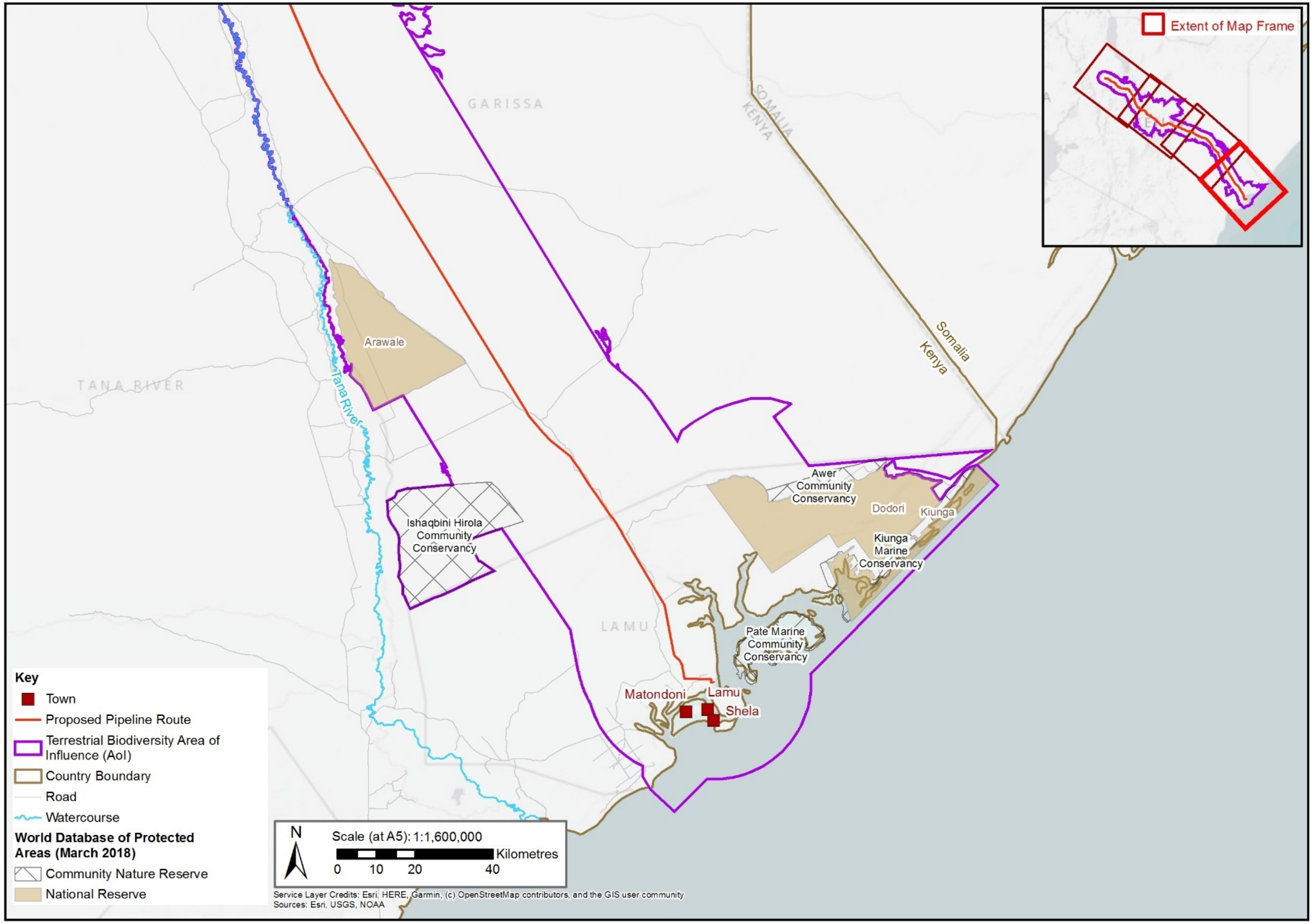

Figure 7.5-5: Protected areas within the AoI (4)

7.5.6 Potential Sources of Impact

Direct (within, and immediately adjacent to the Project footprint) and other non-footprint direct impacts (for example, sensory disturbance and edge impacts) were superimposed on the habitat mapping in GIS to evaluate the magnitude and extent of impacts on habitats.

Loss of habitat due to direct disturbance associated with the Project was quantified by overlaying the current, baseline extent of the habitat with the Project footprint. Additional, indirect impacts to habitat receptors were estimated by applying the results of other technical discipline impact analysis to indicate possible changes in habitat quantity and/or quality caused by edge impacts, fragmentation, sensory disturbance (light, noise, vibration), and air emissions and dust. It should be note, that the majority of, these impacts are wholly temporal in nature. The transient nature of these impacts reduces the magnitude to receptors.

Species and Habitat Receptors

Indicators used to assess impacts to species receptors were:

- No mortality of individuals; survival and the subsequent ability to reproduce;
- Maintenance of species functional habitat connectivity;
- Vegetation restoration and establishment efficacy post construction; monitoring to review the timely restoration of floral species composition and the potential introduction of invasive species; and
- Measurable changes in habitat quality and quantity from baseline.

The analysis focuses on quantifying potential Project impacts relative to baseline conditions.

Potential changes in survival and reproduction were assessed qualitatively by considering potential disturbances (that is, severance (temporary and permanent) traffic, light, noise and vibration). These disturbances were considered with relation to known or inferred impacts to the survival and reproduction of species for which data on these types of impacts are available as presented in published literature and in consultation with experts. Changes in habitat connectivity were assessed by identifying potential barriers, including sensory barriers, to movement and species mobility.

Species-specific habitat loss was quantified by overlaying known species distribution data with the proposed Project footprint. At the species level, the concept of a self-sustaining[3] population was used as a benchmark when describing the magnitude of an impact.

Identification of Impacts

Potential sources of impacts have been interpreted with other technical disciplines to ensure that a coherent and holistic approach has been applied. As such, the biodiversity impact assessment has used results from impacts analysis from the following Project disciplines:

- Air Quality (Section 6.2);
- Noise and Vibration (Section 6.3);
- Water Resources (Section 6.4);
- Soils, Geology and Geohazards (Section 6.5);

[3] A self-sustaining population is one that will be maintained into the future with a low risk of extirpation (local extinction). Long-term population persistence is the outcome of maintaining viable populations and maintaining or achieving self-sustaining populations is frequently applied as a conservation target by conservation biologists and resource managers (Fahrig 2001; Nicholson *et al*. 2006; Ruggiero *et al*. 1994; With and Crist 1995). By definition, self-sustaining populations are not populations at the brink of extirpation; they are healthy, robust populations capable of withstanding environmental change and accommodating random population processes (Fahrig 2001).

- Traffic and Transport (Section 6.8);
- Social (including influx, livelihoods, land use and ownership, community health, safety and security, tourism etc. Section 6.12));
- Emergency, Accidental and Non-Routine Events (QRA, OSM results etc., Section 6.14)); and
- Traffic (Section 7.8).

The Project has the potential to cause impacts on biodiversity during all its phases. The Project description (Section 4) has been reviewed, and key activities and sources of impacts relevant to biodiversity are presented below.

Potential Construction Phase Impacts

Direct impacts on habitats and species:

- The temporary and permanent land take required to accommodate and construct Project facilities;
- Temporary habitat severance;
- Construction camp land take and disturbance;
- Increases in air emissions (NO_x, SO_x and CO) and dust deposition during construction;
- Sensory disturbance (light, noise, vibration, odour);
- Direct mortality of fauna (e.g. on roads, in open trenches);
- Temporary changes to surface water regimes;
- Discrete spillages of contaminants due to poor working practice;
- Waste generated from the Project activities, including solids and liquids e.g. hydro-test water; and
- The introduction and spread of invasive pests and diseases.

Indirect Construction Impacts resulting from the Project including:

- Population influx to nearby settlements during construction, and subsequent increases to natural resource harvest, bushmeat hunting and grazing/browsing pressure on vegetation communities and habitats;
- Increased access for people and vehicles (via the permanent easement and roads); and
- Creation of temporary artificial water bodies through the development of discharge settling ponds for hydrotesting.

Potential Operations Phase Impacts

- Increased access for people and vehicles (via the permanent easement and roads).
- Operational fire risk.
- Discrete or large-scale spillages of contaminants due to failure of Project infrastructure or poor working practice.
- Increases in air emissions during operation from station generators.
- Sensory disturbance (light, noise, vibration, odour) from operational activities.

Decommissioning Phase

- Increase in footfall and vehicular movements associated with decommissioning of the Project.
- Management of water used to flush the pipeline prior to decommissioning of the Project.

Methods for Identifying and Assessing Impacts

Impacts were assessed for Project activities that are likely to result in a measurable change, which could contribute to adverse impacts to receptors, relative to baseline or guideline values. Changes in condition were defined as changes to the size or function of a population, habitat, or ecosystem from baseline condition. Methods to estimate change in condition included models, calculations, and qualitative analyses based on available information from baseline reports, scientific literature, and expert consultation. The biodiversity impact assessment follows the overall methodology described in Section 3 and its results focus on the impacts of the Project on Species of Conservation Concern (SoCC)[4] only. The following sections provide some of the criteria used to evaluate the impacts.

Sensory Impacts – Noise, Lighting and Vibration

- Vibration and noise. Noise is considered to affect species presence and distribution when ambient levels exceeded 45 dBA. This threshold is a general approximation for disturbance of wildlife is based upon the threshold for night-time disturbance of people defined by the World Bank Group (1999). Vibration has the potential to affect species in particular mammals of the genus Heterocephalus including the naked mole rat (*Heterocephalus glaber)* can be affected by seismic and vibration disturbances described by Šklíba *et al* (2008).
- Light disturbance will result from Project infrastructure because Project infrastructure must be lit at night to ensure minimum health and safety standards. Interactions between nocturnal receptors (in particular, terrestrial invertebrates, birds and bats) and light sources are predicted to be most important during construction and operation of the Project where light placement may be adjacent to receptor habitat. Lighting can decrease habitat use by nocturnal species adapted to night-time conditions or lead to increased mortality of individuals that may be attracted to lights.
- Odours can attract certain animals, or they can elicit avoidance behaviours because the odours are associated with human presence. Odours will originate from human presence, chemicals, food, and waste.

Habitat Loss, Modification and Fragmentation

- Habitat loss, modification and 'edge' impacts. Edge impacts concern the reduction of available habitat area for a receptor and also the cumulative increase in circumference that separates adjacent habitats. This exposes the remaining species within the available habitat to a different ecosystem network.
- Permanent and temporary land take will occur in congruence with the Project footprint. Areas where habitat is restored along the Project route may experience altered species composition resulting in a loss of biodiversity despite restoration efforts. Habitat availability may also result from temporary and permanent sensory disturbance.
- Surface water flow may be altered in lugga and river systems. Open cut river crossings may discretely alter channel morphology, flow and substrate composition.
- Physical habitat severance and adverse impacts to ecological connectivity. Habitat severance is particularly focussed on mega-fauna and other SoCC. Severance that impedes species whist they

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([4]) Due to the number of features which might have been considered in the impact assessment, they were prioritised so that only features defined as being of high importance, or of lower importance but expected to have a significant impact, are included in this biodiversity impact assessment section.

undertake seasonal migration or prevents access to water and grazing at crucial parts of their life cycle has the potential to be particularly damaging.

- For emissions of NO_x and SO_x, the vegetation guideline value over which impacts are predicted is 30 µg/m³, averaged over a year (World Health Organisation (WHO), 2000). This is the guidance value used in this assessment. Concentrations of NO_2 may have a beneficial impact (that is, increasing growth) at low concentrations in the range of 20-90 µg/m³ (Hutchinson and Meema, 1987; WHO, 2000, Adam *et. al*., 2008). Above 90 µg/m³, NO_2 is expected to have a negative impact on vegetation (Amundson and Maclean, 1982, in Adam *et al.,* 2008). Given that the construction will be moving along spreads as work progresses, impacts related to construction deposition are likely to be low to negligible.
- Dust deposition on vegetation can reduce the quality of habitats or degrade it to a point where it is no longer viable. A clear guideline value to protect vegetation from dust is not available. The guideline value for the loss of human amenity value is based on a threshold of 350 mg/m^2/day. Given that the construction will be moving along spreads as work progresses, impacts related to construction dust deposition are likely to be low to negligible.
- The introduction of exotic and invasive species, and/or the spread of established populations of such species.
- Hazards, such as oil and chemical spills and accidents, have the potential to reduce habitat quality and quantity. However, oil and chemical handling, storage, and spill response are expected to be part of the Projects standard policies, Environmental Management Plans, and emergency procedures. Furthermore, given the high wax content of the oil, if a leak did occur, it is doubtful that the oil would flow very far. The potential impacts of environmental risks and accidents are assessed in Section 7.17.

Direct (within, and immediately adjacent to the Project footprint) and other non-footprint direct impacts (for example, sensory disturbance and edge impacts) were superimposed on the habitat mapping in GIS to evaluate the magnitude and extent of impacts on habitats.

Loss of habitat due to direct disturbance associated with the Project was quantified by overlaying the current, baseline extent of the habitat with the Project footprint. Additional, indirect impacts to habitat receptors were estimated by applying the results of other technical discipline impact analysis to indicate possible changes in habitat quantity and/or quality caused by edge impacts, fragmentation, sensory disturbance (light, noise, vibration), and air emissions and dust. It should be note, that the majority of, these impacts are wholly temporal in nature. The transient nature of these impacts reduces the magnitude to receptors.

7.5.7 Incorporated Environmental Measures

7.5.7.1 Introduction

Incorporated environmental measures to manage project-related traffic, soils, air quality, noise and vibration, water quantity, water quality, social impacts, and hazard and risk are considered in the relevant chapters.

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are GIIP. The following incorporated environmental measures are specifically relevant to water resources.

The ESIA has used the mitigation hierarchy to assess and minimise impacts. The inherent mitigation has also been supplemented by route selection mitigations focussing on avoidance, informed by baseline biodiversity surveys, as described in Annex II of the ESIA. The mitigation hierarchy (Figure 7.5-6) is utilised in this Project context as a way of avoiding biodiversity impact. This approach is based upon on a series of reasoned, sequential steps that will be taken throughout the Project's life cycle in order to limit any negative impacts on biodiversity.

Figure 7.5-6: The mitigation hierarchy

7.5.7.2 Inherent Design Measures

The measures that have been incorporated into the Project design to reduce impacts or avoid creating them are presented below.

Mitigation: Route Selection

The Project has sought to use baseline biodiversity data to inform Project design in accordance with the mitigation hierarchy. The key to successful route selection with regard to mitigation of potential biodiversity impacts is to remove doubt and raise confidence in Project design. As such, the greater the extent of avoidance delivered, the higher the likelihood of minimising biodiversity impact. Project route selection has evolved over time and this process has been informed by biodiversity data collected as part of the ESIA process. The following route optioneering examples show how biodiversity data has been used to support final route selection.

Kilometre Point (KP) 0 – KP 49: CPF to Kerio River (Turkana County)

Between Kilometre Point (KP) 0 – KP 49 slight deviations were made to avoid ephemeral watercourses and riparian vegetation recognised as exhibiting higher value habitat. This measure resulted in only minor increases in straight-line length, due to changes in surface conditions, including from sandy sediment to surface rock and boulders.

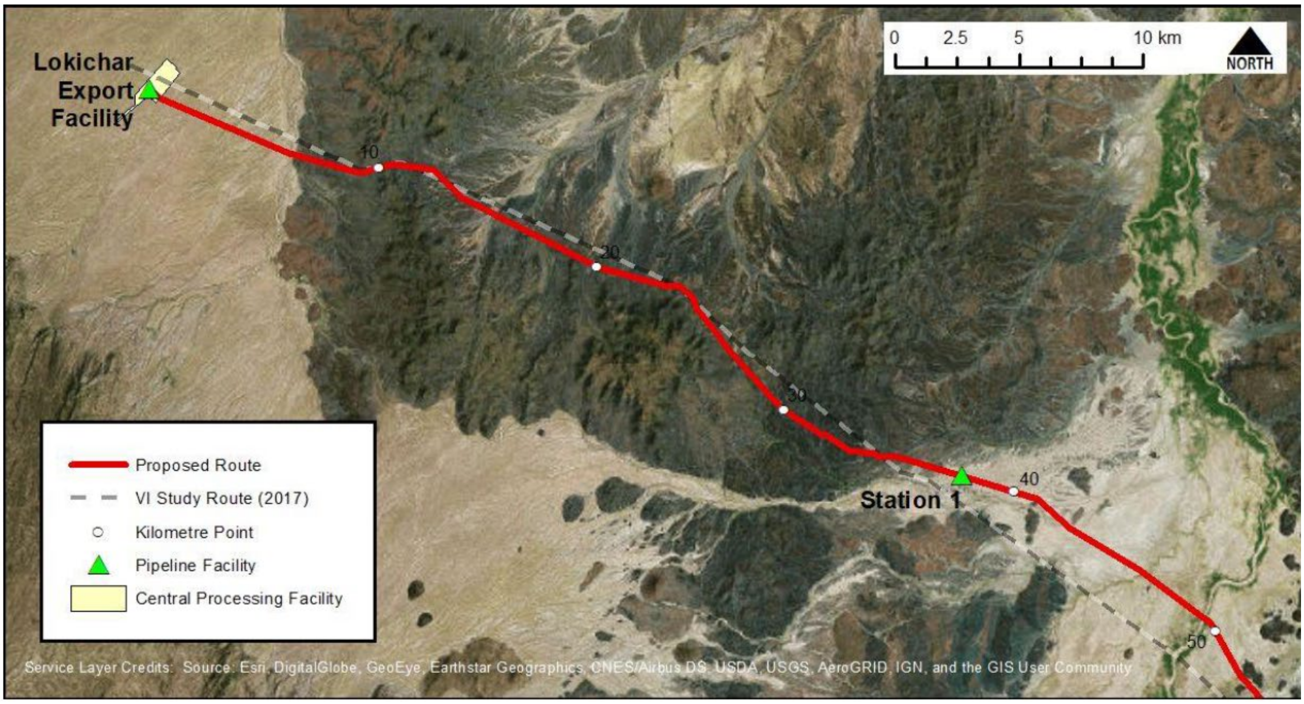

Figure 7.5-7: KP0 to KP49

KP 49 – KP 50: Kerio River (Turkana County)

The first of three permanent rivers on the Project route is the Kerio River, which is approximately 150 m wide at the identified crossing location (Figure 7.5-8). In consultation with the Project team, including biodiversity specialists, the crossing location was revised and moved 1.8 km downstream (northwards) to a location that is narrower, on a straighter stretch of river, and with less impact on riverine wooded vegetation, a habitat defined by Van Breugel *et. al*. (2015).

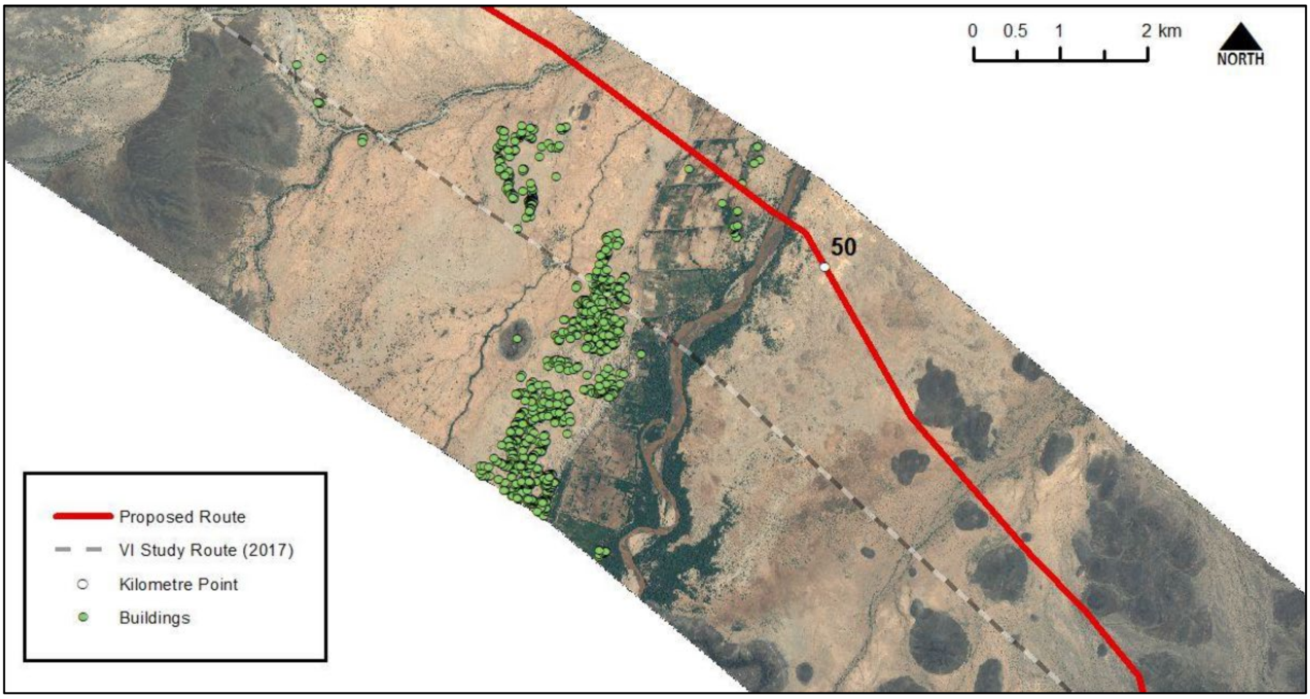

Figure 7.5-8: The Kerio river crossing

KP 112 – KP 248: Baragoi to Matthews Range (Samburu County)

At KP207, the Project enters the first community conservancy known as Meibae. There are a number of conservancies forming part of the Northern Rangelands Trust, covering extensive areas of land from Isiolo to Marsabit. Whilst avoiding these areas is not possible, consultation with the Project team, including biodiversity experts from the National Museum of Kenya (NMK), has resulted in efforts being made to route the Project adjacent to existing roads wherever practicable to minimise the impact. Areas of disturbed or modified habitat, such as existing trackways, have taken precedent regarding route selection over areas of natural habitat[5] in order to avoid and minimise impacts to natural habitat.

KP 220 – KP 255: Routing Adjacent to Wamba (Samburu County)

Baseline biodiversity studies presented as Section 6.6 indicated that the Project route may conflict with areas of important habitat for the Grevy's Zebra (*Equus grevyi*). Kenya supports approximately 90% of the global population of Grevy's Zebra (KWS, 2012). Furthermore, habitat in and around the Wamba region is recognised as providing 'core' habitat for foaling and weaning (KWS, 2012). Between KP 220 and KP 255, some species-specific route selection mitigation has been adopted. Through engagement with NGOs such as the Grevy's Zebra Trust, review of research published by the Grevy's Zebra Trust and baseline surveys undertaken by the Project team an area of importance for the Grevy's Zebra was identified within the AoI.

[5] Natural habitats are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

After an extensive period of engagement involving the Project team, stakeholders and local experts, an agreement was reached and the Project route in Figure 7.6-5 was selected to minimise biodiversity impacts to this species.

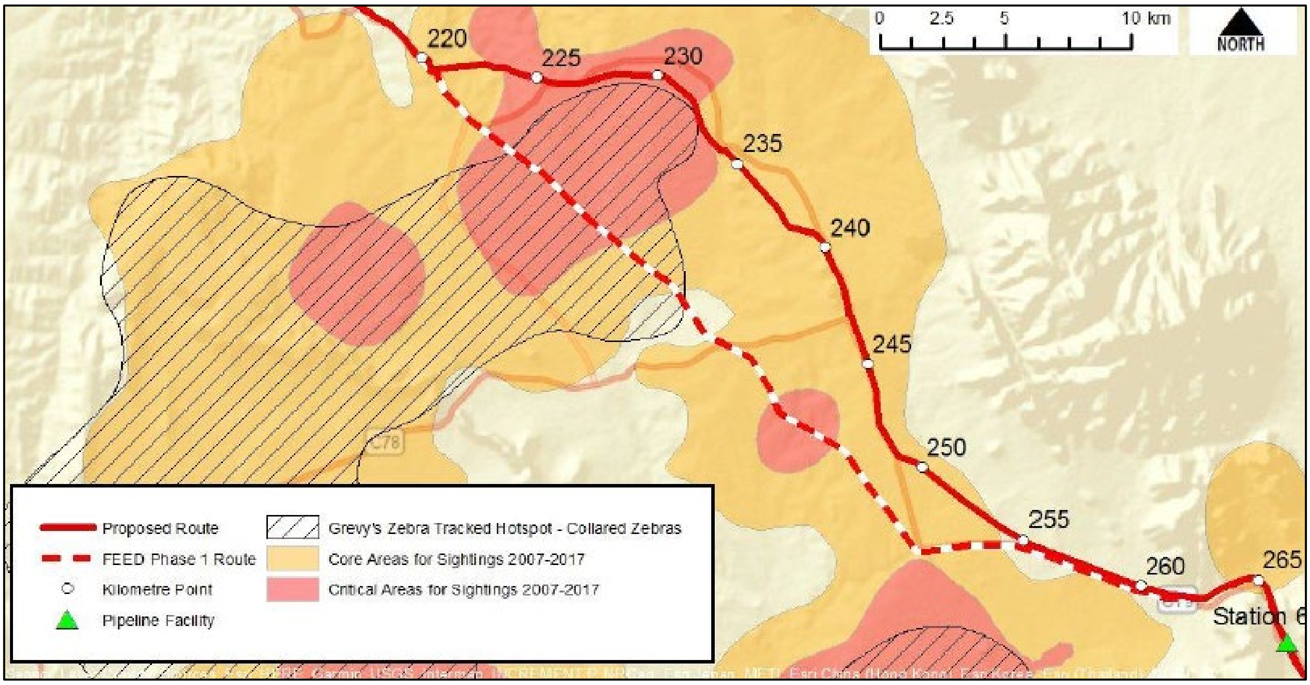

Figure 7.5-9: Avoidance of key Grevy's Zebra area between KP220 and KP255. Old route red dashed and new route solid red line following existing road.

As agreed amongst the stakeholders (specifically GZT), the route selected avoids important Grevy's Zebra habitat. Furthermore, following ground truthing, it was concluded that the new route was able to run parallel to existing roads and tracks that are already disturbed habitats. As such, the Project will be situated in modified habitats already experiencing anthropogenic disturbance and used infrequently by Grevy's Zebra (Figure 7.5-10) below.

Figure 7.5-10: Samburu County, over grazed habitat damaged by livestock.

Figure 7.5-11: Samburu County, example of optimum habitat. Taken just a few hundred meters from Figure 7.5-10 and illustrating stark differences in habitat quality.

KP 302 – Ewaso Ng'iro River Crossing (Samburu/Isiolo County)

The Ewaso Ng'iro River Crossing at KP302 (Figure 7.5-12) close to Archer's Post is the third permanent river crossing along the Project route. This section has been selected to avoid impinging upon Shaba and Buffalo Springs National Reserves at this point. Both these reserves are protected by Kenyan legislation and are also protected as IUCN management category II.

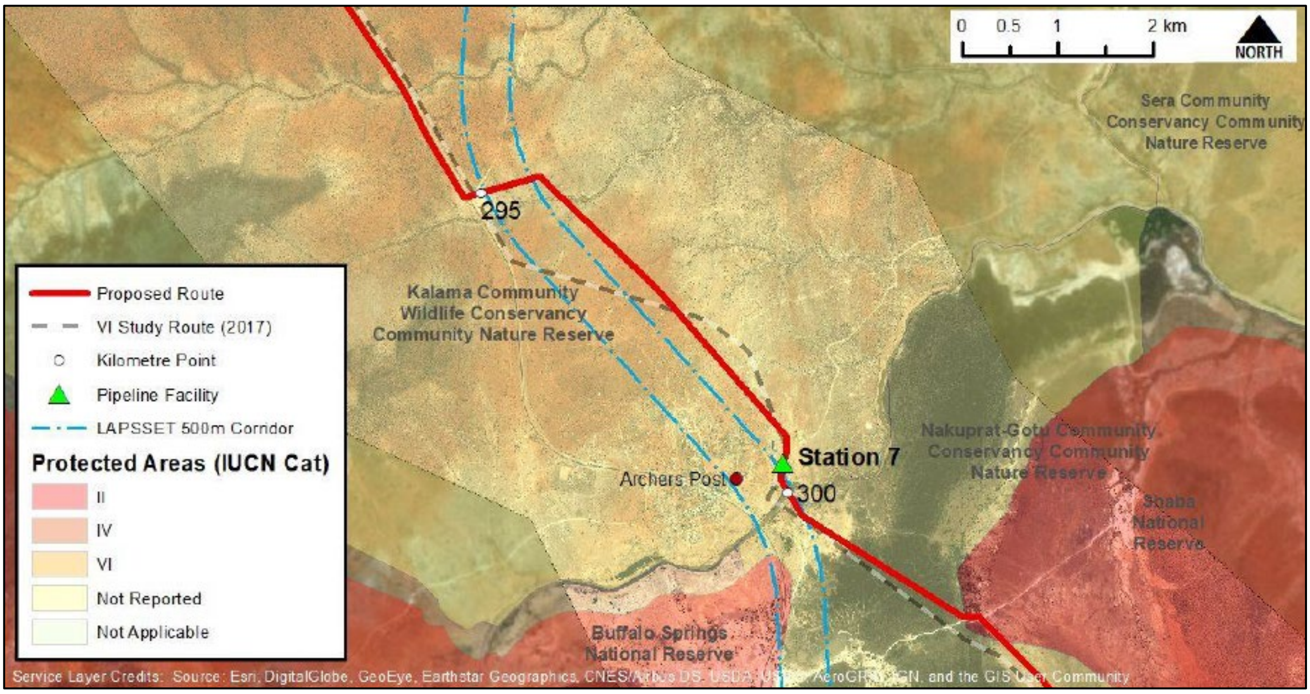

Figure 7.5-12: River crossing close to Archer's Post.

KP 603 – KP 742.7: Garissa to Ijara (Garissa County)

At KP603.2, the Project route leaves the existing LAPSSET[6] corridor, which heads towards the Tana River and the town of Bura. The pipeline route takes a direct route to the town of Ijara where it picks up the LAPSSET corridor again. This design avoids a wetland area north of Ijara, which is likely to contain greater levels of biodiversity than the Project route now selected. In addition, the route change also increases the distance between the Project and the Arawale National Reserve which hosts species such as the critically endangered Hirola (refer Figure 7.5-13 below).

[6] The Lokichar to Lamu Crude Oil Pipeline (LLCOP) will be routed, for the most part, within the proposed Lamu Port, South Sudan, Ethiopia, Transport Corridor (LAPSSET), LAPSSET is a linear land corridor selected by the Government of Kenya for strategic infrastructure development and is a major initiative for Kenya and the East African region.

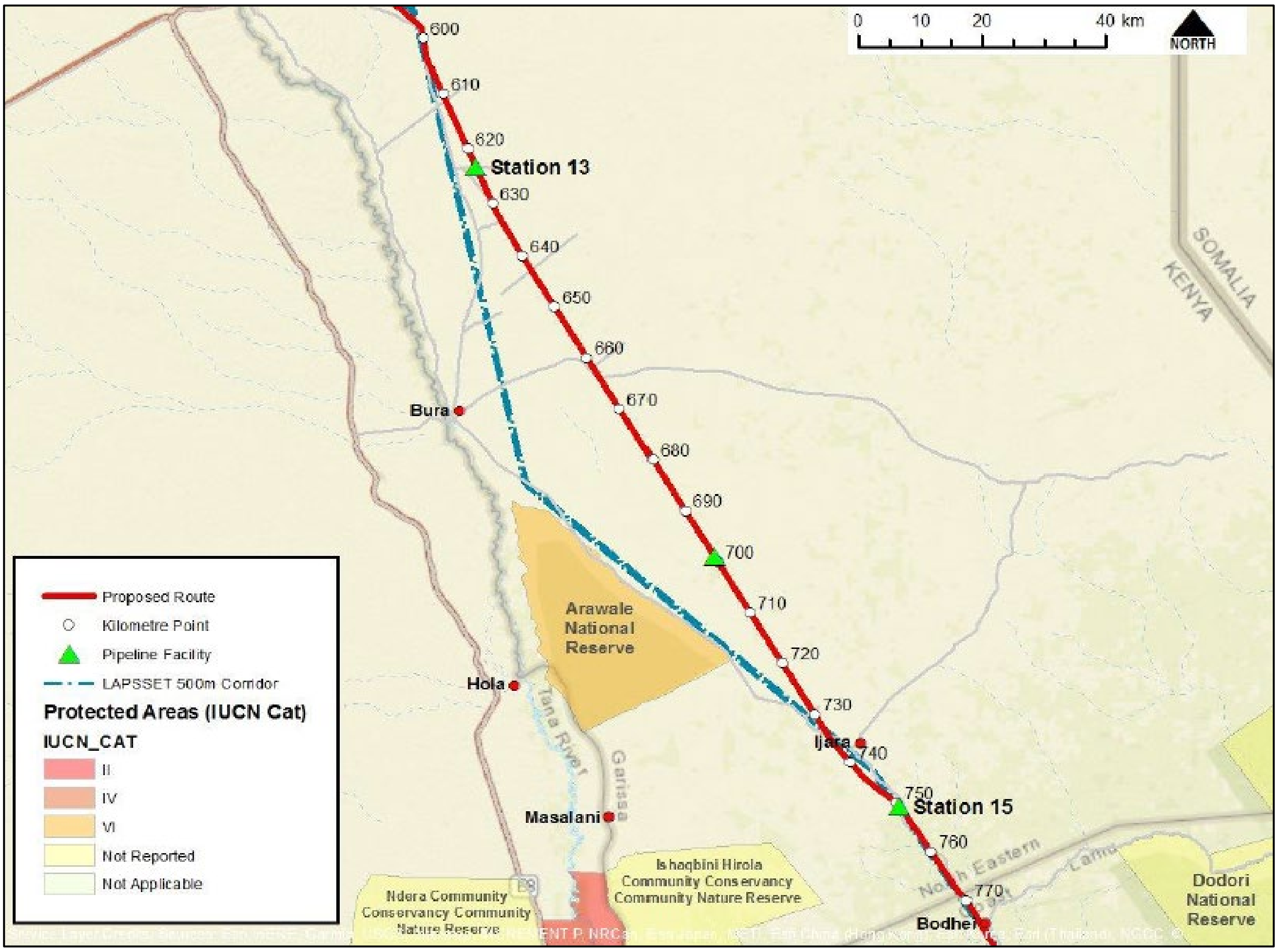

Figure 7.5-13: At KP603.2 the Project has moved avoiding a wetland

7.5.8 Impact Classification

7.5.8.1 Introduction

Taking into account the baseline biodiversity setting (Section 6.7), the relevant incorporated environmental measures (Section 4), and the potential sources of impact (Section 7.5.6), the potential source-pathway-receptor impact linkages for the construction and the operational phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant incorporated mitigation applicable to each receptor are summarised. The magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Section 7.5.3.

7.5.8.2 Construction Phase

National Parks and Reserves

National Parks and reserves (Figure 7.5-14) can be divided into two sub-sets. Those that will be physically crossed by the Project RoW which will be a permanent feature e.g. Rahole and Nyambene National Reserves and National Parks and Reserves that could be temporarily impinged or contain Project infrastructure (potential for species disturbance and severance) via proximity of the Project that will not have a permanent footprint. Those are, Shaba, Samburu, Rahole, Nyambene, Kiunga, Dodori, Buffalo Springs, Arawale. All of these Parks and reserves have been classified as having high sensitivity given the presence of species protected under the Kenya Wildlife Act.

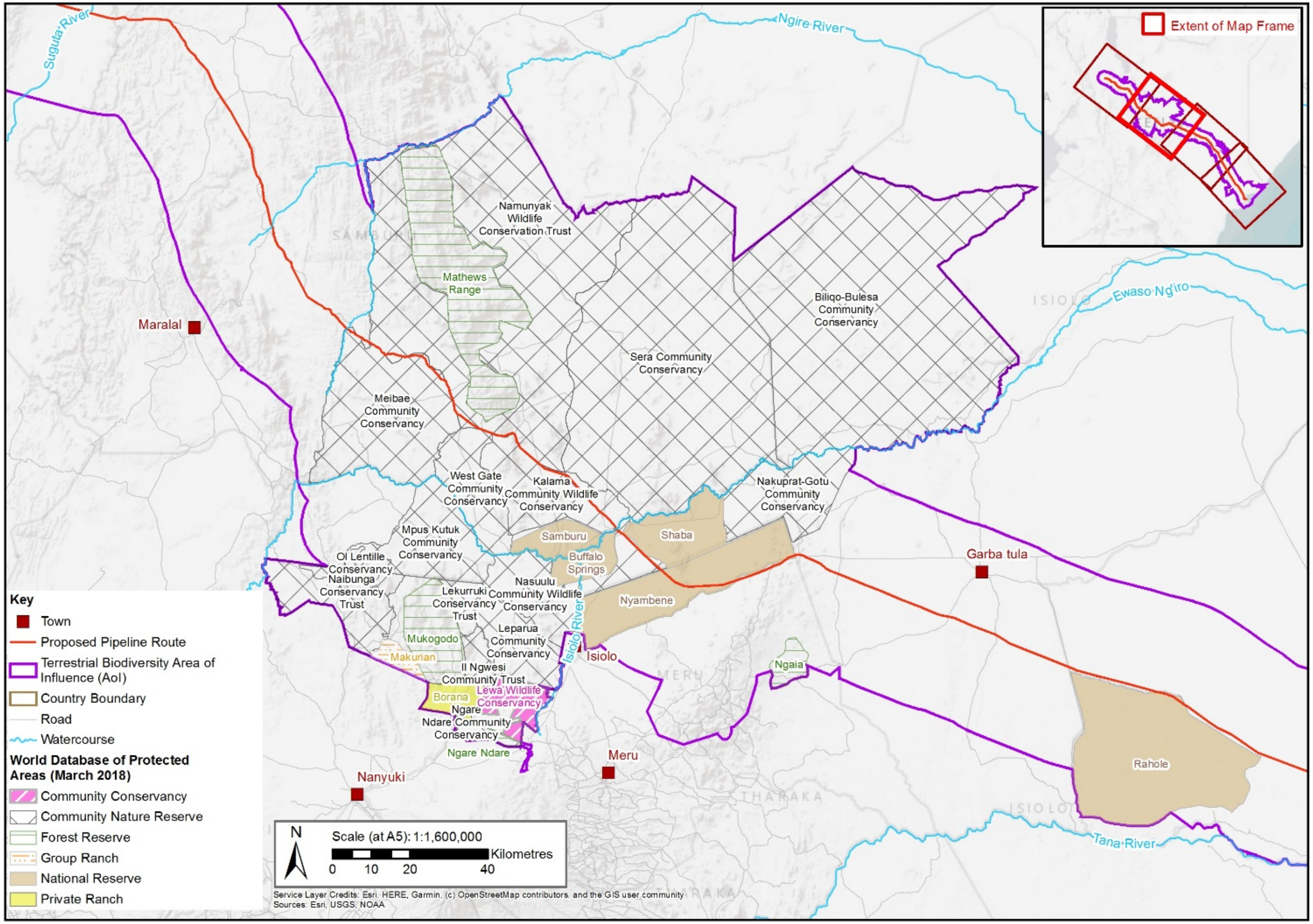

Figure 7.5-14: National Parks and reserves within the key section of the AoI for biodiversity sensitivities

Considering the implementation of inherent mitigation and the exclusion of operational mitigation the impact of the creation of a permanent RoW is considered to be **moderate (adverse)** to Rahole and Nyambene National Reserves**.** Conversely, construction impacts to Parks and Reserves via impingement, that is Shaba, Samburu, Rahole, Nyambene, Kiunga, Dodori, Buffalo Springs, Arawale is considered to be **minor (adverse)** as ecological connectivity will be restored promptly on spread completion.

Community Conservancies

Community Conservancies such as Nakuprat-Gotu, Namunyak Meibae, Kalama, Sera and West Gate will be crossed by the Project during construction. In addition, stations are scheduled to be constructed within Kalama (2 no.) and Awer[7] (1 no.). This has the potential to alter species behaviour, affect water availability and create a linear barrier to species dispersal. These conservancies have been assigned high sensitivity owing to the potential presence of species protected under the Kenya Wildlife Act. Considering the implementation of inherent mitigation and the exclusion of operational mitigation the impact of the creation of a permanent RoW is considered to be **moderate (adverse).**

Permanent Habitat Loss and Fragmentation

Baseline assessment undertaken by the Project team sought to understand the extent to which habitats are degraded, and how that may affect SoCC in terms of presence or likely absence, species density, carrying capacity and ability to maintain ecological functionality. The presence of invasive species; extent of habitat fragmentation; viability of existing naturally occurring species assemblages and resemblance of existing ecosystem functionality all contributed to this evaluation used to formulate an assessment of residual impact as described herewith.

Habitat losses attributed to the Project will either be permanent or temporary in accordance with the restoration proposals. Temporary land take will be a maximum of a 26 m wide RoW during construction. On completion of construction, the Project will retain a 6 m wide permanent easement, (3m either side of the pipeline centreline) within the RoW. There are some restrictions on allowable development within the permanent easement, as access may be required in future for maintenance activities, but the full 26m RoW will be reinstated and the topsoil restored, to allow vegetation to regenerate. Wherever possible, the pipeline route has been selected to utilise existing tracks and roads that are within modified habitat. In addition, construction of stations along the route will also lead to the permanent loss of terrestrial habitat.

It is important to note that the permanent loss of habitat illustrated within Table 7.5-4 does not necessarily correlate with habitat that is in pristine or even natural condition. Much of the habitat within the Project footprint is degraded by overgrazing, erosion, and is also under competitive pressure from non-native and invasive species as described in the biodiversity baseline (Annex II).

[7] Awer appears to have been extended recently but does not historically extend to the Project Footprint

Table 7.5-4: Permanent modification of habitat within a 6 m width for the Permanent Easement and from the footprint of Stations

Vegetation Community	Approximate Area (Ha)
Acacia-Commiphora stunted bushland	80
Somalia-Masai Acacia-Commiphora deciduous bushland and thicket	325
Somalia-Masai semi-desert grassland and shrubland	30
Riverine wooded vegetation	4
Desert	4
Dry combretum wooded grassland	5
Edaphic grassland on drainage-impeded or seasonally flooded soils	22
Coastal mosaic	72
Mangrove	<0.5
Total	**544**

The results of baseline survey undertaken during 2018 and presented in Table 7.5-5 indicates that <1 ha of mangrove would be impacted. Impacts to mangrove habitat is further assessed in the marine impact assessment (Section 7.6). Therefore, the impact of permanent habitat loss is considered to be **low (adverse).**

Permanent habitat loss and fragmentation may occur from non-Project footprint sources. Specifically, the location and volume of water required to pressure test the Project during construction has the potential to permanently degrade habitats. If water is extracted during the dry season, then this will exacerbate pressure on floral and habitat communities already under grazing pressure from domestic livestock and wild fauna. Considering the implementation of inherent mitigation and the exclusion of operational mitigation the impact of un-managed water extraction is considered to be **moderate (adverse).**

Temporary Habitat Loss and Fragmentation

The majority of habitat losses will be temporary in nature (Table 7.5-5). After trenching, pipe-laying and backfilling, the Project team will restore the work area as soon as possible. After the pipeline is backfilled and tested, disturbed areas will be restored as close as possible to their original contours. The magnitude of construction losses to habitats is considered to be low owing to the relatively discrete, short-term and infrequent impacts to habitats during construction. The rapid restoration of the Project spreads, using the soil handling methods detailed in Section 7.4, is likely to result in the re-colonisation of habitats by favourable species, in the short term, that is < 5 years.

Temporary losses of habitat will occur within the entire Project spread and associated footprint. As previously described, these areas will be restored as defined in Sections 7.5. These losses are expected to occur along the length of the Project route and are calculated based on an average spread width of 26 m. As described by National Museum of Kenya (NMK) Botany specialists and presented in Annex II, vegetation outside of protected areas along the Project route was often highly modified largely attributed to pastoralist communities over grazing accessible areas.

Table 7.5-5: Temporary modification of habitat within the working width of 26 m (not including the Permanent Easement or Station footprints which are permanent losses)

Vegetation Community	Approximate Area (Ha)
Acacia-Commiphora stunted bushland	260
Somalia-Masai Acacia-Commiphora deciduous bushland and thicket	1,050
Somalia-Masai semi-desert grassland and shrubland	95
Riverine wooded vegetation	15
Desert	15
Dry combretum wooded grassland	15
Edaphic grassland on drainage-impeded or seasonally flooded soils	75
Coastal mosaic	125
Mangrove	1
Total	**1,651**

Temporary losses of habitat will occur within the entire Project spread and associated footprint. As previously described, these areas will be restored as defined in Sections 7.5. These losses are expected to occur along the length of the Project route and are calculated based on an average spread width of 26 m. As described by National Museum of Kenya (NMK) Botany specialists and presented in Annex II, vegetation outside of protected areas along the Project route was often highly modified largely attributed to pastoralist communities over grazing accessible areas.

Furthermore, field observations indicated that areas of Wamba, Archer's Post, and within Garissa County (mainly used by pastoralist communities and hence enjoy minimal protection status) were mostly comprised of highly modified Acacia bushlands and small sections of Acacia-Commiphora bushlands. Generally, these areas were overgrazed, and, as a result, had high rates of soil erosion and low floristic diversity.

The primary drivers of change in vegetation communities in the AoI are overgrazing by livestock (primarily goats, donkeys and camels), and timber harvest for firewood and/or charcoal production. The intensity of these existing impacts tends to increase with the proximity to areas of permanent settlement and with proximity to water supply points, and roads.

In contrast to much of the Project route, which exemplified areas of high degradation, sampling points around Shaba National Reserve, specifically within the protected area, comprised habitats that were minimally disturbed Acacia-Commiphora vegetation types. In addition, as described in baseline Field reports (Annex II), areas of high botanical diversity and endemism were noted at Station 6 in Wamba; point 2 Shaba National Reserve in Isiolo_N00037'29.4"; E37041'07.9"; and point 3 N00034'27.5"; E38005'26.9" in Isiolo, on Isiolo-Mandera road.

Sensitive habitat areas encountered, can be adversely affected by a number of factors. The materials used in the construction of haul and access roads have the potential to influence natural habitats and species composition. Surface water run-off from new or upgraded service roads and tracks may alter the soil or substrate quality, with a potential transition from natural to modified vegetation communities. Erosion control measures in the Project design will lessen such impacts, however any change may further benefit alien or invasive species introduced by increased road traffic. Some local species with broad habitat tolerance may also benefit from increased ground disturbance and change in soil conditions.

Habitat degradation could also occur in the event of a construction-related fire. Re-fuelling of plant and machinery, metal welding and cutting, and the storage of fuel and third-party vandalism all create fire risk that could contribute to species loss. Considering the implementation of inherent mitigation and the exclusion of operational mitigation the impact of temporary habitat loss is considered to be **minor (adverse).**

Invasive Plant Species

Invasive species can cause severe detrimental impacts to local ecosystems. Seven invasive plant species were recorded in the AoI (Table 7.5-6).

Table 7.5-6: Alien invasive plant species recorded along the pipeline corridor along with the vegetation communities they were recorded in

Family	Species	Vegetation Community
Cactaceae	*Opuntia vulgaris*	Riparian woodland
Solanaceae	*Datura stramonium*	Riparian scrubland and Riparian woodland
		Riparian heavily invaded by *Prosopis juliflora*
Leguminosae	*Prosopis juliflora*	Riparian vegetation with sand dunes and *Hyphaene compressa*
		Vachellia reficiens shrubland
		Riparian scrubland amd Riparian woodland
		Riparian woodland heavily invaded by *Prosopis juliflora*
Poaceae	*Setaria verticillata*	Acacia woodland/shrubland
Solanaceae	*Solanum campylacanthum*	Riparian scrubland
		Broadleaf woodland community
		Vachellia reficiens shrubland
		Riparian scrubland
		Acacia woodland/shrubland
		Disturbed shrubland community
Asteraceae	*Tagetes minuta*	Riparian scrubland
		Riparian woodland heavily invaded by *Prosopis juliflora*
Asteraceae	*Xanthium strumarium*	Dwarf acacia shrubland

Although the origins and pattern of introduction of invasive species into Kenya are not well known, research on invasions is limited though virtually all countries in the East African region are affected by the problem (Gichua, *et al.* 2013). Even given the precautions for soil handling and management in Section 7.4, risks of introducing these species throughout the Project route are posed.

Considering the implementation of inherent mitigation and the exclusion of operational mitigation the impact of invasive species is considered to be **minor (adverse).**

Temporary habitat severance, fauna impacts and water availability

In the absence of mitigation; construction of the Project could constrain ecological connectivity for a number of species (Figure 7.5-15), that may be reliant on movement as part of their ecological function. The impact of constraining the movement of species would be commensurate with the sensitivity of the receptor and the magnitude of the severance. Large mammals such as African elephant (*Loxodonta africana*), Reticulated Giraffe (*Giraffa camelopardalis reticulata)* (Figure 7.5-16) and Lion (*Panthera leo)* are likely to be present within Samburu, Meru and Isiolo counties that the Project dissects.

Equally, small mammals and herpetofauna are not immune from severance impacts. The mammal species listed in Table 7.5-7 were recorded in the AoI. All of these species rely on ground or arboreal connectivity, and habitat severance would constrain their ability to maintain ecological functionality. In the absence of mitigation, the consequence of these impacts is likely to be **moderate (adverse)** rather than major as the impacts would be temporal in nature ceasing once the Project construction is complete.

Habitat severance afforded to the mammals listed in Table 7.5-7 will be temporary in nature. Water availability and quality has the potential to impact SoCC. The location and volume of water required to pressure test the Project during construction has the potential to reduce the availability of water resources for species within the Project footprint. If water is extracted during the dry season then this will exacerbate pressure on species, potentially at key points in their lifecycle for example when they are lactating or during their gestation period. Species such as Hirola and Ader's Duiker are considered to be critically endangered (CR) in accordance with the Kenyan Wildlife Act.

In addition, the Hirola is also considered to be CR in accordance with the IUCN classification. However, although the Project is technically within the extant natural range for this species the remaining population outside of the Ishaqbini Community Conservancy is likely to be virtually extinct. Indeed, surveys in 2011 suggested a population of 402-466 animals (ca 280-330 mature individuals) within their natural range (King et al. 2011). However, numbers have fallen steadily since; few if any remain in Arawale National Reserve. The population in Ishaqbini Community Conservancy outside the predator-proof sanctuary fell from 152 in 2008 to 63 in 2016, though some of this decline is accounted for by the 48 animals transferred into the sanctuary: these had increased to 97-103 in February 2016 (King et al. 2016).

The total population is now likely to contain <250 mature individuals. Consultation with the Hirola Conservation Program and review of the Abdullahi (2019) report indicates that one of the biggest threats to Hirola conservation is the spread of the invasive and alien *Acacia reficiens* tree which has transitioned former open grassland habitats into scrubby bare ground mosaic habitats of little conservation value. Habitat restoration for reducing fragmentation, and semi-captive breeding have been high on the list in efforts to recover the ailing population of Hirola. Sanctuary-bred Hirola are to be released in their historic range that includes current areas that form part of the AoI (Abdullahi, 2019). Given the scarcity of this species it is considered unlikely that any interactions between the Project and this species will be afforded. However, on a precautionary basis, Hirola are discussed within the mitigation sections of this section of the ESIA.

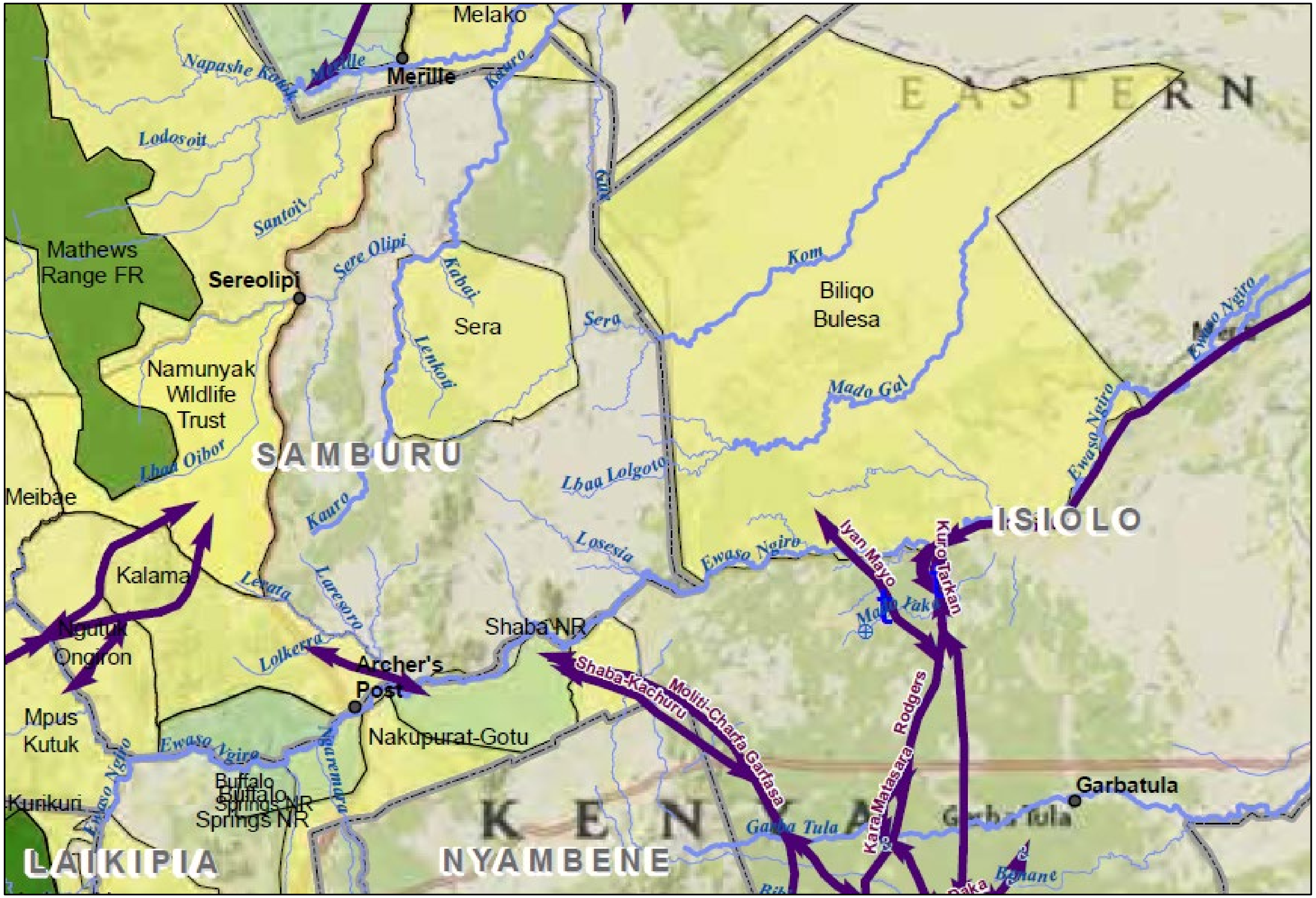

Figure 7.5-15: Elephant movements associated with the AoI documented by KWS (Wildlife Corridors and Dispersal Areas, Ojwang *et al* (2017))

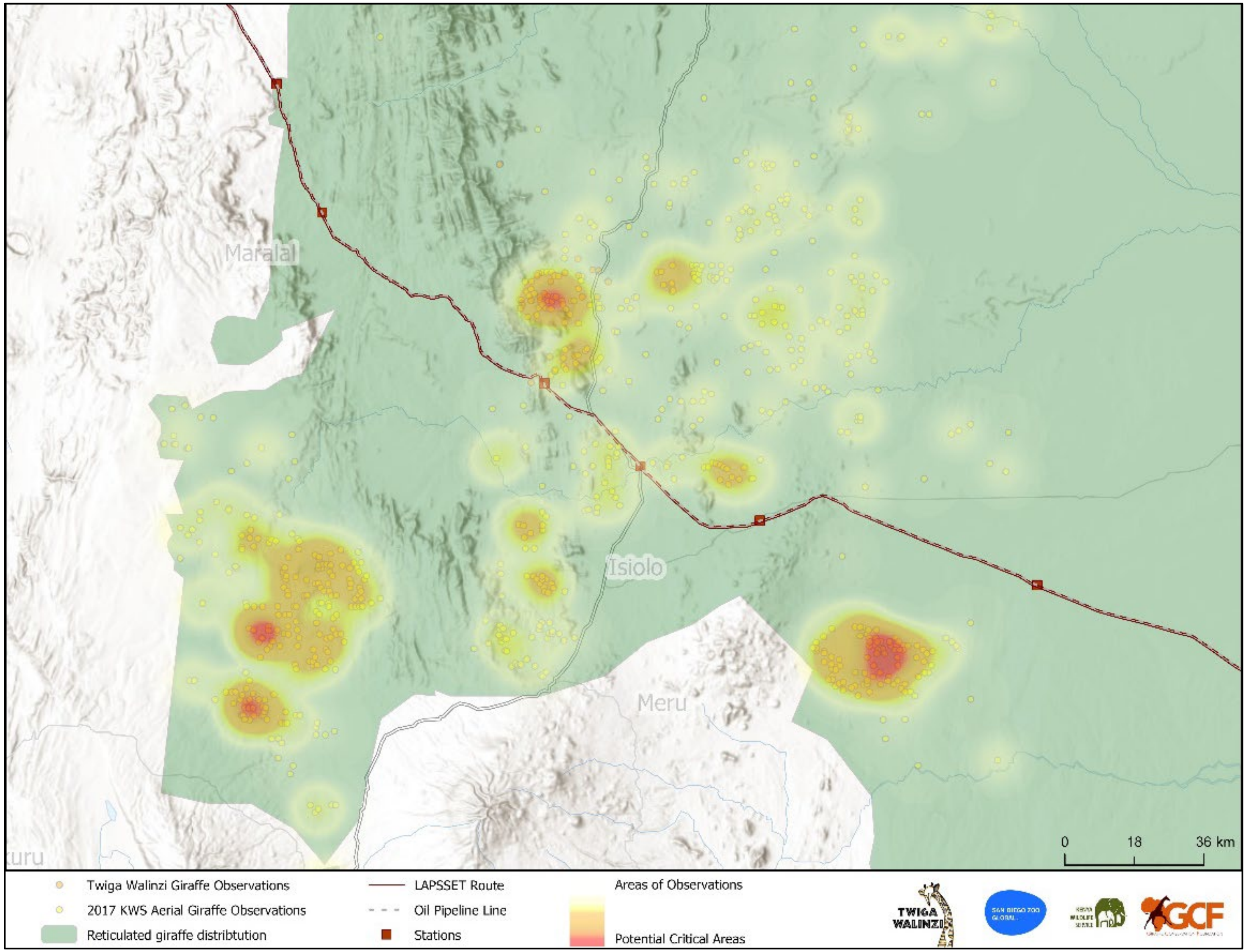

Figure 7.5-16: Reticulated giraffe distribution and critical areas in relation to the Project.

Table 7.5-7: Mammal species within the AoI potentially sensitive to severance

Scientific Name	Common Name	Conservation Status				
		Kenya	IUCN Red List	CMS[8]	CITES[9]	Other
Beatragus hunteri	Hirola	CR	CR	-	-	-
Cephalophus adersi	Ader's Duiker	CR	VU	-	-	-
Equus grevyi	Grevy's Zebra	EN	EN	I	I	-
Galagoides cocos	Kenya Coast Galago	-	LC	-	II	-
Hyaena hyaena	Striped Hyaena	EN	NT	-	III	-
Loxodonta africana	African Elephant	EN	VU	II	I/II	-
Lycaon pictus	African Wild Dog	EN	EN	II	-	-
Oryx beisa	Beisa Oryx	-	EN	-	-	-
Otolemur garnettii	Garnett's Greater Galago	-	LC	-	II	-
Panthera leo	Lion	EN	VU	II	I/II	-
Panthera pardus	Leopard	EN	VU	II	I	-

[8] Convention on Migratory Species

[9] Convention on International Trade in Endangered Species of Wild Fauna and Flora

Increases in emissions of NO_x, SO_x, CO_2 and dust deposition during construction

Given the mobile and temporary nature of the construction Project, any increases in emissions of NO_x, SO_x, CO_2 and dust deposition during construction are unlikely to measurably contribute to habitat degradation. Plant and machinery will transect the construction spreads moving in a sequential process upon completion of tasks. The inherent mitigation measures committed to by the Project team are likely to minimise this impact to an extent that is not significant in terms of magnitude or residual impact.

Sensory disturbance (light, noise, vibration, odour)

Noise during construction will result from vehicles including plant and machinery used to excavate the pipe trench. In addition, some blasting of rock may be required within Turkana County though this method is an exception rather than the rule on construction. Noise from construction is likely to affect species composition within the Project footprint area on a temporary basis. Some animal species may cease to feed or breed within the proposed Project footprint or could potentially be displaced from affected habitat outside the Project footprint.

It is considered likely that some SoCC, including species protected under Kenyan legislation could be temporarily displaced as they avoid areas of disturbance and activity. However, delivery of committed mitigation measures will minimise these residual impacts. Bird species such as the White-backed Vulture VU (*Gyps africanus*) and Hooded Vulture NT (*Necrosyrtes monachus*) both protected under the WCMA (2013) were recoded within the AoI. These species have large home ranges, they are mobile and sensitive to sensory disturbance. However, these and other bird species are likely to naturally disperse from the Project footprint during construction and given the relatively swift restoration of the spread section by section they are unlikely to be adversely affected and will return to areas once construction activities have stopped in a particular area.

The magnitude of impacts associated with sensory disturbance are considered to be low, limited and experienced over a short timeframe. No additional Project lighting during construction is proposed. Therefore, no additional impacts, in terms of sensory disturbance due to lighting, over and above those already experienced, are anticipated. In the absence of operational mitigation, the impact significance of sensory disturbance to species receptors is considered to be **moderate (adverse).**

Injury/mortality of species receptors

During construction, there will undoubtedly be an increase in traffic localised at the specific spread being developed. This has the potential to increase the levels of species mortality via collision with Project vehicles. In addition, increases in vehicle-related mortality could attract scavenging species receptors, such as White-backed Vulture (*Gyps africanus*), Lappet-faced Vulture (*Torgos tracheliotus*) and Striped Hyena (*Hyaena hyaena*), which may then themselves be subject to increased collision risk.

The temporary open trench, excavated during construction, also has the potential to trap fauna. Mammals, including SoCC have the potential to become trapped within the open trench. In addition, fifty-nine species of herpetofauna (reptiles and amphibians) were recorded within the baseline AoI (44 reptile species, and 15 amphibian species). A full list of herpetofauna species recorded during the baseline biodiversity assessment is provided in Appendix B of the baseline biodiversity report. Herpetofauna are particularly vulnerable to open trench digging. In essence, an open trench acts like a pit fall trap, which could result in individual mortality. As a consequence of this, the magnitude of the unmitigated impact is considered to be **moderate (adverse).**

Indirect impacts resulting from the Project

Indirect impacts may include population influx to nearby settlements during construction, and subsequent increases to natural resource harvest and grazing pressure on vegetation communities and habitats. In addition, the construction of the Project will also increase the prevalence of access tracks for people and vehicles. This will result in greater accessibility to areas previously not exposed to increases in foot fall and regular vehicular movements. In addition, any unregulated increase in access could result in increases in hunting pressure. The regulation of access to the Project RoW, to be defined within the Biodiversity Management Plan (refer operational mitigation), will be critical to the avoidance of indirect impacts associated with increased access. The regulation of access within conservancies and habitats supporting SoCC will be most strictly governed. In the absence of operational mitigation, the impact significance of population influx is considered to be **moderate (adverse).**

Aquatic Habitats and Species

Introduction

Impacts to aquatic habitats and species are concentrated at the construction phase. With the exception, of a spill event operational impacts are limited. As such, aquatic impacts are presented in the construction phase only. This accurately places the focus on the temporal nature of impacts to the aquatic environment. In essence, once a source of impact, to either water quality or quantity (flows or levels) has been removed at the end of the construction periods, baseline conditions can return, so the impacts would be temporary.

Aquatic Fauna

The potential for freshwater aquatic SoCC was identified by Golder (Annex II). This report identified 4 aquatic macro-invertebrate species and 23 freshwater fish SoCC along the pipeline corridor. Of these, 2 species of fish were recorded during the baseline field surveys, namely:

- Neumayer's Barb (*Enteromius neumayeri*), recorded in Kerio River; and
- A subspecies of Nile Tilapia (*Oreochromis niloticus sugutae*), recorded in Suguta River.

However, these fish species are not protected under the WCMA (2013). The Kerio River supported the highest diversity of fish species, with 5 species recorded throughout the survey work. Conversely, Ziwa (an ox-bow lake) was recorded to have the lowest diversity of fish species, only recorded to support African Catfish (*Clarius gariepinus).* There is a potential for impact when construction occurs. For example, in times of low flow dissolved oxygen is likely to decrease, particularly in the hotter months. Fish could become trapped in shallow water during construction activities and fish would also become more vulnerable to predators such as birds. A **minor (adverse)** impact is therefore predicted.

Riparian and Instream Habitats

No riparian floral species protected under the WCMA (2013) were recorded during field surveys. However, the riparian habitats are likely to support SoCC and riparian and instream habitats also provide nursery habitat for fish species as well as facilitating linear species dispersal corridors for fauna. A **minor (adverse)** impact is therefore predicted.

Water quantity and quality

Direct impacts to water quantity and quality, specifically in main and secondary seasonal watercourses, which may adversely affect biodiversity receptors, may include discharging a substance into surface water, which would have a direct impact on surface water quality or; taking groundwater from a borehole would have a direct impact on groundwater and surface water availability. In addition, biodiversity receptors may also be impacted by activities such as ground excavation within rivers (leading to mobilisation of suspended solids), storage of materials and/or waste, maintenance activities, leaks/spills, discharges, abstractions and backfilling.

As described in Section 7.4 (Water Resources) the source (or sources) of water for construction activities, construction workers and hydraulic testing is currently unconfirmed. If water is taken from surface watercourses it could directly impact flows and have an indirect secondary impact on the availability of water for flora and fauna. Discharges to surface water (intended or accidental), and/or temporary blocking of rivers during pipe crossing construction activities, could have the potential to directly impact flow and erosion rates, flood risk, temperature and quality. These changes could also result in indirect secondary impacts on the availability and quality of water to flora and fauna receptors. The consequences of adverse changes to water quality and quantity to biodiversity are considered to be of medium magnitude.

Given that shallow aquifers adjacent to and beneath watercourses could be in hydraulic connection with surface water (i.e. the aquifer could be being recharged by surface water or be providing baseflow to watercourses), direct impacts to surface water could result in indirect impacts to shallow groundwater, and direct impacts on shallow groundwater could indirectly impact surface water. For example, pollution of surface water through a leak or discharge could impact surface water quality and in turn impact shallow groundwater quality if the surface water provides recharge to the aquifer. As such, a **minor (adverse)** impact is predicted.

The construction phase impact assessment with respect to biodiversity is presented in Table 7.5-8.

Table 7.5-8: Construction phase impact classification and impact significance

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Statutory Protected Sites – National Parks and Reserves Protected Under the WCMA 2013						
Rahole and Nyambene National Reserves (High)	▪ Presence of a Project RoW and increased access. ▪ Temporary impingement of ecological connectivity. ▪ The introduction and spread of invasive species. ▪ Reduction in water availability caused by hydrotesting. ▪ Temporary changes to the local hydrological regime. ▪ Fauna road collision of protected species could occur.	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ▪ PipeCo to employ a Biodiversity Officer (BO) to supervise all activities, with a focus on areas of biodiversity sensitivity and implementation of biodiversity-related management controls. BO to prepare location specific Biodiversity Management Plans to address local biodiversity management issues. ▪ BO to have “stop work” authority exercised where there is imminent risk to SoCC. The BO will liaise with key stakeholders such as KWS and conservation institutions to consider all biodiversity issues, including species presence and/or movement in relation to construction schedules and associated activities. ▪ Develop and implement area-specific (for each spread) biodiversity management procedures including pre-construction surveys. Working in collaboration with relevant Conservancies and/or KWS to guide site clearance, pipeline installation and rehabilitation activities. Procedures to be approved by PipeCo prior to commencement of site activities. Develop and implement Wildlife Rescue Procedure for animals becoming trapped within open trench e.g. use crawl boards/fauna ramps at regular intervals along the length of open trench. In areas where potential animal	Low – Short-term – temporary.	Minor (adverse)
Shaba, Samburu, Rahole, Nyambene, Kiunga, Dodori, Buffalo Springs, Arawale (High)	▪ Temporary impingement of ecological connectivity.	Low – short-term – temporary (Geographically discrete, short-term (duration) and infrequent	Minor (adverse)		Negligible – short-term – temporary	Negligible

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	■ The introduction and spread of invasive species. ■ Reduction in water availability caused by hydrotesting. ■ Changes to the local hydrological regime. ■ SoCC Fauna road collision could occur.	during construction)		migration/ movement across the open trench is considered to be a high risk, species-specific measures will be developed and implemented to minimise the length of open trench, discourage wildlife from approaching the open trench, and to monitor the open trench to ensure that any animals trapped are rescued as quickly as possible. Develop and implement an Invasive Species Management Procedure, to include specifications for vehicles and cargo hygiene, site clearance and rehabilitation. ■ All staff receive training on avoiding introduction or spread of invasive species. Invasive Species to be identified and destroyed during vegetation clearance of pipeline RoW and areas designated for other permanent and temporary facilities. ■ Additional area-specific control measures to be developed, in consultation with BO, in identified invasive species "hotspot" areas along pipeline corridor (e.g. areas of major prosopis infestation in southern Samburu, and in the region of Garissa Town). ■ Develop and implement a Wildlife Access Control Procedure. ■ Ensure that biodiversity considerations are taken into account in the selection of sources for hydrotest water. ■ Stations adjacent to conservancy boundaries to be designed to blend in with the surrounding topography. If possible, this should include being		

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				painted in natural colours and landscaping with trees and scrub (natural planting of endemic species) and minimisation of sensory disturbance by no night-time construction and the use of timers and cowls on external lighting/flood lighting during construction. No night working in areas adjacent to National Reserves or Community Conservancies unless agreed and supervised by PipeCo BO. Develop and implement a wildlife awareness component to worker induction and driver training programmes. Implement surface water mitigations as defined in Section 7.3.		

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Community Conservancies						
West Gate, Sera, Ol Lentille, Ngare Ndare, Matthews Range, Nasuulu, Nakuprat-Gotu, Mpus Kutuk, Meibae, Lewa Wildlife, Leparua, Lekurruki, Kalama, Namunyak, Ishaqbini Hirola Community Conservancy, Il Ngwesi Community Trust, Biliqo-Bulesa and Awer Community Conservancy. (High)	■ Presence of a Project RoW increases access. ■ Temporary impingement of ecological connectivity. ■ Reduction in water caused by hydrotesting. ■ The introduction and spread of invasive species. ■ Temporary changes to the local hydrological regime. ■ Fauna road collision of protected species could occur.	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ GIIP construction management procedures, BO supervision, area-specific biodiversity management procedures, Invasive Species Management Procedure, area-specific invasive species control measures, Wildlife Rescue Procedure, Wildlife Access Control Procedure, biodiversity hydrotest considerations, stations adjacent to conservancy boundaries to be designed to blend in with the surrounding topography, no night-time construction, timers and cowls on external lighting, species-specific measures in open trench, wildlife awareness component for workers, Site Restoration Procedure, surface water mitigation (as above).	Low – Short-term, temporary.	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Acacia-Commiphora stunted bushland, Somalia-Masai Acacia-Commiphora deciduous bushland and thicket, Somalia-Masai semi-desert grassland and shrubland. (medium)	■ Temporary land take. ■ Reduction in water caused by hydrotesting. ■ Potential temporary changes to the local hydrological regime including residual heating from the pipe. ■ Increased grazing pressure. ■ Transition from natural to modified habitat. ■ Edge impacts and introduction or spread of invasive species.	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ GIIP construction management procedures, BO supervision, area-specific biodiversity management procedures, Invasive Species Management Procedure, area-specific invasive species control measures, biodiversity hydrotest considerations (as above). ■ Once the pipeline is installed, areas are to be rehabilitated as soon as possible based on a Site Restoration Procedure. ■ Implement surface water mitigations as defined in Section 7.3 (specific to riverine wooded vegetation receptor).	Negligible – Short-term – Temporary	Negligible
Riverine wooded vegetation, Desert, Dry combretum wooded grassland an Edaphic grassland on drainage-impeded or	■ Temporary and permanent land take. ■ Reduction in water caused by hydrotesting. ■ Potential temporary changes to the local hydrological regime	Low – short-term – temporary	Minor (adverse)		Negligible Short-term – Temporary	Negligible

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
seasonally flooded soils. (High)	including residual heating from the pipe. ■ Increased grazing pressure. ■ Transition from natural to modified habitat. ■ Edge impacts; and introduction or spread of invasive species.					
Large and medium Mammals (High)	■ Presence of a Project RoW increased access / Poaching. ■ Temporary impingement of ecological connectivity. ■ Presence of a construction camp. ■ Reduction in water caused by hydrotest. ■ Temporary Changes to the local hydrological regime.	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ GIIP construction management procedures, BO supervision, area-specific biodiversity management procedures, Invasive Species Management Procedure, Wildlife Rescue Procedure, Wildlife Access Control Procedure, biodiversity hydrotest considerations, no night-time construction, timers and cowls on external lighting, species-specific measures in open trench, wildlife awareness component for workers, station design in conservancies (as above). ■ BO to inform relevant Conservancies and KWS of poaching threats identified in the vicinity of construction activities in the pipeline corridor.	Low – Short-Term – temporary	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	■ Sensory disturbance. ■ Fauna road collision of protected species could occur.					
Small mammals and bats (High)	■ Presence of a Project RoW increased access / Poaching. ■ Temporary impingement of ecological connectivity. ■ Reduction in water caused by hydrotest. ■ Changes to the local hydrological regime. ■ Sensory disturbance. ■ Potential mortality in open trench.	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ GIIP construction management procedures BO supervision, BO poaching threat dialogue, area-specific biodiversity management procedures, Invasive Species Management Procedure, Wildlife Rescue Procedure, Wildlife Access Control Procedure, biodiversity hydrotest considerations, no night-time construction, timers and cowls on external lighting, species-specific measures in open trench, wildlife awareness component for workers, station design in conservancies (as above).	Low – Short-Term – temporary	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Herpetofauna (High)	■ Presence of a Project RoW impingement of ecological connectivity. ■ Reduction in water caused by hydrotest. ■ Temporary changes to the local hydrological regime. ■ Potential mortality in open trench.	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ GIIP construction management procedures BO supervision, area-specific biodiversity management procedures, Invasive Species Management Procedure, Wildlife Rescue Procedure, Wildlife Access Control Procedure, biodiversity hydrotest considerations, no night-time construction, timers and cowls on external lighting, species-specific measures in open trench, wildlife awareness component for workers, surface water mitigations (as above).	Low – Short-Term – temporary	Minor (adverse)
Avifauna (High)	■ Mortality of juvenile birds and loss of nests during spread clearance. ■ Birds disturbed by construction methods such as blasting in Turkana region.	Medium – short-term – temporary	Moderate (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ GIIP construction management procedures BO supervision, area-specific biodiversity management procedures, Wildlife Rescue Procedure, no nighttime construction, working, timers and cowls on external lighting, species-specific measures in open trench, wildlife awareness component for workers (as above).	Low – Short-Term – temporary	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding operational mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Invertebrates (Medium)	■ Invertebrate mortality at Project site strip. ■ Entrapment within the open trench.	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ GIIP construction management procedures BO supervision, area-specific biodiversity management procedures, species-specific measures in open trench, wildlife awareness component for workers, timers and cowls on external lighting (as above).	Negligible – Short-term – Temporary	Negligible
Fish (High)	■ Mortality owing to de-watering. ■ Reduction in water caused by hydrotest. ■ Elevated total suspended sediments. ■ Temporary loss of connectivity.	Low – short-term – temporary	Minor (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ GIIP construction management procedures BO supervision, area-specific biodiversity management procedures, biodiversity hydrotest considerations, no night-time construction, species-specific measures in open trench, wildlife awareness component for workers, surface water mitigations (as above). ■ Undertake open cut river crossings at times of minimal flow with method statements reviewed and approved by BO. ■ Undertake fish rescue as required and directed by the BO.	Negligible – Short-term – Temporary	Negligible

7.5.8.3 Predicted Operational Phase Impacts

Predicted impacts on biodiversity during the operational phase of the Project relate to changes in habitat integrity as a result of disturbance and/or changes to behaviour of fauna species receptors as a result of increases in foot fall and vehicular movements, increases in noise and light around stations and also impacts associated with hydrocarbon spills and contaminants. Upon restoration of the Project, during operation, impacts to National Parks, Reserves and Community conservancies are certain to be lower than experienced during construction. The issue of hydrocarbon spills and contaminants is addressed within the Emergency, Accidental and Non-Routine Events section 7.14 of the ESIA.

National Parks and Reserves

Again, it is worth re-iterating that National Parks and reserves can be divided into two sub-sets. Those that will be physically crossed by the Project RoW during operation which will be a permanent feature e.g. Rahole and Nyambene National Reserves and National Parks and Reserves that will be impinged (potential for species disturbance and severance) via proximity of the Project RoW nearby. Those are, Shaba, Samburu, Rahole, Nyambene, Kiunga, Dodori, Buffalo Springs, Arawale. All of these Parks and reserves have been classified as having high sensitivity given the presence of species protected under the Kenya Wildlife Act.

Considering the implementation of inherent mitigation, the impact of the presence of a permanent RoW is considered to be **moderate (adverse)** to Rahole and Nyambene National Reserves**.** Conversely, operational impacts to Parks and Reserves via RoW impingement (proximity), that is Shaba, Samburu, Rahole, Nyambene, Kiunga, Dodori, Buffalo Springs, Arawale is considered to be **minor (adverse).**

Community Conservancies

Community Conservancies such as Nakuprat-Gotu, Namunyak, Meibae, Kalama, Sera and West Gate will be crossed by the Project during the operational use of the RoW. This has the potential to alter species behaviour and may introduce increased footfall to these areas. Additionally, conservancies such as Kalama (on the border with Namunyak) and Awer will have stations positioned within them. Stations 16, 6 and 7 are situated within conservancies. Station 6 and the broader landscape has been identified as an area where Elephant dispersal is likely to occur (Figure 7.5-17 below, blue dots represent indicative dispersal corridors). However, it is considered that the presence of the station will not result in significant behavioural changes to Elephant dispersal in this area given the availability of commuting habitat in the broader landscape. During the operation of the Project elephant, and other fauna are likely to avoid the station before becoming more tolerant of the permanent change in the landform and associated increase in sensory disturbance. These conservancies have been assigned high sensitivity owing to the potential presence of species protected under the Kenya Wildlife Act. Considering the implementation of inherent mitigation, the impact of the creation of a permanent RoW is considered to be **minor (adverse).**

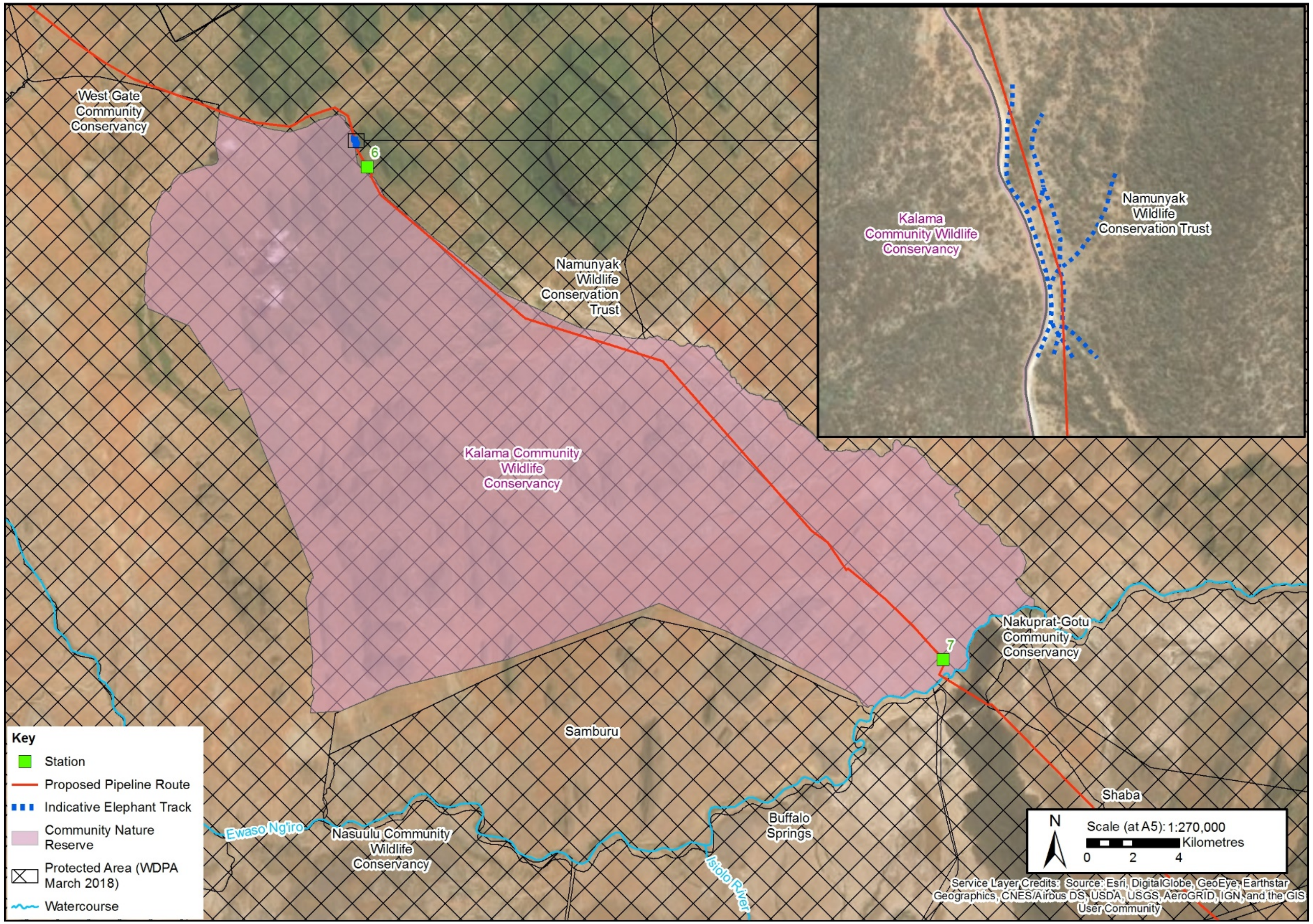

Figure 7.5-17: Habitual elephant movement within community conservancies

Permanent Habitat Loss and Fragmentation

Temporary land take will be a maximum of a 26 m wide RoW during construction. On completion of construction, the Project will retain a 6 m wide permanent easement, (3 m either side of the pipeline centreline) within the RoW. There are some restrictions on allowable development within the permanent easement, as access may be required in future for maintenance activities, but the full 26m RoW will be reinstated and the topsoil restored, to allow the vegetation to regenerate. In addition, permanent land take will occur at station footprints. This also has the potential to fragment habitats, especially where stations occur within conservancies such as Kalama and Awer. This loss of habitat is a residual impact and in the absence of operational mitigation is considered to be a **minor (adverse)** impact.

Invasive Plant Species

As previously described, seven invasive plant species were recorded in the AoI. Riparian vegetation communities appeared to host more invasive plant species than other habitat communities. This is likely to be attributed to the transfer of seeds from invasive species occurring along riparian corridors such as luggas, streams and rivers. Operational impacts concerning invasive species are possible post-recovery of habitat. It is possible that invasive species that were already resident in an area could have been spread more widely during the construction process. Furthermore, invasive species not previously known in-country, or even in continental Africa, have the potential to colonise the Project footprint during the operational life of the Project.

Equally, new introductions of invasive species could have occurred via construction plant or vehicle movements within the RoW, these could establish themselves during the operational period. The appointed BO (refer operational mitigation) would be tasked with monitoring vegetation community's post-construction during the operational phase of the Project to ensure that invasive species including pathogens and fungi are identified and suitable treatment is prescribed at the earliest opportunity. The unmitigated impact significance of invasive species during operation is considered to be **minor (adverse).**

Habitat Severance

A number of species could potentially be affected by habitat severance e.g. the ability to move from one area to another. Guenther's Dik-Dik (*Madoqua guentheri*) and Spotted Hyaena (*Crocuta crocuta*) both protected under the WCMA (2013) were the most widely recorded species along the pipeline route and were both recorded at 13 locations over the course of two surveys (Annex II).

However, the permanent easement which, along with the proposed stations, makes up the vast majority of the permanent land take has been designed to align with existing tracks and roads wherever possible. In addition, the monitoring and maintenance of the Project will largely be undertaken remotely using automated systems which will negate Project associated footfall and vehicle movements which could affect fauna behaviour. The presence of stations, especially in areas such as conservancies, may affect animal behaviours in the short term before tolerance is developed. However, depending on the species-specific tolerance level this is unlikely to permanently alter the ability of species to use dispersal routes. As such, it is predicted that residual habitat severance will be largely avoided, and the unmitigated impact classification is **minor (adverse).**

Increases in Emissions of NO_x, SO_x, and Dust Deposition

Operational impacts from dust deposition are likely to be negligible. Any monitoring or management undertaken by vehicles is likely to be infrequent and immeasurable against non-Project baseline conditions. The potential for air emissions of NO_x and SO_x during Project operation would be limited to exhaust from generators at Project stations. It is understood that generators will be in use during the working day and these will also be supplemented by solar photo voltaic systems. Given the distance between station sites, use in some cases, of renewable solar energy, relatively low power demand and limited use, the contribution of operational Project NO_x and SO_x is considered to be of **minor (adverse)** impact significance to receptors.

Sensory Disturbance (Light, Noise, Vibration, Odour)

In contrast to the construction phase of the Project, sensory impacts will depreciate during the operational phase. Operational light spill will only occur at Station locations constituting a small contribution over the Project length. Light will be controlled in accordance with the mitigation section in order to avoid habitat fragmentation and interference with individual species. Noise impacts will be limited to the Project footprint, generator use at Stations along the Project route, pigging operations and infrequent footfall and vehicle movements associated with Project management, monitoring and observations. Unmitigated impacts to fauna during operation from vibration and odour will be **minor (adverse)** due to the presence of sensory disturbance, specifically from stations within conservancies such as Kalama on the border of Namunyak.

Injury/Mortality of Wildlife due to Vehicle Movements

During operation there will be a minor increase in localised traffic by project related traffic in the vicinity of the stations. Herpetofauna and mammals could be particularly susceptible to mortality via vehicle collision. Baseline surveys confirmed the presence of a number of herpetofauna species of conservation concern including:

- Two species listed under Schedule 6 of the WCMA (2013), namely Savanna Monitor and Tree Gecko;
- Three species which (based on available data sources) may be considered as range restricted, namely Gallmann's Sand Frog, Upland Puddle Frog (*Phrynobatrachus keniensis)*, and Lake Turkana Toad *(Sclerophrys turkanae);* and
- One species is considered to represent a new species in the genus *Hemidactylus*.

Given the predicted low to negligible increase in traffic contribution during the operational phase of the Project the risk of direct mortality, considering the committed mitigations, is considered, to be low even during pigging events.

Indirect Impacts Resulting from the Operational Project

The Project will not create sufficient job opportunities to promote inward migration *per se*. As such, there is no predicted increased pressure on resources along the Project route. However, increased access provisioned via the permanent easement may increase pressure on natural resource such as grassland which will then affect biodiversity receptors. The Project will also increase the prevalence of access tracks for people and vehicles. This could result in greater accessibility to areas previously not exposed to increases in foot fall and regular vehicular movements therefore increasing sensory disturbance. Furthermore, *ad hoc* settlements and trading could occur along the permanent easement, potentially in areas of ecological sensitivity. The unmitigated impact significance from indirect impacts is considered to be **minor (adverse).** The operational phase impact assessment with respect to terrestrial and aquatic biodiversity is presented in Table 7.6-9.

Decommissioning

In accordance with the Project Description (Section 4) it is assumed that removal of above ground facilities, leaving of pipeline after cleaning and filling (hydrocarbon free) would be undertaken at Project decommissioning. Any potential impacts that are identified through the decommissioning process would be managed under the auspices of a BMP (refer sections below).

Table 7.5-9: Operational phase impact classification and impact significance

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Statutory Protected Sites – National Parks and Reserves Protected Under the WCMA 2013						
Rahole and Nyambene National Reserves (High)	▪ Presence of a Project RoW and increased access. ▪ The introduction and spread of invasive species. ▪ Fauna road collision of protected species could occur.	Medium – Medium-term – temporary	Moderate (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ▪ Develop and implement an Invasive Species Management Procedure within BMP, to include hygiene specifications for vehicles and cargo, site clearance and rehabilitation. All staff receive training on avoiding introduction or spread of invasive species. ▪ Maintenance of invasive species-free environment within all fenced Project facilities (e.g. stations, LMT) through regular inspections to identify, remove and safely dispose of invasive species. ▪ Develop and implement a wildlife awareness component to worker induction and driver training programmes.	Negligible – Medium-term – temporary	Negligible
Shaba, Samburu, Rahole, Nyambene, Kiunga, Dodori, Buffalo Springs, Arawale (High)	▪ Changes to the local hydrological regime. ▪ The introduction and spread of invasive species. ▪ SoCC Fauna road collision could occur.	Low – Medium-term – temporary	Minor (adverse)		Negligible – Medium-term – temporary	Negligible
Community Conservancies						
Including but not limited to. Nakuprat-Gotu, Namunyak Meibae, Kalama (Namunyak border), Sera and	▪ Presence of a Project RoW increased access. ▪ Presence of stations. ▪ The introduction and spread of invasive species.	Low – Medium-term – temporary	Minor (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ▪ Invasive Species Management Procedure, invasive species maintenance, wildlife awareness component for workers (as above).	Negligible – Medium-term – temporary	Negligible

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
West Gate, Awer (High)	■ Fauna road collision of protected species could occur.			■ Minimise sensory disturbance in stations within conservancies. No night-time driving, avoid light spill by using timers and cowls. ■ Maintain landscaping at stations to minimise visual impact. ■ Develop and implement a Wildlife Access Control Procedure.		
Acacia-Commiphora stunted bushland, Somalia-Masai Acacia-Commiphora deciduous bushland and thicket, Somalia-Masai semi-desert grassland and shrubland (Medium)	■ Permanent land take. ■ Potential temporary changes to the local hydrological regime including residual heating from the pipe. ■ Increased grazing pressure. ■ Transition from natural to modified habitat. ■ Edge impacts and introduction or spread of invasive species.	Low Medium-term temporary.	Minor (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ Invasive Species Management Procedure, invasive species maintenance, wildlife awareness component for workers, Wildlife Access Control Procedure (as above).	Negligible – Medium-term – temporary	Negligible
Riverine wooded vegetation, Desert. Dry combretum wooded grassland and Edaphic grassland on drainage-impeded or seasonally flooded soils. (High)		Low – Medium-term – temporary	Minor (adverse)		Negligible – Medium-term – temporary	Negligible

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Large and medium Mammals (High)	■ Presence of a Project RoW increased access / Poaching. ■ Presence of stations. ■ Fauna road collision of protected species could occur.	Low – Medium-term – temporary	Minor (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ Invasive Species Management Procedure, invasive species maintenance, BO poaching threat dialogue, wildlife awareness component for workers, Wildlife Rescue Procedure, Wildlife Access Control Procedure, no night-time driving, avoid light spill and maintain landscaping at stations (as above).	Negligible – Medium-term – temporary	Negligible
Small mammals and bats (High)	■ Presence of a Project RoW increased access / Poaching. ■ Changes to the local hydrological regime.	Low – Medium-term – temporary	Minor (adverse)		Negligible – Medium-term – temporary	Negligible
Herpetofauna (High)	■ Presence of a Project RoW impingement of ecological connectivity. ■ Changes to the local hydrological regime.	Low – Medium-term – temporary	Minor (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ Invasive Species Management Procedure, invasive species maintenance, wildlife awareness component for workers, Wildlife Rescue Procedure, Wildlife Access Control Procedure (as above).	Negligible – Medium-term – temporary	Negligible
Avifauna (High)	■ Increases in disturbance a result of operational access to the RoW from increased foot fall and vehicular movements.	Low – Medium-term – temporary	Minor (adverse)	Measures described in Section 7.5.7. Additional mitigation required: ■ Wildlife awareness component for workers, Wildlife Rescue Procedure (as above)	Negligible – Medium-term – temporary	Negligible

7.5.8.4 Key Influences on the Project Design from the ESIA Process

In accordance with the mitigation hierarchy, avoidance of optimal habitat for Grevy's Zebra, and other SoCC such as Hirola and Reticulated Giraffe, is just the first fundamental step in delivering confident mitigation strategies. Commitments to minimise impacts and restore habitats to reduce or negate residual impacts have been made by the Project team. To be defined within the BMP, and in consultation with local experts, including the Grevy's Zebra Trust, The Twiga Walinzi Initiative (Reticulated Giraffe) and the Hirola Conservation Program, the appointed BO will deliver the following measures:

- Further definition and protection of Grevy's Zebra movement corridors to avoid temporary severance. Specific focus on potential for severance during construction between grazing habitat and known watering holes e.g. the Suiyian Well. The Grevy's Zebra's connectivity to the Suiyian Well will be affected by the Project RoW, so mitigations will be applied throughout these areas;
- Minimising the length of trench left open throughout the Project length as directed by the BO to deter ingress into the open trench;
- Use of soil ramps (crawl boards) to assist the egress of species should they become trapped in the trench; and
- Avoid night working. Evidence gleaned though engagement with specialists and local stakeholders, including the Grevy's Zebra Trust, indicates that Grevy's Zebras travel to watering holes at night.

In order to robustly address the potential conflict with Grevy's Zebra, a proactive round of engagement and additional field surveys were undertaken. These additional engagements between PPMT and the Grevy's Zebra Trust and associated additional field survey study is described below verbatim.

Suiyian Area

1) Suiyian Trough is an area used for pastoralists for animal watering in the dry season, Grevy's Zebra do not use it.
2) The Suiyian Well is used by Grevy's Zebra and is a significant distance from the pipeline crossing. It was agreed that separation distance was adequate and that with the depth of the lugga (10 m) it was unlikely that noise would be an issue.
3) Grevy's Zebras come to water at night, so a ban on night working and driving in sensitive areas is required. The transit corridors to the Suiyian Well will be affected by the pipeline RoW, so "*sensitive area*" mitigations should be applied throughout this "*critical*" area.
4) There is an area used for communal water supply about 200 m down gradient from the pipeline crossing. This will require special mitigations and monitoring to ensure continuity of water supply.
5) It was concluded that the pipeline alignment was fine, but that mitigations will be required to protect down-gradient water users and that pipeline crossing should be undertaken as early as possible in the dry season (June - July).

Barsoloi Area

1) Due to the separation distances, this was not seen as an issue regarding Grevy's Zebras.

2) A movement corridor across the pipeline alignment to the water wells was identified. This reinforces the need for a set of "*sensitive area*" mitigations to be developed for the "*critical areas*" (such as minimise time of disturbance, minimise length and time that trench is left open, no night working/activity, ensuring no disruption to down gradient water quality/quantity).

Wamba Area – Project (Pipeline) Crossing

1) The FEED Phase 1 route or "*southern*" option, as currently defined, was viewed as not feasible as it passes through "critical" Grevy's Zebra sighting areas and also passes very close to a critical impoundment identified from field survey and indicated on the map.

2) The locations of the structures along the Baragoi-Archer's Post Road were verified and confirmed that a standalone pipeline could be constructed along the road with careful alignment avoiding more sensitive areas.

In addition, and specifically focusing on Hirola, the Project commits to working closely with the Hirola Conservation Program (HCP) to identify a line of communication during Project construction between the BO and the HCP. As previously committed in the mitigation tables, the BO will have authority to "stop work" should risks to SoCC be identified. In areas where Hirola are known to exist, area-specific biodiversity management procedures within the BMP will be used to guide site clearance, pipeline installation and rehabilitation activities.

7.5.9 Summary of Mitigation

In order to protect SoCC, a Biodiversity Management Plan (BMP) will be prepared as part of the Project Environmental & Social Management Plan (ESMP). The BMP will set out the mitigations and management controls defined in the ESIA in a clear, implementable and auditable manner. Mitigations will cover the complete mitigation hierarchy from avoidance through minimisation through to biodiversity restoration.

The BMP will provide details of required actions, procedures for documentation and communication, plus a description of implementation and monitoring needs. The BMP will be structured to ensure adaptive management can be followed with monitoring results providing feedback to earlier stages in the BMP development process. Mitigations can be refined through both adaptive management plus additional consultation with stakeholders and additional input from local specialists who have already assisted with the production of the ESIA. The BMP will also identify additional conservation actions that can be delivered to benefit SoCC within the AoI.

The additional construction mitigation measures that will be undertaken to reduce construction impact magnitudes, or reduce the potential for creating the impact, include the following:

- PipeCo to employ a Biodiversity Officer (BO) to supervise all activities, with a focus on areas of biodiversity sensitivity and implementation of biodiversity-related management controls. BO to prepare location specific Biodiversity Management Plan to address local biodiversity management issues. BO to have "stop work" authority exercised where there is imminent risk to SoCC. The BO will liaise with key stakeholders such as KWS and conservation institutions to consider all biodiversity issues, including species presence and/or movement in relation to construction schedules and associated activities.

- Develop and implement area-specific (for each spread) biodiversity management procedures including pre-construction surveys. Working in collaboration with relevant Conservancies and/or KWS to guide site clearance, pipeline installation and rehabilitation activities. Procedures to be approved by PipeCo prior to commencement of site activities. Develop and implement Wildlife Rescue Procedure for animals becoming trapped within open trench e.g. use crawl boards/fauna ramps at regular intervals along the length of open trench. In areas where potential animal migration/ movement across the open trench is considered to be a high risk, species-specific measures will be developed and implemented to minimise the length of open trench, discourage wildlife from approaching the open trench, and to monitor the open trench to ensure that any animals trapped are rescued as quickly as possible. Develop and implement an Invasive Species Management Procedure, to include hygiene specifications for vehicles and cargo, site clearance and rehabilitation.

- All staff receive training on avoiding introduction or spread of invasive species.
- Additional area-specific control measures to be developed, in consultation with BO, in identified invasive species "hotspot" areas along pipeline corridor (e.g. areas of major prosopis infestation in southern Samburu, and in the region of Garissa Town).
- Invasive Species to be identified and destroyed during vegetation clearance of pipeline RoW and areas designated for other permanent and temporary facilities.
- Develop and implement a Wildlife Access Control Procedure.
- BO to inform relevant Conservancies and KWS of poaching threats identified in the vicinity of construction activities in the pipeline corridor. Ensure that biodiversity considerations are taken into account in the selection of sources for hydrotest water.
- Stations adjacent to conservancy boundaries to be designed to blend in with the surrounding topography. If possible, this should include being painted in natural colours and landscaping with trees and scrub (natural planting of endemic species) and minimisation of sensory disturbance by no night-time construction and the use of timers and cowls on external lighting/flood lighting during construction.
- No night working in areas adjacent to National Reserves or Community Conservancies unless agreed and supervised by PipeCo BO.
- Develop and implement a wildlife awareness component to worker induction and driver training programmes.
- Once the pipeline is installed, areas are to be rehabilitated as soon as possible based on a Site Restoration Procedure.
- Implement surface water mitigations as defined in Section 7.3.
- Undertake open cut river crossings at times of minimal flow with method statements reviewed and approved by BO.
- Undertake fish rescue as required and directed by the BO.

As described in the Project description (Section 4), a pipeline construction project looks like a moving assembly line. A large project typically is broken into manageable lengths called "*spreads*," and utilises highly specialised and qualified workgroups. The pipeline Project will have a number of spreads along the pipeline route. Each spread is composed of various crews, each with its own responsibilities. All spreads will be subject to a bespoke set of BMPs in accordance with the SoCC, habitats and/or biodiversity attributes likely to be encountered within that spread. The BMPs will define the suitably qualified biodiversity experts employed by PipeCo that will manage the delivery of biodiversity method statements within the spreads (hereafter the Biodiversity Officer or BO).

Mobilisation to a new spread will trigger a number of bespoke actions pertaining to biodiversity. These actions include:

- **Pre-construction Surveys by the BO**

  Before construction begins, and in accordance with the management actions defined in the BMP, the BO will undertake a visual appraisal of the spread at key biodiversity areas indicated on maps in the BMP, as identified through the baseline survey process. For example, the BO may use vehicles to disperse larger fauna of conservation concern as sensitively as possible prior to subsequent clearing and grading of the spread. In addition, less mobile species may be captured during habitat and refuge searches and subsequently translocated to a receptor site away from the spread.

- **Clearing and Grading**

  The clearing and grading of the spread may require the BO to be present in order to undertake plant salvage and translocation, species translocation (including arboreal fauna, fish and amphibian rescue), and to oversee de-watering operations at river crossings. In addition, the BO would oversee and sign off on the temporary erosion control measures, which will be installed prior to any earth-moving activities.

- **Trenching and Soil Management**

  Soil management in areas of high floristic diversity, including areas exhibiting floral endemism, and SoCC, will be defined within BMPs. Top-soils, i.e. seed bearing soils, will be stripped from the work area and stockpiled separately from sub-soils in accordance with good practice to avoid over compaction and oxygen starvation. Soils containing species-rich seed banks will be clearly marked by the BO, with signage to enable the accurate restoration of soils at the earliest opportunity in accordance with the BMP. The BO will check open tranches and pipe strings, on a daily basis, before work commences, and during work activities, to remove fauna that may have become trapped. Soil ramps (crawl boards) will be used to assist the egress of species should they become trapped in the trench.

- **Restoration**

  The Project description describes a commitment to restore the work area as soon as possible. After the pipeline is backfilled and tested, disturbed areas will be restored as close as possible to their original contours using top-soils, as demarcated to reinstate on a *'like for like'* basis under the auspices of the BMP as managed by the BO. Restoration measures will be maintained until the area is restored, as closely as possible, to its original condition. Measurable targets will be defined for ground restoration within the BMP. Restoration, in accordance with the mitigation hierarchy, will also be used to prevent the Project RoW and other access roads being used to promote the incursion of people into sensitive habitats, including protected areas. Specifically, any new Project RoW within the Rahole and Nyambene protected areas, in addition to all Grevy's Zebra 'critical' habitat (GZT, 2018), will be actively restored as promptly as possible post-construction.

  The restoration of this RoW will include the removal of aggregates in order to actively discourage pedestrian and vehicle incursion. The on-going management and active restriction of public incursion to this area will be defined within a biodiversity and access method statement presented within the BMP. In addition, the BMP will define actions around the delivery of a biodiversity response plan. This plan would be triggered, in the event that an alarm was raised, by the BO or other Project personnel concerning the welfare of SoCC. The plan would define a cascade response, which would include a list of flora and fauna specialists who could be mobilised to assist in the event of an emergency pertaining to biodiversity. The plan would contain contact numbers and sequential procedure statements to minimise impacts.

The additional operational mitigation measures that will be undertaken to reduce impact magnitudes, or reduce the potential for creating the impact, include the following:

- Develop and implement an Invasive Species Management Procedure within BMP, to include hygiene specifications for vehicles and cargo, site clearance and rehabilitation.
- All staff receive training on avoiding introduction or spread of invasive species.
- Maintenance of invasive species-free environment within all fenced Project facilities (e.g. stations, LMT) through regular inspections to identify, remove and safely dispose of invasive species.
- Develop and implement a wildlife awareness component to worker induction and driver training programmes.
- Minimise sensory disturbance at stations within conservancies. No night driving and avoid light spill by using timers and cowls. Maintain landscaping within stations to minimise visual impact.
- Develop and implement a Wildlife Access Control Procedure.
- BO to provide poaching threat dialogue to NGO's and KWS.

7.5.9.1 Summary of Residual Impacts

Using the decision matrix presented in the impact assessment methods section; the classification of the impacts before, and after, the adoption of mitigation has been presented. Impacts such as the presence of a RoW, temporary reductions in ecological connectivity and sensory disturbances have moved from moderate adverse to minor adverse with the implementation of mitigation.

In some cases, outcomes may remain uncertain because the information needed to predict impacts is not yet available. For example, the availability and source of water for Project hydrotesting is yet to be determined. Where this is the case, measures such as monitoring or additional local or regional surveys will be proposed to be delivered through the Biodiversity Management Plan (BMP) to reduce uncertainty, provided that risks of irreversible adverse impacts, can reasonably be concluded to be acceptable.

In all cases, the biodiversity features importance, and sensitivity is aligned with the likely magnitude of impact considering the temporal nature, discrete footprint and low frequency of impacts afforded by the Project.

7.6 Ecological Impacts - Marine Flora and Fauna (Habitats and Species of Concern)

7.6.1 Introduction

As set out in the impact assessment for terrestrial and aquatic flora and fauna (Section 7.5), the Project aims to ensure that biodiversity and ecosystem functions are not adversely impacted to an unacceptable level by the Project's construction, operation and decommissioning. This marine impact assessment has considered effects on receptors and resources in the coastal zone below the high tide level, i.e. mangrove and beach habitats, in the waters of the channel with Manda and Pate Islands at its mouth, and areas offshore (as appropriate).

The determination of the Project AoI (Figure 7.6-1) drew upon information gathered through secondary data collection, consultation and reconnaissance surveys in mangrove habitats (including in the area of mangrove that the Project RoW and working width will traverse). It took account of the fact that in the vicinity of Lamu Port the scope of the LLCOP ESIA extends to, and includes the Lamu Marine Terminal along with the permanently moored VLCC, acting as an FSO (even though this vessel will likely be owned and operated by a third party). However, it is also recognised that whilst third party export tankers are within the buoyed port approach channel, they will come under the jurisdiction of the Lamu Port Harbour Master and, as such, have been considered as associated facilities for the purposes of this ESIA[1]. Taking these factors into consideration, an AoI was described in Section 6.7 that covers locations where potentially significant impacts of the Project might affect receptors and resources; this was defined to include coastal and marine habitats within a 10 km buffer of the berth for the permanently moored VLCC.

In addition to defining the AoI, this assessment considered the broader Lamu-Kiunga seascape within which the AoI is situated. This seascape (Figure 7.6-2) meets criteria for an Ecologically or Biologically Significant Area (EBSA) (Clearing House Mechanism of the Convention on Biological Diversity, 2015). It comprises a continuous mainland and island archipelago system with a common habitat complex of mangroves, patchy and marginal coral reef systems, seagrass beds and exposed sandy beaches. This seascape provides ecosystem functions for sea turtles (nesting and foraging habitat), fish (spawning, nursery, foraging), marine mammals (resident and migratory) and sea birds. Its relevance to the marine impact assessment lies in the broader biodiversity values of the seascape taking account of species populations, migratory movements, habitat connectivity, habitat continuation, and the definition of wider eco-regions or biomes where there is a similarity of conditions. In some cases (e.g. highly mobile, wide-ranging species such as some cetaceans and sea turtles) broader connectivity outside the seascape was also considered.

[1] Whilst this marine impact assessment considers effects that may be experienced within the AoI (as defined) outside the buoyed port approach channel, when third party tankers are in the open sea they are not considered to be an associated facility. Any impacts that originate from a tanker outside the buoyed port approach channel are assessed in the Cumulative Impact Assessment (Section 7.15).

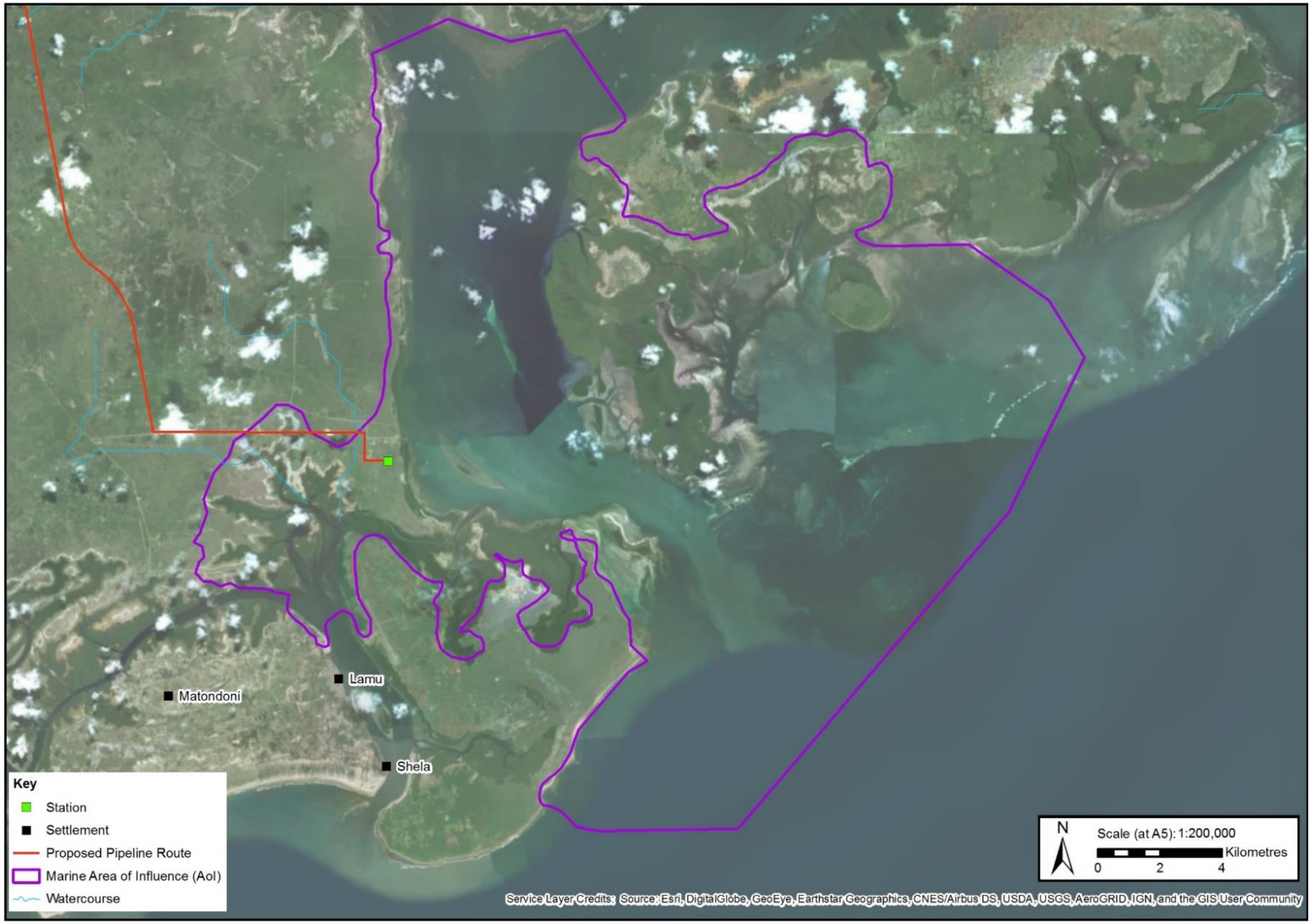

Figure 7.6-1: AoI for the assessment of impacts to marine receptors and resources

Figure 7.6-2: Setting of the AoI in the context of the wider seascape (the Lamu-Kiunga EBSA)

7.6.2 Receptor Importance

Sensitivity and Importance of Receptors

The sensitivity and importance of species and habitat receptors and the sensitivity/importance rating for each receptor group is provided in Table 7.6-1. For species receptor groups, the individual species in that group with the highest sensitivity determined the overall group's sensitivity. For the purposes of this assessment, protected sites (National Reserves and IUCN II/VI reserves) and flora and fauna species of conservation concern (SoCC) are considered with reference to the presence of species protected under the Kenyan Wildlife Conservation and Management Act (WCMA) (2013) and their designated IUCN threat category as described in Section 7.5.

In order to identify the importance of the receptors, the scale of relative importance presented in Table 7.6-1 has been used with reference to the information collated in the baseline to classify the selected receptors according to how they might respond to Project activities, based upon receptor exposure, receptor sensitivity and receptor vulnerability.

Table 7.6-1: Criteria for determining importance and sensitivity of receptors

Receptor Importance	Example Receptor Types
Very high	Designated Areas: Internationally protected areas where the receptor and Project site share habitat or species synergies. Habitats: supporting a set of nationally unique species in comparison to other examples of the habitat; habitats already threatened within the region; habitats with a limited global extent or a significant proportion of the total extent of that habitat type will be affected. Also includes habitats used by high importance species as important feeding or spawning/breeding areas. Plant and Animal Species: Critically Endangered (CR) or Endangered (EN) species (IUCN 2009), and species listed in the WCMA, 2013) dependent on a case by case basis using expert opinion. Species and taxa having a particularly Restricted Range (i.e. endemic to a site or found globally at fewer than 10 sites or animal species having a distribution range less than 50 000 km^2 or restricted-range bird species (those with a global breeding range less than 50 000 km^2). Following the precautionary principle, IUCN VU species are also included if they meet the following the Restricted Range criteria, particular vulnerability to certain threats, are of high stakeholder interest or considered in expert opinion to be of high importance, have been classed as being of high importance.
High	Designated Areas: areas not included in the criteria for very high importance. Habitats: locally rare, small or scattered; vegetation communities or sub-communities; habitats which include one or more sets of species uncommon in Kenya; habitats supporting species which have specific adaptations to that habitat; habitats with significant richness in biodiversity. Includes any low importance habitats used by moderate or high importance species as important spawning/breeding or feeding areas. Plant and Animal Species: Endangered (EN) Vulnerable (VU), Near Threatened (NT) LC or Data Deficient (DD) species (IUCN 2009), some species from WCMA were assessed on a case by case basis using expert opinion.

Receptor Importance	Example Receptor Types
Medium	Habitats: not globally regionally or nationally protected or listed and which are common or abundant and which are not critical to other ecosystem functions. Habitats which are very common and widespread along the East African coast or habitats generally modified or degraded by anthropogenic activities, or any area that has no real conservation significance in expert opinion. Plant and Animal Species: not protected or listed, common or abundant and is not critical to other ecosystem functions and is not included in the criteria for high or very high importance.
Low	Habitats: which are common, abundant, robust and which are not critical to other ecosystem functions. Habitats which are very common and widespread on the East African coast or habitats generally modified or degraded by anthropogenic activities, or with no real conservation significance in expert opinion. Plant and Animal Species: not protected or listed, common or abundant and are not critical to other ecosystem functions and are not included in the criteria for medium, high or very high importance and sensitivity. Plant and animal species are ubiquitous and tolerant of anthropogenic impact.

7.6.3 Magnitude of Impact

Table 7.6-2 details the magnitude of impact criteria used for the qualitative assessment of potential impacts on marine biodiversity.

Table 7.6-2: Magnitude assessment parameters for biodiversity

Magnitude	Geographical Extent	Duration	Frequency
Negligible Individuals will not be affected; disturbance to habitat integrity (area, quality, composition, configuration, processes, and functions) will be absent, or transient. **Low** Impacts could affect individuals; that is, in the case of fauna receptors, individuals may become disturbed, but not injured, with some minor reversible disturbance to habitat receptor integrity (area, quality, composition, configuration, processes, and functions). For flora receptors, individual plants may be destroyed. **Medium** Impacts would affect individuals detrimentally, with injury or death of individuals. The local population may be affected through the loss of individuals, but not the local population and/or species as a whole. The integrity of habitat receptor's integrity may be affected detrimentally and possible permanently. **High** Impacts will affect the viability of the local habitat or local population of a receptor and/or the species as a whole	**Project Footprint*** **Broader Area of Influence**	**Short-term** Impact is reversible at end of construction **Medium-term** Impact is reversible at end of operational life **Permanent** Impact is not reversible	**Infrequent** Impact occurs intermittently during construction, but not continuously, over the assessment period **Frequent** Impact occurs repeatedly or continuously over the assessment period

** Definition as per that used in Section 7.5*

Indicators used to assess impacts to species receptors are the same as those used with respect to terrestrial and aquatic biodiversity in Section 7.6, i.e.:

- No mortality of individuals. Survival and the subsequent ability to reproduce;
- Maintenance of species functional habitat connectivity;
- Vegetation restoration and establishment efficacy post construction. Monitoring to review the timely restoration of floral species composition and the potential introduction of invasive species; and
- Prevalence of changes in habitat quality and quantity from baseline.

The analysis used a mix of quantitative and qualitative techniques to identify potential Project impacts relative to baseline conditions.

Potential changes in individuals' survival and reproduction were assessed qualitatively by considering potential disturbances (e.g. severance (temporary and permanent), ship traffic, light, noise and vibration), as an indicator of potential localised changes in species' population density. These disturbances were considered in relation to known or inferred impacts on the survival and reproduction of species for which data are available from published literature, and in consultation with experts. Changes in habitat connectivity were assessed by identifying restrictions to movement and species mobility.

Habitat loss was quantified with reference only to the area of mangrove that will be lost to the permanent Project RoW or temporarily disturbed by construction activities in the wider working width.

7.6.3.1 Marine Biodiversity-specific Assessment Criteria

Additional criteria used to evaluate impacts on marine biodiversity were as follows:

- Qualitative criteria to understand the impact of potential changes to water and sediment quality, informed by the limited water quality baseline sampling reported in in Section 6.4;
- The latest threshold guidance for sensory impacts on key species associated with non-impulsive sound have been used to inform the assessment, taken from NOAA (2016) and Southall et al. (2019). These thresholds are detailed in Annex I-C. No modelling of noise from vessels was undertaken due to the small volume and intermittent nature of movements (i.e. a maximum of one export tanker movement to and from the berth per week) in the context of the much greater volume of vessel traffic that will occur within the Lamu Port area as it becomes operational and increasingly fully developed; and
- For mangrove habitats, the impacts on habitat due to direct disturbance associated with the Project was quantified by overlaying the current baseline extent of the habitat within the Project RoW and working width and using GIS analysis to evaluate the magnitude and extent of effects on habitats. Other direct effects on habitats and species (for example, sensory disturbance and water quality impacts) in the AoI were considered where possible. Habitat loss was quantified only with reference to mangrove, by considering the area that will be lost to the permanent Project RoW and that temporarily disturbed by construction activities in the wider working width.
- This impact assessment took into account the results of detailed oil spill modelling (Section 7.14.5.1) that will inform development of the Emergency Preparedness and Response Plan.

7.6.4 Key Guidance and Standards

As described in Chapter 2, the marine impact assessment has been completed in accordance with Kenyan legislation (WCMA, 2013), and to align with international guidance and good practice such as that defined by the International Petroleum Industry Environmental Conservation Association (IPIECA) and by IFC PS6 and relevant supporting IFC/World Bank Group sectoral guidance. Mitigation measures have drawn upon appropriate good practice guidance. In addition, with specific reference to the marine biodiversity impact assessment the following guidance documents have been consulted:

- IMO 2009 guidance documents for minimising the risk of ship strikes with cetaceans;
- Reference to good practices as adopted at other port sites (e.g. as reported by Silber et al., 2012);
- IWC Guidance for Cruise Line Operators to Minimise Risk of Collisions with Cetaceans (Ritter and Panigada, 2014);
- IWC ship strike working group REPORTS (IWC, 2016);
- Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing - Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts (NOAA, 2016);
- Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects produced by Southall et al. (2019);
- Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee, Popper et al. (2014);
- Case studies where special mitigation measures have been developed for ports with potential impacts of marine mammals of conservation note, including the North Atlantic right whale on the NE coast of the US (NOAA, 2008); humpback whales in Glacier Bay, Alaska (National Park Service, 2013); and whales that migrate to the Santa Barbara Channel in California, US (Santa Barbara County, date unknown);
- Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine wildlife by MEPC (2014);
- Good Practice Guidance for Oil and Gas Operations in Marine Environments (FFI, 2017); and
- Good Practices for Biodiversity Inclusive Impact Assessment and Management Planning (Hardner et al., 2015).

7.6.5 Receptors of Interest and Importance

Indicators used to assess impacts to habitat receptors were changes in:

- Extent;
- Condition;
- Regional representativeness; and
- Landscape connectivity.

Table 7.6-3 presents the assigned importance for these receptors considered to be of very high and high biodiversity importance, following the criteria presented in Section 7.6.2. The rationale for, and contributing factors to, the assigned importance are elaborated on within the table and described further in the following text.

Table 7.6-3: Receptors and importance

Receptor	Importance	Comment
Pate Marine Community Conservancy; Lamu-Kiunga EBSA; Kiunga Marine National Reserve; Kiunga Marine Community Conservancy; Lamu-Kiunga Archipelago (proposed UNESCO World Heritage Site)	High	Designated protected areas meeting the criteria for High importance: ■ Pate Marine Community Conservancy: area established in accordance with the provisions of WCMA (2013) that is significantly overlapped by the AoI and contains significant areas mangrove, coral reef and seagrass beds; ■ Lamu-Kiunga EBSA: Meets criteria defined by the Convention for Biological Diversity, but does not have protected area status at this time; overlaps the entire AoI and is representative of the wider seascape within which the AoI sits; contains mangrove and tidal flat habitats that are recognised as some of the most extensive and species-rich in East Africa; ■ Kiunga Marine National Reserve: IUCN category VI), also an Important Bird Area (IBA) and a UNESCO-Man and the Biosphere Reserve; ■ Kiunga Marine Community Conservancy: established in accordance with the provisions of WCMA (2013); and ■ Lamu-Kiunga Archipelago: included based on candidature as a UNESCO site, and as representative of the wider seascape within which the Project sits.
Dodori National Reserve (Terrestrial: IUCN management category II)	High	Nationally designated protected area meeting the criteria for High importance, and a KBA[2] . Dodori is primarily terrestrial but contains a shore frontage and mangrove creek which may provide ecosystem functions for SoCC.
Mangroves	Very High	Habitat type considered by conservation bodies (e.g. IUCN) to be of global importance; it is relatively uncommon and under threat in the East African region; over 60% of Kenya's mangrove occurs within the Lamu-Kiunga seascape; it provides ecosystem functions important in supporting a wide range of species. (e.g. for feeding, breeding/spawning, nesting/refuge).
Coral reefs	Very High	Habitat type considered by conservation bodies (e.g. IUCN) to be of global importance; and is relatively uncommon and in decline in the East African region, mainly due to human activities. Coral reefs in the AoI/seascape have a unique mix of corals that are representative of the Red Sea and Arabian Gulf more than those further south on the East African coast. Provides important ecosystem services important in supporting a wide range of species (e.g. for feeding, breeding/spawning).
Seagrass beds	Very High	Habitat type considered by conservation bodies (e.g. IUCN) to be of global importance; and is relatively uncommon and in decline in the East African region. Provides important ecosystem functions for fish, sea turtles and dugong (e.g. for feeding, breeding/spawning, nursery).

[2] The Global Standard for the Identification of Key Biodiversity Areas (IUCN 2016) sets out globally agreed criteria for the identification of KBAs worldwide.

Receptor	Importance	Comment
Marine mammals	Very High	Indian Ocean humpback dolphin (Endangered); Dugong (Vulnerable, of conservation concern because the population in the AoI has recently been reported as potentially in single figures and be locally extinct); Humpback whale (listed as Least Concern, but of conservation concern due to its migratory behaviour).
Sea turtles	Very High	Of the turtles known to nest on beaches within the AoI and wider seascape, hawksbill and leatherback turtles are Critically Endangered and green turtle (the most common species nesting in the area) is Endangered. All are likely to forage on offshore seagrass beds, coral reef areas, and associated algal beds.
Birds	Medium	Coastal areas with mangrove and beach habitats support a range of feeding and roosting birds; of species with a preference for these habitats that are expected to occur in the AoI, apart from the curlew sandpiper (Near Threatened) most are considered of Least Concern. No pelagic bird species were observed during surveys in the marine AoI. Many other bird species that can be observed in the mangrove zone are inland coastal forest and savanna species that occasionally venture into mangrove: these have been considered in the terrestrial and aquatic assessment (Section 7.5). A medium biodiversity importance has been applied to bird species on a precautionary basis.
Fish (several shark and ray species, Napoleon wrasse)	Very High	Critically Endangered and Endangered species as categorised by IUCN, 2009

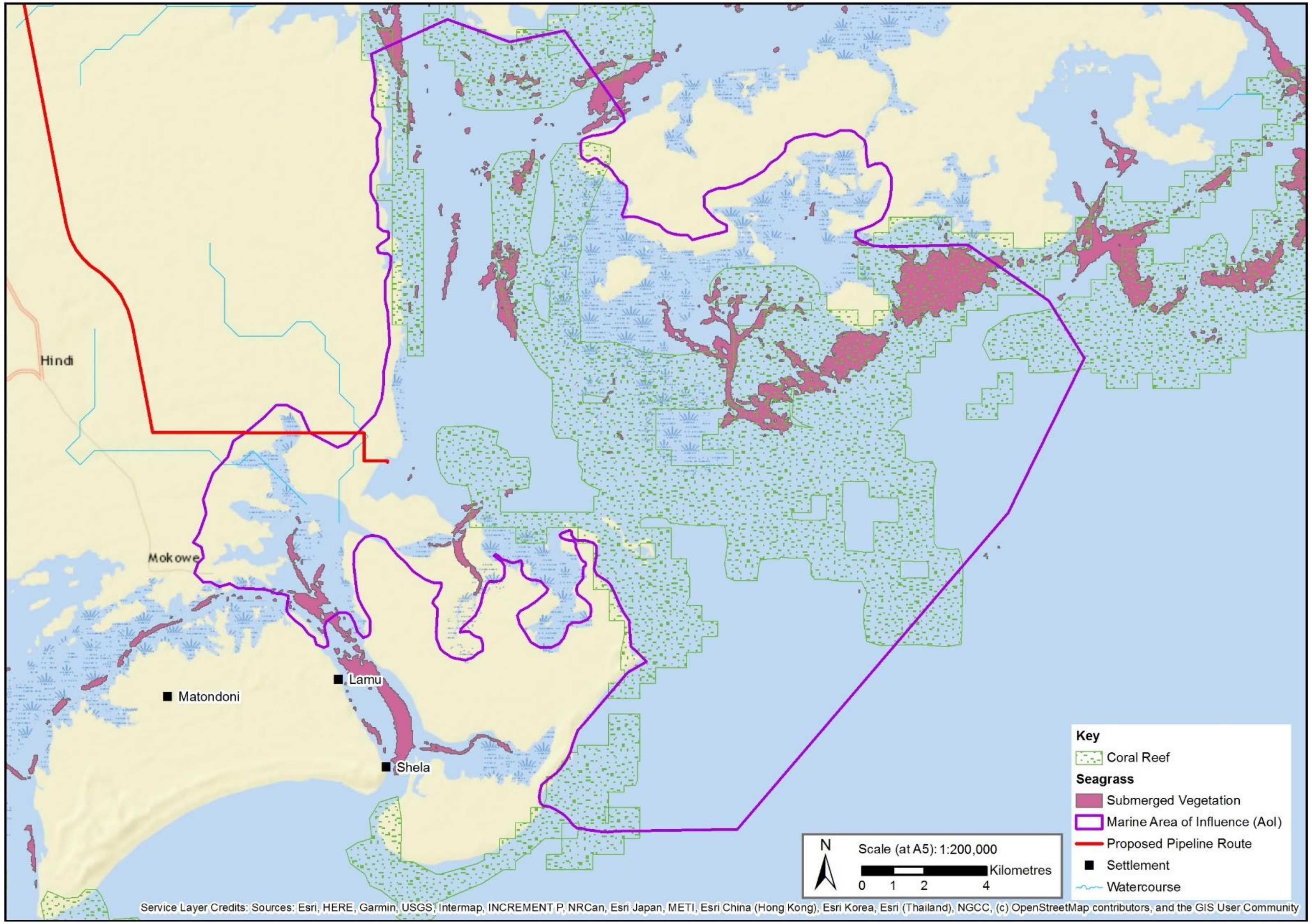

Figure 7.6-3: Receptors within the AoI (benthic habitat)

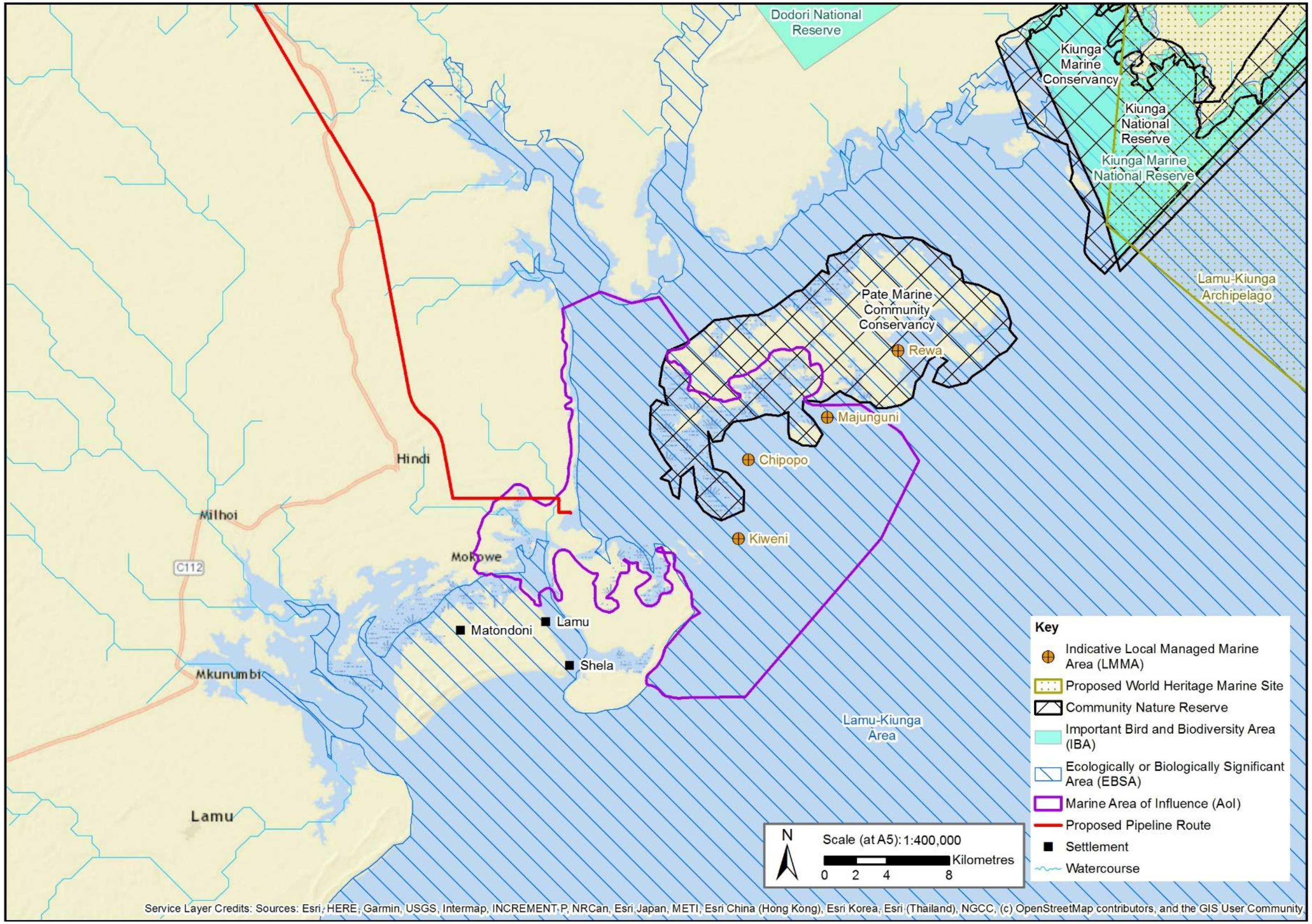

Figure 7.6-4: Receptors within the AoI (protected areas)

Mangroves

The AoI is located in the within the WWF East Africa Mangroves Global 200 ecoregion, and over 60% of Kenya's mangrove forest coverage is located in the Lamu-Kiunga area. Mangroves provide important ecosystem functions for birds and a wide range of marine fauna, including sea turtles, fishes, crustacea and dugong, as well as ecosystem services such as coastal protection. There is high connectivity between mangrove belts and other important habitats such as coral reefs and seagrass beds.

Coral Reefs and Seagrass Beds

Other habitats defined as important biodiversity features include coral reefs and seagrass beds. Seagrass beds are considered to be among the most threatened ecosystems on earth and of high biodiversity value due to the important ecosystem functions they provide for fish, sea turtles and dugong. Coral reefs in this far northern region of Kenya have a unique mix of species from the Red Sea/Arabian Gulf, which are not found further south. Eight coral species that are possibly present in the AoI and broader seascape have been classified as Evolutionarily Distinct and Globally Endangered (EDGE) species under the worldwide EDGE of Existence programme coordinated by the Zoological Society of London.

Beaches

Sandy beaches in the AoI and seascape provide nesting habitat for sea turtles. In the Lamu-Kiunga seascape, which provides the most important nesting beaches for sea turtles in Kenya, the main areas of nesting concentration are beaches in the Kiunga Marine Reserve area, Manda Island and Shela on Lamu Island. Offshore seagrass beds, coral reef areas, and associated algal beds (see Section 6.7) provide important foraging habitat for sea turtles. The most important turtle species are hawksbill and leatherback (Critically Endangered) and the green turtle (Endangered; the most common nesting species).

Marine Mammals

Although there are gaps and uncertainties in the data, many marine mammals are known to occur in the AoI and across the broader seascape, and others may be present on a permanent or seasonal/temporary basis. As a result, this impact assessment has taken a precautionary approach with respect to whether these often very wide-ranging species are present in the AoI and wider seascape (and therefore potentially affected by the Project's activities). As described in the marine baseline (Section 6.7) those considered as likely to be present in nearshore waters include humpback whale, Indian Ocean humpback dolphin, bottlenose dolphin, long-beaked common dolphin, spinner dolphin, pantropical spotted dolphin and dugong. Although other species noted in Section 6.7 may also occur in coastal waters at times, there have been few, if any, sightings. Therefore the species considered of most conservation concern are: humpback whale, which although considered by IUCN as being of Least Concern, is recorded in the Lamu-Kiunga seascape and is of particular significance due to its migratory nature; the Endangered Indian Ocean humpback dolphin; and the Endangered dugong (although this has only been recorded in very small numbers in recent years and is regarded by some experts as possibly locally extinct in the Lamu-Kiunga seascape).

Birds

Intertidal areas within the AoI (mostly mangrove and beach habitats) support a range of birds, of which the curlew sandpiper is Near Threatened; other species expected to be present are mostly of Least Concern; e.g. the migratory little stint and roseate tern, waterbirds including the crab-plover and yellow-billed stork, and seabirds such as the roseate tern. Many other bird species that can be observed in the mangrove zone are inland species that will occasionally venture into mangrove (likely to forage or refuge): these have been considered in the terrestrial and aquatic assessment (Section 7.5). No pelagic (ocean-going) bird species are known to nest or breed close to the AoI, and none were observed during baseline surveys. The Kiunga Marine National Reserve, further to the north outside the AoI, is classified by Birdlife International as an IBA.

Fish

The habitats in the AoI and seascape provide ecosystem functions for a range of fish species, including shark species and rays, as described in the marine biodiversity baseline (Section 6.7). There are three Endangered shark species that are regularly seen and fished within the AoI (whale shark, scalloped hammerhead and great hammerhead) and a further Endangered species (zebra shark) that is not sighted or fished frequently. Four of the species of ray recorded in the area are Vulnerable), and amongst Endangered fish species the Napoleon (or humphead) wrasse has been recorded in the AoI close to the shipping channels into the port southeast of Pate Island, with some experts suggesting this may be potential evidence of spawning aggregations.

7.6.6 Potential Sources of Impact

The Project has the potential to cause effects on marine biodiversity during construction and, to a greater extent than other elements of the Project, during operation. Consideration has also been given to the broader seascape context including impacts relating to the inherent interconnections of habitat and species values that may be affected by the Project. The scale of assessment has been defined to take account of mainly localised effects during construction, and both localised and more widespread effects during operation, as described below. It provides an appropriate context for the biodiversity values in the AoI that may be affected by Project activities, including internationally recognised areas (e.g. the Lamu-Kiunga EBSA).

Impacts were assessed for Project activities that were considered likely to result in a measurable change that could contribute to adverse impacts on receptors, relative to baseline or guideline values. Changes in condition were defined as changes to the size or function of a population, habitat, or ecosystem from baseline condition. Methods to estimate change in condition included models, calculations, and qualitative analyses based on available information from baseline reports, scientific literature, and expert consultation. The biodiversity impact assessment follows the overall methodology described in Section 3.0, the following sections provide some of the criteria used specifically to evaluate the impacts in the marine AoI.

In evaluating potential sources of impact to receptors and resources, the marine impact assessment drew upon information from other technical disciplines as necessary, to ensure that the source and potential effect of an impact was considered using a coherent and holistic approach. The disciplines concerned, and the relevant sections, were as follows:

- Noise and Vibration (Section 7.2);
- Water Resources (Section 7.3);
- Soils, Geology and Geohazards (Section 7.4);
- Social (including influx, livelihoods, land use and ownership, community health, safety and security, tourism and ecosystem services; Section 7.10 to 7.13); and
- Emergency, Accidental and Non-Routine Events (Section 7.14).

The Project description (Chapter 4) has been reviewed, and key activities and sources of impacts relevant to biodiversity were identified as presented below.

With respect to the criteria used to evaluate impact significance, these are set out for air-borne noise, lighting, habitat loss/degradation/fragmentation and population influx and human pressure in Section 7.6.6 and these are also applicable as appropriate for assessment of impacts in the intertidal mangrove zone.

Construction

Direct impacts on habitats and species:

- The temporary land take required for Project construction activities in the mangrove zone leading to habitat loss, fragmentation and degradation, estimated as a maximum of 1.6 ha (note: this figure represents all land that will be disturbed during construction, and the assessment of construction impacts therefore includes effects occurring within the 0.4 ha of permanent, operational, land take for the RoW during the period when this this area is subject to clearance, trenching, pipelaying and restitution. The potential impacts to the permanent loss of the 0.4 ha RoW are described under Operation below);
- Sensory disturbance and potential for temporary injurious impacts (light, air-borne sound in mangrove areas and underwater noise; collisions with or entrapment in construction plant and vehicles);
- Temporary changes to surface water and sediment quality; and
- Discrete spillages of contaminants and other solid and liquid wastes as a result of accidents or poor Project construction working practices (including poor waste management).

Indirect Construction Impacts resulting from the Project:

- Temporary induced access during and in the aftermath of construction due to the improved access to the mangrove area afforded to the local population; this may have consequent temporary and localised increases in fishing and other natural resource harvest creating additional pressure on the mangrove habitat and the species it supports.

Operation

Direct impacts on habitats and species:

- Permanent land take in the mangrove belt for the Project RoW (i.e. the 6 m-wide strip through the mangrove zone that will be kept clear of vegetation throughout the life of the Project); the land take is calculated at 0.4 ha, which could cause habitat loss and severance;
- Sensory disturbance of marine mammals and fish due to light and underwater noise emissions from third-party export tankers, with a resultant potential for (most likely temporary) avoidance of areas causing intermittent habitat severance and loss of access to food and other resources;
- Third-party export tanker collisions with marine wildlife causing injury and possible mortality;
- Accidental, discrete spillages of contaminants and pollutants (including solid and liquid wastes) during routine operations (note: this excludes the risks, consequences and mitigation of major oil spills from Project infrastructure, the VLCC or third party export tankers as a result of either natural events (e.g. extreme weather conditions) or man-made causes (e.g. human error during load out, or during navigation through the buoyed channel): this would be classed as a non-routine event and so is considered in Section 7.14);
- Short-term changes to surface water and sediment quality; and
- Waste from the Project activities, both solids and liquids.

Indirect Operational Impacts resulting from the Project:

- Introduction of alien invasive species into the marine environment via Project vessels, equipment or personnel.

7.6.7 Incorporated Environmental Measures

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are Good International Industry Practice (GIIP). The following incorporated environmental measures are specifically relevant to the marine environment.

7.6.7.1 Inherent Design Measures

There are no inherent mitigation measures specifically for construction and operation.

7.6.7.2 Good Practise

The following measures are applicable to all phases of the Project and will be applied/followed in order to manage the magnitude of impacts on marine biodiversity:

- The Project and all its contractors will maintain strict compliance with all relevant Kenyan legislation and regulations that are relevant to protection of the natural environment and biodiversity, including but not limited to:
  - Disposal of all liquid and solid wastes using approved disposal pathways, and where appropriate employment of licensed waste disposal operators; and
  - All materials required for construction, including but not limited to chemicals, cement and fuel, will be stored in compliance with Kenyan regulations relating to the prevention of pollution and contamination of soils and water.

The following measures are applicable to the construction phase of the Project:

- Sediment management procedures to be developed and implemented;
- Solid waste management plan will be developed and implemented for activities within or adjacent to marine environments to minimise likelihood of sources of contamination;
- Wastewater treatment and management plan, contaminant management and control procedures will be developed and implemented to minimise likelihood of sources of contamination to the marine environment;

The following environmental measures are applicable to the operational phase of the Project:

- All activities within the Port Area will be required to comply with all regulations established by the Lamu Port Authority, including those relating to vessel speeds within the buoyed channel, and discharge of solid and liquid wastes;
- To manage the risk of introduction of invasive species, PipeCo will include contractual provisions such that all third party export tankers berthing to load crude from the VLCC will be required to follow the International Maritime Organisation (IMO) International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM); and
- To mitigate pollution from tanker vessels, PipeCo will require all vessels (including third party export tankers) to comply with the requirements of MARPOL 73/78, including Annex I, IV and V requirements relating to: 1) drainage and bilge water; 2) liquid sewage wastewater; and 3) food waste.

It should be noted that all of the above measures may be enforced by the Port Authority once it is established, however, will remain a requirement of the project regardless.

7.6.8 Impact Classification

Taking into account the baseline biodiversity setting (Section 6.7), the relevant incorporated environmental measures (Section 4), and the potential sources of impact (Section 7.6.6) determined from the Project description, the potential impacts for the construction and the operational phases are presented in this section. In accordance with good international ESIA practice (see, for example, African Development Bank, 2015) expert judgement was used to focus the assessment on receptors and resources of high biodiversity importance. Unless there were specific reasons (e.g. additional conservation concerns) that indicated they should be included, biodiversity receptors of medium or lower importance/sensitivity and receptors where the magnitude of an impact is low or negligible, are not included in the impact classification. Impacts of minor or negligible significance to these receptors will likely be further mitigated by some of the inherent and specific mitigation measures targeted primarily at effects on receptors of higher importance, and on impacts of medium or high magnitude. Where taxa are grouped, the assigned importance and sensitivity rating will be determined by those taxa with the highest rating (e.g. if the taxa covered included are a mix of high and medium importance/sensitivity, a high rating will be used).

Each discussion is followed by a table where the potential sources of impact and relevant incorporated mitigation applicable to each receptor are summarised. The magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Section 7.6.3.

7.6.8.1 Construction Phase

Temporary Habitat Loss and Fragmentation

Temporary habitat loss from construction activities relates to the mangrove habitat that lies within the Project working width (i.e. including the RoW that will be permanently occupied by the Project). The baseline review (Section 6.7) determined that these areas situated at KP 820, are where the pipeline will cross a coastal inlet that is approximately 550 m wide, with a narrow channel (10-20 m wide) fringed by mangrove and floodplains (Wood, 2019) (Figure 7.6-5). This area is understood to flood only during spring tides, approximately every two weeks (Figure 7.6-6). This mangrove was assessed in baseline surveys as being of relatively low diversity typical of the mangrove zone on the northerly part of the East African coast. Kenyan Port Authority drawings show that the area of mangrove affected by pipeline construction would in any case be lost, as it is to be in-filled as part of the Lamu port development (Wood, 2019).

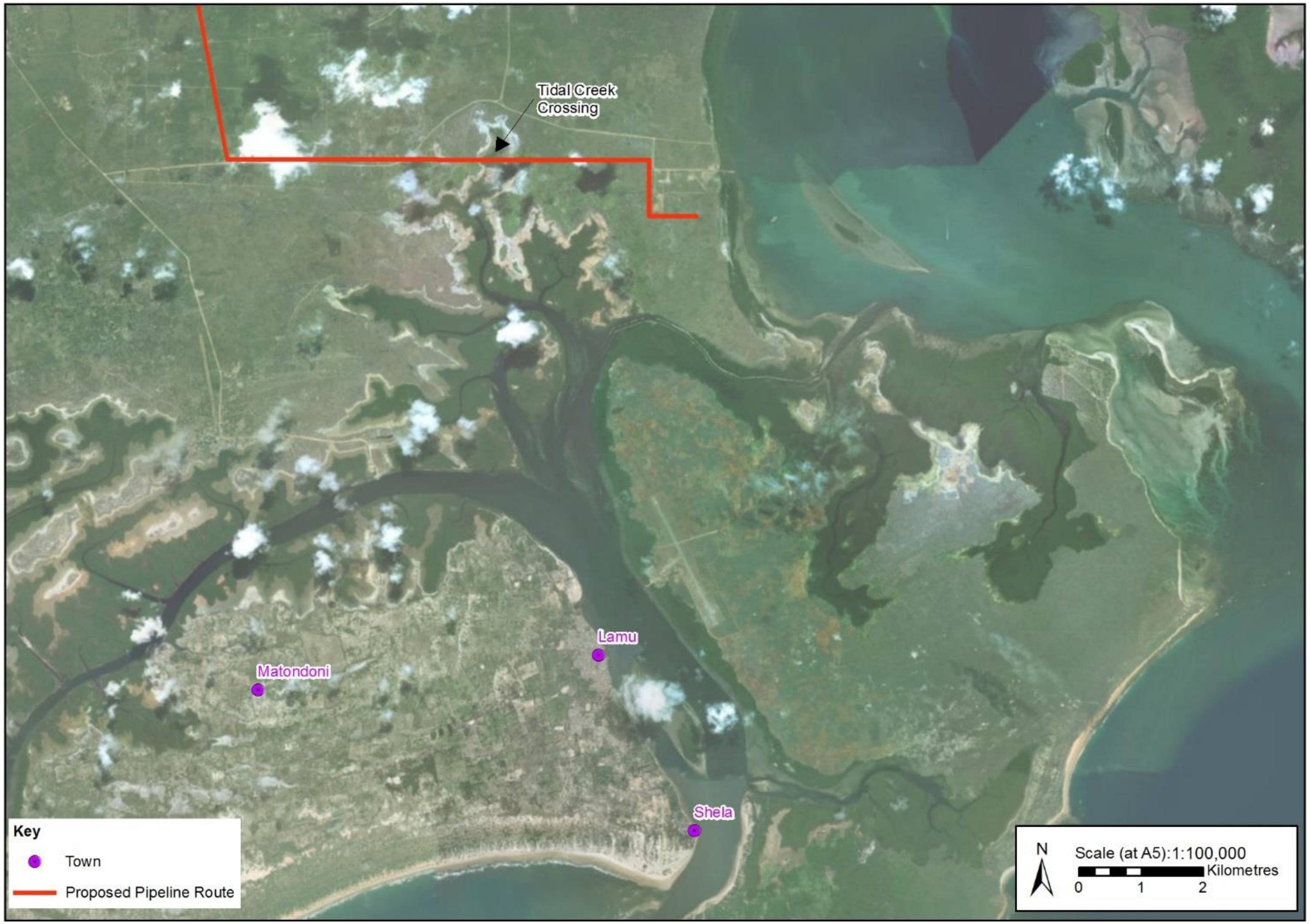

Figure 7.6-5: Map of pipeline crossing at KP 820 showing coastal inlet and fringing mangrove

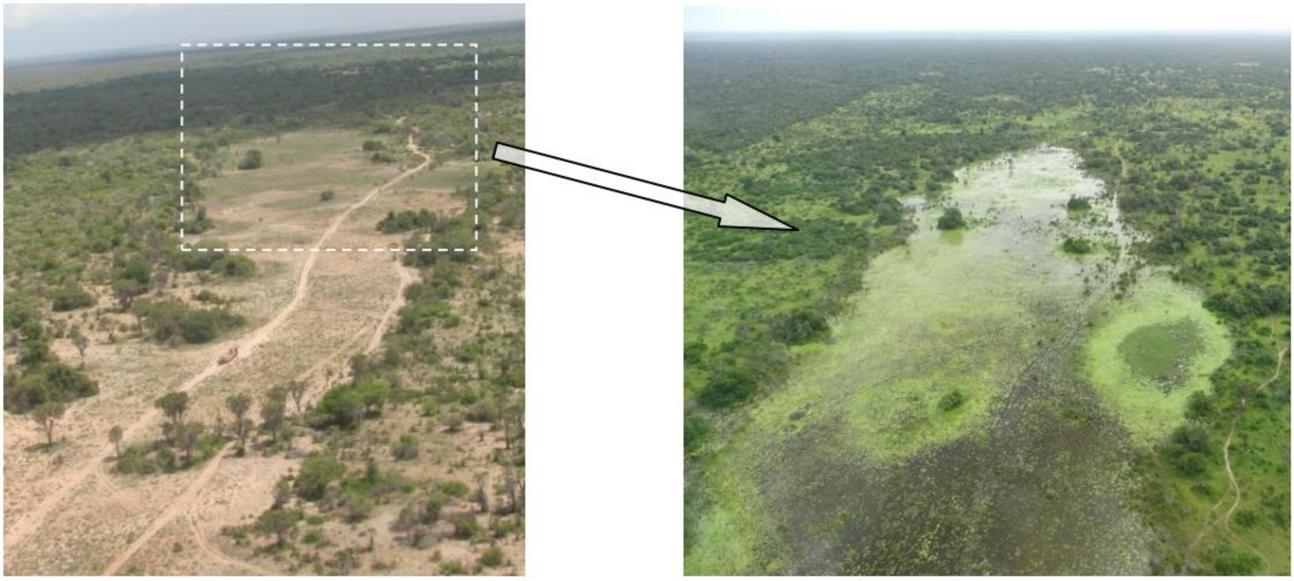

Figure 7.6-6: Area of pipeline crossing of coastal inlet at KP 820, showing dry (left) and spring tide (right) conditions

As described in Section 7.6.6.1, the maximum temporary land take (including the future RoW) has been calculated as 1.6 ha. The area may in reality be less, as efforts will be made to limit the area disturbed for reasons related to both logistical considerations and impact avoidance. The maximum temporary land take for construction is therefore <0.01% of the 37,350 ha of mangrove habitat in the Lamu-Kiunga seascape. This is assessed to be an impact of **negligible** magnitude.

Sensory disturbance (light, noise, vibration and odour)

Sensory air-borne noise and light impacts may affect species present in mangrove areas during construction; it is likely that birds would be most sensitive to these construction-related impacts. The magnitude of impacts would be decreased if juvenile birds had fledged nests and become mobile prior to clearance of the mangrove vegetation.

The temporal land use changes and disturbance associated with Project construction could affect a variety of bird species. However, birds are mobile and relatively adaptable and will be able to disperse to alternative areas away from the Project working width during construction. In view of the short duration of construction work in the mangrove zone (estimated at approximately one month, and the small total area that will be disturbed during construction (i.e. not more than 1.6 ha), impacts to birds and other fauna are likely to be temporary, and of **negligible** magnitude. There may also be underwater noise generated during laying of the pipeline to the load out facility on the berth, and construction of the facility itself, but this will be intermittent and of relatively short duration and is also deemed to be of **negligible** magnitude.

Injury/mortality of species receptors

Vegetation clearance, trenching and infilling works within the mangrove area have the potential to lead to injury or mortality of intertidal and subtidal species. As noted in Section 6.7, mangroves serve as habitat for fauna including fish, crabs and molluscs, e.g. by providing important foraging, spawning and nursery grounds; mammal, bird and herpetofauna taxa could also be affected. The baseline survey of mangrove areas identified mostly mollusc species (oysters and crabs) and no SoCC were reported. Individuals of more highly mobile intertidal and subtidal species may be able to move out of the working width, away from active works; the same will be true of birds and other terrestrial vertebrates (although during the breeding season bird nests and nestlings could be at risk).

In the absence of any confirmed SoCC in the area of the mangrove working width and RoW (a maximum of 1.6 ha), and the short duration of construction activities, it is considered that prior to mitigation the magnitude of impacts to taxa of higher biodiversity importance and sensitivity should on a precautionary basis be considered **medium**.

Impacts to water quality

Impacts on marine water quality during construction can result from a number of different sources as follows:

- Disturbance, suspension and dispersal of sediments from trenching and infilling works in intertidal mangrove areas leading to direct impacts on marine biodiversity; and
- Accidental releases of pollutants and contaminants to marine waters leading to direct impacts on marine biodiversity.

Compared to the scale of impact from existing port development activities being undertaken by Kenya Ports Authority for the ongoing construction of the Lamu Port, the very minor suspended sediment plumes that result from trenching through a short traverse of mangrove zone would lead to very limited and temporary impacts; and it is likely that receptors such as crustacea would be tolerant to temporary fluctuations in water quality that would occur until sediments settle. Tidal flows may also help to flush suspended sediments out into the marine system reducing localised effects, although it is acknowledged that mangroves often comprise low energy environments with limited tidal flushing.

In addition, there is potential for the accidental release of waste from construction activities into the mangrove habitat (e.g. plastics), and also waste associated with increased human presence in the area: poor waste management can cause pollution at construction sites; and litter and garbage may fall or be thrown from construction areas; these both have the potential to impact marine and bird life, particularly if any waste materials are ingested. However, as noted above, construction activities in the mangrove zone will be over a restricted area and will be of short duration. Prior to mitigation, the impact magnitude is deemed to be **minor**.

Indirect impacts resulting from the Project

Section 6.7.6 provides a discussion of indirect impacts associated with increased population and human pressures in the area that also relate to intertidal mangrove habitat area and is not repeated here. There is a possibility of a temporary increase in fishing activity by contractors' staff and by local people who may have increased access to the area. There may also be an increase in harvesting of mangrove resources such as wood for construction or firewood. However, the limited duration of construction in the mangrove zone, and adherence by Project and contractors' staff to inherent mitigation that requires compliance with Kenyan legislation relevant to protection of wildlife and the natural environment, results in the impact being considered of **negligible** magnitude.

The construction phase impact assessment with respect to marine biodiversity is presented in Table 7.6-4.

Table 7.6-4: Impact Classification and Consequence Table – Construction

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Impact Significance
National Protected Areas and Internationally Recognised Areas - IUCN management category II and VI, IBAs, EBSA and UNESCO World Heritage Site						
Kiunga Marine National Reserve, Lamu-EBSA; proposed Lamu-Kiunga Archipelago UNESCO World Heritage Site, Pate Marine Conservancy, Dodori National Reserve (high).	Temporary loss and degradation of habitat (for the working width in mangrove); although construction is not within a designated area this habitat forms part of, and provides ecosystem functions for, the EBSA and its constituent and neighbouring designated areas.	Medium – Short-Term – Temporary	Moderate (adverse)	Additional measures beyond those described in Section 7.6.7: Construction activities in the mangrove zone (c. 500m in length) at the head of tidal creeks on the approach to the Port to be overseen and monitored by the BO, in accordance with a biodiversity method statement. This will set out procedures for: ■ Monitoring and implementation of necessary actions during clearance, pipelaying and reinstatement of the RoW; ■ Supervision of mangrove habitat planting at agreed location to achieve no net loss of mangrove habitat from Project activities; and ■ Unforeseen impacts on biodiversity by describing procedures for emergency response and mitigation on site (e.g. accidental spills). No night working in the mangrove area. A no hunting or fishing policy will be developed and implemented. Disturbance to the environment and natural resources will only be permitted when required for the specific purpose of the Project, e.g. vegetation clearance in the RoW prior to trenching.	Negligible – Short-Term – Temporary	Negligible

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Impact Significance
Habitats of Biodiversity Importance						
Mangrove (very high)	- Temporary land take of Project working width causes larger habitat fragmentation effect (working width is significantly wider than permanent RoW). - Impacts from accidental release of construction wastewater and contaminants, sediments and waste. - Easier access to the working width and adjacent areas of mangrove habitat creating a temporary increase in human pressures on natural resources.	Medium – Short-Term – Temporary	Major (adverse)	Additional measures beyond those described in Section 7.6.7: GIIP construction management procedures, BO supervision, no night working, and no hunting or fishing policy to prevent damage of natural resources (as above). Local community access to the mangrove zone RoW during construction will be controlled. No storage of materials or storage/discharge of solid and liquid wastes in the mangrove zone; and no refuelling or chemical handling within mangrove areas. No net loss of mangrove habitat as a result of temporary land take for construction; since the land taken will subsequently be lost to the port development this will be achieved by investigating opportunities for further mangrove enhancement at other locations around Lamu Port, in consultation with for example KFS, KEMFRI and the Lamu Port Authority.	Negligible – Short-Term – Temporary	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Impact Significance
Coral reef and seagrass bed subtidal habitats (very high)	■ Impacts from accidental release of construction wastewater and contaminants, sediments and waste in the mangrove and inshore construction areas, which are carried to adjacent coral reef and seagrass habitat by currents. ■ Impacts on water quality from accidental release of construction wastewater and contaminants, sediments and waste into the marine environment.	Medium (Geographically discrete, short- to medium-term)	Major (adverse)	Additional measures beyond those described in Section 7.6.7: GIIP construction management procedures, BO supervision, and no hunting or fishing policy to prevent damage of natural resources (as above).	Negligible – Short-Term – Temporary	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Impact Significance
Fauna of Biodiversity Importance						
Birds supported by mangrove and other intertidal habitat (e.g. for feeding and roosting, including nesting adults and their nestlings) (Medium)	■ Mortality due to clearance, construction and reinstatement activities. ■ Avoidance of the mangrove construction zone by birds due to the effects of light and noise pollution during construction; behavioural changes.	Low (Geographically discrete and short- term)	Minor (adverse)	Additional measures beyond those described in Section 7.6.7: GIIP construction management procedures, BO supervision, no night working, and no hunting or fishing policy to prevent damage of natural resources (as above). No construction in the mangrove zone during the main bird nesting season (which peaks in May and June). Use of directional lighting and cowls to prevent excessive light spill into mangrove areas adjacent to the RoW.	Negligible – Short-Term – Temporary	Negligible (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Impact Significance
Crustacea and marine macroinvertebrates in intertidal mangrove zone and adjacent subtidal habitats (Medium)	■ Mortality due to clearance, construction and reinstatement activities. ■ Impacts from deterioration of water quality caused by accidental release of construction wastewater and contaminants, sediments and waste into the mangrove and marine environment.	Low (Geographically discrete and short- term)	Minor (adverse)	Additional measures beyond those described in Section 7.6.7: GIIP construction management procedures, BO supervision, no night working, and no hunting or fishing policy to prevent damage of natural resources (as above).	Low – Short-Term – Temporary	Minor (adverse)

7.6.8.2 Operational Phase

This section characterises and predicts the potential impacts during the operation phase on species and habitat receptors having taken into account the environmental measures and mitigations described in Section 7.6.2.

Predicted effects on marine biodiversity during the operational phase of the Project relate to impacts associated with unplanned hydrocarbon spills, increases in light and noise from vessel movements, potential for injury of megafauna resulting from collision with vessels and also the potential for the introduction of alien invasive species. Of the impacts considered in this section, only those of a medium or high magnitude have been carried forward into the operational impact classification and consequence analysis (Table 7.6-5).

Oil spills are assessed in the Emergency, Accidental and Non-planned events section (Section 7.14), but detail of the likely pathway and receptor are presented here.

Permanent Habitat Loss and Fragmentation

The permanent habitat loss relates to the mangrove habitat that lies within the Project RoW (i.e. the 6 m-wide easement that will be kept clear of vegetation throughout Project life). This is part of a continuous mangrove system that forms a key biological component of the coastal and marine Lamu-Kiunga landscape/seascape.

It is estimated that 0.4 ha of mangrove would be permanently lost to the Project RoW, representing approximately 0.001% of the available mangrove habitat in the Lamu-Kiunga landscape/seascape. The barrier effect and habitat fragmentation of a 6 m-wide strip are not considered important with respect to SoCC. This permanent loss of habitat is therefore deemed to result in an impact of **negligible** magnitude.

Water and Waste

Vessels provide potential for accidental pollutant release and spillages from deck drainage, ballast water (in emergency situations only), contaminated drainage from machinery spaces, fuel, cable oils and grey water. In addition, vessels produce wastewater that could be discharged to the marine environment, but if vessels comply with MARPOL 73/78 requirements and relevant Kenyan regulations (this compliance being defined as inherent mitigation) the impacts from accidental, discrete spillages are deemed to be of **negligible** magnitude.

Sensory Disturbance and Injurious Impacts (Light and Underwater Sound)

Artificial Lighting

Artificial illumination may have an impact on a range of marine species. In the seascape, nesting sea turtle populations are particularly sensitive to light impacts, which can lead to disruption of nest selection and movement of turtles to sea in adults, and misorientation in hatchlings. The nearest known nesting beach to Lamu Port is on the eastern side of Manda Island at Takwa beach, adjacent to the buoyed channel approach to the port between Manda and Pate islands and approximately 8 km from the Project (i.e. the VLCC/load out facility). However, as stated in Section 6.7 nesting elsewhere where suitable beach habitat exists cannot be discounted. The current baseline illumination is created by settlements and vessel movements; this will likely increase as Lamu Port becomes operational and continues to be developed. The Project’s low frequency of vessel movements will only add a small, intermittent amount to baseline light conditions when a Project third party export tanker transits the buoyed channel: this would be unlikely to lead to adverse impacts on nesting turtles at Takwa beach or other beaches farther away. Almost all other lighting emitted from the berths and wider port will not be of a consequence of Project activities, except for the small contribution to overall luminance from lighting on the permanently moored VLCC and load out facility. The magnitude of impact on turtles is therefore considered to be **negligible**.

Light emissions from vessels also has the potential to affect marine birds, especially night-flying and migrating species, which can be attracted to light and could become disoriented and suffer related behavioural impacts. In the context of other potential light sources that that will result from broader development of Lamu Port and its hinterland, the magnitude of impacts to birds from illumination originating from the Project's vessels and onshore activities is considered to be **negligible**.

Underwater Sound

Vessel noise may be generated by vessels during operation, both from activities at the VLCC/load out facility, and the ongoing movement of the Project's third-party export tankers moving to and from Lamu Port. The proposed frequency and volume of third-party export tanker movements for the Project is low – estimated as being one single tanker per week moving into and out of the Port, but as noted in Section 6.7 there are few data on the underwater ambient baseline noise conditions in the AoI (although it can be assumed that the area is subject to a range of noise from anthropogenic and natural sources, including existing vessel movements related to the wider port area and beyond). Whilst volumes and frequency of vessel movements may be low at this time, they will increase over time as the new port infrastructure increases and attracts more traffic, and larger vessels. In offshore zones, existing traffic is already more frequent and is related to vessel movement across the broader Kenyan coastal area. There are also artisanal fisheries in the area that transit across the AoI which also generate underwater noise. Other main sources of underwater sound contributing to the current baseline conditions include works for the construction of port infrastructure. Since there will be further construction of later phases of the port development and subsequent infrastructure maintenance, these sources will persist to some degree through the whole operational period of the Project. Apart from the noise created by the movements of one third-party export tanker per week, there will also be intermittent noise as a result of pumping oil to tranship it from the VLCC to the third-party export tanker, and more constant operational noise from the VLCC (e.g. generators); however, other additional sound sources noted that are not a consequence of Project activities in the wider port will undoubtedly contribute far more to the ambient underwater noise conditions as Lamu Port develops.

Continuous, widespread noise in the marine environment may have chronic effects including degradation of habitat and long-term population consequences on the SoCC that have been identified in this impact assessment section. Knowledge of the effects of underwater noise on marine animal taxa are described in Annex I-C, and may be summarised as follows:

- Large commercial vessels generally produce relatively loud, low frequency non-impulsive sounds at a frequency range between 10 Hz and 1000 Hz (1 kHz) which under the right conditions can travel over hundreds of kilometres. However, higher frequency sound emissions from vessels (up to tens of kHz) can occur at relatively close range (typically less than 1 km). Sound is generated primarily from propeller cavitation, and also from hydrodynamic flow noise and onboard machinery. The frequency of noise generated by large vessels overlaps the hearing range of low frequency species (7 Hz to 35 kHz) (baleen whales) and mid-frequency species (150 Hz to 160 kHz) (dolphins, toothed whales, beaked whales, bottlenose whales): it is therefore possible that the underwater sound generated by large vessels is in the hearing range of all of the cetacean species that are known to occur, or potentially occur, in the AoI. It is likely that these sounds are also within the hearing range of dugong;
- The possible effects on marine mammals have been categorised as:
  - Physical (including physiological) effects: to include damage to body tissues, gross damage to ears, permanent auditory threshold shift (PTS), temporary auditory threshold shift (TTS) with eventual recovery, and chronic stress effects that may lead to reduced viability;
  - Perceptual effects: including masking of biologically significant sounds (e.g. communication signals, echolocation, and sounds associated with orientation and navigation, finding prey or avoiding natural or manmade threats);

- Behavioural effects: including disruption of foraging, avoidance of particular areas, altered dive and respiratory patterns, and disruption of mating systems; and
- Indirect effects: including reduced prey availability resulting in reduced feeding rates;

- The ambient underwater noise environment for marine mammals within the AoI will be created by sounds from a number of sources, including all vessels (i.e. an increasing number of vessel movements in addition to the Project's one vessel per week) and non-Project activities such as pile-driving, dredging and other port construction and maintenance activities. The main potential effects of vessel noise on marine mammals will be masking (of communication) and habitat displacement. The effects from other (non-Project) noises may also include habitat displacement, as well as physical trauma, hearing loss, behavioural change and other behaviourally mediated effects:
  - Reference to available guidance (Annex I-C) suggests that marine mammals move away from a noise source (i.e. a vessel) as it approaches, so the risk of physical injury from close exposure to a noise source is likely to be low. It should, however, be noted that current understanding of the response of an individual marine mammal to sound is incomplete and movement away from noise emitted from a Project vessel could be hampered in the confined spaces of the approaches to the port (e.g. for larger cetaceans that may be present in the channel between Manda and Pate islands or within Manda Bay); and
  - In addition to injurious impacts, underwater sound from large vessels is likely to lead to behavioural effects on marine mammals, including impacts on communication, social interactions, foraging, and predator avoidance; such behavioural responses can theoretically take place anywhere in the zone of audibility, which will extend over a long distance from source. The type of response to underwater sound generation will vary greatly from small changes, such as a startle response, to strong avoidance. Behavioural responses are complex, and dependent upon a number of factors relating to the animal and more precise properties of the source sound/transmission.

Sound exposure guidelines for sea turtles and fish state that there is no direct evidence of mortality or potential mortal injury to either taxa from ship noise; further conclusions can be summarised as follows:

- Sound is an important source of sensation and communication in fish, with marked differences in both acuity and frequency response between and within species, although in most cases sensitivity is in the 50-3,000 Hz range. Broadly, fishes can be categorized as hearing specialists (broad hearing frequency range with low auditory thresholds) or hearing generalists (narrower frequency range with higher auditory thresholds). The hearing generalists, such as sharks, rays, flatfish, flounder and many large pelagic fish do not have swim bladders and are likely to be at less risk from underwater noise than hearing specialists (i.e. fish with swim bladders);
- For the 'non-impulsive' sounds that are relevant to the Project's potential effects, criteria for effects of 'recoverable injury' and TTS for fish with swim bladders are reported as being 170 dB and 158 dB, respectively. This means that injury from large vessel movements for fish could occur, but it would be based on relatively long periods of exposure (12-48 hours) with recovery occurring with 2-8 days, and some species showing no effects even with long periods of exposure. No effects on fish eggs or larvae have been reported;
- Continuous noise can mask signal detection, and thus affect fish behaviour (e.g. induce avoidance, alter swimming speed and direction, and affect schooling); and
- The ear of sea turtles appears to be adapted to sense noise in water, through retention of air in the middle ear to detect sound pressure. This allows them to perceive important biological signals, the possible

functions of which include predator avoidance, navigation, communication and the identification of nesting beaches. Hearing damage may lead to a reduced ability to avoid natural and anthropogenic threats, such as fisheries by-catch and vessel collisions, which are major sources of turtle mortality, but there are few data on TTS or behavioural effects and it is not known what levels of sound exposure (or frequency) would cause permanent or temporary hearing loss or what affect this may have on sea turtle fitness or survival; no absolute thresholds exist for behavioural responses, but experimental studies have found that exposure to sound elicits a behavioural response in turtles. Research has indicated that sea turtles can detect frequencies between 50 Hz and 1600 Hz, which overlaps with the frequency of large vessels, and show behavioural responses (e.g. coming to the surface). However, these research data are not backed up by observations in a natural setting, and so can only be treated as indicative of a potential risk if sea turtles in the wild reacted in a manner that could increase the risk of vessel collisions.

In summary, based on criteria from best available guidance, it is possible that underwater noise from large vessels operating to export oil from the Project could lead to temporary physical effects (localised), and also behavioural impacts (localised and wider) on marine mammals, sea turtles and fish. The impacts are, however, uncertain as a result of the relative lack of baseline evidence and also of expert knowledge relevant to the scale of impacts that might ensue. However, Project vessel movements are infrequent and of low volume, and the magnitude of potential impacts from the Project has to be considered in this context, especially considering the much greater number of marine traffic movements that are expected to occur due to activity in the new port development as a whole and noise from ongoing port construction and maintenance activities. The magnitude of this impact prior to operational mitigation is therefore considered to be **low**.

Vessel Collisions with Marine Wildlife

During operation, the risk of vessel collisions with marine wildlife causing injury and mortality will occur as a result of the weekly third-party export tanker transits through the buoyed channel. The risk will particularly attach to marine mammals and sea turtles, as both taxa are surface-breathing and therefore more likely to be at a depth at which they could come into contact with a vessel. Slow-moving whales and dugong are particularly vulnerable, but small cetaceans are also known to be affected. Collision risks are known to be greater for fast-moving vessels (Jensen and Sibler, 2003).

In the case of Project vessels within the AoI the risk of collision is reduced by the low frequency of vessel movements, and the slow vessel speeds as they pass through the buoyed navigation channel between Manda and Pate islands to and from the VLCC/load out facility. However, it should also be noted that the collision risk may be greatest in the approaches due to the presence of animals engaged in foraging or other activities that may distract their attention from potential threats such as an approaching third party export tanker, and the more restricted space to move away from vessels that is available in the buoyed channel to Lamu Port. Despite the potential risks and the uncertainties in baseline, in light of the low frequency of Project vessel movements within the context of the expected high volumes of ship traffic in the buoyed channel port approach, the magnitude of the potential impacts is deemed to be **low**.

Alien Invasive Species

Alien invasive species introduction could result from the transport of species from distant locations in the ballast water of vessels, or as fouling organisms on hulls, and/or from the transport of stowaway animals such as cats, mice and rats in vessels. The potential for the importation of pests is low as no goods will be transferred from vessels into Kenya.

Vessels can be a significant pathway for the introduction of invasive plant and animal species into the coastal and inshore marine environment through discharge of ballast water containing the invaders. Whilst the probability of introduction of marine invasive species is considered low, invasions are well documented in many other parts of the world, and the resulting impacts to the environment can be extremely severe and almost impossible to reverse. One of the most significant problems is that alien invasive species introduced from a distant location will have no natural predators in their new environment; this, combined with the likelihood that they are adaptive and have a rapid breeding cycle, enables them to expand in population at a rate faster than less viable native species with which they compete (Bruno et al. 2005). In some instances, potential native predators are naïve to non-indigenous species, preventing biological control and effective predation of the invasive species. In an environment such as a port that is suffering disturbance due to anthropogenic impacts, open niches can be created that invasive species can occupy: not only do pollution, dredging, artificial structures, and other anthropogenic stressors open niches for non-indigenous establishment, but there is a constant flux of ships, many of which are likely to harbour foreign species (Byers, 2002). However, these risks are proportionate to the number of vessel movements; therefore although risks exist and efforts should be made to mitigate potential impacts from invasive species, as already noted the number of vessel movements resulting from this Project during operation is low compared to those likely to occur from Lamu Port as a whole.

It is possible the introductions of invasive plant species into the inland Project area could occur via plant and equipment required for Project operation and maintenance that is imported into Kenya unless stringent inspection and eradication procedures are implemented at the port of entry.

Because of the very high and high biodiversity importance of coastal and marine habitats and SoCC, the potential magnitude of the impact of alien invasive species prior to mitigation is considered **medium** in coral reef and seagrass bed habitats, and **low** in mangrove habitat**.**

Marine Oil Spill Events

The discussion in this section relates to the effects on biodiversity receptors of a non-routine oil spill event, and serves to provide biodiversity context for the assessment of the risks and consequences of such an event, and mitigation measures. This discussion is not, therefore, an impact assessment of major oil spills: the issue of hydrocarbon spills and contaminants is comprehensively addressed in Section 7.14: Emergency, Accidental and Non-Routine Events.

The transfer of oil from the pipeline to the VLCC and transfer from the VLCC to third party vessels could give rise to unplanned oil spill events. Such events could occur at the berthing location or relate to accidental vessel collisions that might happen. All marine species present in the AoI could be adversely affected by an oil spill event, with the scale of impact dependent upon the extent of spill and also the behaviour of the oil once discharged. In the case of the waxy oil associated to this Project, it behaves in such a way that is solidifies on contact with water: this has been demonstrated in laboratory test simulations carried out in support of Project oil spill modelling and this ESIA. Usually oil can coat breathing surfaces of mangrove roots, stems, seedlings, and surrounding sediments, and fauna present in burrows and root hollows, or can foul the feathers of seabirds on the water's surface. However, this is considered unlikely given the behaviour of waxy oil in water.

In addition to mangrove areas, the baseline studies have determined a range of habitats and SoCC in the AoI that may be sensitive to the effects of an oil spill. These include coral and seagrass habitats, marine mammals, sea turtles, birds, fishes, and marine invertebrates. Impacts that relate to wide-ranging species may mean that impacts are felt across the whole Lamu-Kiunga seascape and beyond (including internationally). Whilst, as discussed in Section 7.14, the consequences of an oil spill can be severe prior to development and implementation of appropriate measures in an Emergency Preparedness and Response Plan, adoption of such measures ensures that impacts are minimised and any effects on sensitive biodiversity receptors avoided as far as possible. Detailed core oil spill modelling has been undertaken for the ESIA, and the results are detailed in Section 7.14; effective mitigation of the oil spill risk will be achieved through the additional modelling, along with additional baseline studies such as may be required to confirm the location and characteristics of features of biodiversity importance, to inform finalisation of the Emergency Preparedness and Response Plan.

Table 7.6-5: Impact classification and consequence table – Operations

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Residual Impact Significance
Habitats of Biodiversity Importance						
Mangrove (very high)	■ Permanent loss, fragmentation and further degradation of habitat (due to the permanent RoW in mangrove); although not within a designated EBSA area this habitat forms part of, and provides ecosystem functions for, the EBSA and its constituent designated areas. ■ Impacts to mangrove habitat in the RoW, AoI and wider seascape from accidental, discrete spillages of liquid and solid pollutants and contaminants, from Project tanker vessels and the load out facility.	Low – short-term/medium-term (for invasive species, geographically limited extent) Negligible (for accidental, discrete spillages and permanent loss of habitat)	Moderate (adverse) Negligible	Additional measures beyond those described in Section 7.6.7: Implementation of Emergency Preparedness Response Plan. Specific measures incorporated in the Invasive Species Management Plan relating to Project activities in the marine environment. Monitoring of areas of mangrove restored after construction (i.e. vegetation re-establishment and health, and water flows). Continue consultation to investigate and where appropriate implement opportunities for mangrove enhancement in and around Lamu Port, in consultation with KFS and the Lamu Port Authority. A no hunting or fishing policy will be developed and implemented. Disturbance to the environment and natural resources will only be permitted when required for the specific purpose of the Project. Ongoing adaptive management of risks and impacts to marine and mangrove biodiversity, with reference to relevant monitoring data and *ad hoc* sightings and reports; this will be carried out by the designated Project staff member with responsibility for Project interactions with biodiversity.	Negligible	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Residual Impact Significance
	■ Introduction of alien invasive species.			Coastal oil spill dispersion modelling will be updated, and an Oil Spill Contingency Plan will be developed for operations.		
Coral reef and seagrass bed subtidal habitats (very high)	■ Impacts to habitats from accidental, discrete spillages of liquid and solid pollutants and contaminants, from Project tanker vessels and the load out facility. ■ Introduction of alien invasive species.	Low – short-term/medium-term (for accidental, discrete spillages, geographically limited extent) Medium – short-term/medium-term (for invasive species, infrequent during operation, but could cause mortality, or medium-term effects on important habitat)	Moderate (adverse) Major (adverse)	Additional measures beyond those described in Section 7.6.7: Emergency Preparedness and Response; Invasive Species Management; no hunting or fishing policy to prevent damage of natural resources; coastal oil spill dispersion modelling updated and Oil Spill Contingency Plan; and ongoing adaptive management of potential Project risks to the marine environment.	Negligible	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Residual Impact Significance
Fauna of Biodiversity Importance						
Marine mammals and fish (very high).	▪ Impacts to individuals and supporting habitats from accidental, discrete spillages of other liquid and solid pollutants and contaminants, from Project tanker vessels and the load out facility. ▪ Impacts resulting from underwater noise generated by Project vessels. ▪ Vessel collision risk.	Low – short-term	Moderate (adverse)	Additional measures beyond those described in Section 7.6.7: Emergency Preparedness and Response; Invasive Species Management; no hunting or fishing policy to prevent damage of natural resources; coastal oil spill dispersion modelling updated and Oil Spill Contingency Plan; and ongoing adaptive management of potential Project risks to the marine environment. Marine traffic collision risk assessment, covering all Project vessels, third party export tankers, other vessels using the port and local fishing vessels operating in and around Lamu Port; implementation of appropriate operational procedures based on the risk assessment's conclusions.	Negligible	Minor (adverse)
Sea turtles (very high)	▪ Impacts to habitats (including turtle nesting beaches) from accidental discrete spillages of liquid and solid pollutants and contaminants, from	Low – short-term	Moderate (adverse)		Negligible	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Residual Impact Significance
	Project vessels and the load out facility. ■ Impacts resulting from underwater noise generated by Project vessels. ■ Vessel collision risk.					
Birds (Medium)	■ Impacts to taxa and their supporting habitats from accidental, discrete spillages of liquid and solid pollutants and contaminants, from Project tanker vessels and the load out facility.	Low – short-term	Minor (adverse)	Additional measures beyond those described in Section 7.6.7: Emergency Preparedness and Response; no hunting or fishing policy to prevent damage of natural resources; coastal oil spill dispersion modelling updated and Oil Spill Contingency Plan; and ongoing adaptive management of potential Project risks to the marine environment.	Negligible	Negligible
Crustacea and marine macroinvertebr ates in intertidal mangrove zone and adjacent subtidal habitats (Medium)	■ Impacts to taxa and their supporting habitats from accidental spillages of liquid and solid pollutants and contaminants, from Project tanker	Medium – short-term/medium-term (for accidental, discrete spillages and invasive species,	Minor (adverse)	Additional measures beyond those described in Section 7.6.7: Emergency Preparedness and Response; Invasive Species Management; no hunting or fishing policy to prevent damage of natural resources; coastal oil spill dispersion modelling updated and Oil Spill Contingency Plan; and ongoing adaptive management of potential Project risks to the marine environment.	Low	Minor (adverse)

Receptor (Importance/ Sensitivity)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual impact classification magnitude (including all mitigation)	Residual Impact Significance
	vessels and the load out facility. ■ Impacts to taxa and supporting habitats resulting from introduction of alien invasive species.	geographically limited extent)				

7.6.9 Decommissioning

As described in the Project Description (Section 4) removal of Project facilities (after an operational life currently planned at 25 years) will be carried out according to a Decommissioning Plan that will have been developed for agreement with the appropriate authorities. As part of this, all marine Project facilities will be emptied of oil product and removed from the site for safe disposal, and the pipeline through the mangrove zone will be emptied, flushed, plugged and abandoned. Any potential impacts to features of marine biodiversity importance would be managed and mitigated under the auspices of a BMP developed within the Decommissioning Plan.

7.6.10 Summary of Mitigation

In addition to the inherent mitigation measures (i.e. Project design measures, and compliance with all relevant Kenyan laws and regulations, and with relevant international conventions such as MARPOL 73/78) that will be put in place during construction and operation to avoid impacts on marine receptors or reduce their magnitude, the following additional mitigation or monitoring will be applied. The measures include those reiterated from relevant specialist studies within the ESIA that contribute to mitigation of impacts on marine receptors, as well as additional, marine-specific mitigation measures based on sources including the guidance provided by IPIECA/OGP for oil and gas project impacts and dependencies (IPIECA, 2011). These mitigation measures follow the mitigation hierarchy (Section 3.4), and they are detailed in the Project ESMP (Section 8.0) to ensure the minimum possible impacts on marine receptors.

Construction

- All construction activities in the mangrove zones (facility. 500m in length) at the head of tidal creeks on the pipeline's approach to the Port to be overseen and monitored by the BO, in accordance with a biodiversity method statement. This will set out procedures for:
  - Pre-construction surveys;
  - Monitoring and implementation of necessary actions during clearance, pipelaying and reinstatement of the RoW;
  - Supervision of mangrove habitat planting at agreed location to achieve no net loss of mangrove habitat from Project activities; and
  - Unforeseen impacts on biodiversity by describing procedures for emergency response and mitigation on site (e.g. accidental spills).
- No night working in the mangrove area;
- No storage of materials or storage/discharge of solid and liquid wastes in the mangrove zone; and no refuelling or chemical handling within mangrove areas;
- No construction in the mangrove zone during the main bird breeding season (which peaks in May and June);
- Use of directional lighting and cowls to prevent excessive light spill into mangrove areas adjacent to the RoW;
- Local community access to the mangrove zone RoW during construction will be controlled;
- No net loss of mangrove habitat as a result of land take for construction, since the land taken will subsequently be lost to the port development this will be achieved by investigating opportunities for further mangrove enhancement at other locations around Lamu Port, in consultation with for example KFS, KEMFRI and the Lamu Port Authority;

- Investigate opportunities for further mangrove enhancement in and around Lamu Port, in consultation with KFS and the Lamu Port Authority; and
- A no hunting/fishing policy will be developed and implemented. Disturbance to the environment and natural resources will only be permitted when required for the specific purpose of the Project, e.g. vegetation clearance in the RoW prior to trenching.

Operation

- Specific measures incorporated in the Invasive Species Management Plan relating to Project activities in the marine environment;
- Marine traffic collision risk assessment, covering all Project vessels, third party export tankers, and other vessels using the port and local fishing vessels operating in and around Lamu Port; implementation of appropriate operational mitigation based on the risk assessment's conclusions;
- Monitoring of areas of mangrove restored after construction (i.e. vegetation re-establishment and health, and water flows);
- Continue consultation to investigate and where appropriate implement opportunities for further mangrove enhancement in and around Lamu Port, in consultation with KFS and the Lamu Port Authority;
- A no hunting/fishing policy will be developed and implemented. Disturbance to the environment and natural resources will only be permitted when required for the specific purpose of the Project, e.g. vegetation clearance in the RoW prior to trenching;
- Ongoing adaptive management of risks and impacts to marine and mangrove biodiversity, with reference to relevant monitoring data and *ad hoc* sightings and reports; this will be carried out by the designated Project staff member with responsibility for Project interactions with biodiversity;
- Implementation of Emergency Preparedness Response Plan; and
- Coastal oil spill dispersion modelling will be updated, and an Oil Spill Contingency Plan will be developed for operations.

7.6.11 Summary of Residual Impacts

With mitigation that has been incorporated into the design, or that will take place during pre-construction, construction or operational phases, it is considered that the magnitude of potential impacts to marine biodiversity receptors is acceptable. The associated impact significance that results from the combination of resource importance and predicted post-mitigation impact magnitude is in all instances reduced to **minor** or **negligible**.

7.7 Landscape and Visual

7.7.1 Introduction

This section presents the findings of the landscape and visual impacts analysis. There are two main parts to the assessment:

- Landscape impacts: which relate to the permanent impacts on the fabric, character and scenic quality of the landscape resulting from physical and perceptual changes (i.e. to landform, vegetation cover, or tranquillity of the landscape); and
- Visual impacts: which relate to changes in existing views due to Project infrastructure and activities, and the impacts of those changes on the current population (e.g. residents, workers or visitors).

The aim of the assessment is to identify any significant changes to landscape characteristics or views and, where appropriate, to develop appropriate mitigation measures to reduce adverse impacts.

7.7.2 Receptor Importance

In order to identify the importance of the receptors, the scale of relative importance presented in Tables 7.7-1 and 7.7-2 have been used with reference to the information collated in the baseline to classify the selected receptors.

7.7.2.1 Landscape Importance

Table 7.7-1: Criteria for determining landscape importance of receptors

Receptor Importance	Example Receptor Types
Very high	■ International importance. ■ Protected or designated areas of international importance (e.g. world heritage sites). ■ Landscape with a high quality and rarity, regional or national scale and limited potential for substitution/replacement.
High	■ National importance. ■ Protected or designated areas of national importance (national reserves). ■ Landscape with a high quality, local scale and limited potential for substitution/replacement.
Medium	■ Regional importance. ■ Designated areas of national or regional importance (e.g. community conservancies).
Low	■ Local, limited or no known importance.

7.7.2.2 *Visual Importance*

Table 7.7-2: Criteria for Determining Visual Importance of Receptors

Receptor Importance	Example Receptor Types
Very high	■ Views of a high quality and rarity, regional or national scale and limited potential for substitution/replacement.
High	■ Permanent residential user/dwelling with open views; and/or ■ Tourist dwellings with open views.
Medium	■ Permanent residential user/dwelling with limited views and/or transient residential user/dwelling.
Low	■ Incidental/transient and amenity user.

7.7.3 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change at each of the receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline environment and consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential impact has then been classified between ‘negligible’ and ‘high’, as described in Table 7.7-3.

Each potential impact can be either adverse or beneficial to the receptor of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment the following durations apply:

- A short-term impact is defined as up to 38 months (the maximum anticipated construction period);
- A medium-term impact is defined as between 3 and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur at the Project itself. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one receptor has another knock-on impact on one or more other related receptor(s).

7.7.3.1 *Landscape Assessment Methodology*

The following activities were used to evaluate the impacts on the landscape:

- Overlaying the infrastructure footprints on the landscape character area (LCA) plan and aerial photographs to estimate the physical extent of the changes to the landscape attributes within the Landscape Character Areas;
- Preparing a computer-generated model of the main project components to assess the permanent changes to landform and land cover; and
- Comparing the main project components with observations/judgements made during the baseline study.

Changes to the landscape attributes within each LCA were assessed and categorised individually using the criteria in Table 7.7-3 to determine the magnitude of impact on the landscape.

Table 7.7-3: Criteria for assessing the magnitude of impact on the landscape

Magnitude of Impact	Description Criteria	
	Criteria	Geographical Extent
High	Loss of resource/receptor, loss of quality and integrity of the resource/receptor, severe damage to key characteristics, features or elements. Major loss or alteration to the landscape.	Very extensive or complete impact on landscape character area.
Medium	Partial loss of resource/receptor, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements. Notable loss or alteration to the landscape character.	Affecting a substantial proportion of the landscape character area.
Low	Some measurable change in/damage to attributes, quality or vulnerability. Minor loss or alteration to the landscape character.	Impacted by the immediate setting of the Project component site.
Negligible	No, or very minor (immeasurable), change to characteristics, features or parameters describing resource/receptor quality. Very minor loss or alteration to the landscape character.	Typically, no major changes to key landscape attributes.

7.7.3.2 Visual Methodology

The visual impacts on the local population (viewers) were considered in relation to the predicted appearance of the sites and the associated infrastructure receptors and assessing the degree of change compared to the existing baseline views. Visual impacts were assessed using the following methods:

- Generating the Zone of Theoretical Visibility (ZTV) mapping and analysis to predict the visual envelope for indicative heights of infrastructure, to inform the baseline data gathering;
- Generating simplistic computer-generated visualisations to provide an indication of the views of the project development from locations which represent typical views from settlements, roads, and tourist destinations; and
- Comparing the main project components with observations/judgements made during the baseline study.

Impacts on viewers were assessed in relation to change to the composition and quality of the view, the prominence of the development and the distance between the viewer and the development.

7.7.3.2.1 The Composition and Quality of the View

A view comprises a number of attributes which collectively contribute to the composition and scenic quality of the view. The assessment considers changes to these attributes (which include scale, colour, texture, form and pattern) to determine the overall impacts on the view composition.

7.7.3.2.2 Prominence of the Development

The overall prominence of the site components is measured in terms of the extent or proportion of the viewer's field of vision occupied by the proposed development (Figure 7.7-1). There is usually a strong correlation between prominence and distance.

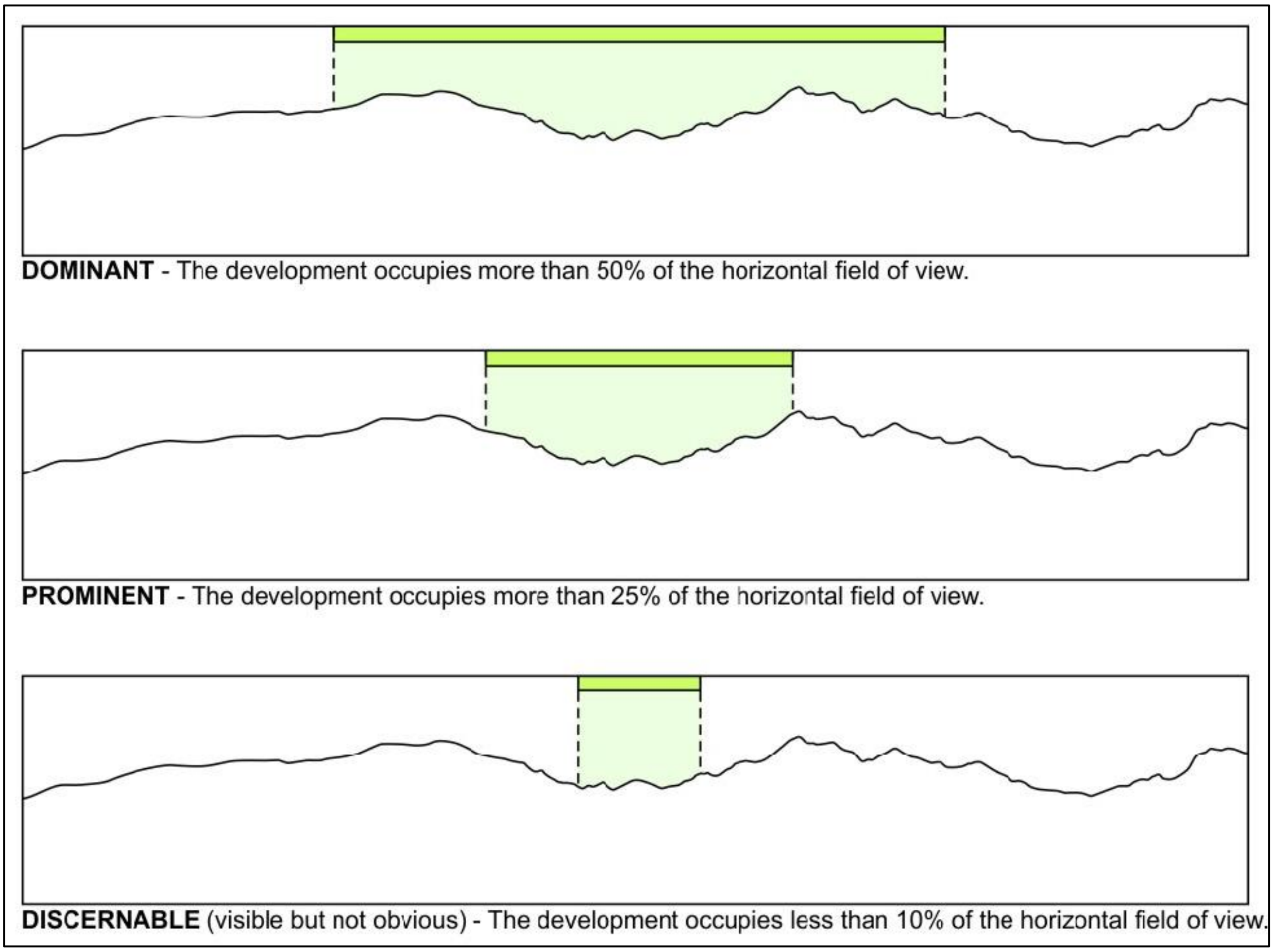

Figure 7.7-1: Criteria for assessing the prominence of the development

7.7.3.2.3 Distance between the Viewer and the Development

There is usually a correlation between viewer distance and magnitude of change (i.e. the greater the distance, the less the visual impact), though occasionally distant viewers may be more adversely affected than closer viewers whose views are screened by intervening landform and / or vegetation.

7.7.3.2.4 Magnitude of Visual Change

The overall impacts on view composition, prominence and distance are calculated using the criteria in Table 7.7-4. The magnitude of change is based on a qualitative assessment by the ESIA Team and does not necessarily reflect the individual opinions or perception of the viewers within the communities who may be disposed or predisposed to the project, altering their tolerance to visual change.

Table 7.7-4: Criteria for determining the magnitude of visual impact

Magnitude of Impact	Description Criteria	
	Change to the composition and quality of the view	Prominence of the development
High	Major change to all attributes.	The development is dominant.
Medium	Moderate change to all attributes or major change to some attributes.	The development is prominent.
Low	Low change to all attributes or moderate change to some attributes.	The development is discernible.
Negligible	Negligible change to attributes	The development is not visible or barely discernible.

7.7.4 Key Guidance and Standards

Kenya's Environmental (Impact Assessment and Audit) Regulations (2003) identifies the following landscape issues which have been considered in the making of this landscape and visual impact assessment:

- Views opened up or closed;
- Visual impacts (features, removal of vegetation, etc);
- Compatibility with surrounding area; and
- Amenity opened up or closed, e.g. recreation possibilities.

The International Finance Corporation (IFC) *Performance Standard 3: Resource Efficiency and Pollution Prevention* (2012) highlights the need to reduce pollution from new development. The term is deemed to include "potential visual impacts, including the impacts of lighting".

In the absence of international guidance, the proposed methodology employed for this assessment is based primarily on current UK guidance, namely:

- Landscape Institute with the Institute of Environmental Management and Assessment. 2013. *Guidelines for Landscape and Visual Impact Assessment, Third Edition*.

Reference has also been made to:

- United States Department of the Interior, Bureau of Land Management. 1986. *Visual Resource Inventory*.

7.7.5 Receptors of Interest and Importance

The Landscape and Visual AOI comprised the area surrounding the pipeline, i.e. the ROW, and the associated 16 stations proposed along the pipeline route. Using the LLCOP project description and the baseline landscape information presented in full in the baseline report (Annex II), and summarised in Section 6.10, a number of primary landscape and visual receptors have been identified as being potentially susceptible to changes in the landscape and visual setting.

7.7.5.1 Landscape Receptors

Table 7.7-5 presents landscape features considered to be of particular importance due to their respective designations, importance for local communities and tourism, and proximity to proposed above ground LLCOP project infrastructure. The table presents the assigned landscape character areas of these features and their importance as receptors, following the criteria presented in Table 7.7-1.

Figure 7.7-2 presents the key landscape character features.

Table 7.7-5: Landscape character features of particular importance

Character Feature / Area	Receptor Representation	Importance	Context
Kalama Community Wildlife Conservancy	LCA 2 Grassland	Medium	A conservancy is considered of regional importance. The proposed location for Station 6 is situated within an enclosed valley area and is less than 200 m from the boundary of the Conservancy. The proposed location for Station 7 is situated adjacent to the urbanised area of Archers Post which is located within the conservancy.
Namunyak Wildlife Conservancy Trust	LCA 1 Dense Scrub	Medium	A conservancy is considered of regional importance. The proposed location for Station 6 is situated within an enclosed valley area within the conservancy.
Nyambene National Reserve	LCA 3 Scattered Shrub	High	Reserve is a designated national reserve. Station 8 is situated within the national reserve area.

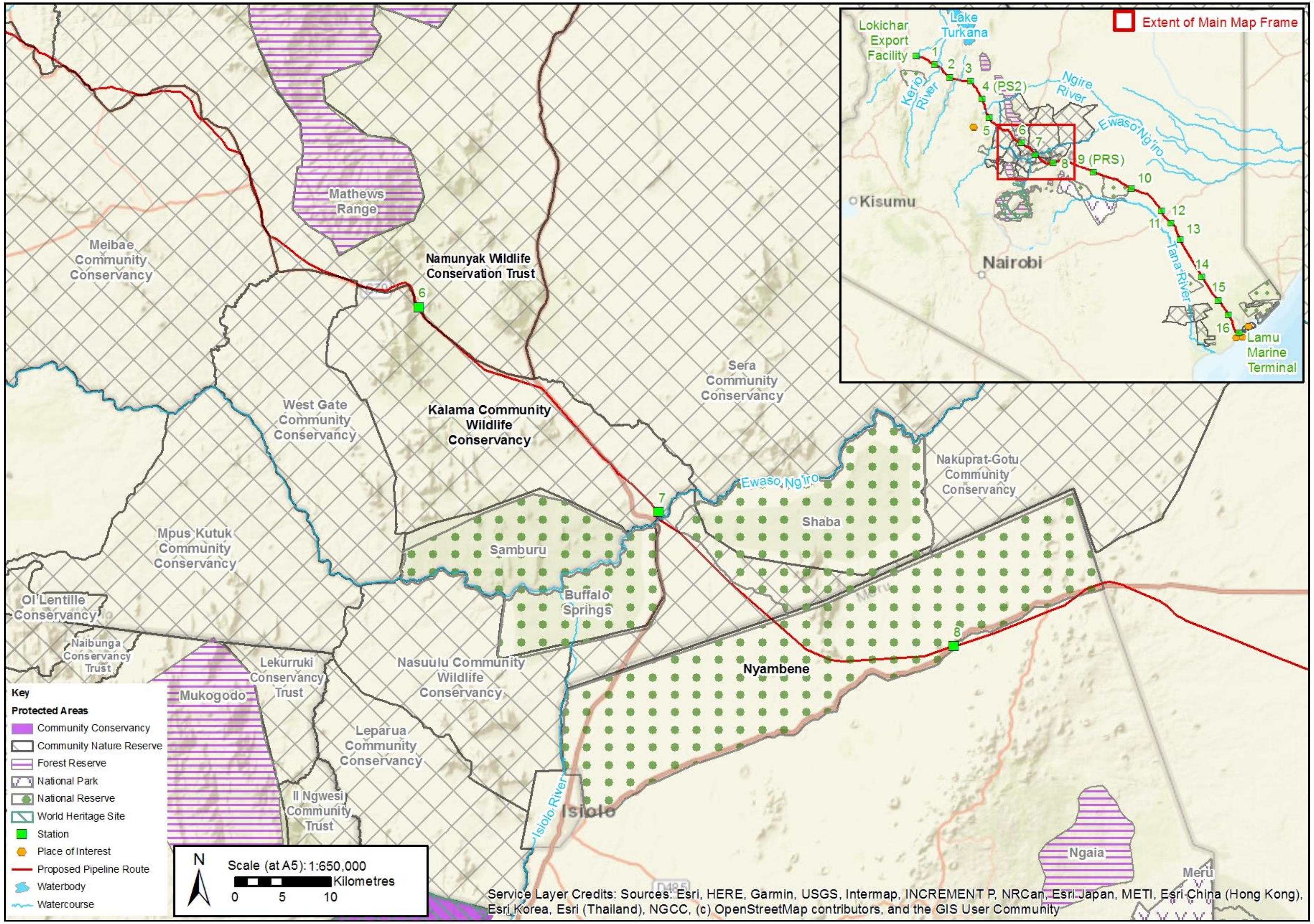

Figure 7.7-2: Landscape character features of particular importance

7.7.5.2 Visual Receptors

Due to a number of constraints, in particular access and security constraints, it was not possible to undertake a visual assessment at all stations along the route. As a result, the number of receptors to be assessed comprises 7 viewpoints, which are considered representative of the Stations situated along the LLCOP route. Nevertheless, station viewpoint proxies have been identified for areas that have not been visited, as identified in Table 7.7-6, except Stations 2 (rocky shrub) and 14 (forested), which do not have an identifiable proxy due to their individual landscapes.

The selected viewpoints are typical of views from settlements, roads and visitor destinations. Mapping was undertaken for the impacts analysis to ascertain potential visual receptors within the landscape.

The viewpoints used to assess potential visual impacts as well as their assigned importance are listed in Table 7.7-6, illustrated on Figure 7.7-3 and are presented in the Landscape and Visual baseline (Annex II).

Drawings 7.7.11 to 7.7.15 show typical views from the vicinity of the station locations.

Table 7.7-6: Viewpoints and importance

Viewpoint	Receptor Representation	Importance	Comment	Proxy for Other Stations
VP1 – view of Station 4	Residential users (herders and travellers – nomadic view)	Medium	Represents views from access road – Archer's Post – Baragoi Road.	VP1 proxy for Station 1
VP2 – view of Station 5	Residential users (herders and travellers – nomadic view)	Medium	Represents views 570 metres from Archer's Post – Baragoi Road.	VP2 proxy for Station 16
VP3 – view of Station 6	Residential users (herders and travellers – nomadic view)	Medium	Represents views from access road – 512 metres from Archer's Post – Baragoi Road.	VP3 proxy for Station 3
VP4 – view of Station 7	Residential users (Archer's Post – permanent settlement)	High	Represents views from Archer's Post to Station 7.	VP4 proxy for Station 8
VP5 – view of Station 9	Residential users (herders and travellers – nomadic view)	Medium	Represents views from Bushland off the Garba Tula Banae Road.	VP5 proxy for Station 13
VP6 – view of Station 10	Residential users (herders and travellers – nomadic view)	Medium	Represents views from access road – Garissa Modogashe Route.	VP6 proxy for Station 11 and 12
VP7 – view of VLCC	Tourists (hotels, restaurants)	High	Represents views from Manda Bay Lodge – 4 km from the VLCC.	n/a

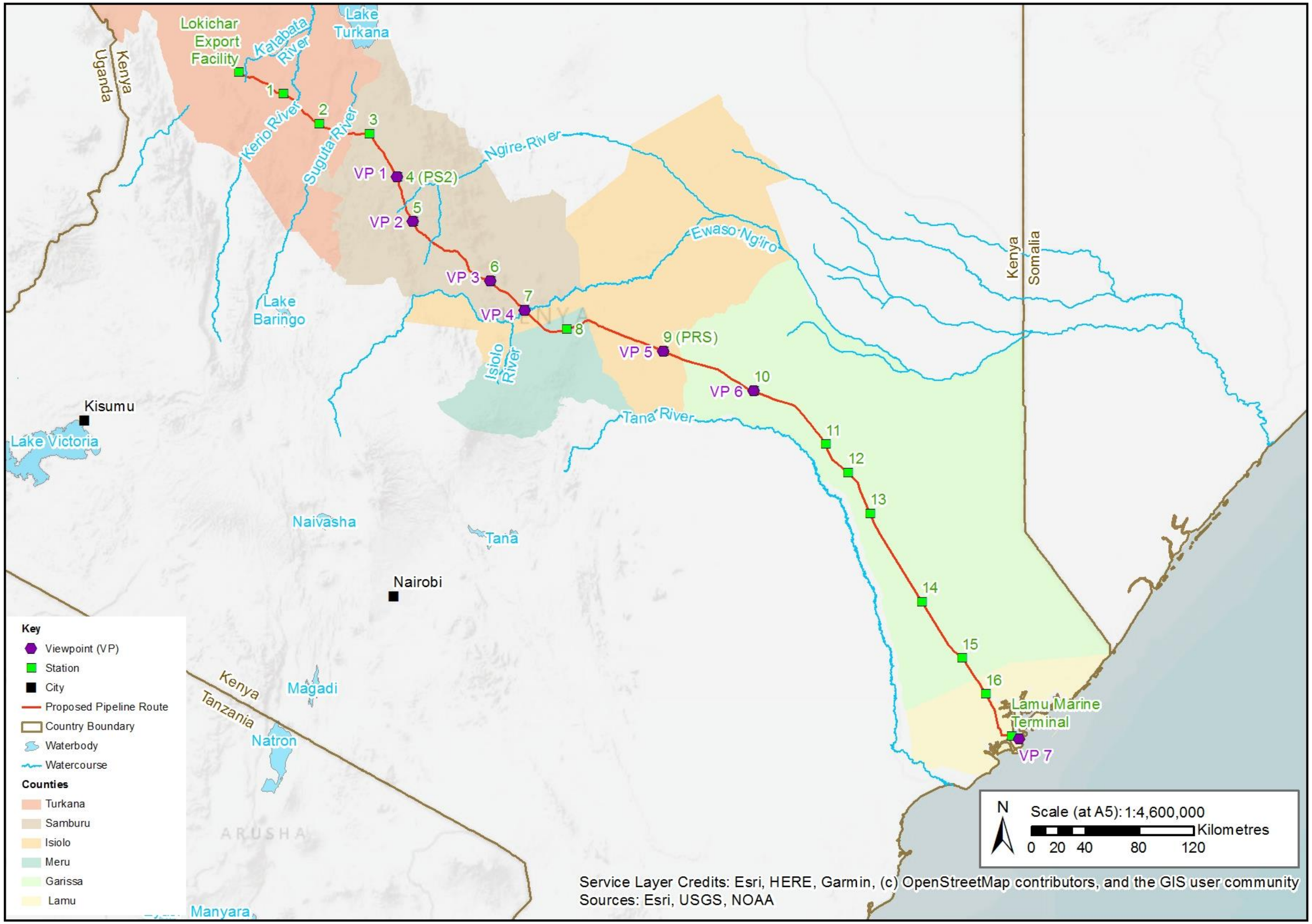

Figure 7.7-3: Viewpoints at station locations

7.7.6 Considerations from Stakeholder Engagement

The scoping consultation process identified specific issues relevant to landscape and visual impacts, including whether the VLCC FSO will be visible from tourist destinations (hotels) in the Manda Bay area. The impacts are assessed within this study and impacts are addressed in Section 7.7.9.

7.7.7 Potential Sources of Impact

Elements of the Project identified as potential sources of change to the landscape and visual baseline include:

7.7.7.1 Construction Phase

Based on the project description and the understanding of the baseline landscape and visual setting that has been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact during the construction phase. The potential sources of impact are as follows:

- Works associated with construction of stations and temporary infrastructure, including the access roads, camps;
- Mobilisation of plant, deliveries of materials and supplies and transportation of construction personnel by vehicle;
- Site activity during construction, including dust plumes associated with construction works and temporary lighting emissions; and
- Construction of the LOF.

7.7.7.2 Operation Phase

Based on the project description the following aspects of the Project have been identified as presenting potential sources of impact during the operational phase:

- Location of the stations and supporting infrastructure;
- Site activity during operation, including lighting emissions;
- Transportation of operational and maintenance personnel by vehicle; and
- Permanently moored VLCC FSO vessel and movements of Suezmax export tankers at Lamu Port.

7.7.8 Incorporated Environmental Measures

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are GIIP. The following incorporated environmental measures are specifically relevant to landscape and visual.

7.7.8.1 Inherent Design Measures

The measures that have been incorporated into the Project design to reduce impacts or avoid creating them are as follows:

- Disturbance areas will be limited to within the pipeline RoW.
- Route selection to avoid protected and designated areas where possible;
- Where practicable, the pipeline route will follow existing transport routes, limiting impacts on unspoilt landscape areas;
- Where practicable, the pipeline will use existing infrastructure for the Project RoW;

- The pipeline will generally be buried at least 0.9 m below the surface, but in areas of rock the burial depth may be reduced to 0.6m, and
- The project has been designed using materials that will minimise glare. Where practicable, metal surfaces will be matt and painted surfaces will be in muted colours to minimise visual impact.

7.7.8.2 Good International Industry Practise

The following measures are applicable to all phases of the Project and will be applied/followed in order to manage the magnitude of impacts on landscape characteristics and visual amenity:

- Applicable national and Project speed limits will be adhered to by Project vehicles to on all roads to reduce dust generation which may cause visual impacts.

The following measures are applicable to the construction phase of the Project:

- Prompt removal or covering of stored materials that have a potential to produce dust (including spoil) which may cause visual impacts, unless being re-used on site;
- Daily site inspections will be undertaken by the PipeCo Site Representative when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions, which could cause visual impacts;
- If dust is either observed or is considered likely to cause a nuisance to adjacent settlements, dust suppression will be undertaken using recycled grey water as a first preference. Where this is not available, water from other sources may be used provided this is appropriately permitted. Dust suppression will minimise dust generation which may cause visual impacts.;
- Dampening down of roads will be undertaken if dust is being re-suspended, which may cause visual impacts; and
- Uncontrolled burning of waste materials will be prohibited to reduce associated visual impacts.

7.7.9 Impact Classification

Taking into account the baseline landscape and visual setting (Section 6.8), the relevant incorporated environmental measures (Section 7.7.8), and the potential sources of impact (Section 7.7.7) determined from the project description and the construction and the operational phases are presented in this section.

A discussion regarding feasible impacts during each of the Project phases is presented in the sub-sections below. The potential sources of impact and relevant incorporated mitigation applicable to each receptor, along with the magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Section 7.7.2.

7.7.9.1 Summary of Impacts on the Landscape

7.7.9.1.1 Community Wildlife Conservancy

Stations 6 and 7 are located within the Namunyak Wildlife Conservancy Trust and Kalama Community Wildlife Conservancy respectively. The predicted residual impacts during construction and operation on the Community Wildlife Conservancies will be **Minor (negligible)**, due to the stations being located within an enclosed valley with some existing infrastructure present and the landscape only being affected by the immediate setting of the Project component site.

7.7.9.1.2 National Reserve

Station 8 is located in Nyambene National Reserve. It is understood that the surrounding landscape is comprised of low-lying scattered scrub, meaning that the Project infrastructure will not be in keeping with the landscape character. Due to the high importance of the receptor, it is anticipated that there will be a **Minor (negligible)** residual impact during construction and operation, due to the partial loss or damage to key characteristics, features or elements in an important area during the Projects lifetime. However, the landscape will only be affected by the immediate setting of the Project component site.

7.7.9.2 Summary of Significant Visual Impacts

7.7.9.2.1 Viewpoint 4 – Station 7 (Archer's Post)

Archer's post village is located adjacent to Station 7 and as such, this receptor location is of high importance. The view will be experienced by a large number of people living in the village and pastoralists/herders roaming the surrounding agricultural land. Full views of the Station facilities protruding from the boundary wall/fence will be possible from properties on the edge of the village. The Station outline will break the skyline as the surrounding landscape has particularly low-lying vegetation and grasses and therefore, vegetative screening in keeping with the surroundings will be unlikely. Lighting associated with the development could also impact local residents. The Station will lie 100 m north east of Archer's Post. In terms of viewshed size the potential visibility of the Station is high.

Overall, with suitable inherent and additional mitigation in place, including lighting controls, the residual visual impact of the development will be **Moderate (negligible)** during construction and operation.

7.7.9.2.2 Viewpoint 7 – Lamu Marine Terminal (VLCC)

The VLCC will be permanently moored a berth 3 at Lamu Marine Terminal. Figure 7.7-4 shows typical views from the Manda Beach Hotel location of the proposed VLCC at berth 3, 4 km away.

Partial views of the VLCC will be possible from the beach and at hotels. In terms of viewshed size the potential visibility of the VLCC is low. The viewshed is a theoretical tool and does not take into account the screening impact of vegetation, buildings and atmospheric conditions. The scenic impact of the VLCC decreases exponentially with distance from the viewer and will be minimal beyond 5 km (Hull and Bishop 1988).

Overall, the residual visual impact of the development will be **Minor (negligible)** during both construction and operation, predominantly due to the distance from the Manda Bay viewpoint location.

Figure 7.7-4: Photomontage of VLCC at LMT from viewpoint 7, view direction NW (top), and dimensions of VLCC (bottom)

7.7.9.3 Construction Phase

The construction phase impact assessment for landscape and visual is presented in Table 7.7-7. The magnitude of impacts resulting from the construction phase are generally anticipated to be low to medium for landscape and visual impacts, associated with temporary construction activities during the construction of the Stations.

Table 7.7-7: Construction phase impact classification and impact significance

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
Landscape Features/Character Areas						
Medium: Kalama Community Wildlife Conservancy (Station 7)	Construction activities for Station 7 and associated infrastructure, including access roads, camps.	Low/short-term/ temporary	Minor (adverse)	No additional measures beyond those described in Section 7.7.8.	Low/short-term/ temporary	Minor (adverse)
Medium: Namunyak Wildlife Conservancy Trust (Station 6)	Construction activities for Station 6 and associated infrastructure, including access roads, camps.	Low/short-term/ temporary	Minor (adverse)	No additional measures beyond those described in Section 7.7.8.	Low/ short-term/ temporary	Minor (adverse)
High: Nyambene National Reserve (Station 8)	Construction activities for Station 8 and associated infrastructure, including access roads, camps.	Low/ short-term/ temporary	Moderate (adverse)	No additional measures beyond those described in Section 7.7.8.	Low/short-term/ temporary	Minor (adverse)
Viewpoints						
Medium: VP1 (Station 4), VP2 (Station 5), VP3 (Station 6), VP5 (Station 9), VP6 (Station 10)	Construction activities of stations and associated infrastructure, including access roads, camps. May result in temporary impacts associated with construction works such as plant mobilisation, transport, material stockpiles and lighting emissions.	Medium/ short-term/ temporary	Minor (adverse)	Measures described in Section 7.7.8. Use of lighting, including at Stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the CEMP . Dust suppression will be undertaken in accordance with measures identified in	Medium/short-term/ temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
				the Construction Environmental Management Plan (CEMP). Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.		
High: VP4 (Station 7)	Construction activities of Station 7 access roads, plus associated infrastructure, mobilisation, lighting and plant.	Medium/short-term/ temporary	Moderate (adverse)	Measures described in Section 7.7.8. Use of lighting, including at stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the CEMP. Dust suppression will be undertaken in accordance with measures identified in the CEMP. Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	Medium/short-term/ temporary	Moderate (adverse)
High: VP7 (VLCC FSO and LMT)	Construction activities of LMT access roads and camps, plus associated infrastructure, mobilisation, lighting and plant.	Medium/short-term/ temporary	Moderate (adverse)	Measures described in Section 7.7.8. Use of lighting, including at stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the CEMP.	Medium/ short-term/ temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
				Dust suppression will be undertaken in accordance with measures identified in the CEMP. Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.		
	Construction of the LOF and positioning of the VLCC tanker at Lamu port.	Medium/short-term/ temporary	Moderate (adverse)	No additional measures beyond those described in Section 7.7.8.	Low/short-term/ temporary	Minor (adverse)

7.7.9.4 Operations Phase

The operations phase impact assessment with respect to landscape and visual is presented in Table 7.7-8. The magnitude of impacts resulting from the operational phase are generally anticipated to be low to medium for landscape and visual impacts, associated with changes to landforms and receptor views during the operation of the Stations.

Table 7.7-8: Operation Phase Impact Classification and Impact Significance

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
Landscape Features / Character Areas						
Medium: Kalama Community Wildlife Conservancy (Station 7)	Changes to landform throughout operations due to presence of Station 7, supporting infrastructure and access roads.	Low/medium-term/ temporary	Minor (adverse)	No additional measures beyond those described in Section 7.7.8.	Low/medium-term/ temporary	Minor (adverse)
Medium: Namunyak Wildlife Conservancy Trust (Station 6)	Changes to landform throughout operations due to presence of Station 6, supporting infrastructure and access roads.	Low/medium-term/ temporary	Minor (adverse)	No additional measures beyond those described in Section 7.7.8.	Low/medium-term/ temporary	Minor (adverse)
High: Nyambene National Reserve (Station 8)	Changes to landform throughout operations due to presence of Station 8 supporting infrastructure and access roads.	Low/medium-term/ temporary	Minor (adverse)	No additional measures beyond those described in Section 7.7.8.	Low/medium-term/ temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
Viewpoints						
Medium: VP1 (Station 4), VP2 (Station 5), VP3 (Station 6), VP5 (Station 9), VP6 (Station 10)	Changes to views throughout operations due to presence of the stations, supporting infrastructure, access roads and lighting.	Medium/ medium-term/ temporary	Minor (adverse)	Measures described in Section 7.7.8. Use of lighting, including at stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the OEMP. Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	Low/medium-term/ temporary	Minor (adverse)
	Operational site activities, transportation of operation personnel by vehicle.	Low/medium-term/ temporary	Minor (adverse)	Measures described in Section 7.7.8. Use of lighting, including at stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the OEMP. Dust suppression will be undertaken in accordance with Operational Environmental Management Plan (OEMP). Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	Low/medium-term/ temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
				Subject to site specific conditions, including vegetation type and density and where appropriate, planting of endemic natural vegetation should be considered to act as screening of the Project infrastructure.		
High: VP4 (Station 7)	Changes to views throughout operations due to presence of Station 7, supporting infrastructure, access roads and lighting adjacent to residential area.	Medium / medium-term / temporary	Moderate (adverse)	Measures described in Section 7.7.8. Use of lighting, including at stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the OEMP. Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	Medium / medium-term / temporary	Moderate (adverse)
	Operational site activities, transportation of operation personnel by vehicle.	Low / medium-term / temporary	Minor (adverse)	Measures described in Section 7.7.8. Use of lighting, including at stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the OEMP. Dust suppression will be undertaken in accordance with OEMP. Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints	Low / medium-term / temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Impact Significance
				related to Project activities which could contribute to visual impacts.		
High: VP7 (VLCC FSO and LMT)	Changes views throughout operations due to presence of LMT, access roads, supporting infrastructure and lighting.	Medium / medium-term / temporary	Minor (adverse)	No additional measures beyond those described in Section 7.7.8. Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	Medium / medium-term / temporary	Minor (adverse)
	Operational site activities, transportation of operation personnel by vehicle.	Low / medium-term / temporary	Minor (adverse)	No additional measures beyond those described in Section 7.7.8.	Low / medium-term temporary	Minor (adverse)
	Berthing and operational activities of VLCC FSO vessel and Suezmax export tankers at Lamu Port.	Medium / medium-term / temporary	Moderate (adverse)	No additional measures beyond those described in Section 7.7.8. Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	Medium / medium-term / temporary	Minor (adverse)

7.7.9.5 Decommissioning

Post-decommissioning, all above ground infrastructure will be evaluated for dismantling, removal and rehabilitation, and all marine facilities will be emptied of oil product and removed from site for safe disposal. It is therefore anticipated that there will no permanent and long-term impacts of the Project on the identified receptors.

7.7.10 Summary of Mitigation

The additional mitigation on top of the incorporated mitigation identified in Section 7.7.8 should include:

- Commitment to and adoption of good practice techniques and measures during construction and operation;
- Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts;
- Dust suppression techniques to reduce airborne dust as outlined in the CEMP and OEMP;
- Use of lighting, including at stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the CEMP and the OEMP; and
- Subject to site specific conditions, including vegetation type and density and where appropriate, planting of endemic natural vegetation should be considered to act as screening of the Project infrastructure.
- Stations adjacent to conservancy boundaries to be designed to blend in with the surrounding topography. If possible, this should include being painted in natural colours and landscaping with trees and scrub (natural planting of endemic species).
- No night-time working in areas adjacent to National Reserves or Community Conservancies unless agreed and supervised by PipeCo BO

7.7.11 Summary of Residual Impacts

The Project has the potential to important landscape and visual receptors during both station construction and operations of above ground features. Overall, with inherent mitigation that has been incorporated into the design and the additional mitigation discussed in Section 7.7.11, significant residual impacts to these receptors are anticipated to be minor. One potentially moderate visual impact was identified at Station 7 associated with the relative proximity of Archer’s Post settlement in an open visual environment.

7.8 Cultural Heritage

7.8.1 Introduction

As described in the cultural heritage baseline report (Annex II) and ESIA baseline summary (Section 6.9), cultural heritage is comprised of both tangible and intangible sites. As noted in Section 6.9, ESIA team members met with various key informants, local citizens or associations and government agencies during the baseline data gathering to inform this analysis. Topics raised relating to cultural heritage included grave sites, shrines, sacred trees and plants used for traditional medicine.

7.8.2 Receptor Importance

To identify the importance of potential receptors, the scale of relative importance presented in Table 7.8-1 has been used with reference to the information collated in the baseline to classify the selected receptors.

Table 7.8-1: Criteria for determining importance of receptors

Receptor Importance	Example Receptor Types
Very high	■ Cultural sites of international or national importance with significant cultural or touristic value. Sites that cannot be moved because they are natural features and are critical[1] and/or rare at the national or international level. ■ Archaeological and palaeontological sites of national or international importance, with the highest potential for further, significant discoveries to be made. Archaeological and palaeontological sites with rare and/or previously unstudied or understudied features with high potential for crucial further research. Archaeological and palaeontological sites that are afforded protection and where no intrusion is permitted. ■ Living heritage sites with the greatest social[2] and/or historical[3] and/or scientific[4] and/or environmental[5] value. Living heritage/intangible cultural heritage that is recognised and designated at a national or international level. Living heritage endemic to a certain place or group of people (and therefore 'rare'), and which is widely representative of that specific toponym or group. Living heritage that is non-replicable.
High	■ Cultural sites of national or regional importance with significant cultural value. Non-replicable cultural sites that are not critical and/or rare, or cultural sites that are potentially replicable and that could be moved in highly exceptional circumstances (in consultation with the affected communities). ■ Archaeological and palaeontological sites of regional or national importance, with high potential for further discoveries to be made. Archaeological and palaeontological sites with understudied features and/or high potential for further research. ■ Living cultural heritage with significant social and/or historic and/or scientific and/or environmental value. Living/intangible cultural heritage that is endemic to a certain place or group of people (and therefore 'rare'), and that is representative of a significant proportion of that specific toponym or group. Non-replicable intangible cultural heritage or that which is difficult to replicate.

[1] 'Critical cultural heritage consists of one or both of the following types of cultural heritage: (i) the internationally recognised heritage of communities who use, or have used within living memory, the cultural heritage for long-standing cultural purposes; or (ii) legally protected cultural heritage areas, including those proposed by host governments for such designations' (IFC, 2012d).

[2] Value to society in the present.

[3] Value to our understanding of the human past.

[4] Value to our understanding of people and their environment.

[5] Value to our understanding of the environment.

Receptor Importance	Example Receptor Types
Medium	■ Cultural sites of local importance with significant cultural value. Cultural sites that are replicable and that can be moved in certain extenuating circumstances (in consultation with affected communities). ■ Archaeological and palaeontological sites of local importance, with some potential for further discoveries to be made. Archaeological and palaeontological sites with features that have been comprehensively studied and/or are poorly preserved, with limited potential for further research. ■ Living cultural heritage with social and/or historical and/or scientific and/or environmental value. Living/intangible cultural heritage that is common and widely representative of the population as a whole and therefore potentially replicable, through community engagement.
Low	■ Cultural sites of limited local importance and cultural value. Cultural sites that are defunct and/or have little or no historic value. Cultural sites that are replicable and which can be moved or destroyed (in consultation with affected communities). ■ Archaeological and palaeontological sites of limited local importance, with low or no potential for further discoveries to be made. Archaeological and palaeontological sites with features that have been comprehensively studied and/or are poorly preserved/destroyed, with no potential for further research. ■ Living cultural heritage with limited social and/or historic and/or scientific and/or environmental value. Living/intangible cultural heritage that is common and widespread, but only representative of a limited proportion of the population. Intangible cultural heritage that has the greatest potential to be replicated, through community engagement.

7.8.3 Magnitude of Impact and Impact Significance

The characterisation of the magnitude of impact considers the Project description and how the Project could result in a change at potential receptors. The potential for an impact to occur at a receptor has been determined using the understanding of the baseline conditions and a consideration of whether there is a feasible linkage between a source of the potential impact and each receptor. The magnitude of each potential adverse impact has then been classified from 'negligible' to 'high', as described in Table 7.8-2. Beneficial impacts may include an increase in knowledge of the past or cultures, employment, knowledge transfer and capacity building. Using the impact magnitude and the receptor importance classification, the matrix presented in ESIA Section 3.4 has been used to determine impact significance.

Each potential impact can vary in its duration and geographic extent. For the purposes of this assessment the following criteria have been used:

- Duration:
  - A short-term impact is defined as up to 38 months (the maximum anticipated construction period);
  - A medium-term impact is defined as between 3 and 25 years (anticipated duration of operations); and
  - A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

- Geographic Extent:
  - Site-specific – the expected measurable effects are within the specific heritage resource boundary;
  - Component-specific – the expected measurable effects are within a single component of the Project activity zone;
  - Multiple Components – the expected measurable changes occur in more than one Project component; and
  - Project activity zone – the expected measurable changes occur throughout the entire Project activity zone.

Table 7.8-2: Criteria for assessing magnitude of adverse impact

Magnitude of Impact	Description of Adverse Criteria
High	■ Archaeological and palaeontological receptors or their settings are altered, and key elements are changed such that the resource value is entirely altered or lost. ■ Living/intangible cultural heritage receptors, or component parts thereof, are altered; removed; damaged and/or their functionality/setting/accessibility are entirely changed or lost; their value or traditional beliefs, practices and/or behaviours cannot continue and are lost, or severely inhibited.
Medium	■ Archaeological and palaeontological receptors or their settings are altered, and key elements are changed such that the resource value is modified and/or information is lost. ■ Living/intangible cultural heritage receptors, or component parts thereof, are altered such that their value and/or functionality/setting/accessibility are changed. Such actions result in modification of receptor use and/or modification of traditional beliefs, practices or behaviours.
Low	■ Archaeological and palaeontological receptors or their settings are slightly altered but their integrity is maintained, or archaeological and palaeontological receptors are altered but no information is lost (through archaeological/palaeontological excavation and recording). ■ Living/intangible cultural heritage receptors, or component parts thereof, are altered such that their value and/or functionality/setting/accessibility are slightly changed. Such actions do not result in modification of receptor use or traditional beliefs, practices or behaviours.
Negligible	■ Archaeological and palaeontological receptors or their settings are not altered, or changes are so minor that their integrity is maintained, and no information is lost. ■ Living/intangible cultural heritage receptors, or component parts thereof, are not altered or changes are so minor that that their value and/or functionality/setting/accessibility remain unchanged and no modification of receptor use is required. Traditional beliefs, practices or behaviours are not modified.

7.8.4 Key Guidance and Standards

The cultural heritage impact assessment has been completed in accordance with Kenyan legislation. The *National Museums and Heritage Act* (2006) is the key legislation pertinent to the cultural heritage impact assessment.

Consistent with good practice, the impact assessment has been completed in concordance with IFC Performance Standard 8: Cultural Heritage (2012d) [including accompanying guidance – Guidance Note 8: Cultural Heritage (2012e)].

7.8.5 Receptors of Importance

The cultural heritage baseline assessment identified 129 cultural heritage sites within the Area of Influence (AoI) (see ESIA Section 6.9 and Annex II). The AoI for the LLCOP Project extends 5 km to either side of the proposed pipeline route and includes the RoW, a 26 m wide corridor within which construction disturbance is likely to occur. For archaeological and palaeontological receptors, only those sites that fall within the RoW are carried forward in this impact assessment. For Living Cultural Heritage, a wider area of 500 m either side of the route is considered appropriate for assessment of potential impacts (Table 7.8-3). The locations of receptors are shown in Figures 6.9-2 to 6.9-8 in the Cultural Heritage baseline summary.

As some areas of the Project footprint could not be surveyed due to logistical/access considerations or security concerns, there is potential that additional sites could exist within those areas. Once the routes for any additional project related infrastructure and new access roads to the pipeline spread are defined, the impact upon other receptors within the AoI may need to be re-evaluated.

Primary receptors include the following:

- Archaeological Sites;
- Living Heritage Sites; and
- Palaeontological Sites.

Table 7.8-3 presents the assigned importance for these primary receptors following the criteria presented in Table 7.8-1.

Table 7.8-3: Cultural heritage receptors and importance

Receptor	Importance	Comment
Archaeological Sites		
Burial site, multiple	High	Culturally sensitive site with high potential for further research.
Burial site, single	High	Culturally sensitive site with high potential for further research.
Artefact (isolated find)	Low	Limited potential for further research.
Artefact (multiple surface finds)	High	High potential for further research.
Monument	Low	Limited local importance and cultural value.
Potsherds	Medium	Limited potential for further research.
Living Heritage Sites		
Beads (modern)	Low	Limited local importance and cultural value.
Burial items	High	High cultural value for local communities.
Burial site, multiple	High	High cultural value for local communities.
Burial site, single	High	High cultural value for local communities.
Sacred/ritual site (feasting)	Medium	Locally important.
Sacred/ritual site	Medium	Locally important.
Settlement	Low	Abandoned; modern.
Subsistence (extraction area)	Medium	Locally important.
Subsistence (stock pens)	Medium	Locally important.
Well (water)	Low	Locally important.
Palaeontological Sites		
Bovid	Low	Limited potential for further research.
Fossil bone – unspecified	Low	Limited potential for further research.
Mammal teeth	Low	Limited potential for further research.

7.8.6 Potential Sources of Impact

Cultural heritage sites have the potential to be impacted by Project-related interactions that cause alteration, such as physical disturbance, compaction, rendering them inaccessible or, alternatively, by making them more accessible and susceptible to vandalism and unauthorised collection. Any form of alteration to these sites can be permanent and irreversible. Project activities and physical works with the potential to interact with cultural heritage resources would occur during the construction and operations phases.

Two basic types of potential impacts to cultural heritage resources are considered in this assessment.

- Changes to resource integrity:
  - Disturbing cultural heritage sites and features;
  - Disturbing elements essential to the heritage character of features; and
  - Disturbing artefacts, features, human remains, and fossils.
- Changes to resource accessibility:
  - Hindering or increasing access to sites and destroying contextual information.

Potential sources of impact to cultural heritage resources during the construction, operation and decommissioning phases are listed in the sections that follow.

7.8.6.1 Construction Phase

Construction phase activities linked to direct effects include, but are not limited to, the following ground altering activities that involve surface and subsurface disturbance:

- Vegetation clearing;
- Surface stripping and excavation; and
- Temporary placement of stockpiled materials and fill (compaction).

7.8.6.2 Operation Phase

Potential impacts during the operations phase would result from road and pipeline maintenance, and increased public access or, conversely, restricted access to cultural heritage resources.

7.8.6.3 Decommissioning Phase

While most impacts are likely to occur during the construction phase, potential impacts during the decommissioning phase would result from road and pipeline deactivation and/or removal, and increased public access or, conversely, restricted access to cultural heritage resources.

7.8.7 Incorporated Environmental Measures

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are GIIP. The following incorporated environmental measures are specifically relevant to cultural heritage.

7.8.7.1 Inherent Design Measures

There are no inherent design mitigation measures specifically for construction and operation.

7.8.7.2 Good International Industry Practice

The following GIIP measures are applicable to the construction phase of the Project and will be followed in order to manage the magnitude of impacts on cultural heritage:

- Construction activities and all site-related vehicle movements will be limited to the pipeline RoW to minimise potential impacts on cultural heritage sites;
- Micro alignment of Project components to avoid cultural heritage sites; and
- Existing road infrastructure has been identified for use where possible to reduce the need for creation of new roads and minimise area which could have potential impacts on cultural heritage sites.

7.8.8 Impact Classification

Taking into account the baseline cultural heritage assessment (Section 6.9), the relevant incorporated environmental measures (Section 7.8.7), and the potential sources of impact (Section 7.8.6) determined from the project description, the potential source-pathway-receptor impact linkages for the construction, operational and decommissioning phases are presented in this section.

A discussion regarding feasible impact linkages during each of the Project phases is presented in each of the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant incorporated mitigation applicable to each receptor are summarised. The magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Section 7.8.3.

7.8.8.1 Construction Phase

Table 7.8-4 to Table 7.8-6 summarise predicted impacts to archaeological, living heritage and palaeontological sites based on the current Project design. Each location has been assigned a unique site identification label (e.g. LLCOP-27). Figure 7.8-2 to Figure 7.8-8 presents the locations of cultural heritage sites along the LLCOP route. Archaeological receptors within the RoW comprise potsherds found on the ground surface at LLCOP-27 and 28, single cairn burials at LLCOP-47, 48 and 49, and two grave sites documented at LLCOP-40.

Table 7.8-4: Summary of predicted impacts to archaeological sites

Predicted Impact	Extent of Predicted Impact	Additional Mitigation Measures Necessary?
Total impact from proposed land-altering activities: LLCOP-27, 28, 40, 47, 48, 49, 73, 74	RoW	Yes

With regards to Living Heritage within the RoW, LLCOP-43 is a recently abandoned settlement.

Figure 7.8-1: Recently abandoned settlement along the pipeline RoW (LLCOP-43)

Within 500 m of the proposed pipeline route there are 28 Living Heritage sites present, comprising:

- A historical well (LLCOP-1);
- Abandoned settlements (LLCOP-9, 42, 44 and 114);
- Burial sites (LLCOP-78, 109, 110, 111, 112 and 113), including three cemeteries;
- Locations containing grave offerings (LLCOP-19, 20 and 21);
- A site containing modern, plastic beads (LLCOP-45);
- Sacred sites;
  - Akiriket (LLCOP-77), a traditional meat feasting/ritual site;
  - A cross placed on a hill (LLCOP-81);
  - A Ngasenon (LLCOP-83), a ritual site comprised of an accumulation of pebbles, creating a cairn-like feature;
  - A Maulac (LLCOP-105), a community prayer space for women;
  - A Mingani (LLCOP-107), a sacred grove where Elders meet;
  - A shrine tree (LLCOP-124); and
  - Tumaini Christian Church (LLCOP-130).
- Subsistence resource sites (LLCOP-79, 80, 103, 104 and 126); and
- A gathering location (LLCOP-106) comprised of acacia trees in Archers Post.

Table 7.8-5: Summary of predicted impacts to living heritage sites

Predicted Impact	Extent of Predicted Impact	Additional Mitigation Measures Necessary?
Total impact from proposed land-altering activities: LLCOP-43	RoW	No
Potential receptors identified: LLCOP-1, 9, 19, 20, 21, 42, 44, 45, 77, 78, 79, 80, 81, 83, 103, 104, 105, 106, 107, 109, 110, 111, 112, 113, 114, 124, 126, 130	Within 500 m of route	Yes

No palaeontological remains have been identified within the RoW.

Table 7.8-6: Summary of predicted impacts to palaeontological sites

Predicted Impact	Extent of Predicted Impact	Additional Mitigation Measures Necessary?
Total impact from proposed land-altering activities: None	-	-

Construction phase impacts to cultural heritage are presented in Table 7.8-7. The magnitude of impact is expected to be **high** as a result of activities like soil stripping and stockpiling, particularly for those cultural heritage sites within the RoW, as they are expected to be entirely lost as a result of ground disturbance or compaction. **Medium** magnitude impacts are expected where access to cultural heritage receptors will be affected by the project, as they will not be lost but use may be modified.

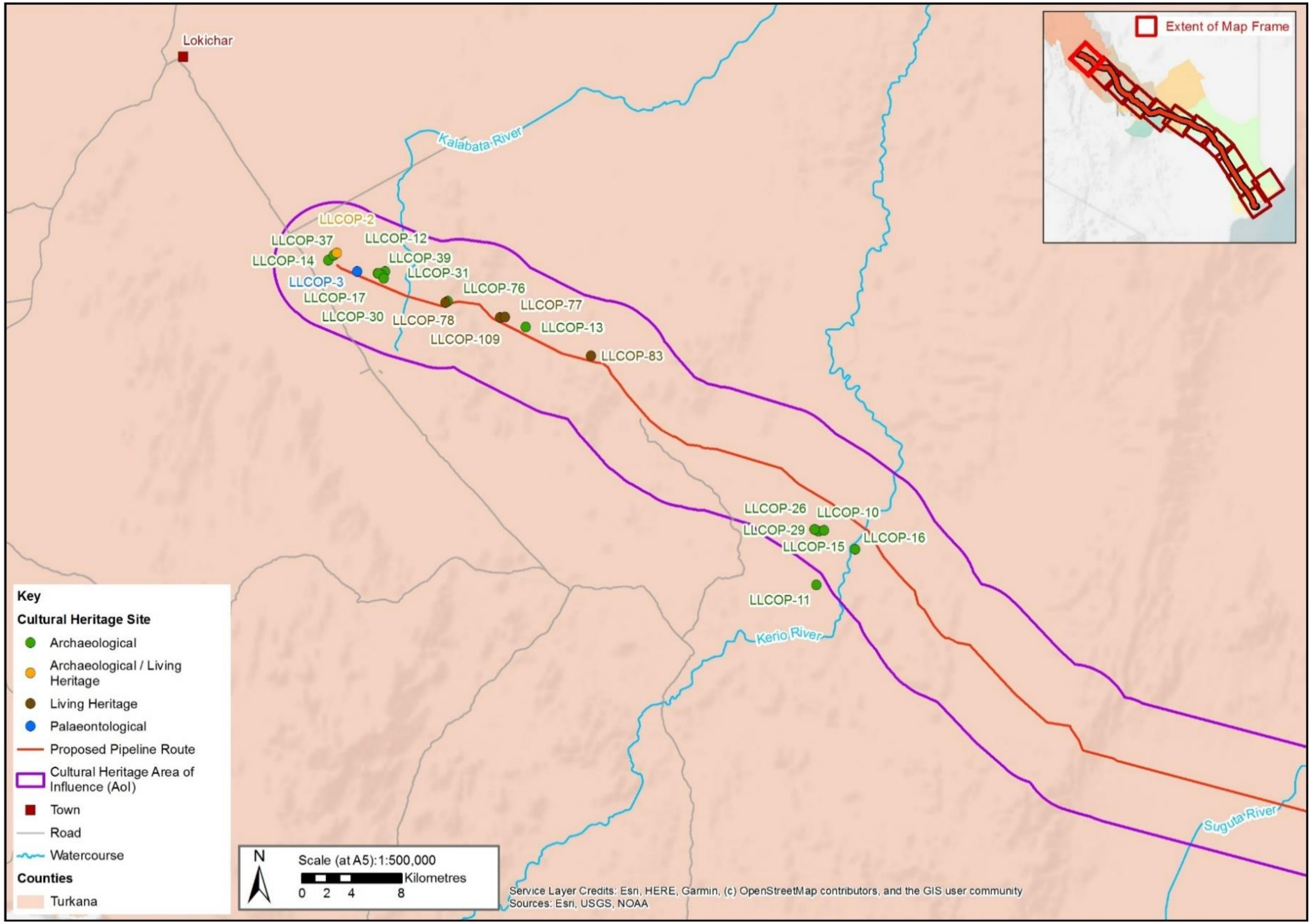

Figure 7.8-2: Cultural heritage sites (Turkana)

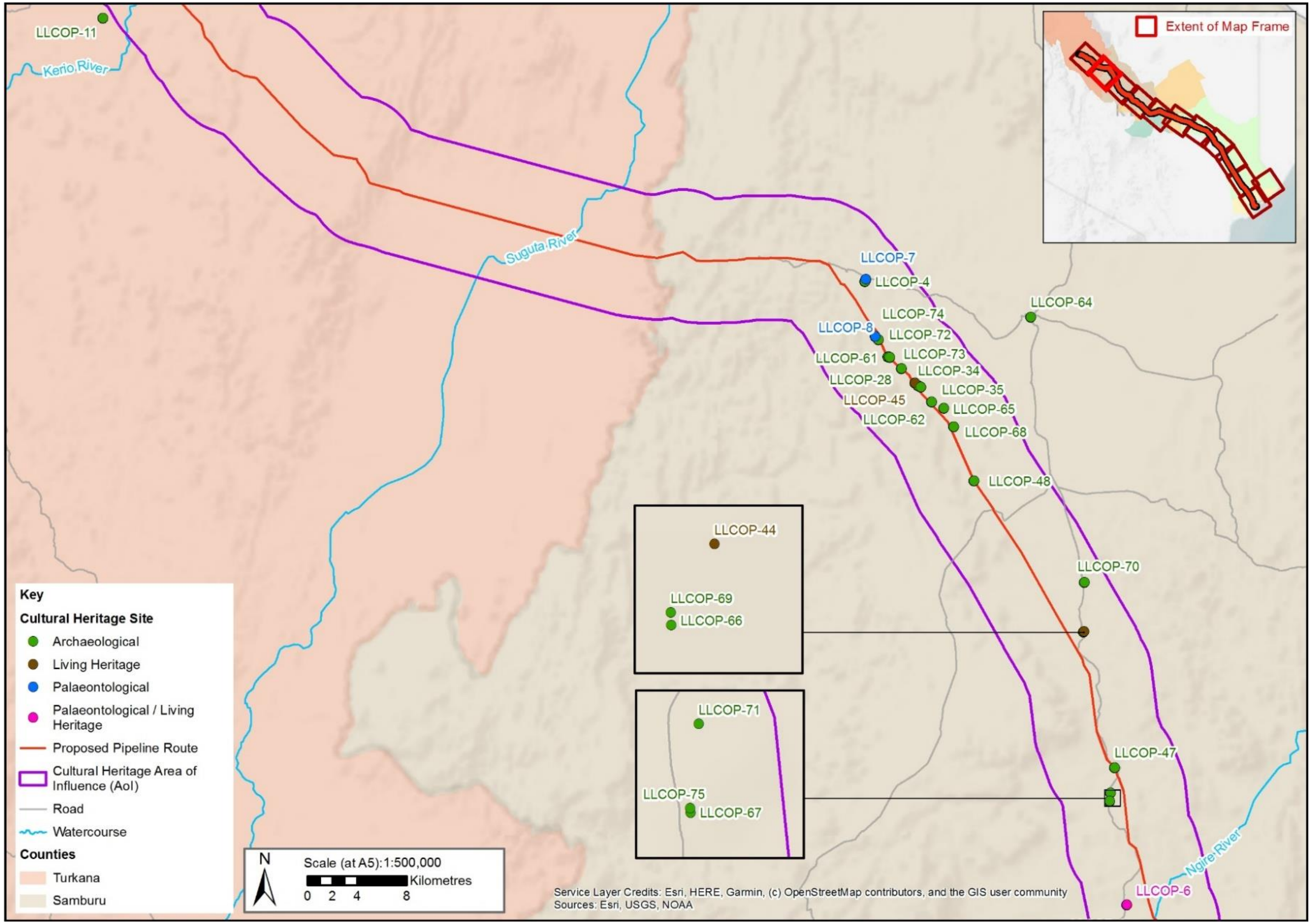

Figure 7.8-3: Cultural heritage sites (Turkana and Samburu)

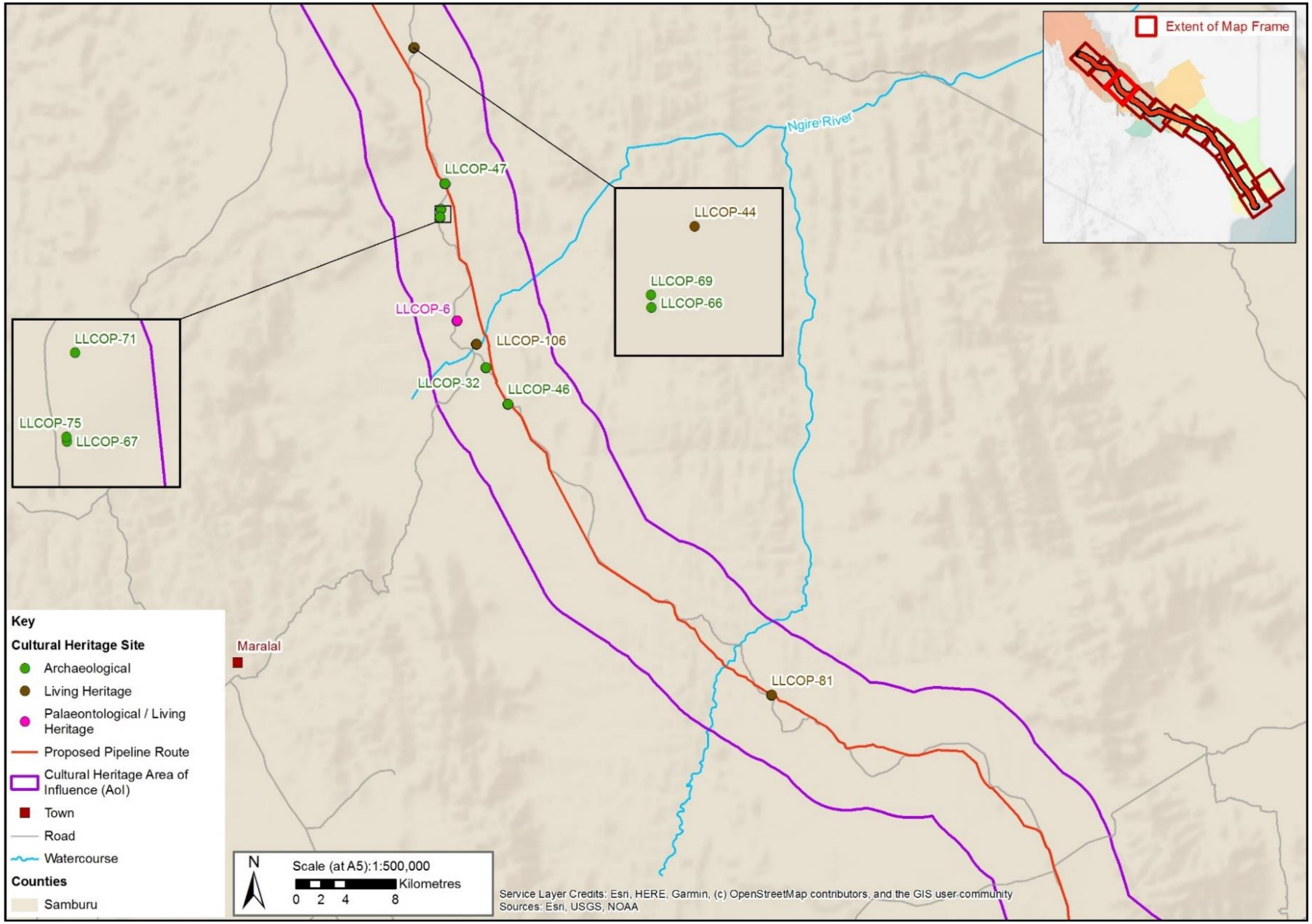

Figure 7.8-4: Cultural heritage sites (Samburu)

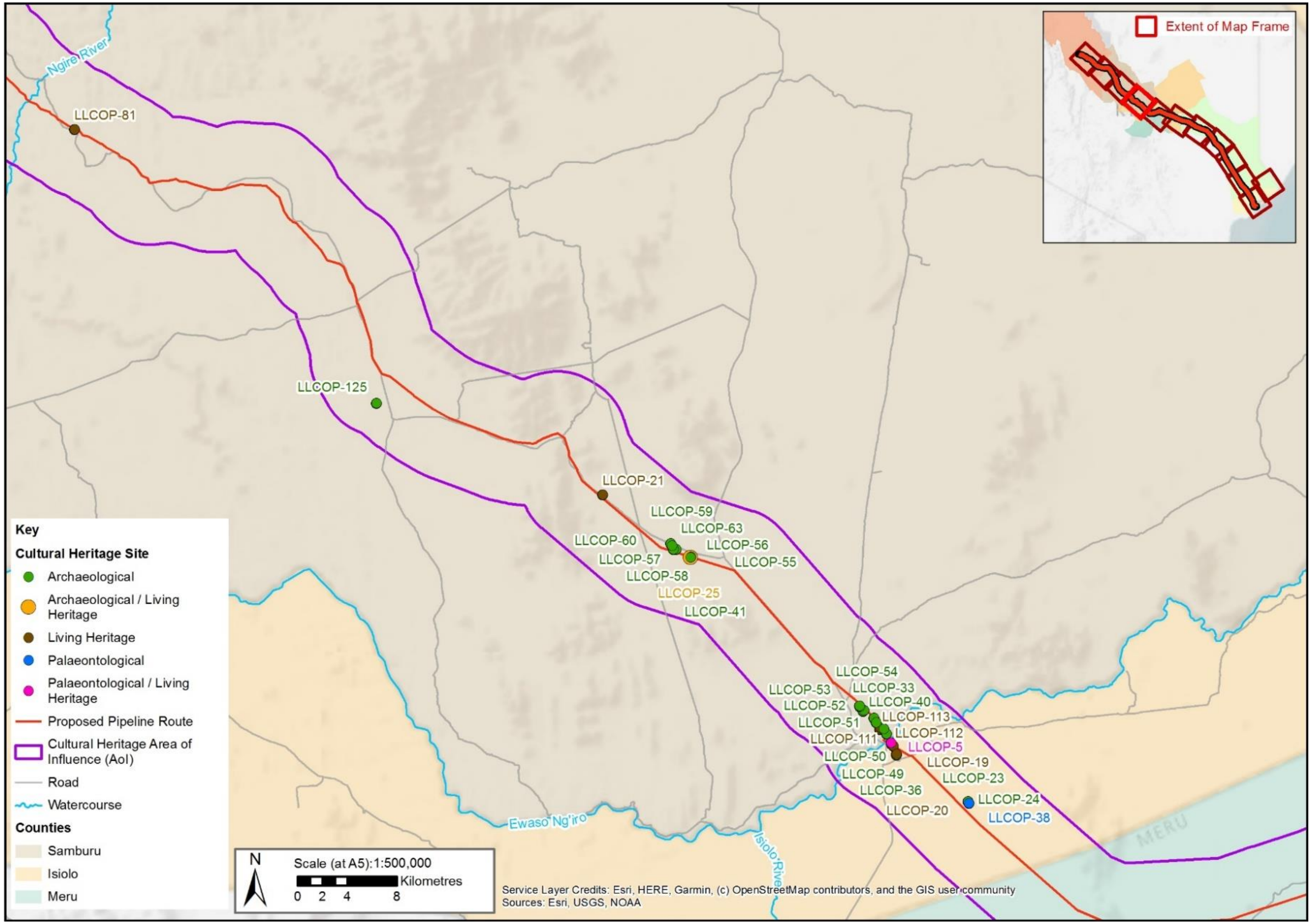

Figure 7.8-5: Cultural heritage sites (Samburu and Isiolo)

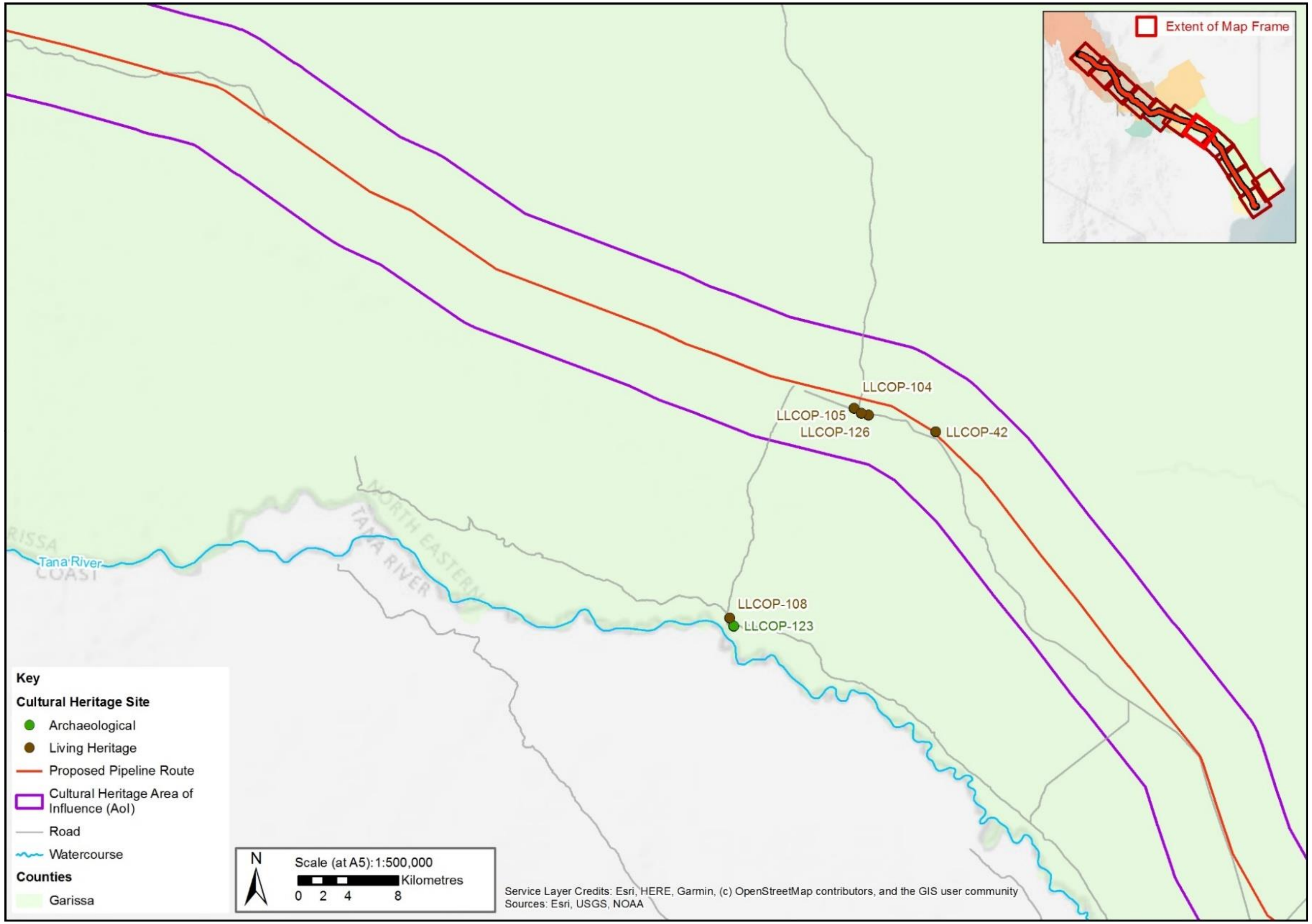

Figure 7.8-6: Cultural heritage sites (Garissa)

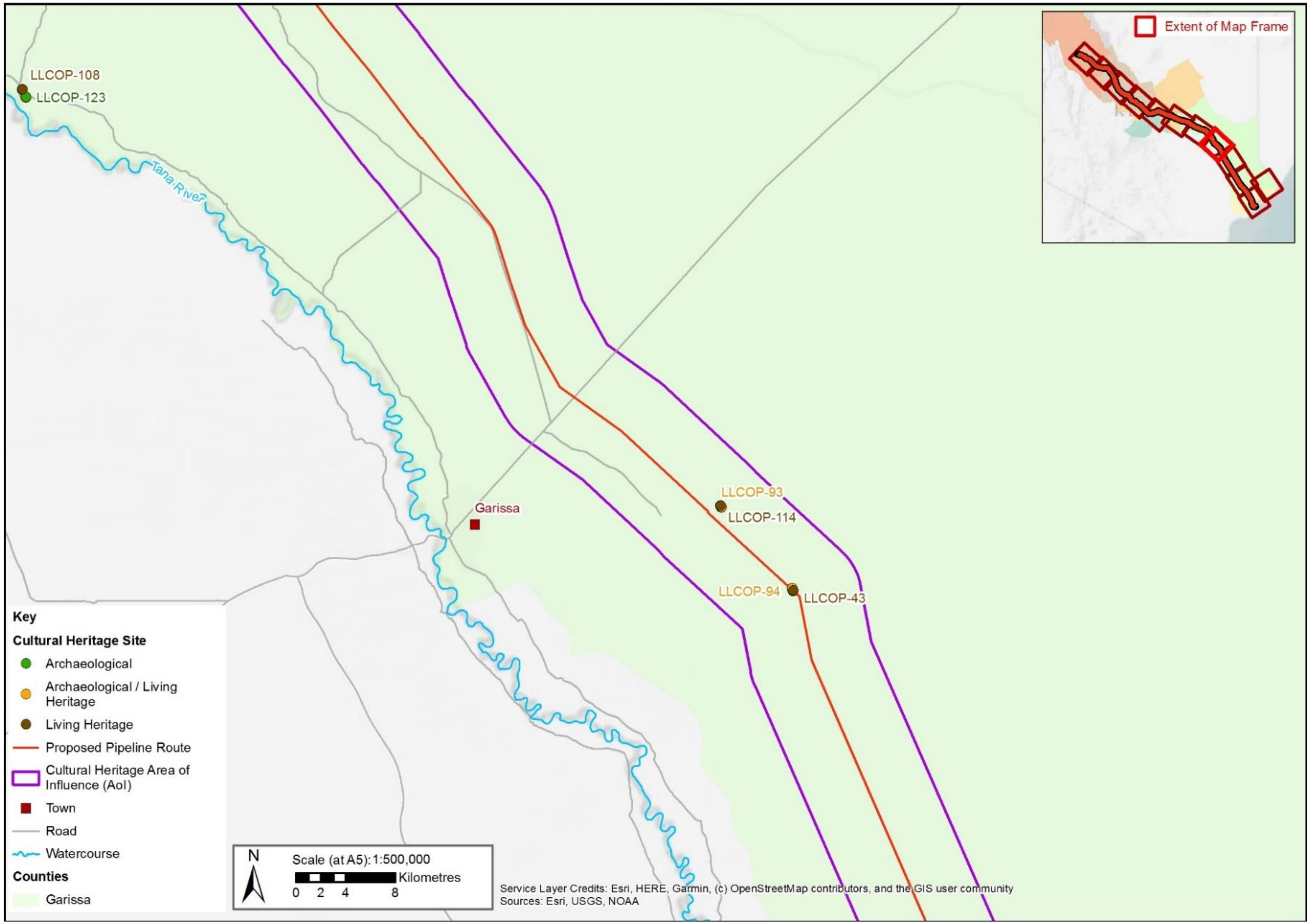

Figure 7.8-7: Cultural heritage sites (Garissa)

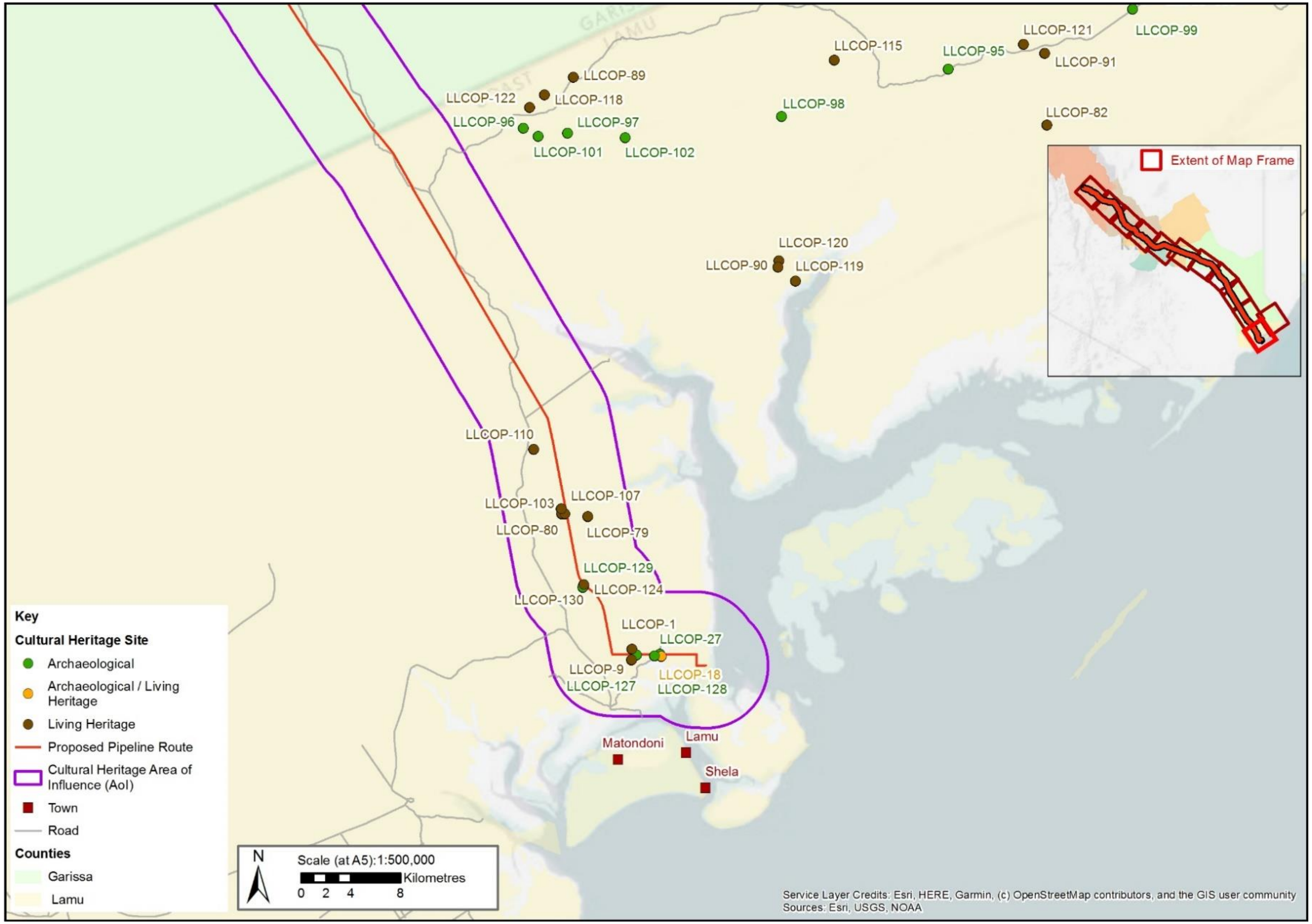

Figure 7.8-8: Cultural heritage sites (Lamu)

Table 7.8-7: Construction phase impact classification and impact significance

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Burial sites, single, multiple and cemeteries; LLCOP-40, 47, 48, 49, 78,109, 110, 111, 112 and 113 (High)	Vegetation clearing	Low – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ Implementation of Cultural Heritage Management Plan (CHMP) and Chance Finds Procedure (CFP). ■ Consultation and engagement with local communities prior to commencement of construction activities, to identify any cultural heritage sites on the RoW, which may be avoided by micro-routing where appropriate. ■ The pipeline routing design has used satellite imagery and site visits to identify and avoid known cultural heritage sites. Appropriate mapping and documentation will be developed for any additional cultural heritage sites identified in consultation with local communities prior to construction or found during construction. ■ If micro-alignment cannot avoid graves/burial sites, exhumation and re-internments of burials at a location acceptable to local communities and government authorities will be undertaken in accordance with procedures agreed with local communities. ■ In areas identified as being of cultural heritage significance, monitoring of vegetation clearance, surface stripping, excavation and construction will be undertaken by a suitably qualified Cultural	Low – Short-Term – Temporary	Minor (adverse)
	Surface stripping and excavation	High – Short-Term – Temporary	Major (adverse)		Low – Short-Term – Temporary	Minor (adverse)
	Temporary placement of stockpiled materials and fill (compaction)	High – Short-Term – Temporary	Major (adverse)		Low – Short-Term – Temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
				Heritage (CH) professional appointed by PipeCo.		
	Increased public access to cultural resources.	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ Periodic surveillance of known cultural heritage sites (e.g. burial sites) in proximity to the Project during the period of construction activity. ■ Develop system or protocol for reporting illicit activities (i.e. looting) at cultural heritage sites adjacent to active construction areas to government authorities.	Low – Short-Term – Temporary	Minor (adverse)
	Restricted access to cultural heritage resources.	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ Facilitate legitimate site access by local community members with ties to those locations during the period of construction activity in vicinity of identified sites. ■ Identified sacred sites close to construction areas will be protected through demarcation of no-go areas for vehicles and Project personnel.	Low – Short-Term – Temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Grave offerings (LLCOP-19, 20 and 21) (High)	Vegetation clearing	Low – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ CHMP and CFP, consultation with local communities, mapping and documentation of sites, agreed procedures for exhumations and re-internments, monitoring of clearance and excavations (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Surface stripping and excavation	High – Short-Term – Temporary	Major (adverse)		Low – Short-Term – Temporary	Minor (adverse)
	Temporary placement of stockpiled materials and fill (compaction)	High – Short-Term – Temporary	Major (adverse)		Low – Short-Term – Temporary	Minor (adverse)
	Increased public access to cultural resources.	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ Periodic cultural heritage site surveillance, reporting of illicit site investigations (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Restricted access to cultural heritage resources	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ Appropriate site access by local community members, demarcation of no-go areas (as above).	Low – Short-Term – Temporary	Minor (adverse)
Sacred sites (LLCOP-77, 81, 83, 105, 107, 124 and 130) (High)	Vegetation clearing	High – Short-Term – Temporary	Major (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ CHMP and CFP, consultation with local communities, mapping and documentation of sites, monitoring of clearance and excavations (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Surface stripping and excavation	High – Short-Term – Temporary	Major (adverse)		Low – Short-Term – Temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	Temporary placement of stockpiled materials and fill (compaction).	High – Short-Term – Temporary	Major (adverse)	■ Where sacred sites are encountered and avoidance is not possible, relocation of sacred site, resources or activity if technically feasible, in consultation with local communities.	Low – Short-Term – Temporary	Minor (adverse)
	Increased public access to cultural resources.	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ Periodic cultural heritage site surveillance, reporting of illicit site investigations (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Restricted access to cultural heritage resources.	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ Appropriate site access by local community members, demarcation of no-go areas (as above).	Low – Short-Term – Temporary	Minor (adverse)
Potsherds; LLCOP-27 and 28 (Medium)	Vegetation clearing	Low – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ■ CHMP and CFP, consultation with local communities, mapping and documentation of sites, monitoring of clearance and excavations (as above). ■ Surface collection of artefacts shall be carried out under supervision of a suitably qualified cultural heritage professional (as set out in the CFP. Sampling and archiving protocol to be agreed with the NMK.	Low – Short-Term – Temporary	Minor (adverse)
	Surface stripping and excavation	High – Short-Term – Temporary	Moderate (adverse)		Low – Short-Term – Temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Subsistence resource sites (LLCOP-79, 80, 103, 104 and 126) (High)	Vegetation clearing	High – Short-Term – Temporary	Major (adverse)	Measures described in Section 7.8.7. Additional measures include: CHMP and CFP, consultation with local communities, mapping and documentation of sites, relocation of resource or activity (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Surface stripping and excavation	High – Short-Term – Temporary	Major (adverse)		Low – Short-Term – Temporary	Minor (adverse)
	Increased public access to cultural resources.	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: - Periodic cultural heritage site surveillance, reporting of illicit site investigations (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Restricted access to cultural heritage resources.	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: - Appropriate site access by local community members, demarcation of no-go areas (as above).	Low – Short-Term – Temporary	Minor (adverse)
Abandoned settlement, modern; LLCOP-9, 42, 43, 44 and 114 (Medium)	Vegetation clearing	Low – Short-Term – Temporary	Minor (adverse)	No additional mitigation beyond measures described in Section 7.8.7.	Low – Short-Term – Temporary	Minor (adverse)
	Surface stripping and excavation	Low – Short-Term – Temporary	Minor (adverse)	No additional mitigation beyond measures described in Section 7.8.7.	Low – Short-Term – Temporary	Minor (adverse)
	Temporary placement of stockpiled materials and fill (compaction).	Low – Short-Term – Temporary	Minor (adverse)	No additional mitigation beyond measures described in Section 7.8.7.	Low – Short-Term – Temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	Increased public access to cultural resources.	Low – Short-Term – Temporary	Minor (adverse)	No additional mitigation beyond measures described in Section 7.8.7.	Low – Short-Term – Temporary	Minor (adverse)
	Restricted access to cultural heritage resources.	Low – Short-Term – Temporary	Minor (adverse)	No additional mitigation beyond measures described in Section 7.8.7.	Low – Short-Term – Temporary	Minor (adverse)
Historical well (LLCOP-1) (Medium)	Vegetation clearing	Low – Short-Term – Temporary	Minor (adverse)	No additional mitigation beyond measures described in Section 7.8.7.	Low – Short-Term – Temporary	Minor (adverse)
	Surface stripping and excavation	High – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ▪ CHMP and CFP, consultation with local communities, mapping and documentation of sites, relocation of resource or activity (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Temporary placement of stockpiled materials and fill (compaction).	High – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ▪ CHMP and CFP, consultation with local communities, mapping and documentation of sites, relocation of resource or activity (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Increased public access to cultural resources.	Low – Short-Term – Temporary	Minor (adverse)	No additional mitigation beyond measures described in Section 7.8.7.	Low – Short-Term – Temporary	Minor (adverse)

Receptor (Importance)	Source of Potential Impact	Impact classification (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	Restricted access to cultural heritage resources.	Medium – Short-Term – Temporary	Moderate (adverse)	Measures described in Section 7.8.7. Additional measures include: ▪ Appropriate site access by local community members, consultation with local communities (as above).	Low – Short-Term – Temporary	Minor (adverse)
Gathering location (LLCOP-106) (High)	Vegetation clearing	High – Short-Term – Temporary	Major (adverse)	Measures described in Section 7.8.7. Additional measures include: ▪ CHMP and CFP, consultation with local communities, mapping and documentation of sites, relocation of resource or activity (as above).	Low – Short-Term – Temporary	Minor (adverse)
	Surface stripping and excavation	High – Short-Term – Temporary	Major (adverse)		Low – Short-Term – Temporary	Minor (adverse)
	Increased public access to cultural resources.	Low – Short-Term – Temporary	Minor (adverse)	No additional mitigation beyond measures described in Section 7.8.7.	Low – Short-Term – Temporary	Minor (adverse)
	Restricted access to cultural heritage resources.	High – Short-Term – Temporary	Major (adverse)	Measures described in Section 7.8.7. Additional measures include: ▪ Appropriate site access by local community members, demarcation of no-go areas (as above).	Low – Short-Term – Temporary	Minor (adverse)

7.8.8.2 Operational Phase

All anticipated Project impacts will occur during the Construction Phase. No further impacts to cultural heritage resources are anticipated during the operational phase as the pipeline will be buried and there will be no further changes to access of cultural heritage resources.

7.8.8.3 Decommissioning

All anticipated Project impacts to cultural heritage resources will occur during the construction phase. Further impacts to cultural heritage anticipated during the Decommissioning Phase are mostly related to road and pipeline abandonment and increased public access or, conversely, restricted access to cultural heritage resources.

As the operational phase of the project nears its end (no less than five years prior to end of pipeline design life), a decommissioning plan will be developed that will include measures to protect cultural heritage resources and mitigate any potential impacts identified.

7.8.9 Summary of Mitigation

The mitigation of cultural heritage will be guided by the Site Clearance Procedure and a Cultural Heritage Management Plan (CHMP) which will include a chance finds procedure. This will be implemented to addresses cultural heritage site stewardship and protection related to Project construction, operational and decommissioning activities. The CHMP will include procedures for pre-construction survey and monitoring of Project work in key sensitive areas by a suitably qualified Cultural Heritage (CH) professional and a documentation and approval mechanism for sites when all required mitigation has been completed. The CHMP will also include a Chance Finds Procedure, to be implemented when undocumented cultural heritage sites are encountered during construction or other Project activities and where gaps in the cultural heritage survey coverage exist (due to logistical/access constraints and security concerns). The CHMP will be developed with guidance from the National Museum of Kenya (NMK) and in consultation with local communities.

In addition to the CHMP and inherent mitigation, the following mitigation has been recommended for cultural heritage sites:

- Consultation and engagement with local communities prior to commencement of construction activities to identify any cultural heritage sites within the RoW, which may be avoided by micro-routing where appropriate;
- In areas identified as being of cultural heritage significance, monitoring of vegetation clearance, surface stripping, excavation and construction will be undertaken by a suitably qualified Cultural Heritage (CH) professional appointed by PipeCo. All such activities will be documented and approved by the CH professional when all required mitigation has been completed;
- Periodic surveillance of known cultural heritage sites (e.g. burial sites) in proximity to the Project during the period of construction activity;
- Surface collection of artefacts shall be carried out under supervision of a suitably qualified cultural heritage professional as set out in the CFP. Sampling and archiving protocol to be agreed with the NMK.
- The pipeline routing design has used satellite imagery and site visits to identify and avoid known cultural heritage sites. Appropriate mapping and documentation will be developed for any additional cultural heritage sites identified in consultation with local communities prior to construction or found during construction;

- If micro alignment cannot avoid graves/burial sites, exhumation and re-interment of burials at a location acceptable to local communities and government authorities, will be undertaken in accordance with procedures agreed with local communities;
- Facilitate legitimate site access by local community members with ties to those locations during the period of construction activity in vicinity of identified sites;
- Where sacred sites are encountered and avoidance is not possible, relocation of sacred site, resources or activity if technically feasible, in consultation with local communities;
- Develop system or protocol for reporting illicit activities (i.e. looting) at cultural heritage sites adjacent to active construction areas to government authorities; and
- Identified sacred sites close to construction/operation areas will be protected through demarcation of no-go areas for vehicles and Project personnel.

7.8.10 Summary of Residual Impacts

Based on our understanding of the baseline conditions, 35 cultural heritage sites will be impacted during the construction phase. These sites fall within the AoI, with nine of them within the RoW. Other undiscovered cultural heritage sites located in un-surveyed portions of the AoI (due to security or access issues) may also be impacted.

Without mitigation, impacts are predicted to range from minor to major, with loss of receptors within the RoW and restricted access to sacred sites within the AoI, resulting in the major significance impacts. Minor and moderate impacts are predicted where access to receptors will be changed and receptor use modified. With the proposed mitigation, as summarised in 7.8.8.4, in place, all impacts are expected to be minor or negligible.

7.9 Physical and Social Infrastructure

7.9.1 Introduction

This assessment discusses the LLCOP Project impacts on physical and social infrastructure in communities along the RoW and addresses comments about Project induced population influx that were raised at Scoping consultation meetings (June 2018) and in Impact Assessment consultations (July 2019). Issues and concerns related to the impact of the Project on physical and social infrastructure as expressed by communities and stakeholders through consultations are presented below by sub-heading. Issues that were not raised in consultations (e.g. direct Project demand for infrastructure), but that are still of relevance to the ESIA are also addressed below. The following topics[1] are the focus of the discussion of infrastructure impacts:

- Population influx;
- Educational infrastructure;
- Water and waste infrastructure;
- Energy sources; and
- Transportation.

The Project's impacts on physical and social infrastructure are driven largely by population influx of opportunity-seekers looking to capitalise on economic activity during construction and operations and are adverse. The Project's direct demand placed on water, waste and transportation infrastructure are also potentially adverse. Project-driven influx represents increased demand in the face of limited capacity. Where negative impacts are identified, mitigation measures are proposed to minimise the magnitude of the impact. This section goes on to characterise the residual impacts of the Project on infrastructure following the implementation of mitigation measures using socio-economic impact assessment criteria (Table 7.9-1). Potential impacts, mitigation, and residual impacts are detailed in the sections below, and summarised in Section 7.9.8.

Table 7.9-1:Socio-Economic Effects Analysis Criteria

Type of Impact	Magnitude	Geographic Extent	Duration
Positive Impact is beneficial **Negative** Impact is adverse **Neutral** Impact is neither positive nor negative	**Negligible** An impact that does not result in a discernible change from baseline conditions **Low** A discernible impact that is not expected to materially alter the socio-economic feature in question **Medium** A discernible impact that is potentially detrimental but manageable, or potentially beneficial to the socio-economic feature in question **High** A discernible impact that is expected to substantially interfere with or enhance the socio-economic feature in question	**Local** AoI stakeholders/ local communities* Areas adjacent to the Project site **Regional** Counties **National** Kenya	**Short-term** Impact is reversible during a phase of construction **Medium-term** Impact is reversible at the end of the two-year construction period **Long-term** Impact is reversible during operations or at closure **Permanent** Impact is not reversible

**Note: AoI Communities within 25 km of the Project. This includes formal communities as well as informal settlements potentially impacted by the Project within the 25 km area.*

[1] Potential impacts on health infrastructure are addressed in the Community Health, Safety and Security Impact Assessment.

7.9.2 Issues and Concerns

Issues and concern regarding potential influx towards the Project, especially where worker accommodation camps are located, and the resulting impact on infrastructure were raised extensively in consultations. This feedback was typically not expressed solely in relation to one particular type of social or physical infrastructure, instead applying broadly to infrastructure as a whole. Issues and concerns have, therefore, been summarised in this section pertaining to all aspects of social and physical infrastructure, rather that under infrastructure-specific headings. Healthcare services are addressed in Section 7.10-2 (Community Health, Safety and Security).

- Concern was raised regarding the potential for local infrastructure and services not to be able to support a population increase as newcomers are drawn to the Project area (Mokowe, 24 October 2018; Hindi, 27 October 2018).
- The potential impact of construction on social infrastructure located along or near the pipeline route (e.g. primary school, health centre, secondary school, polytechnic, a women's group area, mosque, technical institute, catholic church and manyattas); the communities indicated that new facilities should be built to replace the ones that will be affected, particularly schools so education provision is not affected (Archer's Post, 19 October 2018; Baragoi, 23 October 2018; Nachola, 22 October 2018; Suyian, 24 October 2018; Barsaloi, 25 October 2018; Swari, 26 October 2018).

7.9.3 Potential Sources of Impacts

Potential sources of impacts include influx-driven demand for infrastructure and services, and the Project's direct demand for waste management, water, energy and transportation services due to construction activities, hydro-testing, camp operations, and the transportation of goods and equipment.

7.9.3.1 Project-Induced In-Migration

Large, high profile development such as that represented by Project construction can lead to the relocation of those in search of economic opportunity, either directly with the development or to capture small business opportunities. It is anticipated that Project pre-construction and construction activities may result in in-migration of people and their families to communities adjacent to the right of way, particularly near workforce camps.

In-migration itself is neither positive nor negative, but can result in other impacts, some of which may be adverse (e.g. pressure on services, changes in community life), others positive (e.g. local spending).

Informal settlements outside of communities near the Project may develop as a result of in-migration of opportunity-seekers. Larger communities near the Project with available services (e.g. Nkaroni, Isiolo, Garissa, Meru, Lamu, Maua) as well as those around the terminus at the Upstream Project (e.g. Lokichar, Nakukulas, Kapalata) are likely to attract migrants (Figure 7.9-1). Communities near primary camp accommodations (e.g. Nachola, Katilia, Suyian, Wamba, Lerata, Kaichuru, Yaq Barsadi, Shimbiri, Dagoob, Balambala, Modika, Mansabubu) could also experience influx as vendors hoping to service the camps and the Project workforce move in. Primary camps will be in operation for the full duration of construction (i.e. up to two years), while secondary camps will operate for shorter periods in association with individual spread construction.

As noted above, in-migration itself is neither positive nor negative. However, the resulting pressure placed on social and physical infrastructure can prove detrimental to the system in question. While it is not possible to predict the scale of speculative in-migration in response to the Project with great accuracy, influx is highly likely given the high level of regional unemployment and the speculation that proximity to Project development activities will improve the chances of securing some sort of employment or business opportunity. The Project's residual impacts on infrastructure, including those resulting from in-migration, are characterised in the impact classification section.

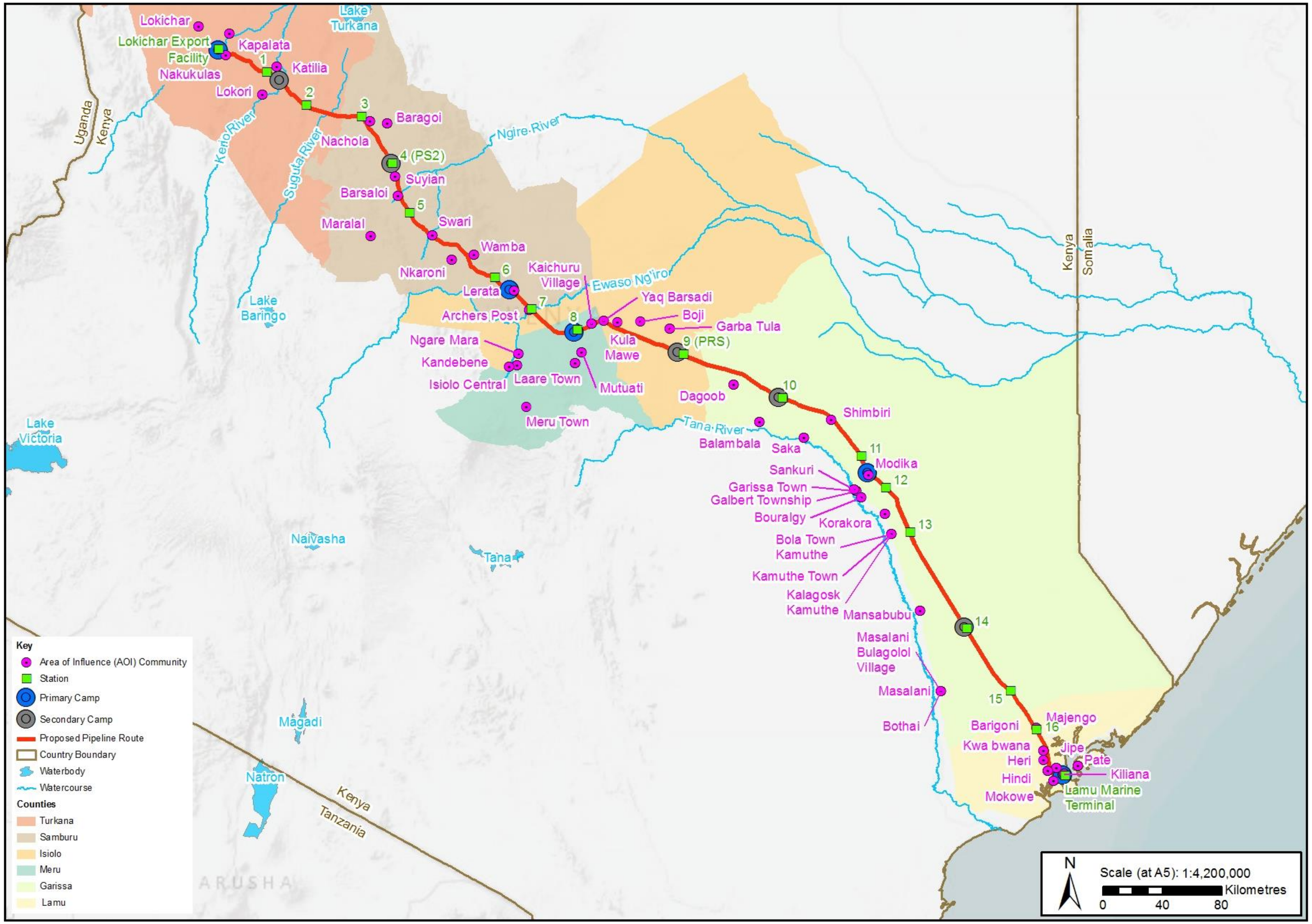

Figure 7.9-1: Location of communities relative to camp accommodation

PPMT will control their messaging regarding workforce requirements and employment opportunities, and will manage their own workforce; however, influx of opportunity seekers is not entirely within the control of the Project. Once the locations of camps are confirmed, an impact assessment of the selected location will be carried out and will include an assessment of water, electricity and other aspects of the socio-economic environment potentially impacted by influx. If warranted, a site-specific Influx Management Plan (IMP) will be developed at each primary camp to address the potential for in-migration of opportunity seekers. The IMP will estimate the potential level of population increase, based on examples in Kenya and elsewhere, determining where people are most likely to settle, and which infrastructure and services would face the greatest pressure.

The IMP will begin by defining the elements of the Project (e.g. camp accommodation) potentially generating influx and characterising the context in which influx could occur, as well as establishing goals, objectives, and desired outcomes of influx management efforts and measures for success. The IMP will identify the roles of various parties (e.g. the proponent, the government, NGOs), and their responsibilities with respect to their mandate to manage influx and resulting impacts. This exercise will include a description of the capacity of each party to execute their responsibilities and the identification of resources required to do so. Potential alternatives to the chosen management interventions will also be evaluated and considered.

7.9.3.2 Education

With rising populations, both inadequate staffing and school infrastructure are issues in all six counties. Challenges to educational attainment in the counties are attributed to poverty, high ancillary education costs, long commuting distances to schools, school understaffing and inadequate infrastructure (i.e. school facilities and utilities).

The Project is unlikely to draw people with children toward the camps; opportunity seekers are generally young adults. However, if people stay in the area, over time, the resulting population growth from initial in-migration could put pressure on the school system. The Project is not expected to have a direct impact associated with demand for local vocational training of the workforce.

7.9.3.3 Water and Waste

Potable water supplies and sanitary wastewater disposal infrastructure in communities is limited. Waste management infrastructure is similarly lacking in the six counties traversed by the Project and the lack of waste transportation, storage and disposal facilities is of major concern. The Project has the potential to influence water and waste infrastructure both through direct demand, and induced demand from Project-driven in-migration.

The Project could interact with water and waste infrastructure in communities along the RoW by placing direct demand on these services, and through Project-driven influx of opportunity-seekers.

7.9.3.4 Energy Sources

Connection to electricity from generators and renewable sources is uncommon in most communities adjacent to the Project, with most households using wood and charcoal to meet their energy demands.

While the Project's direct energy demands are expected to be met through generator stations and the market electricity grid, Project-driven influx has the potential to increase demand for some sources of energy.

7.9.3.5 Transportation

Road infrastructure in the six counties is generally in poor condition with many roads in need of repair and maintenance. The roads in all counties are made primarily of earth, with only a small proportion paved. As a result, during the rainy season many sections of the earthen roads become impassable. Accessibility to some rural communities is limited due to poor road conditions. In Turkana County, most of the population moves on foot between destinations. In Lamu, roads are in similar condition and Lamu County has the additional transportation infrastructure of eight large jetties used by passengers, fishermen and shippers.

The Project will use shipping and port services in Lamu, but not at a scale that will generate demand beyond the capacity of the port. The Project's ground transportation of goods, equipment and personnel is, however, expected to result in wear and tear on local county road infrastructure, changes in traffic volume and composition, and the potential for vehicle collisions.

Impacts have not been differentiated between construction and operations in this section with the exception of road wear and tear, which is more likely to occur during the construction phase.

7.9.4 Impact Classification

7.9.4.1 Education

The Project is not expected to result in direct impacts on educational infrastructure (schools, post-secondary) in the six counties through which it runs. The construction workforce requiring formal training is expected to be sourced from contractors with an existing, trained workforce. Similarly, technical employment opportunities available during operation would be taken up by candidates possessing the necessary formal training and supplemented with on-the-job training. Some job opportunities may be sourced through local technical schools in each county.

There is low potential for Project-induced in-migration of opportunity-seekers to bring their families to larger rural centres near primary camp accommodations; however, over time, should these newcomers stay, the population could grow and place additional demand on educational services in the counties. If this growth results in additional demand for educational services, the already understaffed schools and their inadequate infrastructure would be further stressed, impacting the service including the provision of educational services sufficient to ensure successful school completion.

The potential impact of the Project inducing influx-driven demand for educational services is adverse based on the limited capacity of educational services to respond but categorised as minor in consideration of the fact that many movers are expected to be young men and not moving with their families. The potential impact would be rural to rural and localised to communities receiving in-migrants. As the majority of employment-generating activity will occur during construction, the potential for influx is likely limited to this phase; however, anecdotal evidence (ESF June 12, 2019) suggests that the potential for in-migrants to remain in informal settlements, or to move into communities, will likely extend indefinitely. As a result, the impact would extend into the long-term. The potential impact of the Project inducing influx-driven demand for educational services is, therefore, assessed as being a minor (negative), given that young adult males will come alone initially but then potentially being of greater significance as families may join the male, or population growth from the initial influx eventually puts pressure on education as families expand.

The potential of the Project to impact educational services is related to the in-migration-induced increase in demand for classroom spaces associated with the in-migration of families. As a result, mitigation is consistent with that presented above under Project-induced in-migration, and will be aimed at discouraging the in-migration of opportunity-seekers to the Project area and working with local leadership on potential educational enhancement through the implementation of site-specific Influx Management Plans, where needed.

The residual impact of the Project inducing influx-driven demand for educational services is adverse and would be of low magnitude based on the limited capacity of educational services to respond, but also considering the limited potential for young adult males to relocate with families with school-aged children. The impact would be localised to communities receiving in-migrants, likely those closest to the primary camp accommodations. As the majority of employment-generating activity will occur during construction, the potential for influx is likely limited to this phase; however, the potential for in-migrants to remain in informal settlements, or to move into communities will likely extend indefinitely due to population growth and resultant larger market and business opportunities. As a result, the impact would extend into the long-term. The residual impact of inducing influx-driven demand for educational services is, therefore, assessed as being a **minor (negative)** (Table 7.9-3).

7.9.4.2 Water and Waste

Direct Water Use and Treatment

The Project will require water for hydro-testing. Potential water supply options for hydrotest, subject to the necessary permit approvals, include lakes and rivers, existing water wells, and where available, local municipal water supply. In Lamu use of sea water will be considered. New wells/boreholes coupled with temporary pumps, filtration and treatment sets may need to be considered in the case there is insufficient water, along with possible water diversions from far areas and the construction of artificial ponds. Where water source locations are limited, test water will be transferred between adjacent test sections. Prior to water abstraction a hydro-census will be undertaken to determine likely receptors. Water abstraction locations will be selected to limit impacts on communities. Should there be any potential for changes in water supply, the Project will provide water to communities. Similar to the cleaning process, water will be tested to determine chemical properties before pumping into the pipeline. Biocides and corrosion inhibitors will be avoided where possible, based on the water quality. Water will be extracted, filtered and pumped into the settling tanks at least 24 hours before filling operations begin, as appropriate.

Pipeline cleaning and testing will require disposal of used hydrotest water and any solid matter removed from the pipeline. The preferred course of action is to recycle hydrotest water from one section to another. Post-use, all hydrotest water will be tested, then discharged at a controlled rate to a site. Land disposal is expected to be into infiltration beds or percolation ponds, incorporating erosion control measures. Where the hydrotest water being disposed of is found to contain contaminants, corrosion-inhibitors or elements of rust and dirt, it will be disposed of to an approved disposal facility and with approvals from NEMA.

The Project will require water and waste management for other construction activities and the camp accommodations. Potential water points from groundwater sources will be assessed as to suitability and potential for negative effects on communities, and permits will be sought for the suitable option.

Given this approach, the Project is not expected to place additional demand on water treatment or waste disposal services in the counties that could push them beyond capacity. No further mitigation is required and no residual impact is predicted.

Direct Waste Generation and Disposal Requirements

The Project will generate waste from shipping and receiving procured goods and services, development of the pipeline and associated facilities, pre- and de-commission activities and the operation of camps, offices, and compounds. The estimate of approximately 1,000,000 m^3 of wastewater (sanitary, pre-commissioning, hydro-testing, runoff, and water contaminated at refuelling areas) will be treated and recovered where possible. Construction is expected to generate approximately 2,000 t of metal waste from fabrication and other installation activities, and 5,000 t of solid waste (e.g. paper, wood, cardboard, plastics, fencing).

All direct waste materials created during the construction phase of the Project will be separated at source, stored in segregated storage areas or containers and either re-used, recycled, traded or disposed of appropriately. Construction waste generated by the Project in Turkana county will be transported to, and recycled and/or disposed of appropriately, in the Waste Management Facility built for the Upstream project. In other counties, where a waste disposal facility/landfill is not present within close proximity of significant waste generating locations (main camps), or of sufficient size to handle additional quantity, upgraded or existing licensed disposal facilities will be used where required along the pipeline route. The limited quantities of hazardous waste created by construction activities will be handled, stored, treated, and disposed of in line with applicable standards.

Given this approach, the Project is not expected to place additional demand on water treatment or waste disposal services in the counties that could push them beyond capacity. No further mitigation is required, and no residual impact is predicted.

In-Migration-Induced Demand for Water and Waste Infrastructure

An influx of opportunity-seekers speculatively hoping to secure employment with the Project or sell goods and services to its workforce and settling in informal settlements could result in increased demand for water (both potable and for washing). Such settlements would also generate solid waste that would require storage, transportation, and disposal. Water is scarce in the counties crossed by the Project, and infrastructure providing water for drinking, washing and sanitation is limited. Similarly, waste management infrastructure is sparse, and in some areas in need of improvement. Depending on the efficacy of influx mitigation measures, and the resulting scale of in-migration, the potential impact on water and waste management infrastructure could be pronounced.

The potential impact of inducing in-migration-driven demand for water and waste management infrastructure is adverse and without investment in improvements or mitigation, would be of high magnitude considering the already constrained water supply situation in communities and potential for uncontrolled in-migration. The impact would be possible throughout the six counties traversed by the Project but would be localised to communities with primary camps. With most employment-generating activity occurring during construction, the potential for an influx of opportunity-seekers is likely limited to this phase; however, the potential for in-migrants to remain in informal settlements, or to move into communities will likely extend indefinitely. As a result, the impact would extend into the long-term. The potential impact of inducing in-migration-driven demand for water and waste management infrastructure is, therefore, assessed as being a major (negative) without mitigation

The potential of the Project to impact water and waste infrastructure is related to the in-migration-induced increase in demand for water and waste disposal. As a result, mitigation is consistent with that presented above under Project-Induced In-Migration, and will be aimed at discouraging the in-migration of opportunity-seekers to the Project area and working with local leadership on potential water and waste management solutions through the implementation of site-specific Influx Management Plans, where needed.

The residual impact of inducing in-migration-driven demand for water and waste management infrastructure is adverse, and with mitigation, would be of low magnitude given the implementation of site-specific IMPs that would address in-migration-driven demand. The impact would be possible throughout the six counties traversed by the Project but would be localised to communities receiving in-migration. With most employment-generating activity occurring during construction, the potential for an influx of opportunity-seekers is likely limited to this phase; however, the potential for in-migrants to remain in informal settlements, or to move into communities will likely extend indefinitely. As a result, the impact would extend into the long-term. The residual impact of inducing in-migration-driven demand for water and waste management infrastructure is, therefore, assessed as being a **minor (negative)**.

7.9.4.3 Energy Sources

Direct Demand for Energy

Heating, pumping, and other operational activities will be powered through crude oil-driven power generation stations and will draw some power from the local electrical supply or infrastructure in the counties. During construction, camp accommodations will be self-sufficient, employing generators for heat (if needed) and electricity. The Project will not require the use of other fuels commonly used by households, such as charcoal or firewood. The Project has been designed to avoid direct demand on local energy infrastructure or supplies to the extent possible. Where the Project is tapped into local power grids, market rates will be paid for electricity. No further mitigation is recommended, and no residual impacts are anticipated.

In-Migration-Driven Demand for Energy

Informal settlements of in-migrants to areas adjacent to communities near Project construction activities would not be connected to the electrical grids or renewable energy developments, and so would not draw on this infrastructure for power. An influx of in-migrants could, however, result in increased competition for charcoal and firewood which are key sources of household fuel. It is likely that most in-migrant households would use wood as the primary source of household fuel given the lack of other cost-effective alternatives. Given the arid nature of much of the landscape, additional demand for wood could stress a limited resource with slow regrowth.

The potential impact of inducing in-migration-driven demand for household fuel sources is adverse and could be of medium magnitude without mitigation to curb in-migration. The impact would be possible throughout the six counties traversed by the Project but localised to communities near the primary camps. With most employment-generating activity occurring during construction, the potential for influx is likely limited to this phase; however, the potential for in-migrants to remain in informal settlements, or to move into communities will likely extend indefinitely. As a result, the impact would extend into the long-term. The potential impact of inducing in-migration-driven demand for household fuel sources is, therefore, assessed as being a major (negative) without mitigation.

The potential of the Project to impact energy sources and infrastructure is related to the in-migration-induced increase in demand for water and waste disposal. As a result, mitigation is consistent with that presented above under Project-Induced In-Migration, and will be aimed at discouraging the in-migration of opportunity-seekers to the Project area and working with local leadership on potential energy management solutions through the implementation of site-specific Influx Management Plans, where needed.

The residual impact of inducing in-migration-driven demand for household fuel sources is adverse and would be of low magnitude given the implementation of site-specific IMPs that would address influx-driven demand. The impact would be possible throughout the six counties traversed by the Project but localised to communities receiving in-migrants, most likely near the primary camps. With most employment-generating activity occurring during construction, the potential for in-migration is likely limited to this phase; however, the potential for in-migrants to remain in informal settlements, or to move into communities will likely extend indefinitely. As a result, the impact would extend into the long-term. The residual impact of inducing in-migration-driven demand for household fuel sources is, therefore, assessed as being a **minor (negative)**.

7.9.4.4 Transportation

Shipping Traffic and Port Use

Project construction will involve the importation of goods and equipment through the port of Mombasa. The port is the largest in east Africa, with 21 deep water berths capable of receiving large freight ships. The port also has freight storage areas (Kenyan Port Authority 2015). It is expected that, while the Project's shipping requirements would be substantial, the port would be able to accommodate incoming shipments. Further, the Project would pay all applicable berthing, unloading, and storage fees levied by the port authority. Shipping traffic is controlled, and movement in the port's waters is scheduled and planned. As a result, the Project is not expected to place strain on the port or pose an uncontrolled risk to other shipping traffic. No further mitigation is recommended and no residual impacts on shipping are predicted.

Degradation of Road Infrastructure

The local road system will be used when transporting goods to storage areas and workers to site, with the option of also using the right of way to reduce wear. From the Import Storage Facility in Mombasa to the Primary Storage Facilities in each county, roads that allow the fastest route to the destination will be used. Transportation to Primary Storage Facilities will be possible throughout the year, as routes are not anticipated to be affected by the rainy seasons. From the Primary Storage Facilities// to the Secondary Storage Facilities, local roads and the right of way will be used wherever possible to minimise the amount of new access roads required. Transportation to Secondary Storage Facilities, and to the site may be suspended during the rainy season due to the degradation of local roads and the right of way. This is particularly true of unpaved sections of local roads and the right of way, which will require upgrades to facilitate transport of goods and personnel during construction. Heavy truck traffic is expected to cause wear and tear of local unpaved roads beyond that imparted by local traffic. As a result, it is estimated that approximately 435 km of local roads will require upgrades prior to, or during construction.

During operations, the Project will not require substantial road shipping of goods, materials, and equipment. Wear and tear on road infrastructure due to maintenance and inspection traffic is expected to be within the normal range of baseline conditions. As a result, operational wear and tear on local road infrastructure has not been carried forward for further assessment.

The potential impact of creating wear and tear on local roads is adverse, and if unmitigated, of medium magnitude requiring further management to maintain current conditions. The impact would be experienced throughout Kenya as goods and equipment are transported from the port in Mombasa to the RoW but would be most felt locally where roads are made of laterite, which degrade quicker. The impact would extend throughout Project construction into the medium-term. The potential impact of creating wear and tear on local roads is, therefore, assessed as a major (negative) prior to mitigation.

Mitigation of wear and tear on local roads is focused on upgrading roads, particularly those that are unpaved, to accommodate large truck traffic, as required. A Traffic Management Plan will be developed to identify roads that require upgrading. Regular inspection of road condition and proactive maintenance repairs will be undertaken to avoid degradation of road integrity. All local roads used by the Project for heavy vehicle access will be monitored and restored to acceptable condition prior to project commencement. Regular inspection of transport routes used by the Project for heavy load movement. Where issues are identified, these will be discussed with appropriate authorities (KeNHA) and a remedial plan agreed.

Taking into account all the preceding subsections, the residual impact creating wear and tear on local roads is adverse, but largely mitigated through monitoring, maintenance, and upgrades. The impact is considered to be of low magnitude not requiring further management outside of the proposed mitigations. The impact would be experienced throughout Kenya as goods and equipment are transported from the port in Mombasa to the RoW but would be most felt locally where roads are made of either asphalt or laterite, which degrade quicker. The impact would extend throughout Project construction into the medium-term. The residual impact of creating wear and tear on local roads is, therefore, assessed as a **minor (negative)**.

Change In-Road Traffic Volume and Composition

Construction traffic will be composed primarily of large trucks and personnel transport, with some smaller vehicles used by supervisors and inspectors. This is expected to represent a change in traffic composition on local roads, which are traversed largely by pedestrians and small personal transport vehicles, and to introduce the possibility of greater congestion and nuisance. The pipe transportation and storage planning has been calculated assuming 12.2 m pipe lengths transported on standard 40 ft flatbed trailers. Truck traffic will be heaviest between the Import Storage Facility and the Primary Storage Facilities along the RoW. Depending on the facility, between five and 30 trucks will be required for resupply. Trucks will likely travel in convoys and will be operating on local roads daily for the duration of construction. Transporting supplies to the Secondary Storage Facilities will involve shorter trips and fewer trucks (two to eight) but will still require the introduction of large industrial traffic on local roads. To reduce interference with public traffic and transportation, the right of way will be used where practical and safe for the transportation of goods and equipment between Secondary Storage Facilities and areas of active construction. Table 7.9-2 provides a breakdown of truck traffic associated with each storage facility along the RoW (refer to Section 4.1.8.4 of the Project Description for further detail on the Project’s transportation approach).

Table 7.9-2: Required trucks and journeys for transportation of line pipe

Route		Route Distance (km)	Total Number of Truck Journeys Required	Minimum Number of Trucks Required
From	To			
Mombasa Port	Import Storage Facility (ISF)	14	7,792	12
ISF	PCS-1	1,145	942	15
ISF	PCS-2	810	1,903	24
ISF	PCS-3	805	1,232	16
ISF	PCS-4	475	3,193	30
ISF	PCS-5	340	527	4
PCS*-1	SCS*-1	65	487	2
PCS-2	SCS-2	150	1,106	8
PCS-3	SCS-3	94	526	2
PCS-4	SCS-4	88	557	2
PCS-4	SCS-5	190	660	6
		Total	**18,925**	**121**

**Note: ISF: Import Storage Facility; PCS: Primary Camp and Storage; SCS: Secondary Camp and Storage*

During operations, the Project will not require large vehicles associated with the shipping of goods, materials, and equipment. The limited number of vehicles use to undertake maintenance and inspection are expected to be smaller vehicles similar in composition to baseline traffic. As a result, operational changes in traffic composition and volume on local roads has not been carried forward for further assessment.

The potential impact of changing traffic volumes and composition on local roads is adverse, as it represents the introduction of large construction vehicles into a setting where local roads are used primarily by pedestrians, often with livestock, and personal-use vehicles. The impact is considered of low magnitude given that, while convoys of large trucks are likely to be on local roads daily, the number of trucks required will be relatively small and trips will be geographically dispersed. The impact would be experienced throughout Kenya as goods and equipment are transported from the port in Mombasa to the RoW however, would be most felt on local roads where traffic includes pedestrians, livestock, and small vehicles. The impact would extend throughout the first third of the construction period and is thus of short-term duration. The potential impact of changing traffic volumes and composition on local roads is, therefore, assessed as a minor (negative) pre-mitigation. Safe driving practices and adherence to speed limits and traffic laws will be inherent to the Project, and so no additional mitigation is proposed. The residual impact of changing traffic volumes and composition on local roads therefore remains a **minor (negative)**.

Table 7.9-3: Summary of Potential Impacts, Mitigation, and Residual Impacts during Construction

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Education, water, waste, and fuel	Influx-driven demand for educational services	Low – long-term – local	Minor (negative)	The following mitigation is recommended, and will be built upon by site-specific IMPs, as required, to reduce the risk of influx to communities near the Project: ■ Implement employment policy forbidding informal labour hire and no "at the gate/camp" hiring to help reduce the risk of influx putting pressure on local infrastructure; ■ Deploy signage in relevant local languages related to Project hiring in relevant locations to help reduce the risk of influx putting pressure on local infrastructure; ■ Develop and implement communications plans on project employment policies in areas identified as potential sources of in-migration, to help reduce the risk of influx putting pressure on local infrastructure; ■ Preferential local recruitment of non-skilled workers and employment of local/regional workforce as outlined in Project local content plans, to help reduce the risk of influx putting pressure on local infrastructure; ■ Regular (quarterly) meetings with County administration to identify and address any emerging issues, to help manage influx which could put pressure on local infrastructure; ■ Advertising of recruitment and hiring procedures, together with jobs specifications and requirements,	Low – long-term - local	Minor (negative)
	Influx-driven demand for water/waste infrastructure	High – long-term - local	Major (negative)		Low – long-term – local	Minor (negative)
	Influx-driven demand for household fuel	Medium – long-term - local	Moderate (negative)		Low – long-term – local	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				to help manage influx which could put pressure on local infrastructure; ■ All (non-local) workers to be housed in designated accommodation camps except where local impacts can be demonstrated to be negligible, to help reduce pressure on local infrastructure and local inflation; and ■ A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates. Should there be any potential for changes in water supply, the Project will provide water to communities, to help reduce the risk of influx putting pressure on local infrastructure.		
Roads and Traffic	Degradation of road infrastructure	Medium – medium-term – local	Major (negative)	■ Major roads will be identified by the EPC Contractor from both Mombasa and Lamu ports to ascertain the most appropriate route to transport pipe and equipment to the selected storage yards along the pipeline route. ■ EPC Contractor will develop a Traffic Management Plan to identify which (if any) non-major roads will need to be rehabilitated for use during the Project.	Negative, minor magnitude, local extent, medium-term	Minor (negative)
	Change in traffic volume/ composition	Low – short-term – local	Minor (negative)		Negative, minor magnitude, local extent, short-term	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				▪ Regular inspection of these roads will be undertaken throughout the Project, and repairs will be carried out as required in consultation with the appropriate Government Agency (KeNHA/ Regional Roads Authority)		

Table 7.9-4: Summary of Potential Impacts, Mitigation, and Residual Impacts – during operations (early phase)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Education, water, waste, and fuel	Influx-driven demand for educational services	Low – long-term – local	Minor (negative)	List of mitigation measures to continue during operations to reduce the risk of influx to communities near the Project: ■ Implement employment policy forbidding informal labour hire and no "at the gate/camp" hiring to help reduce therisk of influx putting pressure on local infrastructure; ■ Deploy signage in relevant local languages related to Project hiring in relevant locations to help reduce the risk of influx putting pressure on local infrastructure; ■ Develop and implement communications plans on project employment policies in areas identified as potential sources of in-migration, to help reduce the risk of influx putting pressure on local infrastructure; ■ Preferential local recruitment of non-skilled workers and employment of local/regional workforce as outlined in Project local content plans, to help reduce risk of influx putting pressure on local infrastructure; ■ Regular meetings (quarterly) with County administration to identify and address any emerging issues, to help manage influx which could put pressure on local infrastructure; ■ Advertising of recruitment and hiring procedures, together with jobs specifications and requirements,	Low – long-term - local	Minor (negative)
	Influx-driven demand for water/waste infrastructure	High – long-term – local	High (negative)		Low – long-term – local	Minor (negative)
	Influx-driven demand for household fuel	Medium – long-term – local	Moderate (negative)		Low – long-term – local	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				to help manage influx which could put pressure on local infrastructure; and ▪ All (non-local) workers to be housed in designated accommodation camps except where local impacts can be demonstrated to be negligible, to help reduce pressure on local infrastructure and local inflation.		

7.9.5 Summary of Mitigation

In addition to the incorporated mitigation that will be put in place during the construction and operational phases of the Project to avoid impacts or reduce their magnitude, additional mitigation is required to reduce the residual impact of the Project.

This section collates and presents further detail relating to those mitigation measures, as specified in Table 7.9-3 and Table 7.9-4, and in addition to the commitments presented as part of the Environmental and Social Management Plans:

Project-Induced In-Migration and Associated Impacts

- Implement employment policy forbidding informal labour hire and no "at the gate/camp" hiring to help reduce risk of influx putting pressure on local infrastructure;
- Deploy signage in relevant local languages related to Project hiring in relevant locations to help reduce risk of influx putting pressure on local infrastructure;
- Develop and implement communications plans on project employment policies in areas identified as potential sources of in-migration, to help reduce risk of influx putting pressure on local infrastructure ;
- Preferential local recruitment of non-skilled workers and employment of local/regional workforce as outlined in Project local content plans, to help reduce risk of influx putting pressure on local infrastructure;
- Regular meetings (quarterly) with County administration to identify and address any emerging issues, to help manage influx which could put pressure on local infrastructure;
- Advertising of recruitment and hiring procedures, together with jobs specifications and requirements, to help manage influx which could put pressure on local infrastructure;
- A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within locatio- specific consented volumes and rates. Should there be any potential for changes in water supply, the Project will provide water to communities, to help reduce risk of influx putting pressure on local infrastructure.

7.9.6 Summary of Residual Impacts

The Project's adverse impacts on education, water and waste infrastructure, and fuel are related to the potential for Project-induced in-migration to result in increased competition for infrastructure, services, and household fuels. With the implementation of mitigation, influx-driven competition for these resources is expected to be of minor significance. Similarly, the Project's residual impact on road conditions and traffic composition is expected to be of minor significance with mitigation.

7.10 Community Health, Safety and Security

7.10.1 Introduction

This section describes issues relating to Community Health, Safety and Security. While there is some overlap of topic areas, the impact and risk assessments are presented separately, with discussion of Project potential impacts on community health presented first, followed by an assessment of the key security impacts. Each impact/risk assessment presents an overview of the methodological approach, relevant information on baseline conditions, significance ranking and suggested mitigation and management measures.

The objective of the health impact assessment is to identify and estimate the lasting or significant changes, due to project activities, on the health status of a defined population/s. This is done by adopting a systematic approach to identifying different health and wellbeing impacts, both positive and negative, and the distribution of these health effects across a potentially affected population considering social inequalities or vulnerabilities and how they might be influenced by the proposed Project.

The geographic scope of the assessment is limited to the counties and AoI communities through which the LLCOP is expected to run as well as the anticipated location of project facilities, including above ground installations (pumping stations, pressure reduction stations and generators camps) and the storage facility at the marine export terminal at the Port of Lamu.

Environmental Health Areas and Thematic Health Areas

Based on a World Bank analysis, the IFC methodology uses 12 Environmental Health Areas (EHAs) to support the systematic analysis of health considerations. This reductionist approach provides a linkage between project-related activities and potential positive or negative community-level impacts and incorporates a variety of biomedical and key social determinants of health.

In this systematic approach to the analysis of potential impacts, cross-cutting environmental and social conditions that contain significant health components or determinants in each EHA are identified and evaluated against specific Project activities to determine the likelihood, consequence and spatial distribution of potential health effects. This provides a holistic approach to evaluating community health impacts instead of an impact assessment focusing solely on disease-specific considerations. While every EHA may not be relevant to a given project, it is still important to systematically analyse the potential for project-related impacts (positive, negative or neutral) across the various EHAs. The 12 EHAs as well as a brief description of each are reflected in Table 7.10-1.

Table 7.10-1:Environmental Health Areas

Number	Environmental Health Areas (EHA)
1.	**Communicable diseases linked to the living environment** – Transmission of communicable diseases (e.g. acute respiratory infections, pneumonia, tuberculosis, meningitis, plague, leprosy, etc.) that can be linked to inadequate housing design, overcrowding and housing inflation. It also considers indoor air pollution related to use of biomass fuels.
2.	**Vector-related diseases** – Mosquito, fly, tick and lice-related diseases (e.g. malaria, dengue, yellow fever, lymphatic filariasis, rift valley fever, human African trypanosomiasis, onchocerciasis, etc.)
3.	**Soil-, water- and waste-related diseases** – Diseases that are transmitted directly or indirectly through contaminated water, soil or non-hazardous waste (e.g. diarrheal diseases, schistosomiasis, hepatitis A and E, poliomyelitis, soil-transmitted helminthiases, etc.)
4.	**Sexually-transmitted infections, including HIV/AIDS –** Sexually-transmitted infections such as syphilis, gonorrhoea, chlamydia, hepatitis B and, most importantly, HIV/AIDS. Linkages of TB will be discussed where relevant under HIV, but often linked to EHA1.
5.	**Food- and nutrition-related issues** – Adverse health effects such as malnutrition, anaemia or micronutrient deficiencies due to e.g. changes in agricultural and subsistence practices, or food inflation; gastroenteritis, food-borne trematodiases, etc. This will also consider feeding behaviours and practices. Access to land plays a major role in developing subsistence farming contexts
6.	**Non-communicable diseases** – Cardiovascular diseases, cancer, diabetes, obesity, etc.
7.	**Accidents/injuries** – Road traffic or work-related accidents and injuries (home and project related); drowning.
8.	**Veterinary medicine and zoonotic diseases** – Diseases affecting animals (e.g. bovine tuberculosis, swinepox, avian influenza) or that can be transmitted from animal to human (e.g. rabies, brucellosis, Rift Valley fever, Lassa fever, leptospirosis, etc.).
9.	**Exposure to potentially hazardous materials, noise and malodours** – This considers the environmental health determinants linked to the project and related activities. Noise, water and air pollution (indoor and outdoor) as well as visual impacts will be considered in this biophysical category. It can also include exposure to heavy metals and hazardous chemical substances and other compounds, solvents or spills and releases from road traffic and exposure to malodours. There is a significant overlap in the environmental impact assessment in this section.
10.	**Social determinants of health** – Including psychosocial stress (due to e.g. resettlement, overcrowding, political or economic crisis), mental health, depression, gender issues, gender based domestic violence, suicide, ethnic conflicts, security concerns, substance misuse (drug, alcohol, smoking), family planning, HSB, etc. There is a significant overlap in the social impact assessment in this section.
11.	**Cultural health practices** – Role of traditional medical providers, indigenous medicines, and unique cultural health practices.
12.	**Health services and systems capacity** – Physical health infrastructure (e.g. capacity, equipment, staffing levels and competencies, future development plans) and institutional capacity within the health service.

While the use of EHAs ensures a systematic and holistic approach to the assessment of potential community health impacts, numerous cross-cutting elements exist between the social and environmental determinants in different EHAs. Therefore, EHA-based reporting of community health impacts and associated mitigation measures, may lead to repetition across health areas. To recognise the cross-cutting nature between different EHAs and minimise duplication in the chapter, potential health impacts and community health-focused mitigation measures are presented in a format of that considers thematic health areas. Where relevant, duplicate impacts and mitigation measures were grouped into themes that address elements across different topics, allowing for better integration across EHAs.

The use of thematic health areas simplifies the approach to community health management and monitoring during the development of a suite of community health management measures and is presented as a subsection of the Environmental and Social Management Plan (ESMP).

The thematic health areas that are relevant to the LLCOP Project, as well as the distinct impacts and the EHAs that they relate to, are summarised in Table 7.10-2).

Table 7.10-2: Community Health Impact Themes

Impact Themes	Impact	EHA
Project impacts on communicable disease transmission	Introduction and transmission of communicable diseases between Project workforce and PACs.	EHA1, 2, 4
	Outbreaks of infectious conditions within Project camps affecting the health of the local workforce and PACs.	EHA1, 3, 4
	An increase in the burden of disease along the project's transport corridors as a result of project drivers spreading communicable diseases.	EHA1, 4
	Effects of environmental alteration on vector densities.	EHA2
	Introduction of new vector related diseases and strains due to Project logistics.	EHA2
Accidents and injuries	Project activities resulting in accidents affecting communities.	EHA7
	Improved access to health care facilities from an improvement in road conditions and regional transport networks.	EHA12
	Risk of conflict between community members and security personnel leading to injury or death.	EHA7
	Risk of wildlife interaction.	EHA8
	Occupational health and safety incidents resulting in injuries and death.	EHA7
Impacts on environmental determinants of health	Abstraction of surface water.	EHA3
	Abstraction of groundwater.	EHA3
	Impacts related to noise.	EHA9
	Impacts on air quality.	EHA9
Social determinants of health	Improved health due to employment.	EHA10
	Increase in GBV.	EHA10
	Impact on NCDs.	EHA10

Impact Themes	Impact	EHA
Infrastructure management	Improper vector management activities result in an increase in vector resistance.	EHA2
	Nutrition of PACs compromised as project procurement results in reduced food security.	EHA3
	Improper waste management.	EHA3, 4, 9
Project Induced In-Migration	Project induced in-migration potentially resulting in an increase in social ills, potentially leading to an increase in GBV, crime, drug use and alcoholism.	EHA10
	Influx may result in environmental changes that promote vector breeding, disease transmission and an increased burden on health systems.	EHA1, 2, 3, 4
	Project induced in-migration (PIIM)resulting in increased pressure on existing health services at a PAC level.	EHA11, 12
	Influx resulting in soil and groundwater contamination from the uncontrolled disposal of waste.	EHA3
	Reduction in the availability of safe water in PACs due to an influx of people attracted by the project.	EHA3

7.10.1.1 Health Assessment Methodology

A separate health baseline for the Project is located in Annex II. Baseline data collection involved both primary and secondary data sources and are briefly described in the sections below. The health baseline report (Annex II) provides additional detail on baseline data collection methods and on health impact assessment methodology.

7.10.1.1.1 Literature Review

A desktop literature review was utilised to inform the health profiling of the communities in the Project area, describing a broad health status of the population, based on a systematic review of the 12 Environmental Health Areas (EHAs) with reference to data at national, county and local level. Core documents consulted during the review include:

- Kenya Economic Survey 2018;
- Kenya Demographic and Health Survey (KDHS) 2014;
- Kenya AIDS Response Progress Report 2018;
- Kenya Tuberculosis Prevalence Survey Report 2018;
- Kenya Malaria Indicator Survey 2015; and
- County Integrated Development Plans (CIDPs).

7.10.1.1.2 Fieldwork and Stakeholder Engagement

Prior to mobilisation, survey protocols and interview tools were developed, based on the findings of the literature review. Formal letters of invitation were sent to each Chief Officer for Health in the affected counties to introduce the survey, secure meetings with the relevant stakeholders and obtain assistance in the arrangement of meetings. Appointments were confirmed telephonically, prior to mobilisation. Activities performed during these county visits include the following:

Participatory Group Meetings

A crucial part of the field visits was to consult stakeholders who have special knowledge of the health status and the social health determinants of the Project area. The objective was to gain an understanding of the general health situation and the potential health impacts of the Project. The activities started off with participatory meetings with County Health Management Teams (CHMTs) in each of the six Project counties. A semi-structured questionnaire was used to guide a formal discussion on the existing health needs/challenges and burden of disease in the study area. Participants also shared their experiences and observations on various aspects of health in their county. In addition, the potential impacts of the Project were discussed.

Figure 7.10-1: Participatory group meeting
Source: Fieldwork December 2018

Key Informant Interviews

Specific departmental heads or programme managers were interviewed individually using a semi-structured interview tool. The key informant interviews (KIIs) focused on specific topics of interest such as communicable diseases including tuberculosis, reproductive health and sexually transmitted infections and HIV/AIDS, food and nutrition, non-communicable diseases, maternal and child health, social determinants of health, water and sanitation, malaria and vector-related diseases. Figure 7.10-2 shows a photo from KII session.

Figure 7.10-2: Key informant interview
Source: Fieldwork December 2018

Health Facility Assessment

Assessment of the quality of health care in the study area was carried out in five health facilities: Lamu County Referral Hospital, Garissa County Referral Hospital, Isiolo County Referral Hospital, Wamba Catholic Hospital and Wamba Dispensary. The assessment was conducted using a modified Service Availability and Readiness Assessment (SARA) tool, a conceptual framework of measuring quality in health care developed by the World Health Organisation (WHO). Key informants at the respective health facilities, generally the person in charge, were interviewed to gain an understanding of the main health challenges in their target population as well as potential structural and operational challenges at facility level.

Figure 7.10-3: Health facility assessment

Source: Fieldwork December 2018

Routine Health System Data and Reports

A review of data available from the health management information system (HMIS) in each of the Project Counties was performed. The data is routinely collected through the District Health Information System (DHIS) and provides an evidence base for longitudinal monitoring of key health indicators and performance of the health system in general. County-level reports were also reviewed, including the County Integrated Development Plans (CIDP), annual health sector performance reports, annual work plans, and programme specific reports.

7.10.1.1.3 Impact Categorisation - Methods

This health impact assessment process involves analyses, modelling and ranks the potential impacts associated with the Project and their potential influence on AoIs through the different life cycle stages of the Project. It includes the analysis of potential negative impacts and their management measures, but also the discussion of potential positive impacts and measures to enhance these. This is based on the evidence presented in the baseline health description (Annex II), the project description and information obtained from other specialist baseline and impact assessment reports/studies.

A standardised risk assessment model was followed and includes:

- Identification of health-related issues where project activities may impact on a variety of receptors. This generally includes a description of prevailing community health vulnerabilities based on baseline data or evidence;
- A prediction of what may happen to the AoI communities and environment as a result of the direct and indirect activities of a project- the impact description. The precautionary principle (Principle 15 from the Rio Declaration on Environment and Development in 1992) was adopted in analysing and modelling the impact definition[1]; and
- The impact analysis which considers the significance of the health impacts based on a consequence and likelihood modelling. This initial inherent ranking considers the risks at baseline (no-go situation/ present health status of communities, or the existing health needs) and the project related impacts without mitigation; and the residual risks consider the significance of risks after the successful implementation of mitigation measures.

The impact analysis is performed by assessing the following elements associated with each impact (Table 7.10-3):

- Magnitude: this considers the intensity/severity of the health effect on receptors as well as the ability of the community to adapt to the pre-impact level of health. In addition, the degree of stakeholder concern to the level or severity of the health effect is considered. As health effects can be detrimental or beneficial to the receptor, this element evaluates how severe negative impacts might be, or how beneficial positive impacts may be on a particular receptor or a potentially affected community;
- Temporal scale/duration: this defines the significance of the impact at various time scales, as an indication of the duration of the impact;
- Geographic extent of the impact on the population: This defines the physical extent of the impact. This is relevant to support the description of the magnitude as the specific impact may influence different levels; from an individual; to a small community; and even extend to influencing national and cross boundary effects.
- The likelihood of the impact occurring as a result of project actions differs between potential impacts. There is no doubt that some impacts will occur (alteration in environment), but other impacts are not as likely to occur (e.g. vehicle accident) and may or may not result from the proposed development. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.

[1] If an action or policy has a suspected risk of causing harm to the public or to the environment, and in the absence of reliable evidence that the action or policy is harmful, then the burden of proof that it is *not* harmful falls on those taking the action. In addition, when an activity raises threats of harm to human health, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

Table 7.10-3: Impact Assessment parameters

Type of Impact	Magnitude	Geographic Extent	Duration	Likelihood
Positive Effect is beneficial **Negative** Effect is adverse **Neutral** Effect is neither positive nor negative	**Negligible** An effect that does not result in a discernible change from baseline conditions. **Low** Minor deterioration (nuisance, annoyance) in health or harm to receptors. The receptors will adapt with ease to the influence of the determinant and maintain pre-impact levels of health. **Medium** Moderate/measurable deterioration in health or harm to receptors. Acute conditions. The influence of the determinant will result in some difficulty in adapting to the health effects and maintaining pre-impact levels of health will require support. Moderate stakeholder concern. Moderate exceedance of thresholds. **High** Substantial deterioration in health or harm to receptors. The influence of the determinant will result in the inability to adapt to the health effects or to maintain a pre-impact level of health. Chronic or terminal conditions. There is substantial stakeholder concern. An identified threshold is often exceeded.	**Localised** Site specific or confined to a sensitive receptor at the local scale. This is generally limited to an individual/ small number of households/small settlement. **AOI** This is localised to the project area as well as the broader project affected area. These can generally extend to influence an administration post or sub-district level. **Regional** County level and beyond. **National** National or influence across international borders.	**Short-term** Short term, < 1-4 years, low frequency **Medium-term** Between 5 and 20 years **Long-term** Between 20 and 40 years (generational) and from an individual human perspective permanent **Permanent** Over 40 years and resulting in a long term and lasting change	**Unlikely** The likelihood of these impacts occurring is slight **Possible** The likelihood of these impacts occurring is possible (<50%) **Probable** The likelihood of these impacts occurring is probable (>50%) **Definite** The likelihood of these impacts will definitely occur

Direct Versus Indirect Impacts

There are two general categorisations of impact effects, namely (i) direct and (ii) indirect. A direct (primary) effect demonstrates a specific cause-and-effect relationship. An indirect effect is a secondary by-product of an interaction among multiple variables and may be a consequence of a direct effect.

Indirect effects are often of equal or greater significance than the more obviously observable direct impacts. The HIA analyses both potential direct and indirect effects.

Management and Mitigation - Methods

The approach to mitigation in the context of health impact assessment refers to measures that avoid, minimise, eliminate an adverse effect, or maximise a potential benefit. Mitigation should be reviewed and adjusted on an on-going basis as per the *plan, do, check, act* (or similar) management cycle.

Recommendations for mitigation/management focus on identification of measures that can be taken to reduce potential impacts to as low as reasonably practicable (ALARP) both from a technical and financial perspective.

For the purposes of the Project, mitigation measures have been divided into three categories based on the focus of the intervention, namely:

- **Project impact mitigation:** Interventions required in order to mitigate the future health impacts of the Project on AoI communities. Due to their influence, these mitigation measures are deemed as required (may be regulatory requirements) and not merely voluntary contributions, and thus the precautionary principle will apply where relevant;
- **Occupational health, safety and environmental management**: Interventions aimed at ensuring a healthy, safe and productive workforce. In addition, it considers aspects that can be controlled in the workforce to prevent community health impacts occurring from a health, safety and environmental perspective; and
- **Social development mitigation and management:** Interventions suggested that will improve the existing health status of the communities. These can be in the form of negotiated commitments (or voluntary contributions) made by the project proponent as well as extended benefits, which should bring about health benefits and improve social license to operate in the receptive communities.

It is noted that there is often an overlap between regulatory requirements and negotiated commitments, which are often voluntary. In general, mitigation measures should be tied to potential project impacts; however, voluntary contributions that are made to maximise potential benefits are important and significantly improve a project's profile in affected communities.

7.10.2 Potential Sources of Impacts – Construction Phase

Potential impacts during construction phase have been addressed in the following sections, according to the mechanism by which the diseases can be communicated

7.10.2.1 Communicable disease transmission

Introduction and transmission of communicable diseases between Project workforce and AoI communities

The utilisation of an externally contracted project workforce, including third country national (TCN) expatriates and Kenyan nationals from outside of the immediate project area, may negatively impact on the burden of communicable diseases in AOI communities in the following ways:

- The expatriate workforce may originate from a country or area within Kenya where the burden of disease regarding infective diseases, e.g. ARI, TB, HIV, STI and others, is appreciably higher than in AOI communities. This may increase local transmission patterns in both the project workforce and ultimately the communities, as people are likely to work and live in close association with one another, especially in areas where construction camps are located;
- An additional impact related to the incoming workforce and disease transmission, is the potential introduction of multidrug or extreme drug resistant strains (in the case of TB), novel strains of diseases or new infective and communicable diseases into counties where poor health seeking behaviour and weak public health systems will, in all likelihood, lead to delayed diagnosis and potentially further transmission of these conditions. These can also include communicable diseases that may have significant public health implications, such as pandemic influenza and other novel communicable conditions; and
- Another impact may be carrier states of Hepatitis B and C in the incoming externally contracted workforce and the potential spread of these diseases to local communities.

Disease outbreaks within Project camps affecting community health.

Multiple factors related to workforce, occupational health and camp management may result in the outbreak of infectious diseases in Project construction camps. If appropriate measures to prevent these outbreaks are not implemented, it is possible that outbreaks of infectious conditions may be transferred to AOIs located in proximity to the construction camps through the mechanisms described above. Grouping of people in close proximity to one another (typically in accommodation camps) may lead to the outbreak and spread of infectious diseases amongst project workforce personnel. This impact relates to the increase in population density in construction camps and considers diseases that can spread through various means, e.g. droplet spread, direct contact, sexually transmitted infections and water- and food borne diseases.

Increase in burden of disease along the Project's transport corridors.

The Project will require significant logistical support during the construction phase, including the transport of pipe and materials from the Port of Mombasa and the movement of the construction workforce along the pipeline route. There is the potential for increased high-risk sexual encounters along transport corridors to and from the Project area. Transport workers are a well-described high-risk group and are known to have multiple sexual partners and to develop sexual networks along transport corridors. There is the potential for an increase in high-risk sexual practices that may promote the spread and incidence of sexually transmitted infections, including HIV.

Long distance truck drivers are an especially high-risk group, often termed 'core spreaders', and communities along the transport corridors will be vulnerable to impacts from this group. Women often target truck drivers as they are away from their usual family network and have disposable income, and the truck drivers (generally men) target women as a form of companionship and entertainment. These encounters are often transactional in nature, and commonly involve a sexual relationship.

Increase of vector densities as a result of environmental alteration.

Alteration in environmental status as a result of Project activities can lead to an increase in vector-related diseases, introducing new diseases and increase the burden of existing diseases. Changes to the environment and inadequate environmental controls during construction and other project activities, may increase the number and suitability of vector breeding habitats. This may lead to an increase in vector density and an increased risk for localised disease transmission. High risk activities that may contribute to this impact include:

- Ground clearing activities;
- Borrow pit development;
- Road construction (with a specific focus in drainage furrows);
- Construction and operation of storage yards and camps with inadequate drainage; and
- General poor housekeeping in project facilities and construction camps, resulting in environmental conditions that promote the collection of standing water.

Introduction of new vector related diseases and strains

The supply chain of equipment, material and other goods need to be considered, especially where this will be supported via shipping of products by sea. There is a risk that movement of goods and materials via road from ports can also introduce arboviral diseases as products will likely be shipped from global locations. Specific countries of origin, especially Asia, may be endemic to different strains and types of arboviral diseases (particularly dengue and chikungunya) and infected larva and eggs may be transferred in goods or packaging, introducing these diseases to Kenya in general and the Project area in particular. Therefore, transport and especially import of goods via sea is a serious consideration and is considered a significant risk, especially in the construction phase.

7.10.2.2 Accidents affecting communities.

Project activities resulting in accidents affecting communities

Accidents and/or injuries as a result of Project activities may impact on community health in the following ways:

- An increase in the quantity of road traffic may increase road traffic and pedestrian vehicle accidents, resulting in an increase in morbidity and mortality amongst the local communities, with children noted to be an especially sensitive receptor. The geographic distribution of the impact depends on the way in which existing traffic volumes are affected as well as the origin of materials and workers and transport routes used. It is expected that construction activities will increase the amount of traffic on the existing road network. This will occur along major transport routes that will be utilised to support project logistical requirements, but also in proximity to localised Project activities via the use of access roads. Similarly, Project Induced In-Migration (PIIM) may result in a further increase in road traffic in the Project area;
- Inadequate access control of Project construction sites may result in community members gaining entry to construction- and other sites and sustaining injuries from accidental interaction with mobile construction equipment or through injuries sustained from falling into excavations, or interaction with construction materials and other environmental changes;
- Spills and accidental discharges of hazardous chemical substances may negatively affect community health. This may also potentially include the re-use of containers that stored hazardous chemical substances by the community to store water, food etc., if disposed of incorrectly. The project will utilise different types of hazardous chemical substances in the construction phase to support elements of the project, including but not limited to:
  - Insecticides, pesticides and rodenticides to control insect and other vermin such as rats;
  - Chlorine and associated water treatment chemicals used in the treatment of potable water as well as wastewater;
  - Concrete batch plant effluent;
  - Materials for construction and maintenance, including paints and solvents as well as flux and welding rods;
  - Domestic cleaning agent;
  - Petroleum products to support heavy vehicles and light duty vehicles, including diesel fuel, mineral oils, grease, degreasers, etc.; and
  - Potentially contaminated surface water including storm water, fire water and wash-down water originating from dirty areas.
- Accidental discharge or inappropriate disposal of any of the abovementioned hazardous chemical substances during the construction phase may affect communities in proximity to the event (through various impact pathways) and potentially result in an acute or chronic health condition in the AoI community;
- An increase in maritime activities associated with the construction of Project infrastructure has the potential to result in accidents and resultant injuries with local boat users, especially local fishermen;
- Improved access to health care facilities; and

- Indirectly, the improvement in the road network may result in the improved access by some AoI communities to health facilities within their respective counties.

Improved access to health care facilities

Indirectly, the improvement in the road network may result in the improved access by some AoI communities to health facilities. This may improve health seeking behaviour in communities, decrease the time to diagnosis and treatment, simplify distribution of supplies to peripheral health facilities and assist in the provision of health-related outreach activities by health authorities.

Risk of conflict between community members and Project security personnel

Community members may have unrealistically high expectations of the Project's capacity to provide jobs and other opportunities to local community members. Similar to other large-scale projects, these unmet expectations may lead to dissatisfaction towards the Project from surrounding communities.

Risk of wildlife interaction.

Zoonotic diseases such as brucellosis and rabies are endemic in most of the Project counties. Transmission of certain disease, e.g. rabies, depends on close interaction between animal hosts while others can be transmitted through other mediums such as water.

Occupational health and safety incidents resulting in injuries and mortality.

Unskilled workers, especially those from the rural communities are unlikely to have had exposure to work conditions and safety standards associated with a project of this nature and magnitude. Although it is anticipated that local unskilled workers will not be utilised in high-risk activities, the risk for involvement in occupational incidents resulting in injury and mortality remains.

7.10.2.3 Environmental determinants of health

Impacts on surface water

Any significant Project-related abstraction of surface water for construction and other activities as well as the disruption of water flows during construction activities (e.g. river crossings at the Kerio, Suguta, Ewaso Ng'iro rivers as well as 14 other smaller crossings) may negatively impact on the quantity as well as the quality of water available to AoI communities that rely on these sources for domestic and other uses.

Abstraction of groundwater

Abstraction of groundwater to supply Project construction camps as well as supplying water for other Project activities such as hydrotesting, may have a direct impact on the groundwater table in the vicinity of the wells through drawdown effects.

Impacts related to noise

The following Project-related activities have been identified as potential contributors to community noise exposure during the construction phase:

- Right of way earthworks;
- Pumping station construction;
- Pressure reduction station construction;
- Camp construction and power generation during pipeline construction; and
- Access roads construction and use.

Impacts on air quality

Logistics and construction activities may generate oxides of Sulphur (SO_x) and Nitrogen (NO_x) as well as dust fall out in AOI communities and settlements adjacent to construction sites and unsealed transport corridors, resulting in negative health impacts.

7.10.2.4 Project infrastructure management

Vector management result in an increase in vector resistance

It is anticipated that the Project will develop and implement malaria and other vector management plans to provide an adequate level of protection to its workforce. Vector control management strategies typically form part of the suite of integrated malaria management measures and require the use of insecticides for space-spraying, indoor residual spraying (IRS) and other control measures. The indiscriminate selection and use of insecticides without the guidance offered by vector insecticide sensitivity studies, may result in the development of insecticide resistance in vector species or the increase in existing insecticide resistance patterns.

Project procurement results in reduced food security

Procurement of food by the Project from local markets may lead to a rise in food inflation and the cost of basic foodstuffs. This escalation in food prices may impact on food security and limit the diet diversity in households that are dependent on food procurement as opposed to subsistence agricultural activities. This may manifest as an increase in malnutrition rates.

Waste management

Project activities have the potential to generate significant amounts of waste belonging to diverse waste streams. This includes, but is not limited to:

- Solid waste
  - Metal;
  - Concrete; and
  - Combustible materials.
- Liquid waste:
  - Surface run-off collected at sub stations; and
  - Other waste waters collected in the site drainage system.
- Hazardous waste:
  - Lubricants;
  - Organic solvents;
  - Chemical additives;
  - Waste containing heavy metals;
  - Hazardous chemicals used in the pipe coating process;
  - Pest control: insecticides, pesticides and rodenticides to control insects and other vermin such as rats; and
  - Petroleum products to support heavy vehicles and light duty vehicles on site, including diesel fuel, mineral oils, grease, degreasers etc.

- Sanitary waste generated at all construction camps:
  - Human excreta; and
  - Grey water generation from sinks and wash-downs.
- Medical waste:
  - Infectious wastes, cleaning agents, laboratory equipment as well as medications (especially expired ones requiring disposal).

7.10.2.5 Project Induced In-Migration (PIIM)

Project induced in-migration (PIIM) impacts on social determinants of health

In-migration is likely to occur in areas and AoI communities where the potential for employment is perceived to be higher. However, it may also be focused towards local trade centres where other indirect benefits of the Project may be anticipated.

PIIM resulting in an increase in the burden of disease within AoI communities

The potential influx of migrant jobseekers remains a risk, specifically at AoI communities where the presence of Project infrastructure may be associated with employment prospects or other indirect benefits. Multiple factors may result in an increase in communicable disease in these communities, including:

- Incoming jobseekers and opportunity seeking migrants may originate from areas where the burden of various communicable diseases may be higher than the communities they migrate to, with the potential to introduce a higher burden of disease to the local population.
- It is anticipated that the living conditions and housing standards of these jobseekers may be of a poor quality, as job opportunities may be of a temporary nature only and migrants may not settle permanently but elect to migrate along the pipeline route (camp- follower settlements). Poor standards of housing associated with overcrowding and poor environmental hygiene, may be a contributing factor to the development and spread of communicable diseases in these settlements.
- Furthermore, the migrant jobseekers may have poorer standards of hygiene and sanitation practices that may increase the risk for the spread of disease. In addition, the potential temporary nature of settlements may not allow for the adequate provision of basic services (including water and sanitation), with a potential risk for spread of water and sanitation related disease.
- As described above, the increase in social ills introduced by the influx of migrant jobseekers, may lead to an increase in commercial sex work, which in the existing polygamous environment, may result in an increase in sexually transmitted infections.

PIIM impacts on vector-related diseases

AoI communities in proximity to construction camps and where influx is expected to occur due to in-migrating jobseekers, are considered at higher risk and highlighted as important receptors. Environmental changes (primarily linked to the development of informal settlements) may lead to an increase in habitats where vectors can breed, leading to an increase in vector densities and subsequent potential increase in the incidence of vector-related diseases.

PIIM impacts on existing health services

The existing health services in the Project counties were noted to experience significant challenges with regards to both capacity and capabilities. All six Project counties listed lack of infrastructure, lack of human resources and poor access to services as part of their top ten challenges in providing adequate health care to AoI communities. Influx would, however, place additional pressure and in some instances, exceed the capacity of what are already limited health care capabilities.

PIIM impacts on soil and groundwater contamination

Living conditions in informal settlements constructed by opportunistic migrants will be of a poor standard, with the baseline findings demonstrating that there is limited local capacity to process municipal and household waste. This may place an additional burden on the existing current waste management activities with the potential for the spread of disease through inadequate waste management.

In addition to this, the majority of the population in the project counties have access to some form of sanitation facility. While access has improved over time, the majority of these facilities are not considered as improved, meaning that they do not adequately prevent contact with human excreta.

7.10.3 Potential Sources of Impacts – Operations Phase

Due to the nature of the operations associated with the pipeline, it is anticipated that impacts related to community health will decrease markedly. Certain anticipated Project activities do, however, retain a measure of risk that could affect community health in the following ways:

- Spillages from the pipeline, both through accidental or intentional rupture, may result in hydrocarbon release in ground or surface water as well as cause contamination of soil.
- The enhanced socio-economic conditions in the local workforce that will be employed by the project into operations, is likely to increase life expectancy and promote an adoption of a more sedentary western lifestyle and diet. A change in values and behaviour may also occur, which may pre-dispose individuals to an increase in lifestyle related diseases such as obesity, hypertension, diabetes, dental caries and some forms of cancer.
- Conflict between community members and security personnel.

  During operations, the project will continue to generate waste belonging to the following waste streams:

  - *Liquid waste*

    Primary liquid waste will likely be from hydrocarbon spills and other activities that generate liquid waste.

  - *Hazardous waste*

    Operational hazardous waste plans will be generated, limited to trace amounts of biocide, anti-corrosive, oxygen scavenger, maintenance wastes and drag reducing agent chemicals.

  - *Sanitary waste*

    There will be minimal sanitary waste requirements at unmanned AGIs.

  - *Food waste*

    Improper management and disposal of food waste has the potential to impact on community health in the same way as during construction, albeit to a lesser extent, due to the decreased amount of generated wastes.

  - *Medical waste*

    Infectious wastes, cleaning agents, laboratory equipment as well as medications (especially expired ones requiring disposal).

- The operation and maintenance activities of the pipeline and above ground installations will introduce traffic onto the road network in the immediate vicinity, primarily for the purposes of maintenance and inspection

7.10.4 Impact Classification

7.10.4.1 Communicable disease transmission - Construction

Geographic distribution

Depending on the nature of the communicable disease considered, the geographical distribution of this impact may vary, but is likely to be limited to the AoI communities where local employment in project construction camps is anticipated as well as along transport corridors and at designated truck stops. This includes communities in proximity to the Lokichar CPF, the three construction camps in Samburu County, Meru County and Garissa County, the Lamu Port and communities in proximity to the smaller mobile camps in Samburu County and Garissa County.

Consideration should, however, also be given to the significant Project-related logistics requirements that span several counties as well as the potential for increased mobility of informal workers between multiple construction spreads. These additional factors may result in the spread of communicable diseases beyond the local AoI communities and Project county borders to have a more regional impact.

Introduction and transmission of communicable diseases between Project workforce and AoI communities

Despite the closed status of Project construction camps, the Project workforce will have a certain amount of direct and indirect interaction with local AoI communities. Local, unskilled workers will be hired from AoI communities to work in the camps while residing in in their respective communities. These local workers may act as a conduit through which infective conditions may be transferred from the camp population to the local population.

In addition to this, the general health seeking behaviour of the communities as well as the general capacity and capabilities of the local health systems in the Project counties are noted as limited, a factor that may delay the initial identification and effective subsequent management of a communicable disease outbreak in local communities.

This negative impact may have a variable magnitude, depending on the nature of the communicable diseases considered. Some communicable diseases, e.g. HIV and TB, are associated with higher rates of morbidity and mortality resulting in a high magnitude impact associated with a long-term duration that affects community members in excess of the construction phase itself. With no mitigation measures in place, the likelihood that this impact occurs, is probable.

From a geographic perspective, it is anticipated that the impact will primarily affect AoI communities in areas where there will be interaction between the incoming Project workforce and local community members. This includes communities in proximity to the Lokichar CPF, construction camps in Samburu County, Meru County and Garissa County, the Lamu Port and communities in proximity to the smaller mobile camps in Samburu County and Garissa County.

From baseline studies and concerns noted by stakeholders, it is evident that infrastructure projects have been associated with a rise in the HIV incidence rates. In addition to this, comprehensive knowledge on HIV was found to be low in all of the Project counties with most measuring well below the national averages.

Pre-mitigation, the impact has a high negative rating. The residual impact, even with adequate mitigation in place, would still represent a moderate negative impact due to the difficulty in managing transport corridors and the likely spread of HIV. Mitigation and management measures will be fully implemented to reduce the risk of increased HIV prevalence in the AoI and in Kenya, however, the overall rating of the impact of communicable disease transmission is **moderate (negative)**.

Disease outbreaks within Project camps affecting community health

If project design elements regarding camp housing standards are inadequate, specific health management plans and infectious disease and outbreak management processes are not planned for and implemented, the risk of disease transmission and the potential for infectious disease outbreaks occurring in construction camps is significant. Meningitis should remain a primary concern given the that the north-western tip of Kenya lies within the African meningitis belt.

Due to the nature of their employment, local workers who reside in AoI communities but work in project sites may contract these diseases, leading to an increase in morbidity and potentially mortality in this group but also the distribution of outbreaks to their families and local communities in general.

The magnitude of this impact may differ based on the nature of the disease but as these are mainly acute conditions, it is not expected to have a magnitude exceeding moderate negative. As acute conditions are considered, the effects of the impact may have a short-term duration on communities and is not anticipated to extend beyond localised receptors. The likelihood of this impact occurring, is possible.

From a spatial perspective, AoI communities in proximity to construction camps (as mentioned above) and especially those communities where local labour hire is anticipated, are considered potentially vulnerable. Local unskilled workers, persons with a compromised immune status, the elderly and children below five years of age are considered as potentially sensitive receptors. Without mitigation, the impact is rated as moderate negative but adequate risk management will reduce this to a **minor (negative)** residual impact.

Increase in burden of disease along the Project's transport corridors.

This negative impact is expected to have a high magnitude as it primarily considers HIV that is associated with long-term morbidity and mortality in community members. The geographical distribution of the impact is likely to occur along the whole transport route (originating at the Mombasa harbour), rest stops along the transport route as well as the end destinations of trucks. It may therefore be considered a regional impact. Truck rest stops are considered to be high risk areas as these are often where sexual encounters originate. Women and young girls who partake in transactional sex and commercial sex work are considered to be particularly sensitive receptors for this impact and has been identified as most at-risk populations (MARP) for contracting sexually transmitted infections (STIs) that include HIV. During data collection in the baseline phase of the HIA, stakeholders expressed concern about communities along major transport routes, especially those in the counties of Isiolo and Turkana.

MARPs such as sex workers and long-haul truck drivers require specific attention during planning for prevention of HIV spread due to the complexity and wide geographic spread of networks along these routes. Both these populations have been the focus of the country's 'National Strategy on HIV and AIDS and STI Programming along Transport Corridors in Africa' as developed and implemented by both the National AIDS Control Council (NACC) and the National AIDS and STI Control Programme (NASCOP). Given the anticipated logistical support required by the Project and the expansive geographic distribution this will cover, it is probable that this impact will occur during the construction phase of the Project.

The pre-mitigation impact is rated as a very high negative. Due to the complexity in managing the impact and the nature of the condition considered, the residual impact is likely to remain a **moderate (negative).**

Increase of vector densities as a result of environmental alteration.

A localised increase in vectors that transmit malaria and other vector-borne conditions may give rise to an increased burden of disease. This includes the risk for the potential spread of rift valley fever if a localised outbreak was to occur. This disease is more of a zoonosis and well known to spread in East Africa, but mosquito vectors play an important role in localised transmission and increased densities may increase the risk.

This negative impact mainly considers acute vector-related diseases that are known to the local health services and is expected to have a moderate and short-term impact on community health only. The impact is linked to a localised geographic spread and is generally limited to AoI communities who reside in close proximity to (within two kilometres) project sites where environmental alteration may occur. It is likely to be of greater importance in counties that have been determined to have a higher sensitivity to change, based on the available baseline information. Communities that are in close proximity to Project activities and infrastructure in Lamu County (situated in a higher-risk malaria endemic area) and Turkana County (demonstrating an increase in malaria positivity rate from 2% in 2017 to 3.5% in 2018) should be considered as higher risk for potential impacts. The impact is expected to be more pronounced during the rainy season. Due to the nature of Project activities, the likelihood of this impact occurring, is probable.

Without adequate mitigation, the impact is rated as a moderate negative but may be reduced to a **minor (negative)** through implementation of the appropriate measures.

Introduction of new vector borne diseases and strains

The impact considers the introduction of novel vector borne diseases or new strains of existing diseases (e.g. arboviral disease such as dengue fever and chikungunya) that may overburden the existing health services and result in a delay in recognising and treating these new conditions, effectively resulting in longer-term impacts that may be experienced beyond the construction period itself. This may result in moderate negative impact on community health. Shipping of products and equipment to support Project execution from international destinations has the potential to introduce arboviruses (or an increase rate of disease transmission) into the area.

There is also the risk that movement of goods and materials via road from other ports can also introduce these diseases, as products may be shipped from global locations. Some may originate in countries where dengue and chikungunya fever are endemic, especially goods and materials from Asian regions. The risk will be highest in goods that are offloaded for import in ports and transported to site at a later date. Infected larva and eggs may be transferred from the point of origin in goods or packaging that can collect water; especially man-made containers such as tires, drums or other receptacles. Mosquitoes that transmit dengue and chikungunya fever do not have to acquire it from a human host before they can transmit it to other humans as eggs or larva can emerge with the virus with resultant transmission.

Due to the expansive nature of the Project's logistical requirements, the geographic distribution of this potential impact may take place on a regional basis and along any part of the Project's anticipated transport corridors. The likelihood of this impact occurring, is possible. Without mitigation, this impact is rated as high negative but may be reduced to a **minor (negative)** residual impact with effective implementation of appropriate and adequate management measures

7.10.4.2 Accidents and Injuries – Construction

Project activities resulting in accidents affecting communities.

This negative impact considers the increase in morbidity and mortality in AoI communities based on the direct and indirect impact pathways described in Section 7.10.2.2 above. This potential for an increase in morbidity and mortality in community members is considered to have a high magnitude that may result in a permanent incapacity. The nature of the impact is such that it is likely to occur on a local level only and is unlikely to extend beyond specific members in an AoI community or, in extreme cases, AoI communities as a whole. Without mitigation, the likelihood of this impact occurring, is probable.

Pre-mitigation rating describes a very high negative impact with impact mitigation resulting in a **moderate (negative)** residual impact.

Improved access to health care facilities

This positive impact is restricted to improvement of the existing road network only, as it is anticipated that access roads will not be open to utilisation by AoI communities. Improvement in road infrastructure as well as the potential increase in informal transport capacity, may result in improved access to health services by AoI communities and, inversely, may result in increased capacity by local health services to perform outreach services to these communities.

The magnitude of the benefit is considered moderate over the medium-term. The geographic distribution is only applicable to AoI communities located on or in proximity to existing roads that will be upgraded to support Project logistics requirements, resulting in a **moderate (positive)** benefit to these communities.

Risk of conflict between community members and Project security personnel

Subjective dissatisfaction towards the Project due to unrealistic expectations regarding employment and other economic opportunities, may increase with time and may manifest in more vocal and physical ways. This has the potential to result in public displays of dissent, e.g. public protests, which in turn may lead to interaction and potential conflict between local community members and Project security personnel or local security forces.

The use of inexperienced security personnel or local security forces that have not been adequately trained in the Voluntary Principles of Security and Human Rights (VPSHR), may lead to the escalation of violence during conflict situations, resulting in injuries or deaths of community members. This impact and topic is discussed in greater detail in Section 7.10.2 and that the mitigation measures associated with this impact are addressed in that section.

The potential for morbidity and potential mortality in association with the reputational risk pertaining to this negative impact is expected to have a high magnitude and will be more relevant during the construction phase, i.e. over the shorter-term. It is not expected to have a broader geographic distribution other than on the local level where it may affect certain individuals within an AoI community. The likelihood of this impact occurring, is considered to be unlikely.

Without mitigation, the impact may result in a moderate negative while adequate mitigation reduces the residual impact to a **minor (negative)**.

Risk of wildlife interaction

Activities related to construction, such as brush-clearing, may result in an increase of animal encounters by members of the AoI communities as well as local workers from adjacent communities. This may lead to a potential increase in disease transmission, bites (including snake bites) and an increase on morbidity and mortality amongst the local workforce members and AoI community members.

The duration of the negative impact, linked to the construction phase, is considered to be medium-term as the sequelae of zoonotic conditions may have extended effects on community health. The nature of the conditions considered during this analysis is expected to have a moderate magnitude but is expected to only affect certain individuals within AoI communities.

Without mitigation, the impact is considered a potential minor negative impact. Implementation of appropriate mitigation measures reduces the residual impact to **negligible**.

Occupational health and safety incidents resulting in injuries and mortality

Unskilled workers, especially those from the rural communities are unlikely to have had exposure to work conditions and safety standards associated with a project of this nature and magnitude. This will be most evident during the construction phase and as this is inherently the most dangerous aspect of the Project, appropriate health and safety standards will need to be introduced to reduce incidents and accidents to a minimum. The

Project will have a range of occupational health and safety risks which will include physical (injuries, UV radiation, heat, noise and vibration), chemical, biological and psychosocial risk factors. These may lead to occupationally acquired illness/disease which may be chronic in nature and may render the individual unable to continue with normal activities. Although it is anticipated that local unskilled workers will not be utilised in high-risk activities, the risk for involvement in occupational incidents resulting in injury and mortality remains.

Similarly, it is expected that the local unskilled workforce will reside in the AoI and will be transported from their communities to their worksites on a daily basis. Therefore, road traffic accidents associated with worker transport is a significant risk, especially as conveyance may include a large number of people. The potential impact may result in significant injury, permanent incapacity and even mortality in certain instances.

Based on the potential outcome of occupational related injuries (i.e. permanent incapacity or death) the magnitude of the impact is considered to be high with the potential for a very long duration on specific members of AoI communities. Spatially, it will only affect specific members on a localised level. As it is not anticipated that unskilled workers will be involved in high-risk activities, the likelihood of this impact occurring is unlikely.

With adequate mitigation, this high negative impact may be reduced to a **minor (negative)** residual impact.

7.10.4.3 Impacts on environmental determinants of health – Construction

Potential impacts during construction phase have been addressed in the following sections, according to the project related activities that can affect health.

Impacts on surface water

The decrease in access to safe water may result in an increased burden of water and sanitation-related diseases, as the use of improved sanitation facilities remain low in the Project counties. These diseases have been demonstrated to be common in all of the project counties and are consistently placed in the top-ten diseases, while adequate knowledge regarding effective sanitation practices is limited. Cholera and Typhoid also remain a significant outbreak risk in the Project area with a variable level of vulnerability across various counties.

Based on the low anticipated use of surface water by the Project and plans to execute river crossings during the dry season, the magnitude of the impact is considered to be low. The duration of the impact is linked to construction activities and only relevant in the short-term. AoI communities in areas located downstream of these river crossings may be impacted and the geographic distribution is limited to specific members within these communities or communities as a whole.

The pre-mitigation impact is considered a minor negative and with adequate mitigation, the residual impact is **negligible**.

Abstraction of groundwater

Groundwater abstraction may lead to direct impacts. This effect may have an adverse secondary impact on the yield of nearby community boreholes and wells, negatively affecting the availability of safe water to AoI communities. Similar to the impact described in abstraction of water from rivers or channels, this may negatively impact on the quantity and quality of available safe water for people in proximity to project construction camps and other above ground installations (stations). As mentioned under surface water use, a decrease in the availability of safe water may, in turn, lead to an increase in water and sanitation related diseases.

Due to the expected two-year lifespan of the construction camps and other construction activities, the duration of the potential impact is considered to be short-term and limited to the construction phase. The impact may affect all AoI communities.

The pre-mitigation impact is considered a moderate negative and with adequate mitigation, the residual impact is **minor (negative)**.

Impacts related to noise

Noise generated by construction and other Project-related activities may lead to both direct and indirect impacts. The role of noise as an environmental pollutant and its impact on health are being increasingly recognised. Beyond its effects on the auditory system, noise causes annoyance and disturbs sleep, and it impairs cognitive performance. The IFC and WHO international standards for noise management for residential, institutional and educational receptors are used as the reference point for the community health aspects to noise exposure. The recommended maximum limits as a result of an operation on residential, institutional and educational receptors are 55 dB(A) LAeq (overall average ambient noise levels) and 45 dB(A) LAeq during the day and night, respectively.

Furthermore, evidence from epidemiological studies have demonstrated that environmental noise is associated with an increased incidence of arterial hypertension, myocardial infarction, and cerebro-vascular accidents (stroke). Both observational and experimental studies indicate that, in particular, night-time noise can cause disruptions of sleep structure, vegetative arousals (e.g. increases of blood pressure and heart rate) and increases in stress hormone levels.

Negative impacts related to community noise exposure are considered to have a low magnitude, resulting in a nuisance/annoyance to community members. The duration of these impacts is considered to be of a short duration in the majority of the abovementioned activities with the exception of noise generated by logistics activities and power generation activities. It is anticipated that the geographic distribution is limited to the local AoI communities and mobile pastoralists in close proximity to the abovementioned project activities.

Without mitigation, the impact is considered a minor negative with a **negligible** residual impact post-mitigation.

Impacts on air quality

Suspended particulate matter from dust may have the potential to impact human health but this is largely dependent on particle characteristics, particularly particle size and chemical composition, and the duration, frequency and magnitude of exposure. The potential of particles to be inhaled and deposited in the lung is a function of the aerodynamic characteristics of particles in flow streams. When the particle size is smaller, $PM_{2.5}$, the particles are inspirable and may penetrate deep into the lungs cause serious health problems including respiratory tract irritation, chronic bronchitis, or asthma exacerbation.

Large lung loads may cause deposition of large amounts of particles in the lungs and cause pneumoconiosis. These small particles can lead to increased respiratory symptoms such as irritation of the airways, coughing, aggravated asthma, development of chronic bronchitis, and breathing difficulty through decreased lung function.

Based on the activities described in the Project description, AOI communities in proximity to construction sites and transport corridors may experience impacts of a moderate magnitude during the construction phase, i.e. shorter-term impacts. The impacts are limited to specific individual community members on a local level. The likelihood of the impact is considered to be possible.

In the absence of appropriate mitigation measures, the impact is rated as a moderate negative while effective mitigation will reduce the residual impact to a **minor (negative)**.

7.10.4.4 Impacts on social determinants of health – Construction

Potential impacts during construction phase have been addressed in the following sections, according to the project related activities that can affect health.

Improvement in the health of people employed by the Project

The Project is developing a local content plan that will set forth the policies, objectives and procedures to maximise national and local content employment for the Project, including relevant training and job-readiness support for host communities.

Members from local AoI communities may therefore have the opportunity to be employed by the Project on a shorter-term (during the construction phase) or longer-term (during the operational phase). As part of the proposed Project health and safety plans, members of the local workforce will be trained in safety principles and be subject to disease awareness and reduction programs implemented during the lifespan of their employment with the Project. Increased knowledge about safety and health on a personal level may lead to a more comprehensive understanding of diseases and improve health seeking behaviour (HSB), all of which may lead to an improvement in general health.

Similarly, the improvement in general HSB and disease knowledge may extend to the employees' immediate family, increasing general health status in additional AoI community members. This potential benefit will however require that these interventions are performed and based on structured information, communication and education (IEC) programmes that promote behaviour change.

This potential benefit may have a low magnitude that extends over the short term. The benefit is expected to extend to individuals within certain AoI communities and specifically those that are located within close proximity to construction camps and from where local labour hire is considered. The likelihood of this occurring is possible

Without mitigation, the impact is considered a **minor (positive)** benefit which is unchanged by any mitigation.

Potential increase in gender-based violence (GBV) and female inequality

GBV is reported to be common in all Project counties with women typically marginalised with regards to education, employment opportunities and decision making at household level. Existing cultural and social norms in the Project districts, dictate the belief that the majority of the available project-related employment opportunities would be afforded to men. This is also more likely given the physical nature of certain jobs, especially in the construction phase. Similarly, women are marginalised with regards to land ownership and financial management on a household level.

Increased financial gains obtained by men from project employment or compensation payments may therefore not necessarily translate into benefits for other members of the household and may increase the incidence of social ills (e.g. substance abuse) and violence, such as gender based domestic violence, in AoI communities. This may result in an increase in injuries amongst community members. In addition, marginalisation of women may lead to an increase in transactional or commercial sex as a means to support and augment livelihoods.

In addition to this, improper financial management by the male heads of households may result in a decrease in food security and result in malnutrition, specifically in those households who are dependent on procuring basic foodstuffs rather than partaking in subsistence agricultural activities. As women are generally responsible for the provision of food in many rural districts this could again lead to potential impacts associated with GBV and transactional sex. In addition to the above, in-migration and the erosion of existing social structures may lead to an increase in social ills and GBV.

This negative impact has a moderate magnitude and its associated effects may extend to the medium term as impacts related to influx may continue post-construction. Women as a marginalised group, together with children under five are deemed to be the sensitive receptors that may be affected by this impact. The geographic distribution of this impact is limited to a localised level and notably affecting sensitive receptors in AoI communities in close proximity to construction camps where local labour hire and influx is anticipated. It is probable that this impact will occur.

Without mitigation, the impact is rated a moderate negative but is expected to reduce to a residual impact of a **minor (negative)**, should effective mitigation be implemented.

Impact on non-communicable diseases (NCD)

Due to the short-term duration of the Project's construction phase, it is unlikely that socio-economic conditions in the study area will sustainably improve as a direct result of Project execution to the extent that non-communicable diseases will develop in local communities. The impact of employment as it relates to NCDs is therefore considered to be negligible during construction and not discussed further or rated.

7.10.4.5 Project infrastructure management – Construction

The potential impacts related to the provision of goods and services during the construction phase of the project are as follows.

Vector management result in an increase in vector resistance

If vector control measures and the associated use of insecticides are not planned and implemented to an adequate technical standard and in alignment with national malaria control strategies, it may result in the development of insecticide resistance in local vector populations and the increase in existing resistance patterns. This may, in turn, lead to reduced susceptibility to chemical control interventions and failure of vector control and bite prevention strategies (including the use of insecticide treated nets) in AoI communities in proximity to Project infrastructure where these vector control measures are implemented. Failure of preventative measures may result in an increase in vector densities and the burden of disease with a potential increase in associated morbidity and mortality.

The negative impact associated with increased insecticide resistance is considered to have a moderate magnitude and may have long-term effects that extend beyond the construction period. The geographic distribution of this impact is localised to AoI communities in close proximity to Project infrastructure where vector control strategies may be implemented. The impact is, however, unlikely to occur.

Without mitigation, the impact is rated as a moderate negative, but adequate mitigation should result in a **negligible** impact.

Project procurement results in reduced food security

The impact will likely be limited to a localised AoI community level and will primarily affect the elderly, the orphaned and poor households. Baseline findings have identified specific counties where increased rates of malnutrition have been noted to be a concern, notably the counties of Samburu, Isiolo and Garissa, all of whom have been identified as food stressed counties. Communities in these counties that are located in proximity to construction camps or from where supplies may be acquired, are of particular concern. The magnitude associated with this impact is moderate but is not expected to extend beyond the shorter-term construction period while the likelihood of occurrence in unlikely.

With adequate mitigation, the moderate negative impact is reduced to a residual **minor (negative)** impact.

Waste management

All of the Project counties have limited local capacity to process municipal and household waste. Waste management facilities are virtually non-existent and formal waste handling and disposal procedures are scarce.

Improper management and disposal of the identified waste streams have the potential to impact on community health in the following ways:

- Contamination of water sources utilised by AoI communities for domestic and other uses. Contamination of water sources (both ground and surface water) may impact on both the quality and quantity of water available for human consumption, pastoral activities, agricultural activities and sanitation practices. This may potentially impact the quality of life, promote the spread of disease and affect food security;

- Localised contamination of water sources utilised for freshwater fishing activities may have a negative impact on fish populations and in so doing, impact on livelihoods and food security;
- Contamination of water sources and soil by infectious wastes from sanitary waste streams have the potential to spread disease to local communities that come into contact with these. This is of particular concern as it relates to spread of infectious diarrhoeal disease and soil-transmitted helminths;
- Exposure of community members to improperly discarded medical waste poses a biological exposure risk to infectious disease, with injuries from needles and other sharp material a significant risk as HIV and hepatitis B and/or C can be transmitted through this route; and
- Improperly managed waste sites have the potential to attract vermin and animals, which can in-turn increase the potential for human-animal interactions. This may result in an increase in injuries from bites (snake or animal) as well as the potential spread of zoonotic diseases.

Unmitigated, the impact has a high negative magnitude but is limited to the local level considering specific communities on proximity to Project infrastructure where waste is generated and disposed of. Health effects associated with this impact may extend into the medium term and it is possible that this impact may occur.

Should effective mitigation be implemented, the major (negative) impact will be reduced to a **minor (negative)** residual impact.

7.10.4.6 Project Induced In-Migration (PIIM) – Construction

In-migration of potential job seekers, commercial sex workers and business opportunity seekers is likely to occur in certain locations in the Project area, specifically AoI communities where local employment in project construction camps is anticipated, larger economic centres in proximity to these communities as well as truck stops along transport corridors. This includes communities in proximity to the Lokichar CPF, the three construction camps in Samburu County, Meru County and Garissa County, the Lamu Port and communities in proximity to the smaller mobile camps in Samburu County and Garissa County.

This may be as a result of the perceived potential for employment prospects associated with the project but also other indirect economic possibilities. This is likely to commence in the construction phase and affect localised areas.

Project induced in-migration (PIIM) impacts on social determinants of health

Influx of external job seekers may result in a loss of social cohesion and traditional values/ structures in these communities, which may, in turn, result in an increase in social ills (e.g. substance abuse, commercial sex work, etc.). As noted in earlier impacts, women are a vulnerable group with GBV reported to occur in all of the Project districts. Substance abuse is a significant contributor to social ills and GBV and may negatively influence crime and practices such as transactional sex and commercial sex work.

The anticipated influx, stress on limited basic resources, altered lifestyle practices and possible development of increased levels of social ills have the potential to increase levels of criminality which may be associated with an increase in violence and injuries amongst AoI community members.

The magnitude of this indirect impact is moderate while the geographic distribution is limited to the local level in AoI communities where influx is anticipated. This includes communities in proximity to construction camps, other Project infrastructure and larger trade centres that may benefit from indirect economic development. The duration of the impact is considered short-term and the likelihood of occurrence is probable.

In the absence of effective mitigation, the impact is rated as a moderate negative while mitigation reduces the rating of the residual impact to **minor (negative).**

PIIM resulting in an increase in the burden of disease within AoI communities

The potential increased introduction of higher rates of disease, together with the inadequate living and social conditions may be more conducive to the spread of communicable disease, with a potential increased incidence of the following conditions (not limited to):

- Communicable diseases linked to the living environment (e.g. ARI, PTB, measles, etc.);
- Soil, waste and water related diseases (diarrhoeal disease, cholera, schistosomiasis, etc.); and
- Sexually transmitted infections, including HIV/AIDS.

As noted previously, the geographical distribution of this indirect impact is limited to communities that are in proximity to the project construction camps as well as larger trade centres that may experience an increase in economic activity due to the presence of the Project. Community members with a compromised immune status, the elderly, children under five and women are considered to be sensitive receptors. The magnitude is expected to be moderate but with a short-term duration only. The likelihood of occurrence is possible.

Successful implementation of effective mitigation may the reduce the pre-mitigation rating of a moderate negative to a **minor (negative)**.

PIIM impacts on vector-related diseases

The impact pathway relies on alteration of the environment during the construction of temporary housing structures as well as general poor housekeeping and environmental hygiene standards often associated with these informal settlements. This may promote the collection of standing water, creating vector breeding habitats and an increased risk for disease transmission.

The geographical distribution of this impact is similar to the preceding impacts, i.e. limited to localised AoI communities in proximity to the project construction camps where influx related to potential job opportunities is expected to occur. Community members with compromised immunity, the elderly, children under five and women are considered to be sensitive receptors. The magnitude associated with this impact is a moderate negative that extends over the shorter-term with a possible likelihood of occurrence.

Post mitigation, the impact is reduced to **a minor (negative)** impact.

PIIM impacts on existing health services

There is minimal institutional capacity to support this potential PIIM-related population growth, either from a planning, budget or a delivery perspective; and without early consultation, awareness and support, the inability to meet a sudden increase in demand may impact on local health service delivery. This can include acceptable infrastructure, effective supply chain of medications and consumables and diagnostic equipment.

This may result in an impact with a moderately negative magnitude over the short-term and effects experienced by health services may extend to the broader Project area as it may affect reference facilities at a County level. This moderate (negative) pre-mitigation impact can be reduced to a residual **minor (negative)** impact through effective mitigation.

PIIM impacts on soil and groundwater contamination

Influx of people will, in all likelihood, place pressure on the limited services, with this compounded by the inability to support the sudden increase in sanitation needs that may result from the development of informal settlements. This has the potential to impact on the health of the AoI community members in the following ways:

- There is an existing high burden of diarrhoeal disease, and deterioration in sanitary waste management has the potential to increase the risk for spread of water and sanitation related diseases in the communities. This can include diarrhoeal disease (of viral, parasitic and bacterial origin), typhoid fever, forms of dysentery, cholera, soil-transmitted helminths and schistosomiasis;
- Unregulated dumping and accumulation of domestic waste may attract insects, vermin and other animals which may potentially result in injuries (due to human-animal interactions) and a risk for zoonotic disease transmission; and
- Discarded domestic waste may result in an increase in favourable breeding sites for vectors, with a potential increase in vector-related disease.

This negative indirect impact has a moderate magnitude but is limited to a local level within specific communities where PIIM is expected. As before, the bulk of the impact is expected to occur during the shorter-term with the likelihood of occurrence rated as probable. Effective mitigation reduces the moderate negative pre-mitigation measure to a **minor (negative)** residual impact.

PIIM impacts on safe water

Access to safe drinking water is varied across Project counties and remains a major challenge in many AoI communities. Influx may increase the pressure on local water resources and the scarcity of water supplies in many settlements may make it difficult for these communities to cope with the additional demands for water, with a decline in the quality and quantity of available potable water resources. This in combination with the poor coverage of sanitation facilities and potential poor hygiene practices may result in an increase in water related diseases (diarrhoea) and potentially increase the risk for outbreaks of typhoid, dysentery and cholera.

Access to potable water is a sensitive issue because it is a fundamental human right. There is also potential for conflicts to arise in communities where local residents and newcomers compete for access to this vital resource. Due to this sensitivity the magnitude is considered high but limited to a local level over the shorter-term. Adequate mitigation should ensure the reduction of the impact from high negative to a **minor (negative)**.

Table 7.10-4 presents the impact classifications for Community Health during construction. The impact classifications match impact categories with proposed preventative measures and management measures.

Table 7.10-4: Summary Impacts Classification - Construction

<table>
<tr><th>Thematic Health Area</th><th>Potential Impact</th><th>Impact Classification (excluding mitigation)</th><th>Impact Significance (excluding mitigation)</th><th>Mitigation measures</th><th>Residual Impact Classification (including mitigation)</th><th>Residual Impact Significance (including mitigation)</th></tr>
<tr><td colspan="7">Construction phase</td></tr>
<tr><td rowspan="5">Project impacts on communicable disease transmission</td><td>Introduction and transmission of communicable diseases.</td><td>High – long-term – local to regional – probable</td><td>High negative</td><td rowspan="5"><u>Direct impact mitigation</u>
- Develop and/or maintain pandemic preparedness policies and plans for Project workforce.
- Develop and maintain strict environmental controls around earth works and related construction activities to reduce risk of standing water and associated risks of communicable diseases. Develop, implement and maintain a workplace malaria and vector control program that includes:
  - Vector control (environmental and chemical).
  - Awareness and education.
  - Bite prevention (including bed nets and insect repellent).
  - Chemoprophylaxis for non-immune workers.
  - Effective diagnosis and case management.
  - Effective reporting/ stewardship of program interventions.
- Develop and implement larval and source control management plans for both malaria and potential arboviral diseases.
Periodic meetings with County health authorities to share information on health issues during construction.
<u>Occupational health and safety management</u></td><td>Moderate – long-term – local to regional – probable</td><td>Moderate negative</td></tr>
<tr><td>Disease outbreaks within Project camps affecting community health.</td><td>Moderate – short-term – local – possible</td><td>Moderate negative</td><td>Low – short-term – local– possible</td><td>Minor negative</td></tr>
<tr><td>Increasing burden of disease along transport corridors</td><td>High – long-term – regional – probable</td><td>Very high negative</td><td>Moderate – long term – regional – probable</td><td>Moderate negative</td></tr>
<tr><td>Environmental alteration</td><td>Moderate – short-term – local – probable</td><td>Moderate negative</td><td>moderate – short-term – local – probable</td><td>Minor negative</td></tr>
<tr><td>Introduction of new vector related diseases/strains.</td><td>Moderate – long-term – regional – possible</td><td>High negative</td><td>Minor – long-term – regional – possible</td><td>Minor negative</td></tr>
</table>

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				■ Ensure appropriate pre-deployment health screenings in the recruitment procedure. Ensure screenings are relevant to expatriates and Kenyan workers. ■ Develop and implement appropriate Project and Operational Workplace Health and Safety plans, and awareness training that consider: ▪ Health Design Specifications of Project infrastructure; ▪ Project Medical Services; ▪ Medical Emergency Response Plan; ▪ Health Management Plans; ▪ Malaria and other Vector Control Management; ▪ HIV /TB Management; ▪ Vaccine Preventable Diseases Management; ▪ Infectious Disease Outbreak Management; ▪ Non-Communicable Disease Management; ▪ Drug and alcohol (substance) abuse; and ▪ STIs. ■ Designate construction camps as having “*closed*” status to prevent interactions between the workforce and local communities. ■ PipeCo to develop and implement a Worker Code of Conduct, to include all workers employed by PipeCo, to help prevent the spread of disease.		

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				■ Ensure that designated rest stops for long distance truck drivers are identified and used. ■ Appropriate medical, water and sanitation facilities for workers available at worker camps.		
Accidents and injuries	Project activities resulting in accidents affecting communities.	High – permanent – local – probable	Very high negative	**<u>Direct impact mitigation</u>** ■ Develop and implement a Project response plan for Project-related incidents. ■ Develop and implement community road safety initiatives in areas adjacent to Project working areas. ■ Develop and implement a Project traffic and transport management plan that includes: ▪ In-Vehicle Monitoring System (IVMS) in designated vehicles; ▪ Driver training; ▪ Speed limits; ▪ Fitness to drive (fatigue policy); ▪ Zero alcohol and drugs policy; ▪ Drivers trained in emergency response procedures;	Moderate – permanent – local – probable	Moderate negative
	Improved access to health care facilities	Moderate – medium-term – regional – possible	Moderate Benefit		Moderate – medium-term – regional – possible	Moderate Benefit
	Conflict between community members and security personnel	High – short-term – local – unlikely	Moderate negative		Low – short-term – local– unlikely	Minor negative
	Risk of wildlife interaction.	Moderate – medium-term – local – possible	Minor negative		Negligible – medium-term – local – possible	Negligible negative

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
	Occupational health and safety incidents	High – long-term – local – unlikely	High negative	▪ Drivers to use approved and designated overnight stops; ▪ Emergency Response Plan; ▪ Daylight driving wherever possible (restrictions on night-time driving); ▪ Community/wildlife crossing points clearly identified and signage installed; and ■ Policy on reversing and needs for trained and competent Traffic Marshal/ Banksman. Develop and implement worker and community education and awareness initiatives relating to the risks of wildlife interaction during Project scrub clearing and construction activities. ■ Develop and implement adequate and appropriate site access control procedures, together with signs in local languages to be placed along active construction areas and lengths of open trench.Develop and implement a community communication process. Include a process through which monthly meetings will be held with local community representatives, when construction is active in their area, to: ▪ Update communities on the construction progress; ▪ Communicate risks to the communities associated with construction; ▪ Communicate the measures that have been, or will be, implemented to protect their health and safety (e.g., provision of safe access);	Low – long-term – local – unlikely	Minor negative

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				- To receive comments, grievances or queries; and - To provide feedback on previous grievances. ■ A health, safety and environmental audit will be included in the project procurement process for local suppliers. Significant shortfalls to appropriate standards will rule out procurement of goods and services from such suppliers. ■ Due diligence will be applied to selecting private security providers, rules of engagement will be devised Performance will be monitored and audited periodically. Activities will be planned and implemented in line with good international industry practice related to security and human rights. **Occupational health and safety management** ■ Develop and implement occupational health and safety training programmes for Project workers that are culturally and linguistically appropriate. ■ Develop an effective occupational health recording, reporting and monitoring system for Project Workers. ■ Ensure job-specific risk assessment processes are undertaken. ■ Develop and implement labour management plan. ■ All activities within the RoW clearly delineated by top-soil stockpile on one boundary and pipe string or excavated trench spoil mound on the opposite boundary. Outside working hours, equipment stored along RoW to be secured by provision of site security.		

<table>
<tr><th>Thematic Health Area</th><th>Potential Impact</th><th>Impact Classification (excluding mitigation)</th><th>Impact Significance (excluding mitigation)</th><th>Mitigation measures</th><th>Residual Impact Classification (including mitigation)</th><th>Residual Impact Significance (including mitigation)</th></tr>
<tr><td></td><td></td><td></td><td></td><td>■ Access routes/crossing points across the pipeline RoW during construction activities are identified, made safe and clearly signposted;
■ Community relations staff to provide regular updates to local communities about potential Project hazards and changing activities during construction activities; and
■ Prior notice given to all adjacent communities for all construction activities in an area.</td><td></td><td></td></tr>
<tr><td rowspan="4">Impacts on environmental determinants of health</td><td>Impacts on surface water</td><td>Low – short-term – local – possible</td><td>Minor negative</td><td rowspan="4"><u>Direct impact mitigation:</u>
■ Verify identified air quality mitigation is implemented and monitoring ambient air quality during construction. Develop and implement site-specific water management plans as part of the CEMP to avoid project water use impacting on the local population's water supply;
■ Implementation of a Grievance Management Procedure and maintain effective communication procedures, enabling the recording and follow up of complaints related to Project activities which could contribute to air quality, water quality and quantity, visual and noise exposure. Ensure that a health, safety, social and environmental assessment based on appropriate standards and national regulations will be included in the project procurement process for primary contractors and suppliers;
■ As part of the development and implementation of site-specific water management plans, ensure more frequent monitoring of vulnerable community water</td><td>Negligible – short-term – local – possible</td><td>Negligible</td></tr>
<tr><td>Abstraction of groundwater</td><td>Moderate – short-term – local – possible</td><td>Moderate negative</td><td>Low – short-term – local – possible</td><td>Minor negative</td></tr>
<tr><td>Impacts related to noise</td><td>Low – short-term – local – unlikely</td><td>Minor negative</td><td>Negligible – short-term – local – unlikely</td><td>Negligible</td></tr>
<tr><td>Impacts on air quality</td><td>Moderate – short-term – local – possible</td><td>Moderate negative</td><td>Minor – short-term – local – possible</td><td>Minor negative</td></tr>
</table>

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				sources in vulnerable and marginalised communities during project activities that could affect such water supplies. ■ Ensure appropriate procedures in place for the procurement, storage, handling and disposal of hazardous chemical substances.; ■ Control vehicle speeds on loose surface roads to reduce dust. Generation. Develop and implement procedures to inform local communities prior to any blasting activities.; ■ A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates; Sediment management procedures to be developed and implemented to minimise the risk of contamination of domestic water resources.; ■ Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures. Hydrotest water abstraction and disposal to avoid/minimise impacts to local water users.; and ■ If considered appropriate, either to address risks identified by the EPC Contractor and/or PipeCo, or to address concerns raised by local stakeholders, participatory environmental monitoring of relevant		

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				parameters will be undertaken in conjunction with affected communities.		
Infrastructure management	Improper vector management activities result in an increase in vector resistance	Moderate – long-term – local - unlikely	Moderate negative	**<u>Direct impact mitigation:</u>** ■ Ensure site selection for construction phase Project infrastructure considers potential community health impacts. **<u>Occupational health and safety management</u>** ■ Ensure that the design of all construction-phase Project facilities consider the development of adequate and appropriate sewage treatment facilities for the management of sewage and wastewater generated by the Project. ■ Develop, implement and monitor processes to ensure that there is sound management of water resources to avoid wastage and leakage of water on all Project sites. Ensure that processes can accommodate unexpected ramp-up of required resources. ■ Develop, implement and monitor effective waste management processes that addresses all waste streams generated by the Project (including contractors) and reduces the risk of ground and surface water contamination. Ensure that processes can accommodate expected ramp-up during the construction phase. ■ Ensure workers are appropriately trained in water and waste management...	Negligible – long-term – local - unlikely	Negligible
	Nutrition of PACs compromised as project procurement results in reduced food security.	Moderate – short-term – local - unlikely	Moderate negative		Low – short-term – local - unlikely	Minor negative
	Improper waste management	High – short-term – local - possible	High negative		Low – short-term – local - possible	Minor negative

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				▪ Ensure that vector management on all project sites (camps and construction) align with national vector control programmes and strategies.		
Project Induced In-Migration	Project induced in-migration potentially resulting in an increase in social ills, potentially leading to an increase in GBV, crime, drug use and alcoholism.	Moderate – short-term – local - probable	Moderate negative	**<u>Direct impact mitigation:</u>** ▪ When camp locations are finalised, undertake a social risk assessment and, if required, develop a site-specific Influx Management Plan ▪ Evaluate supporting the development and implementation of monitoring systems that track population influx. ▪ Preferential local recruitment of non-skilled workers and employment of local/regional workforce as outlined in Project local content plans, to help manage impacts on communicable diseases and other influx related impacts on community health.; ▪ Implement employment policy forbidding informal labour hire and no "at the gate/camp" hiring to help manage impacts on communicable diseases and other influx related impacts on community health; ▪ Advertising of recruitment and hiring procedures, together with jobs specifications and requirements, to help manage influx which could put pressure on community health; and ▪ All non-local workers to be housed in designated accommodation camps except where local impacts can be demonstrated to be negligible, to help manage influx related impacts on community health.	Low – short-term – local - probable	Minor negative
	Influx may result in environmental changes that promote vector breeding, disease transmission and an increased burden on health systems.	Moderate – short-term – local - possible	Moderate negative		Low – short-term – local - possible	Minor negative
	PIIM resulting in increased pressure on existing health	Moderate – regional – local - possible	Moderate negative		Low – short-term – regional - possible	Minor negative

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
	services at a PAC level			**<u>Occupational health and safety management:</u>** ■ Plan and design an appropriate site based medical service to cater for most health-related conditions for the workforce so that referral into the public health sector is not required. ■ Ensure hiring of human resources required for the Project medical services considers the potential impacts on the local, regional and national public health sector.		
	Influx resulting in soil and groundwater contamination from the uncontrolled disposal of waste.	Moderate – short-term – local - probable	Moderate negative		Low – short-term – local - probable	Minor negative
	Reduction in the availability of safe water in PACs due to an influx of people attracted by the project.	High – short-term – local - possible	High negative		Low – short-term – local - possible	Minor negative

7.10.4.7 Community Health Impact Analysis – Operations

Impacts related to spillages

Spillages from the pipeline, both through accidental or intentional rupture, may result in hydrocarbon release in ground or surface water as well as cause contamination of soil. Although monitoring and safety designs will likely limit the amount of hydrocarbon spilled from a rupture and the nature of the oil suggests that it will not easily spread of mix with water or soil, the release of oil could result in impacts on water quality and quantity in certain AoI communities (dependent on the location of the spill).

The magnitude of this impact is considered to be moderate based on the potential associated effects. These effects on human health are not expected to extend beyond the Project area or the short term. The likelihood of this impact occurring is possible. With adequate and effective mitigation measures in place, the high negative pre-mitigation impact is reduced to a **minor (negative)** impact.

Increased risk of developing non-communicable diseases

Baseline findings show that, in general, NCDs are an emerging health burden in the AoI. The enhanced socio-economic conditions in the local workforce that will be employed by the project into operations, is likely to increase life expectancy and promote an adoption of a more sedentary western lifestyle and diet. A change in values and behaviour may also occur, which may pre-dispose individuals to an increase in lifestyle related diseases such as obesity, hypertension, diabetes, dental caries and some forms of cancer. It must be noted, however, that the number of local workers who will be affected by this impact is very small. In addition to the development of NCDs, the impact may also relate to:

- High costs associated with absenteeism due to ill health;
- Loss of trained or skilled people from the workforce as a result of disease; and
- Impact on the family unit with potential social and behavioural impacts.

From an indirect perspective, the impact may also be applicable to the family members of longer-term local employees who will also be exposed to the change in diet and lifestyle and who would, therefore, also be at risk of developing NCDs.

The effects are only likely to impact specific community members on the local level but are considered long-term given the nature of NCDs. It is probable that this impact will occur. With adequate mitigation, however, the residual impact is considered to be **minor (negative)**.

Impacts related to disposal of solid and liquid waste

Increased pressure on regional waste management facilities due to operational activities, resulting in impacts to public health and risk of localised soil and groundwater contamination from disposal of waste. It is anticipated that the amount of waste generated during operations will be significantly less than during construction.

This impact will only be relevant to the areas where permanent Project AGIs generate waste that require disposal. The geographic distribution is restricted to communities in close proximity to these AGIs. The anticipated duration is long-term as it considers the whole of the operational period, however it is unlikely that this impact will occur. With adequate mitigation in place, the impact will reduce from moderate negative to **minor (negative)**.

Impacts on burden of disease along the project's transport corridors

The traffic volumes from operations is unlikely to materially increase the baseline, given the frequency of visits to any single location and the number of workers required on a daily basis at manned locations.

The mobilisation of the operational project workforce, or a portion thereof, may result in workers engaging in casual and high-risk sexual practices on routes, increasing the spread and incidence of sexually transmitted infections, including HIV.

Depending on the geographic extent that the maintenance crews are expected to travel, the geographical distribution of the impact may be regional in nature but will likely be limited to specific AoI communities within these regions. The duration of the impact will extend throughout the whole of the operational phase but based on the limited size operational workforce, it is unlikely that this impact will occur. Pre- mitigation, this impact is rated as a minor negative while adequate mitigation measures should result in a residual impact rating of **negligible**.

Table 7.10-5: Summary Impacts Classification - Operations

Thematic Health Area	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation measures	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Operations Phase						
Operations	Impacts related to spillages.	Moderate – short-term – AOI - possible	High negative	**Direct impact mitigation:** ■ Develop and implement appropriate Project and Operational Workplace Health and Safety plans and awareness training that consider: ▪ Health Design Specifications of Project infrastructure; ▪ Project Medical Services; ▪ Medical Emergency Response Plan; ▪ Health Management Plans; ▪ Malaria and other Vector Control Management; ▪ HIV and TB Management; ▪ Vaccine-preventable Diseases Management; ▪ Infectious Disease Outbreak Management; ▪ Non-Communicable Disease Management; ▪ Drug and alcohol abuse (substance); and ▪ STI Management. ■ PipeCo to develop and implement a Worker Code of Conduct, to include all workers employed by PipeCo, to help prevent the spread of disease;	Low – short-term – AOI - possible	Minor negative
	Increased risk of developing non-communicable diseases	Moderate – long-term – local - probable	Moderate negative		Low – long-term – local - probable	Minor negative
	Impacts related to disposal of solid and liquid waste.	Moderate – long-term – local - unlikely	Moderate negative		Low – long-term – local - unlikely	Minor negative
	Increase in the burden of disease along transport corridors	Minor – long-term – local - unlikely	Minor negative		Negligible – long-term – local - unlikely	Negligible

7.10.5 Summary of Residual Impacts

The Project has the potential to affect Community Health in the following ways:

Construction

- Project impacts on communicable disease transmission:
  - Introduction and transmission of communicable diseases;
  - Disease outbreaks within Project camps affecting community health;
  - Increasing burden of disease along transport corridors;
  - Increasing vector densities as a result of environmental alteration; and
  - Introduction of new vector related diseases/strains.
- Accidents and injuries:
  - Project activities resulting in accidents affecting communities;
  - Improved access to health care facilities;
  - Conflict between community members and security personnel;
  - Risk of wildlife interaction; and
  - Occupational health and safety incidents.
- Impacts on environmental determinants of health:
  - Impacts on surface water;
  - Abstraction of groundwater;
  - Impacts related to noise; and
  - Impacts on air quality.
- Social determinants of health:
  - Improved health due to employment; and
  - Increase in Gender Based Violence and female inequality.
- Infrastructure management:
  - Improper vector management activities result in an increase in vector resistance;
  - Nutrition of PACs compromised as project procurement results in reduced food security; and
  - Improper waste management.
- Project Induced In-migration:
  - Project induced in-migration potentially resulting in an increase in social ills, potentially leading to an increase in GBV, crime, drug use and alcoholism;
  - Influx may result in environmental changes that promote vector breeding, disease transmission and an increased burden on health systems;

- PIIM resulting in increased pressure on existing health services at a PAC level;
- Influx resulting in soil and groundwater contamination from the uncontrolled disposal of waste; and
- Reduction in the availability of safe water in PACs due to an influx of people attracted by the project.

Operation

- Impacts related to spillages;
- Increased risk of developing non-communicable diseases;
- Impacts related to disposal of solid and liquid waste; and
- Increase in the burden of disease along transport corridors.

The initial impacts for community health during construction range from adverse minor to very high impacts. After the application of mitigation, it is considered that the residual impacts related to communicable disease transmission are of minor to moderate significance. The moderate rating of increased burden of disease along transport corridors is related to the potential for HIV transmission and is difficult to manage, although all strategies identified will be employed. Similarly, residual impacts related to accidents and injuries after mitigation are of negligible to moderate significance, with moderate benefit in relation to improved access to health care facilities. Residual impacts relating to social determinants of health, infrastructure management and Project-induced in-migration after additional mitigation are of negligible to minor significance with minor benefit in improved health due to employment. The additional mitigation for these impacts during construction includes maintaining various health and safety plans, management plans, procedures, and processes.

The initial impacts for community health during operation range from adverse minor to moderate impacts. After the application of mitigation, it is considered that the residual impacts related to spillages, increased risk of developing non-communicable diseases and disposal of solid and liquid waste are of minor significance. Impacts related to increases in the burden of disease along transport corridors after mitigation are of negligible significance. The additional mitigation for these impacts during operation includes maintaining various procedures, health and safety plans that were implemented during construction, and processes.

7.10.6 Safety and Security Risk Assessment

7.10.6.1 Introduction

The following sections represent an analysis of the security situation and risk assessment regarding the LLCOP Project. The section is organised differently to other impact assessment sections to show risk ratings per risk category and suggested mitigation and management measures. Chapter 6 and the Social Baseline in Annex II provide information on the security situation across the six counties that the Project will traverse.

7.10.6.2 Mitigation Strategies

7.10.6.2.1 Aligning Upstream and LLCOP Security Strategy

The Project’s security impact and risks increase significantly in terms of significance and likelihood in the lower sections of the LLCOP as it approaches the coast (Garissa, Lamu). This will require robust presence of both public and private physical security providers. Achieving binding resolution of community/company, or wider conflicts, is unrealistic. Resources must be focused on managing and containing conflicts wherever possible to ensure that grievances do not escalate.

The upstream community-based security and conflict risk management strategy is a mixed methodology approach to identify emerging issues and promoting an inclusive approach to managing grievances, reducing conflicts and ultimately creating a graduated response up to and including a robust police intervention if deemed necessary to protect people and assets. Five workstreams have been developed by the upstream project that should be the focus of the LLCOP's security measures:

- Stakeholder Engagement;
- Monitoring Community Tensions;
- Collective Framework Agreements;
- Accessible grievance mechanisms; and
- Multi-Stakeholder Panels.

In addition, the Project will implement the following mitigation:

- Complaints & Grievance Procedure;
- Security forces to comply with Voluntary Principles; and
- Community liaison officers to report potential issues to, and coordinate with, local Chiefs and County Commissioner.

7.10.6.2.2 Data Sharing and Accountability

Information Gathering

Inter-community violence may be indirectly escalated by the Project, but the management of inter-community violence and security and rent seeking behaviour must be the responsibility of local and national Government. However, while the project team cannot 'own' this domain it should certainly understand and pursue measures to influence the external environment by working collaboratively across the organisation and with external stakeholders to mitigate the key conflict drivers. Establishing an integrated structured early warning system to identify emerging risks and resolve disputes is critical and involves the following components as described below.

Capacity Building

The open and transparent sharing of event data is an important way to foster alignment and build capacity amongst security providers in areas that have been challenging historically. This positive impact on the security environment should also be possible for the LLCOP Project security team—especially in Turkana and the upper two thirds of the route given the groundwork laid and lessons learned by the upstream project. The opportunity for positive impact also exists on the lower third of the Project, but the security environment is rather more complex and much more hazardous in Garissa and Lamu.

Codifying Roles and Responsibilities

The project will indirectly increase the intensity of many intra-communal and inter-communal Community/Company conflict. The GoK, National Police Service and other security services must take the lead on these conflicts. The PPMT must try to codify this relationship and responsibilities to the best of their ability lest failure to do so leaves the perception that they are responsible for mitigating conflicts they do not actually have the authority to address directly. National legislation has been proposed which may help address this issue, namely the Critical Infrastructure Protection Bill and the County Policing Authorities provided in the Police Act 2011. These twin pieces of legislation combined would contribute significantly to managing indirect project related conflict impacts.

Grievance Management

Grievance management is one of the most important methods for mitigating tension and the security impact of the Project in the AOIs. The Project should work in conjunction with existing systems of governance and dispute resolution and incorporate a grievance communication mechanism to collect information about local grievances as part of an (aforementioned) early warning system designed to prevent the grievances from escalating. This system should be implemented as soon as possible and incorporate continuous proactive stakeholder consultation.

Security Risk Management Plan

A comprehensive security risk management plan is the critical final component central to mitigating the security impact of the Project. Effective security risk management plans must fuse comprehensive proactive community engagement, information gathering and analysis with flexible, scalable data-driven security management decisions.

The security risk management plan should enable security managers to maximise the safety and security of all stakeholders, including the Project's employees and contractors, while imposing minimal disruption and hardship on those stakeholders. Security risk management plans that are not culturally sensitive, respectful and otherwise nuanced can cause negative direct, indirect and cumulative impacts.

7.10.6.2.3 Key Security Impact Mitigation Measures

Table 7.10-6 includes select high level mitigation measures based on conflict and security risks identified by subject matter experts with extensive experience securing large scale development projects in Kenya and elsewhere. These measures are intended to reduce conflict and manage the social impact of security risks which will change as a result of the project.

Table 7.10-6: General Mitigation Measures

Community/Company Conflicts	Intra/Inter-Community Violence
■ Ensure PipeCo stakeholder messaging sets out project benefits. ■ Activities will be planned and implemented in line with Good International Industry Practice related to security and human rights.	■ Coordinate with County and National police authorities in accordance with PipeCo security procedures.

7.11 Economics and Employment

7.11.1 Introduction

The Project will influence economic conditions and affect employment dynamics in Kenya and in the Project's Area of Influence (AoI)[1]. The Economics and Employment chapter of the ESIA, discusses the LLCOP Project (the Project) and assesses its impact on a number of common economic indicators. Comments raised by stakeholders through consultation and engagement meetings are also addressed as relevant to the topic of economics and employment (Figure 7.11-1). Issues are listed under sub-headings and assessed in Sections 7.11-2 to 7.11-5. The Economics and Employment assessment presents potential impacts, first at the national level, then at the county level, as applicable, on:

- Gross Domestic Product (GDP);
- Government revenues;
- Employment opportunities;
- Price inflation;
- Labour force shift;
- Employment destabilisation at the end of construction;
- Workforce training;
- County-level and national contracting; and
- Regional industries potentially impacted (e.g. tourism).

The majority of the Project's economic impacts are considered to be positive, however the degree of positive impact (high, moderate, minor) depends on the capacity of Kenyan and AoI counties and communities to capture benefits. Where possible, benefit enhancement measures will be implemented to maximise Project opportunity for AoI communities and the nation. Where negative impacts are identified (i.e. inflation, competition for labour, disruption of tourism activities), mitigation measures are proposed to reduce the magnitude of the negative impact. This section then goes on to characterise the residual impacts of the Project on economic conditions following the implementation of mitigation and benefit enhancement measures.

The following socio-economic impact assessment criteria is presented below (Table 7.11-1). Potential impacts, mitigation and benefit enhancement measures, and residual impacts are detailed in the sections that follow and summarised in the conclusion (Section 7.11.6).

[1] 49 Communities within 25 km of the Project in the six counties that the Project traverses (Turkana, Samburu, Meru, Isiolo, Garissa and Lamu. This includes formal villages as well as informal settlements potentially impacted by the Project within the 25 km regional area that will be targeted for benefits and have the potential to experience negative effects of the Project.

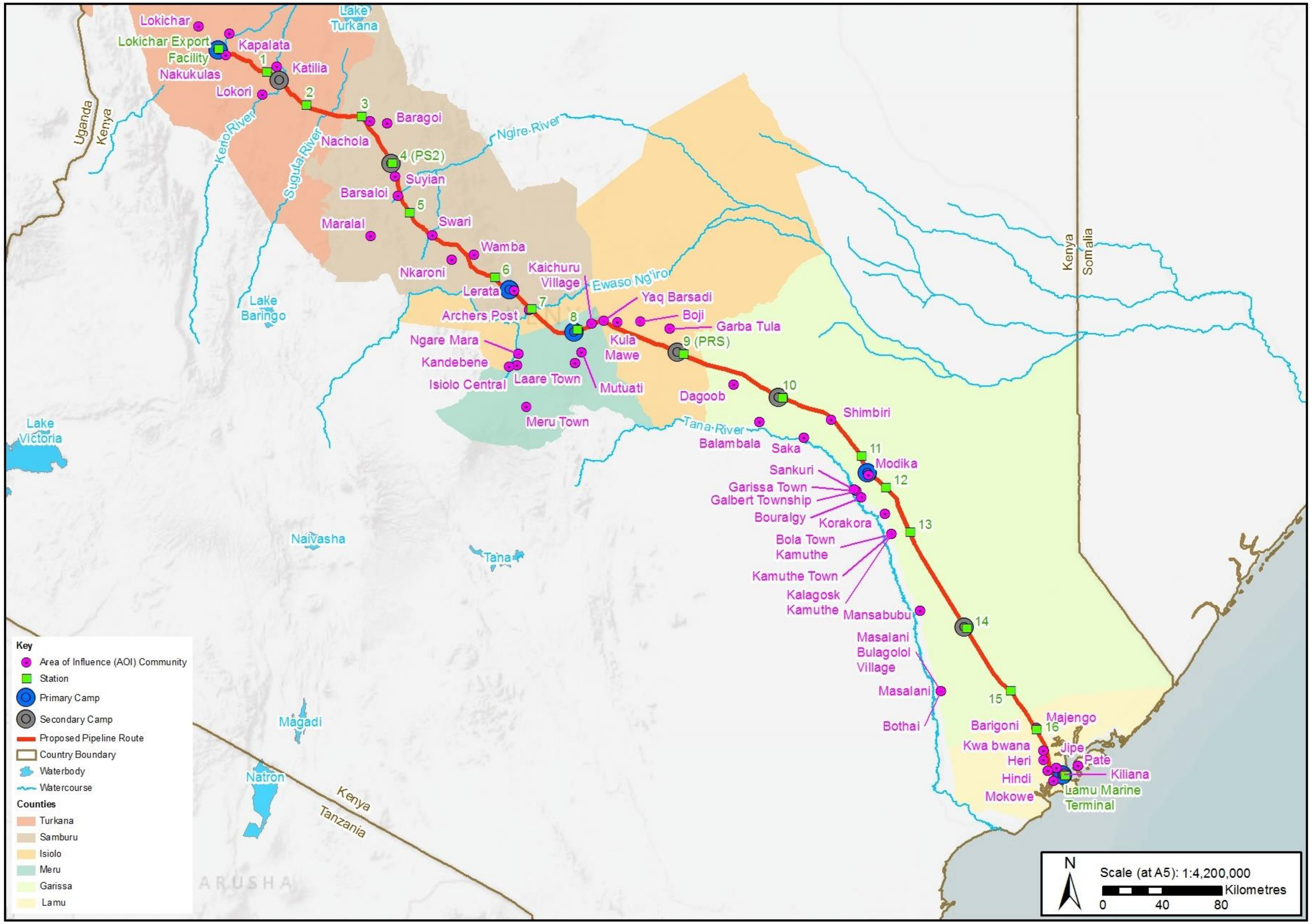

Figure 7.11-1: Location of communities visited during consultations and baseline data collection

Table 7.11-1:Socio-Economic Effects Analysis Criteria

Type of Impact	Magnitude	Geographic Extent	Duration
Positive Impact is beneficial **Negative** Impact is adverse **Neutral** Impact is neither positive nor negative	**Negligible** An impact that does not result in a discernible change from baseline conditions **Low** A discernible impact that is not expected to materially alter the socio-economic feature in question **Medium** A discernible impact that is potentially detrimental but manageable, or potentially beneficial to the socio-economic feature in question **High** A discernible impact that is expected to substantially interfere with or enhance the socio-economic feature in question	**Local** AOI stakeholders/ local communities Areas adjacent to the Project site **Regional** Six Counties **National (Economics)** Kenya	**Short-term** Impact is reversible during a phase of construction **Medium-term** Impact is reversible at the end of the two-year construction period **Long-term** Impact is reversible during operations or at closure **Permanent** Impact is not reversible

7.11.2 Issues and Concerns Raised by Stakeholders

Macroeconomics and Government Revenues

The following issues concerns and questions about the Project's economic impact were raised in consultations at county level meetings during scoping consultations and in the 49 communities within the Project's AoI during baseline consultations and are addressed in this section. Most are related to revenue streams from the Project:

- Communities are concerned about what profits they will receive from the Project (Korakora, 14 October 2018) and indicated that there should be a requirement that the community receive revenue from the pipeline (Shimbiri, 15 October 2018);
- Questions have been raised about what revenue the local government will receive from the Project (Sankuri, 14 October 2018); and
- The county government and Lamu communities should receive a portion of Project revenue (Mokowe, 24 October 2018; Mwanarafa, 23 October 2018).

Employment and Training

Expectations of employment with the Project are high. The following issues and concerns related to employment were identified during consultations in AoI counties and communities:

- There is local concern to have information provided on potential employment opportunities as early as possible;
- The process for applying for positions should be simple (Mokowe,24 October 2018);

- There should be a range of positions available for locals of differing levels of education, ranging from unskilled to the management (Jipe, October 26, 2018; Mokowe,24 October 2018; Pate, 30 October 2018);
- Employment opportunities should be prioritised for the local communities and the counties traversed by the Project (Focus Group, Livestock Herders, Barsaloi 2018; Garba Tula, 14 November 2018; Kula Mawe, 12 November 2018; Ngare Mara, 10 November 2018; Isiolo Central, 9 November 2018; Elders, Laare Town, 2 November 2018; Lantern Resort, 12 October 2018; Kamuthe, 15 October 2018; Modika, 13 October 2018; Sankuri, 14 October 2018; Saka, 16 October 2018; Elders, Pate, 30 October 2018);
- Youth should be targeted for employment (Kaichuru Village, 31 October 2018; Mutuati, 1 November 2018; Laare Town, 2 November 2018; Kandebene, 3 November 2018; Balambala, 17 October 2018; Modika, 13 October 2018; Saka, 16 October 2018; Shimbiri, 15 October 2018; Focus Group, Business Group, Hindi 2018; Pate, 30 October 2018; Barigoni, 28 October 2018; Jipe, 26 October 2018; Kiliana, 25 October 2018; Mokowe, 24 October 2018; Mwanarafa, 23 October 2018; Mwanarafa, 13 November 2018);
- Tenders should be given to community members and local businesses for services, such as using their vehicles for transporting people and materials, and as cooks (Maralal, 17 October 2018; Archers Post, 19 October 2018; Nachola, 22 October 2018; Baragoi, 23 October 2018; Barsaloi, 25 October 2018; Swari, 26 October 2018; Nkaroni, 27 October 2018; Wamba, 28 October 2018; Lerata, 29 October 2018);
- There has been requests to train youth in the technical skills required to work on this project and other projects in other roles beyond manual work (Mwanarafa, 23 October 2018; Mwanarafa, 13 November 2018); and
- Some communities expressed concerns that they will not receive benefits from this Project based on their experience on past projects which did not hire many Kenyans (Bouralgy, 13 October 2018).

Local Procurement

The following issues and concerns were raised regarding local procurement:

- There will be no tangible benefits to local communities, pastoralists or vulnerable groups living near the project (Yaq Barsadi, 11 November 2018; Ngare Mara, 10 November 2018; Isiolo Central, 9 November 2018; Garba Tula, 14 November 2018);
- Would like to see tenders for supply of materials to local businesses (Laare Town, 2 November 2018);
- There is a need for transparency and inclusiveness in decision-marking and tendering opportunities (Mokowe, 24 October 2018); and
- Concerns about the inability to get tenders (Hindi, October 27, 2018).

Select Private Sector Industry Impacts

The following issues and concerns were raised regarding local procurement:

- The potential impact on the tourism industry that communities rely on because of adverse impacts on the environment, including wildlife (Wamba, 28 October 2018; Maralal, 17 October 2018); and
- Potential impacts on Arawela game reserve (Mansabubu, 16 October 2018; Masalani, 17 October 2018).

7.11.3 Potential Source of Impact

This section introduces the socio-economic elements of the Project that contribute to potential economic impacts, as described in detail in Section 7.11.4. The assessment of the Project's economic impacts is focused on the impact of construction and operation of the Project specifically and does not assess the economic impact on government revenues associated with the sale and exportation of oil from upstream production facilities.

Macroeconomics and Government Revenues

Impacts to macroeconomic conditions and government revenues are focused on the Project's potential to positively impact national GDP, and to generate both local and national government revenues through capital and operational expenditures, and through the payment of taxes and levies.

Employment and Training

Potential impacts on employment and training through the Project's workforce demand, in consideration of the ability of the national and local labour forces to take up employment opportunities, is assessed below. Both employment and skills development opportunities were raised as key desired benefits from the Project during consultation.

Local Procurement

The Project's potential to procure goods and services from Kenya includes the local business base, national procurement mandated by Kenyan law, as well as available local camp service support. AoI local businesses and communities have expressed interest in their ability to support Project construction, and the associated contracting opportunities.

Tourism

Potential for the Project's construction and operation activities to disturb wildlife and resources important to tourism near the right of way.

7.11.4 Impact Classification

The Project is expected to have a pronounced, positive impact on the national economy from the payment of taxes, and through the procurement of goods and services from national contractors during construction. It will also generate a large number of positions taken up by the Kenyan labour force during the two-year construction period. During operations, the Project will have more modest procurement and employment impact at the national level but will still represent a significant source of government revenue associated with the payment of taxes and levies on product moved to port. The Project's potential adverse impacts (e.g. temporary labour force depletion, employment destabilisation at the end of construction, and disruption of tourism activities) are of minor significance with mitigations, with the exception of the potential for temporary price inflation in nearby communities, which has been assessed as a moderately significant adverse Project impact. Table 7.11-2 provides a summary of potential impacts, mitigations and benefit enhancement measures, and residual impacts.

7.11.4.1 Macroeconomics and Government Revenues

Gross Domestic Product

The Gross Domestic Product (GDP) of Kenya has been growing steadily in recent years, due largely to government spending and public sector expansion outpacing waning private sector investment. Annual GDP growth rates have approached 6%, while the national economy has grown by nearly a third since 2012. Pastoralism and agriculture dominate the Kenyan economy and Vision 2030 (Vision 2030, 2018) identifies agriculture as one of the key sectors of the national economy identified to deliver 10% annual economic growth. As Kenya's principal blueprint for development between 2008 and 2030, the LAPSSET corridor is a key programme to enable market access in the region and the LLCOP project, in addition to agriculture, is another sub-component. Tourism is also an important private-sector economic driver in Kenya. The country's National Tourism Blueprint 2030 (Oxford Business Group 2018) aims to transform this sector by providing a wider range of tourism opportunities with an aim to increase visitor numbers.

Although Government revenues have been rising in Kenya, expenditures have been rapidly outpacing revenue growth, resulting in a widening national budget deficit. In 2017, total government revenues were approximately USD $86 billion, while total deficits were nearly USD $120 billion, leaving a total deficit of USD $34 billion.

Government deficits have grown in terms of the portion of national GDP that they represent (See Annex II Social Baseline Report: National Economy).

National inflation in Kenya has fluctuated in the last five years but has remained around the high-end target rate of 7.5%, with the exception of a spike in 2017 (Business Daily Africa 2018c; KNBS 2018a) caused by food shortages and a sharp increase in food prices. The Project represents an economic activity that will contribute to the national economy and generate local and national government revenues through the payment of taxes and levies on transported oil.

The Project has the potential to increase the GDP of Kenya by facilitating the exportation of oil. The LLCOP has the capacity to transport 65,000 barrels of oil per day (Project Description Section 4.3). As the Project will be used to facilitate oil exportation through the Port of Lamu, it will generate a substantial contribution to the Kenyan economy. While the impact of the Project in facilitating export of product from the Upstream Project has not been quantified, and is unknown at the time of writing, it will likely constitute a major source of economic activity in Kenya, having a measurable impact on the nation's GDP.

The Project's impact on national GDP is positive, and of high magnitude given the potential for a single-source, private sector contribution to GDP growth, and considering that current national GDP growth has been driven largely by public expenditures. The impact would be felt within the national economy and would persist into the long-term with Project operations. The Project's impact on GDP is, therefore, assessed as a **major (positive)**.

National Taxation Revenues

Project procurement (excluding employment, discussed in 7.11.3) during construction will require the importation of goods and equipment from outside of Kenya, as well as the purchase of supplies and equipment available within the country. Importation of goods and equipment will require the payment of importation taxes, levies, and fees. Both importation and in-country purchasing of taxable foods and services will also result in the payment of a value added tax of up to 16%. The precise procurement demands of the Project are not known at this time and will be determined by the EPC contractor as Project planning advances; however, it can be reasonably assumed that a large-scale construction project requiring over 800 km of pipe and insulation, materials for the development of stations, camps, and other above ground facilities, and specialised equipment for construction would result in substantial procurement nationally and abroad. Given the large-scale procurement requirements associated with construction of the Project, the associated taxes paid to Kenya could represent an important revenue stream.

The Project's impact on national government revenues through the payment of sales taxes is positive. While sales taxes paid by the Project would represent a small revenue stream relative to the overall revenue of the Kenyan Government, as a single-source contributor the Project represents substantial procurement and sales tax payment. As a result, the Project's impact is considered to be of medium[2] magnitude. The impact will be of benefit at the national level and would occur over the medium-term throughout Project construction. The Project's impact on national government revenues through the payment of sales taxes is, therefore, assessed as a **moderate (positive)**.

Price Inflation

While the Project is not expected to result in national-level inflation impacts potentially driving up the national inflation rate[3], Project procurement of consumable goods and services, speculative land purchase in response to Project development, and the influx of opportunity-seekers during construction could all influence local AoI

[2] CAPEX and OPEX was not available at the time of writing. Magnitude and significance of the Project's potential impacts on government revenues from sales taxes is assessed conservatively as moderate.

[3] As a construction project lasting for only a few years with limited workforce requirements, the Project will not represent long-term capital or operational expenditures on consumer goods and real estate at the national scale potentially impacting inflation.

communities nearest the camps and major centres along the Right of Way (RoW). Land acquisition for camps and laydown areas outside of the LAPSSET corridor could attract land speculation and result in upward pressure on land values. It has been anecdotally suggested during consultation that land in the Project area is being purchased in speculation of the ability of the purchaser to sell the land to the Project or to businesses that aim to be located near the LAPSSET corridor, at higher prices. Such speculative land purchase is likely to grow as Project construction nears and has the potential to drive up land prices in the Project host counties where camps and laydown areas are developed.

The Project's detailed procurement requirements have not been finalised. However, should the Project procure consumables to support camp accommodations from local county level suppliers, it could result in the inflation of food prices in communities nearest to the camps. Price inflation of goods could be exacerbated by the influx of opportunity-seekers to these communities hoping to secure employment either directly with the Project, or with camp suppliers, or to sell goods to the Project construction workforce (discussed further in Section 7.15 (Physical Infrastructure and Services)). This influx would increase local demand for food and other consumer goods purchased by households, in turn driving up local costs.

The Project's potential impact on price inflation of land and consumer goods as a result of influx and associated increased demand is negative. Given the heavy reliance on subsistence livelihoods (pastoralism, some agriculture) in the local area, and low-income levels, an increase in the cost of consumer goods and land due to the Project could have a medium magnitude impact on households. The potential impact will be felt locally in communities nearest to the camp accommodations and would occur over the long-term into Project operations. In-migration is expected to curtail during operations as camps are decommissioned, and employment and contractors associated with construction ceases. With the absence of high incomes associated with Project construction, market prices are expected to normalize during operations. The Project's potential impact on local price inflation is, therefore, assessed as a moderate (negative) (Table 7.11-2). Mitigation for price inflation is not practical or entirely within the control of the developer. As a result, the Project's residual impact on price inflation remains a **moderate (negative).**

7.11.4.2 Employment, Procurement and Training

The labour force in Kenya is over 19 million, of which around 17 million are employed. The service sector is the country's largest employer, employing nearly half of the working labour force. Agriculture and, to a lesser extent, industry (manufacturing, value-added mining) are the other major employment-generating sectors. Unemployment in Kenya has remained relatively stable in the last decade, declining to 11.5% in 2017. Over 70% of the labour force is not formally employed. The informal sector constitutes small scale activities, such as subsistence and small-scale agriculture and some trade. Employment in the informal sector is common in rural areas such as those in which the Project will be constructed.

The dominant economic activities in the six counties traversed by the Project are pastoralism, agro-pastoralism, and fishing. Wage employment and self-employment play minor roles in the county economies. Those employed and earning wages make up a small portion of the labour force in all counties and are experienced primarily in the public sector. Workers are largely unskilled, and incomes are low due to the essentially subsistence-level nature of pastoralism. Major challenges to achieving high school level of educational attainment include poverty, drug and substance abuse, absenteeism of students and teachers, peer pressure and parental and cultural values around education. (NCPD 2017). These challenges lead to poor academic results, early marriages, poor concentration in school and early school leaving. Other challenges cited in improving education attainment levels include the long commuting distances to schools and teacher shortage, particularly as many teachers leave education to seek better paying jobs in the newly developed County administration. Unemployment is very high in the six counties at roughly a third of the labour force. The exception to this is Garissa, where government departments, NGOs, and donor agencies provide more abundant public and civil society employment opportunities.

As noted above, the regional economy is focused on pastoralism and agriculture. There is little manufacturing that occurs in the counties through which the Project traverses, and limited capacity to supply large, industrial construction projects. The Project's ability to procure locally at the county level will likely be limited; however, procurement of some goods and services required for Project construction from regional suppliers in larger centres is likely viable. Limited information was available at the time of writing with respect to the goods and services required by Project construction, or the capacity of local business to provide supply. A local capacity analysis will be undertaken to gain understanding of what can be procured in the six counties that the Project traverses.

Kenyan Content Requirements

The Project will procure a portion of its required goods and services from within Kenya. Detailed procurement planning will occur as Project planning advances and the EPC contractor is retained. Under the Joint Development Agreement (JDA) for the Project, the Government of Kenya and the parties developing the Project acknowledge that:

- *"[the Pipeline Project Management Team] will develop a contracting and procurement strategy for approval by the [Project Steering Board] to progress the procurement process for the Project Activities, and;*
- *… that the contracting and procurement strategy shall provide preference to available (i) Kenyan material and supplies [;] and (ii) Kenyan contractors for services, both in accordance to the Constitution and the Law*" (LLCOP 2018).

Provisions for national procurement exist legally in Kenya, including:

- *"Procurement through contributions made by Kenya in treaty, agreement and other conventions to which [Government of Kenya] is party to shall be undertaken in Kenya through contractors registered in Kenya and all insurance shall be placed with Companies registered in Kenya[4];*
- *A requirement for foreign bidders participating in international tenders to provide procurement plans indicating[5]:*
  - *Local procurement based on list of types of goods and services prescribed by Director of Mines;*
  - *The specific support the contractor intends to offer to local service providers and suppliers;*
  - *What measures the contractor would employ to develop local goods and services; and*
  - *How the contractor would broaden access to opportunities/technical support to locals;*
- *In the construction industry, as the construction of the pipeline, a requirement for foreign contractors to be registered in Kenya – a process which requires them to enter into a joint venture with local contractors or to subcontract to such contractors not less than 30% of the value of the contract work for which registration is sought;*
- *Requirement for foreign engineering consultants working in collaborations with firms/companies registered with relevant regulatory bodies and/or consent of CS Mines and Engineering Board of Kenya for engagement of expatriate/foreign engineering companies[6]; and*
- *Requirements for issuance of permits that include work permits for foreign workers"* (LLCOP 2018).

[4] Public Procurement and Asset Disposal Act 2015 Section 6 (4) (a) & (b)

[5] Mining Bill Local Content Regulations 2017

[5] National Construction Authority Act 2011 and National Construction Regulations

Employment-Generating Activities

Pipeline construction is typically broken into manageable lengths called "spreads," employing highly specialised and experienced personnel to complete construction of individual spreads either in sequence, or concurrently. Personnel will be required for the following tasks during spread construction:

- Pre-construction survey: environmental and cultural heritage surveys, identification of utility lines and agricultural drainage, and staking of the pipeline centreline;
- Clearing and grading: clearing of vegetation, installation of erosion control measures;
- Trenching: Removal and stockpiling of topsoil and backfill soil, use of heavy machinery to dig trenches;
- Pipe stringing: Arrangement of lengths of pipe along the trenches and use of pipe-bending machinery to shape pipes to match route alignment;
- Welding and coating pipe: Alignment of pipe sections and welding them together, application of coatings to welded surfaces, and visual, radiographic, and electronic inspection to identify faults or voids;
- Lowering pipe and backfilling: Installation of assembled pipe using side-boom tractors and use of backfilling equipment to restore excavated soil removed during trenching;
- Testing: Hydrostatic testing per federal regulations; and
- Restoration: use of heavy equipment to restore disturbed areas to their original contours and conditions.

The LLCOP pipeline will have six main spreads and a specialised mountain spread. Each spread is composed of various crews, each with its own responsibilities, and will be constructed concurrently. As one crew completes its work, the next crew moves into position to complete its part of the construction process. Construction at a rate of 1 km per day (0.1 km per day in the mountainous parts of the Samburu spread) yields the following approximate construction timelines per spread:

- Turkana Spread (1): 100 days;
- Samburu Spread (M1, 2): 137 days (mountainous), 187 days (flat land);
- Isiolo/Meru Spread (3): 130 days;
- Garissa Spreads (4, 5): 337 days; and
- Lamu Spread (6): 56 days.

In addition, specialised teams will be required to construct the above ground facilities such as pig launchers and receivers, and the various stations supporting Project operations (e.g. pump and block valves, power generation and input, pressure reduction). During construction, personnel will be housed in either main camps (primary and secondary) associated with spread construction in each county, or temporary camps required for construction of more remote part of the pipeline. These camps will require staff to supply camp services (e.g. meal preparation, custodial tasks, security). Further, workers will require transportation to and from camps and sites of active construction, creating employment for drivers and guards. Construction workforce estimates by county are summarised below in Table 7.11-2.

Table 7.11-2: Construction Workforce Requirements

Construction Activity	Workforce Origin	Turkana	Samburu	Isiolo & Meru	Garissa	Lamu	Kenya (Other)	UK/ Europe
Central Base	Expat	0	0	26	0	0	0	0
	Kenyan	0	0	4	0	0	0	0
Base Staff	Expat	6	6	4	6	6	0	0
	Kenyan	27	29	29	33	27	0	0
Service Staff	Expat	0	0	0	0	0	0	0
	Kenyan	7	7	6	14	7	0	0
Pipeline Construction	Expat	122	122	122	244	122	0	0
	Kenyan	946	949	949	1,892	949	0	0
Station Construction	Expat	2	6	5	8	31	0	0
	Kenyan	3	13	11	18	71	0	0
Corporate	Expat	14	14	13	25	33	51	45
	Kenyan	0	0	0	0	0	45	0
Total	Expat	144	148	170	283	192	51	45
	Kenyan	983	998	999	1,957	1,054	45	0
	Total	**1,127**	**1,142**	**1,166**	**2,240**	**1,243**	**96**	**56**

As Project planning advances, an EPC contractor will be selected and will develop estimates of required labour for phase-specific activities. The EPC contractor will identify the approach to meeting the Project's workforce requirements. Given the Project's scope as a large, industrial construction project, the construction labour force requirements would be substantial (over a thousand per spread). During operations, employment opportunities will be largely limited to monitoring and above ground facility maintenance positions. It is expected that these positions will be limited in number (approximately 280).

National Construction Employment

Project construction is expected to generate employment opportunities that would be taken up by the national labour force. It is expected that the Kenyan labour force experienced in the construction industry would be targeted by the Project's EPC contractor for employment, likely facilitated by subcontractor agreements with existing Kenyan construction firms. The Project's Local Content Development Plan (LCDP; LLCOP 2018) prioritises Kenyan representation in construction employment opportunities. While some specialised services (e.g. engineering and quality control) will likely be drawn from outside of Kenya, the majority of contracted Project opportunities extra to the core construction workforce are also expected to be targeted to Kenya businesses and employment candidates:

- Accommodation (hotels, travel agencies);
- Transportation services (e.g. air, four-wheel-drive transport) and logistics support;
- Medical and evacuation services;

- Security (escort and advisory services);
- Facilities management;
- Communications and investor relations;
- Human resources; and
- Export, import, and freight forwarding services.

These contracted opportunities would be in addition to the labour, earth moving, and heavy equipment operating employment opportunities that would be generated directly by the Project's trenching, pipe stringing and installation activities. With six spreads of pipeline under development simultaneously, the Project's construction workforce requirements could be substantial in terms of positions. As noted above, the construction of the spreads will last from several weeks to nearly a year; however, employment opportunities associated with discrete tasks during the construction of each spread would extend for a shorter duration reflective of the phased approach to construction.

In the event that a foreign EPC contractor is selected Kenyan law will require Kenyan content in the construction labour force. The Public Procurement and Asset Disposal Act (Government of Kenya 2017; Section 6 (4) (a) & (b)) identifies the requirement for foreign contractors to either create a joint venture with a local contractor or subcontract a local contractor so that 30% of the value of the contract accrues to Kenyan contractors. The Act further stipulates that employees of such joint ventures / subcontracting agreements be recruited from the Kenyan labour market, with exception given to positions where requisite skills are not available locally. It is anticipated that the requirements of many construction employment positions could be met by the broader Kenyan labour force experienced in trades, equipment operation and supervisory roles.

Construction activities in each county will require a workforce of between 1,100 and 1,200 per county, with the exception of the Garissa spread which will require nearly double the workforce, or 2,240. Of the total workforce, the vast majority are expected to be sourced from the Kenyan labour force. Each spread will generate around 1,000 local employment opportunities, again with the exception of the Garissa spread which is expected to draw on nearly 2,000 Kenyan workers. Total Project employment is estimated at around 7,000, with 5,000 categorized as unskilled, 1,500 as semi-skilled, and 500 as skilled. The vast majority of the Project's construction workforce demand will be associated with the physical construction and installation of the pipeline itself, with station construction and operation of base camps and storage facilities generating a smaller number of employment opportunities, most of which will be filled by Kenyans.

Without targeted recruitment efforts, the Project's positive national construction employment potential impact would be large, but not substantial enough to impact national labour force indicators. The impact would be of high magnitude. Construction employment opportunities will cease with the completion of individual spreads, and so are of short-term duration. The Project's pre-enhancement potential impact of creating construction employment opportunities at the national level is, therefore, assessed as a **moderate (positive)**.

Benefit enhancement measures aimed at maximising local and national uptake of Project employment opportunities will be developed as EPC advances, and the workforce needs of the Project are better understood. Formal recruitment processes that maximises opportunities for employment of local county candidates, accessible and timely job postings, and a simple job application process will be of key importance. Pre-identification of Kenyan content per national standards and the Project's Local Content Plan will aid in securing national-level employment opportunities. The overall approach will be to employ local county level workers who possess the qualifications and experience required for the performance of the relevant work. To facilitate this process, a job readiness and skills development process will be developed and implemented as part of the EPC process.

The Project's residual impact of creating construction employment opportunities at the national level is positive, and of high magnitude depending on the realisation of Kenyan content through the EPC workforce planning process and considering benefit enhancement measures. The high magnitude has been assigned given the relative lack of industrial activity in Kenya, and the role that the Project will play in creating a number of employment opportunities that will contribute to the skill base of the national labour force and their ability to respond to future industrial development opportunities. Construction employment opportunities will cease with the completion of individual spreads, and so are of short-term duration. The Project's residual impact of creating construction employment opportunities at the national level is, therefore, assessed as a **moderate (positive)**.

National-Level Operations Employment

Project operations will require a workforce much smaller than that employed during construction. The operations workforce will be associated with pipeline and above ground facility inspection and maintenance, right of way vegetation management, and environmental monitoring. It is anticipated that much of this workforce demand would be met by Kenyan nationals, in some instances building on the work done during the construction phase. To the extent possible, local candidates from the communities nearest the Project would be sourced for operations employment. Unlike facility operations, maintenance, and inspection activities, vegetation management along the right-of-way does not require highly technical skills and would be accessible to the local county level labour force.

The LCDP identifies the opportunity for a local company or joint venture to handle 100% of operations and maintenance contracts but notes that this is contingent on the uptake of prior training opportunities noted in the LCDP (and discussed below). Kenya has a labour force experienced in pipeline operations and maintenance; however, at a minimum, on-the-job training under the supervision of specialists and experts in areas like trace heating and power generation will be required to achieve this goal.

The operations workforce will be approximately 280 workers. Contract workers will be engaged to provide security support, catering and housekeeping and labour support (Project Description Section 4.7). The Project's impact of creating operations employment opportunities at the national level is positive, but of low magnitude given the relatively small workforce requirements associated with monitoring, inspection, and maintenance. These opportunities will extend into the operational life of the Project, and so are of long-term duration. The Project's impact of creating operations employment opportunities at the national level is, therefore, assessed as a minor positive**.**

Benefit enhancement measures (noted above) to improve national uptake of employment opportunities are not likely to meaningfully change the scale of national employment realised during Project operations given the overall small number of positions required. As a result, the residual impact for the Project's impact of labour force depletion is unchanged. The residual impact remains as positive and of **minor (positive)**.

Local County-Level Construction Employment

Project construction will generate local county level employment opportunities. It is anticipated that the local available labour force (i.e. those in the labour force but unemployed) would have the skill set required to participate in pre-construction flagging and clearing activities, each lasting several weeks per spread. Such employment opportunities would be targeted to the local communities nearest to Project construction activities in each of the six counties. As Project planning advances, the EPC contractor will confirm labour requirements associated with clearing activities and will implement a recruitment and hiring strategy with nearby communities to identify suitable candidates for employment.

During post-clearing construction activities, the opportunity for local employment will shift from direct, on-the ground construction activities, to other support roles. Local livelihoods and employment activities within the counties are not focused on the construction of major industrial projects such as a pipeline, and educational attainment and literacy rates are low. Specialised labour from outside the counties will be required to conduct most of the post-clearing construction work, including the operation of heavy equipment and machinery specific to pipeline installation. However, it is anticipated that the local county labour force will be able to take up employment opportunities associated with the camp and some transportation services noted above. This employment would extend beyond pre-construction clearing, lasting for the duration of construction of a given spread. As with clearing opportunities, the EPC contractor will identify suitable candidates for camp and transportation service employment positions and provide on the job training. Prioritising local candidates from the counties for clearing and camp and transportation service positions would help ensure county level benefit capture associated with Project construction employment.

Contracting from communities and within the AoI counties traversed by the Project will likely be constrained to some extent by the region's economic emphasis on pastoralism and agriculture, and the resulting lack of contractors and businesses supporting the large-scale construction industry. However, it is anticipated that the local agriculture and hospitality industries could provide camp services such as food production and preparation, general facility maintenance, housekeeping, and janitorial services. Depending on the ability of local communities in close proximity to the Project's five main camps, stations, and laydown areas, procurement of camp supplies could extend into the broader counties through which it runs. Further, logistics and transportation services and contractors available in the local area could address some of the Project's commercial transportation and shipping needs. Such services would likely be drawn from communities closest to staging areas for logistical reasons. The EPC contractor will be directed to identify local suppliers of goods and services for camps, and transportation service providers as project planning advances.

Employment multipliers are likely to be realised in association with local employment. A multiplier effect occurs when those employed in AoI communities and the counties in high-paying Project related work use their incomes to hire or spend locally, generating additional employment in local AoI communities. Although this employment is typically in the informal sector (e.g. farm labour, drivers, personal housekeeping), it still provides a meaningful income stream relative to local income levels. In some cases, employment multipliers can be as high as 1:10 (implying that, for every construction position that accrues locally, 10 other jobs are created in the local economy). The same level of multiplier would not be expected at the national level, given that the national, high-skilled construction workforce is likely residing in a more expensive market (i.e. Nairobi). Assigning a multiplier for construction, where few positions would last the entire period is highly speculative. Further, at least some of the construction trades personnel would be redeployed from other projects, so the LLCOP would not represent new employment positions for all workers.

The Project's residual impact of creating local county-level employment opportunities for the six counties within which it falls is positive, but of medium magnitude considering the high local unemployment rate. The local labour force in communities lacks the training and experience in industrial development required of much of the Project's construction workforce. Employment opportunities for which local candidates could be prioritised are likely limited to pre-construction clearing, and camp and transportation services during later phases of construction. These opportunities would cease as the right of way is cleared, or as the construction camps are decommissioned following the completion of construction and clean-up of individual spreads, and so are of short-term duration. However, the ability of these local employment positions to generate a multiplier effect that creates additional employment in AoI communities is positive, even if only short term. The Project's residual impact of creating local employment opportunities is, therefore, assessed as a **moderate (positive)**.

Labour Force Shift Away from Public Employment to Project Employment

The Project's demand for labour during construction is not substantial enough to meaningfully deplete the Kenyan labour force of skilled and semi-skilled workers given the size of its labour force; however, higher-paying Project employment opportunities may be an attractive alternative to those already employed at the local level. Public positions such as teachers, nurses, and other public servants in the local county labour force could decide to take up employment with the Project, especially if it pays a higher salary. Should the Project draw from this labour pool, it would have the impact of reducing the local capacity of public services such as police, teachers, health services and others important to communities. The potential impact is local to the AoI communities and counties near the Project and extends for the entire two-year construction period into the medium-term. The Project's potential impact of labour force depletion is, therefore, assessed as a moderate (negative).

There is limited mitigation for the Project's adverse impacts of labour force depletion within the control of the Project. People may choose to leave their current employment and take up opportunities with the Project for which they are qualified and experienced. As EPC advances, the contractor will communicate the workforce requirements and the recruitment approach to communities and potential employment candidates to discourage speculative movement of workers out of other industries in the hopes of taking up Project employment; however, people in the AoI communities could leave positions in the public service seeking accessible camp services or unskilled positions during Project construction simply because they may make better wages.

The Project's residual impact of labour force depletion is not mitigated further, as it is largely out of the control of the developer if individuals choose to leave their current employment and take up opportunities with the project. As a result, the residual impact for the Project's impact of labour force depletion is unchanged. The residual impact remains as negative, but of **minor (negative)** significance.

Employment Destabilisation

As Project construction ceases, associated employment opportunities will end. This will be limited to some extent by the nature of the construction workforce. Many are expected to be construction contractors who likely will not lose employment with the cessation of Project construction but will instead be hired for other construction contracts. While many may be able to transition to other construction opportunities, for those who become unemployed at the end of Project construction, the loss of income would have a negative impact on their household and if enough workers cannot transition to other opportunities, there could be noticeable unemployment and economic downturn at the community level. Without mitigation, this potential impact is expected to be of medium magnitude given the potential for many to secure other opportunities, but also in consideration of the destabilising impact on small communities that experienced growth for a short period. The impact would be at the national extent, extending to the entire workforce sourced from within Kenya, and would occur in the medium-term with the end of construction activities. The impact would be most pronounced in AoI communities and counties where there are fewer employment opportunities to return to following the end of Project construction. The Project's potential impact of employment destabilisation is, therefore, assessed as be a moderate (negative).

The adverse impact of employment destabilisation following construction can be mitigated to some extent by having provided workers with experience that could assist them finding a new opportunity. As noted above, personnel working for specialised contractors are not likely to lose employment post-construction, instead being moved to other contracts secured by their employer.

The Project's residual impact of employment destabilisation is lessened with mitigation. With training and retrenchment efforts, the residual impact is negative, but of low magnitude. The impact would be most felt in the AoI communities and would occur over the medium-term throughout construction. The Project's residual impact of employment destabilisation is, therefore, assessed as be a **minor (negative)**.

Training Opportunities

The Project will explore opportunities to train Kenyan Citizens as part of the LCDP and the Employment and Skills Development Plan by liaising with existing institutions (e.g. Morendat Institute of Oil and Gas in Nairobi, local and international polytechnics and universities, certification bodies). Short, intensive courses that meet international certification standards could be delivered following the Final Investment Decision stage as EPC contract parameters become clearer, and the need for various positions is understood. Training would be focused on building capacity in the Kenyan labour force to take up employment and meet targets as outlined in the LCDP. These are positions including:

- Welders;
- Machine operators and drivers;
- Technician and artisan fitters;
- Pipeline coating and insulation artisans;
- Control and instrumentation technicians; or
- Equipment (e.g. pumps, generators) operators and mechanics.

The Project's residual impact of providing training opportunities is positive, and of low magnitude depending on the number of candidates successfully trained, and their placement in Project construction employment opportunities thereafter. Training could be taken up beyond the local area by Kenyan employment candidates, and so is of national extent. Once obtained, training and certification can be of benefit to the local labour force far into the future, even if those employed for construction do not secure operational employment. Many skills developed and with the additional experience can be transferred to other construction projects. The benefits of training and certification thus extend into the long-term. The Project's residual impact of providing training opportunities to the Kenyan labour force is, therefore, assessed as a **minor (positive)**.

Procurement from Kenyan Contractors

Given the large scope of the Project it can reasonably be assumed that procurement requirements will be great. With legal provisions requiring 30% local content (Kenyan), Project construction could result in considerable procurement of goods and, more likely, services from Kenyan contractors. Further, direct spending and contracting associated with Project construction would have indirect and induced impacts reverberating into the broader Kenyan economy in supplier industries. While an estimation of the real value of these impacts is not known at this time, given the large-scale procurement needs of the Project and the potential for a high multiplier on direct purchases the Project's indirect and induced impact in supplier industries would be substantial.

The Project's impact of procurement from Kenyan contractors is positive, and of high magnitude given the likely substantial Project procurement requirements, national legal requirements for Kenyan content in construction projects led by international firms, and indirect and induced impacts in supplier industries. The impact would be felt at the national level where contractors capable of supporting large construction projects are available and would extend throughout Project construction into the medium-term. The Project's impact of procurement from Kenyan contractors is, therefore, assessed as a **major (positive)**.

Mitigation of positive Project impacts is not required. The Project will have a local content plan that takes into account Kenyan law and practice, existing capabilities and capacity building initiatives. Benefit enhancement measures aimed at maximising procurement from local and national contractors will be developed as EPC advances, and the procurement needs of the Project are better understood. Formal procurement processes that maximises opportunities for local contractors, accessible and timely requests for bids, and a simple contract bidding process will be of key importance. It is also recommended that the EPC contractor consider allowing bid packages to be broken into smaller scopes to facilitate participation by single-service contractors. Additional mitigation includes the assessment of capacity of county level businesses to participate in the Project.

Given the legal requirements for local content in Kenya, the Project's potential to generate substantial national procurement opportunities will likely not be impacted by localised benefit enhancement measures. The Project's high magnitude, beneficial impact on the Kenyan economy through the procurement of goods and services from national contractors remains unchanged. The residual impact on the economy remains a **major (positive)**.

7.11.4.3 Tourism

Tourism is a growing sector that has become the second-largest foreign exchange earner in Kenya. In 2017, the sector directly contributed USD $2.8 billion or 3.7% of total national GDP. Tourism is a major economic activity in Lamu county but has underperformed in the past five years due to travel advisories issued by Western countries (Daily Nation 2018a). While tourism performance has improved in the country overall due to enhanced security and domestic and international marketing, hotel occupancy (as measured by bed-nights occupancy) has remained low (KNBS 2018). Tourism and game conservancy tourism are developed in the counties of Samburu, Meru and Isiolo. High potential for tourism development exists in the other counties that provide scenic viewscapes, rich traditional cultures, and an abundance of wildlife. Game conservation has been slowly adopted by pastoralists as an alternative land use that may provide better returns when linked to the tourist market. While the development of the LAPSSET corridor, overall, is expected to enhance tourism in the region, the Project itself is not expected to contribute positively to existing tourism operations along its route. Rather, Project construction may represent a temporary disruption to existing tourism activities.

Disturbances to Tourism During Construction

The Project runs near a number of National Reserves that function as game conservation areas where wildlife viewing, and other ecotourism activities may take place. Most of this form of tourism is centred around wildlife viewing (LAPSSET 2017).

Construction activities have the potential to create sensory disturbances such as noise, vibration, dust, odours, and light pollution. Further, the presence of workers, equipment, and machinery creates visual disturbances that will be particularly apparent on flat, treeless portions of the Project's Right of Way. Such disturbances can impact wildlife movement patterns, potentially driving charismatic species sought for viewing by tourists away from areas of active construction. There is existing concern over the development of linear infrastructure in the LAPSSET corridor related to habitat fragmentation. The Project is expected to exacerbate this issue by creating linear access restrictions during construction. Access restrictions will be removed once construction is complete except for areas immediately adjacent to above ground facilities or stations. Sensory and visual disturbances, as well as access restrictions can also impact the experience of tourists visiting adjacent reserves and game sanctuaries as part of tour groups booked with local operators and influence their decision to take-up local opportunities.

Table 7.11-3 presents the reserves in closest proximity to the Project where sensory and visual disturbances potentially impacting wildlife viewing have the greatest possibility of occurring. Those traversed by the Project have the greatest potential to experience disturbance during Project construction.

Table 7.11-3: Reserves within 10 km of the Project

Reserve		Proximity to the Project
National Reserves	Samburu National Reserve	1 km West
	Buffalo Springs National Reserve	1 km Southwest
	Shaba National Reserve	1 km East
	Nyambene National Reserve	Traversed by the Project
	Rahole National Reserve	Traversed by the Project at the Northern Boundary
	Arawale National Reserve	6 km West
Community Nature Reserves	Meibae Community Conservancy	Traversed by the Project at the Northern Boundary
	Naunyak Wildlife Conservation Trust	Traversed by the Project at the Southern Boundary
	Est Gate Community Conservancy	Traversed by the Project at the Northern Boundary
	Kalama Community Wildlife Conservancy	Traversed by the Project at the Northern Boundary
	Sera Community Conservancy	<1 km North
	Nasuulu Community Wildlife Conservancy	Traversed by the Project at the Eastern Boundary
	Pate Marine Community Conservancy	7 km Northeast

The Project's potential impact of disrupting tourism activities is of high magnitude given the importance of the industry to the national and local economy, the proximity of the LLCOP to potential viewing points and businesses and the level of concern expressed in consultations[7]. Disturbances would be localised to areas of active construction and potentially of more concern in areas that attract tourists, such as the Mathews Range. Given the great length of individual spreads and the simultaneous approach to construction, the impact would be of regional extent; however, the pipeline corridor is typically not immediately adjacent to areas frequently used for tourist wildlife viewing as it follows existing roads at the boundaries of conservancy areas in most instances. Disturbance and nuisance would occur for the period of construction activity in a particular area which may be of several months' duration. It is likely that it would take some time before animals returned to areas formerly under construction (refer to the Biodiversity assessment, Section 7.5.8.2 for further discussion of operational impacts to wildlife). As a result, the impact may extend into Project operations in areas where pipeline was last to be laid. Unmitigated, the Project's potential impact on tourism activities due to construction disturbances is a **moderate** (negative).

Consultation with adjacent conservancies and other stakeholders' including Kenya Wildlife Service will occur prior to commencement of construction activities. Project noise emissions will be managed, and night-time lighting minimised as detailed in the Biodiversity Management Plan. Stakeholders will be engaged to explain

[7] Potential impacts on tourism related to wildlife viewing were raised at consultation meetings in Wamba and in Maralal.

timing and short duration of construction activities and limited time that camps will remain in any one area. Information on construction schedule and activities will be shared broadly so that private guides and safari operators can plan their tours accordingly. Mitigation measures identified in the noise and vibration, air quality, visual and biodiversity assessments should be employed to reduce sensory and visual disturbances to both wildlife and tourists. Some examples of mitigation aimed at reducing sensory and visual disturbances include:

- Installation of noise-dampening mufflers on equipment and installation of noise abatement measures;
- Regular maintenance of vehicles and equipment to reduce emissions;
- Factor seasonal wildlife migration into construction planning to avoid construction in areas of active migration to the greatest extent possible; eg construction will not occur during elephant migration; and
- Limiting night-time construction activities and associated lighting.

With the implementation of mitigation, the Project's residual impact on tourism during construction is assessed as minor, as it may represent a temporary nuisance to wildlife viewing in the vicinity of construction but is unlikely to impact many preferred viewing areas as they are located some distance from the right of way. Furthermore, with consultation (notification of construction schedule and activities) private guides and safari tour operators can plan to take tourists to alternative locations to view and photograph wildlife if any potential issues are identified during the limited period of construction. Disturbances would remain localised to areas of active construction but given the length of individual spreads and the simultaneous approach to construction, would still be of regional extent and may extend into Project operations initially while animals return to the area. The Project's residual impact on wildlife viewing-based tourism is, therefore, assessed as a **minor (negative)**.

Disturbances to Tourism During Operation

Project operations will not involve the same scale of activities potentially disruptive to wildlife viewing-based tourism, the presence of Stations will still create noise, light and visual intrusion. Stations are not in close proximity to one another and are limited in number; however, wildlife may avoid areas adjacent to Stations.

The Project's potential impact on tourism during operations is assessed as being of low magnitude, given the small number of above ground facilities in relation to the overall length of the pipeline and considering the availability of wildlife viewing opportunities elsewhere. Disturbances (e.g. noise, light and visual intrusion) would be localised. Wildlife important to tourism activities are likely to avoid Stations before becoming more tolerant of the permanent change in the landform and associated increase in sensory disturbances (refer to the Biodiversity assessment, Section 7.5.8.2 for further discussion of operational impacts to wildlife). Disturbances could thus impact wildlife viewing into the Project's early operations, but not throughout the lifetime of operations. The Project's potential impact on tourism activities during operation is therefore, assessed as a **minor (negative)**.

Mitigation is unlikely to reduce the impact of above ground facility visibility and the associated impact on tourism during operations. The main attraction to some of the northern conservancy areas, such as the Mathews Range, is their wilderness character and remoteness. However, in this area, the pipeline route follows an existing road and the route of overhead power lines, so the character of this area has already by altered within the immediate vicinity of the pipeline route. As a result, the Project's residual impact on wildlife viewing-based tourism is unchanged and assessed as a **minor (negative)**.

Table 7.11-4: Summary of Potential Impacts, Mitigation, and Residual Impacts during construction

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Macro-economics and Government Revenue	Contribution to Gross Domestic Product	High - long-term - national	Major (positive)	Mitigation of positive Project impacts is not required. Tax payments and levies on oil transported through the Project will be subject to agreed rates, and as a result, would not be subject to benefit enhancement measures. No further mitigation or benefit enhancements are recommended for the Project's impact on macroeconomic conditions or government revenues. Mitigation to reduce price inflation: ■ Local business development and skills training as outlined in Local Content Plan. ■ A Livelihood Restoration Plan will be implemented which will outline livelihood support activities. ■ Pre-mobilisation engagement with stakeholders to explain short duration of construction activities and limited time camps will remain in any one area.	High - long-term - national	Major (positive)
	Revenues generated by sales taxes	Medium - medium-term - local	Moderate (positive)		Medium - medium-term - local	Moderate (positive)
	Local price inflation	Medium - long-term - local	Moderate (negative)		Medium – long-term - local	Moderate (negative)
Employment and Training	National construction employment	High - short-term - national	Moderate (positive)	■ Mitigation of positive Project impacts is not required. ■ Recruitment processes to promote opportunities for employment of local and national personnel as outlined in the Local Content Plan including details of end of contract and demobilisation processes. ■ Develop and implement a competency and skills development programme as outlined in the Local Content Plan.	high – short-term - national	Moderate (positive)
	Local construction employment	Medium – short-term - local	Moderate (positive)		Medium - short-term - local	Moderate (positive)

<table>
<tr><th>Topic</th><th>Potential Impact</th><th>Impact Classification (excluding mitigation)</th><th>Impact Significance (excluding mitigation)</th><th>Mitigation or Benefit Enhancement</th><th>Residual Impact Classification (including mitigation)</th><th>Residual Impact Significance (including mitigation)</th></tr>
<tr><td rowspan="3"></td><td>Labour force shift</td><td>Low – medium-term - local</td><td>Moderate (negative)</td><td rowspan="2">Develop a communication plan which promotes awareness in local communities of the labour requirements and recruitment approach of the Project.
Develop and implement a transparent, non-discriminatory recruitment procedure that includes:
Is transparent and open to all regardless of race, political opinion, colour, creed, sexuality or gender;
A local recruitment strategy;
Considers social and cultural sensitivities;
Describes the employment criteria for the recruitment of professional, semi-skilled and unskilled labour; and
Prohibits discrimination or harassment of job applicants.</td><td>Low - medium-term - local</td><td>Minor (negative)</td></tr>
<tr><td>Employment destabilisation</td><td>Medium – medium-term - national</td><td>Moderate (negative)</td><td>Low – medium-term - local</td><td>Minor (negative)</td></tr>
<tr><td>Training opportunities</td><td>Low - long-term - national</td><td>Minor (positive)</td><td>Local business development and skills training as outlined in Local Content Plan.</td><td>Low - long-term - national</td><td>Minor (positive)</td></tr>
</table>

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Local Procurement	National procurement	High - medium-term - national	Major (positive)	■ Goods and Services procurement processes that promote opportunities for local contractors as outlined in the Local Content Plan.	High – medium-term - national	Major (positive)
Tourism	Construction disturbances to tourism	Medium– long-term - regional	Moderate (negative)	■ Consultation and notification of construction schedule and activities with adjacent conservancies and/or KWS/KFS prior to commencement of construction activities to allow time for planning alternate destinations for wildlife viewing. ■ Engagement during construction with stakeholders to explain short duration of construction activities and limited time camps will remain in any one area (KWS/KFS and Conservancies). ■ Factor seasonal wildlife movements into construction planning to minimise negative impacts.	Low – long-term - regional	Minor (negative)

Table 7.11-5: Summary of Potential Impacts, Mitigation, and Residual Impacts during operation

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Macro-economics and Government Revenue	Contribution to Gross Domestic Product	High – long-term - national	Major (positive)	Mitigation of positive Project impacts is not required. Tax payments and levies on oil transported through the Project will be subject to agreed rates, and as a result, would not be subject to benefit enhancement measures. No further mitigation or benefit enhancements are recommended for the Project's impact on macroeconomic conditions or government revenues. Mitigation to reduce price inflation: ■ Local business development and skills training as outlined in Local Content Plan. ■ Livelihood support activities as outlined in Livelihood Restoration Plan.	High – long-term - national	Major (positive)
	Local price inflation	Medium – long-term - local	Moderate (negative)		Medium – long-term - local	Moderate (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Employment and Training	National operations employment	Low – long-term - national	Minor (positive)	- Mitigation of positive Project impacts is not required. - Formal recruitment processes that maximises opportunities for employment of local county candidates, accessible and timely job postings, and a simple job application process. - Pre-identification of suitable Kenyan employment candidates and contractors per national standards and Local Content Plan. - Develop and implement a job readiness and skills development process as part of the EPC process.	Low – long-term - national	Minor (positive)
	Training opportunities	Low – long-term - national	Minor (positive)	- Develop and implement a job readiness and skills development process as part of the EPC process.	Low – long-term - national	Minor (positive)
Tourism	Operations disturbances to tourism	Low – long-term – regional	Minor (negative)	- Consultation and notification of infrastructure locations and operations with adjacent conservancies and/or KWS/KFS prior to commencement of operational activities to allow time for planning alternate destinations for wildlife viewing if necessary.	Low – long-term - regional	Minor (negative)

7.11.5 Summary of Mitigation

Macroeconomics and Government Revenues

Inflation, or upward pressure on land prices and consumer goods is difficult to fully mitigate. Mitigation to reduce the risk of local price inflation includes:

- Local business development and skills training as outlined in Local Content Plan;
- A Livelihood Restoration Plan will be implemented which will outline livelihood support activities; and
- Pre-mobilisation engagement with stakeholders to explain short duration of construction activities and limited time camps will remain in any one area.

Employment and Training

Benefit enhancement measures aimed at maximising local and national uptake of Project employment opportunities will be developed as EPC advances, and the workforce needs of the Project are better understood. Measures could include:

- Recruitment processes to promote opportunities for employment of local and national personnel as outlined in the Local Content Plan including details of end of contract and demobilisation process;
- Develop and implement a competency and skills development programme as outlined in the Local Content Plan; and
- Develop a communication plan which promotes awareness in local communities of the labour requirements and recruitment approach.

Labour Force Shift and Employment Destabilization

- Develop and implement a transparent, non-discriminatory recruitment procedure that includes:
  - Is transparent and open to all regardless of race, political opinion, colour, creed, sexuality or gender;
  - A local recruitment strategy;
  - Considers social and cultural sensitivities; and
  - Describes the employment criteria for the recruitment of professional, semi-skilled and unskilled labour.
- Prohibits discrimination or harassment of job applicants.

Training

National Procurement

Mitigation of positive Project impacts is not required. Benefit enhancement measures aimed at maximising procurement from local and national contractors will be developed as EPC advances, and the procurement needs of the Project are better understood. Measures could include:

Goods and Services procurement processes that promote opportunities for local contractors as outlined in the Local Content Plan. Tourism

Stakeholders will be engaged to explain short duration of construction activities and limited time that camps will remain in any one area. Mitigation measures identified in the noise and vibration, air quality, visual and fauna assessments should be employed to reduce sensory and visual disturbances to both wildlife and tourists. Some examples of mitigation aimed at reducing sensory and visual disturbances include:

- Consultation and notification of construction schedule and activities with adjacent conservancies and/or KWS prior to commencement of construction activities to allow time for planning alternate destinations for wildlife viewing.;
- Engagement during construction with stakeholders to explain short duration of construction activities and limited time camps will remain in any one area (including KWS and Conservancies);
- Factor seasonal wildlife movements into construction planning to minimise negative impacts.

7.11.6 Summary of Residual Impacts

The Project is expected to represent a highly significant contribution to the Kenyan Economy through GDP impacts and national-level procurement. The Project's employment impact will be pronounced, but largely confined to the construction period, representing a moderately significant impact within the local and national labour forces. The adverse potential impact of the Project in terms of creating price inflation and disturbing tourism activities will be of moderate significance, extending into the early years of operations, while the adverse potential impact of employment destabilization and temporary competition for labour with other, lower paying industries is expected to be of minor significance with mitigation.

7.12 Livelihoods

7.12.1 Introduction

The Livelihoods assessment discusses the LLCOP Project's impacts on dominant livelihood activities along the RoW and in adjacent areas and addresses comments raised by stakeholders during consultation. Issues and concerns related to the impact of the Project on livelihoods as expressed by communities and stakeholders[1] through consultations are presented under each relevant sub-heading and assessed in Sections 7.12-2 to 7.12-5. Issues that were not raised in consultation, but that are of relevance to the ESIA are also addressed below. The Livelihoods assessment predicts potential impacts from Project construction and operations through direct disturbance to livelihood activities, changes in access, and impacts on the resources relied upon. The following topics are the focus of the discussion of livelihood impacts:

- Pastoralism;
- Fishing; and
- Agriculture (including bee keeping).

The Project's impacts on the livelihoods of people and communities living within 25 km (AoI) of the pipeline were assessed and have the potential to be adverse, representing a disturbance to pastoralism, fishing, and agriculture. Where negative impacts are identified, mitigation measures are proposed to minimise the magnitude of the impact. This section goes on to characterise the residual impacts of the Project on livelihoods following the implementation of mitigation measures using socio-economic impact assessment criteria (Table 7.12-1). Potential impacts, mitigation and benefit enhancement measures, and residual impacts are detailed in the sections below, and summarised in the conclusion (Section 7.11.5).

Table 7.12-1:Socio-economic effects analysis criteria

Type of Impact	Magnitude	Geographic Extent	Duration
Positive Impact is beneficial **Negative** Impact is adverse **Neutral** Impact is neither positive nor negative	**Negligible** An impact that does not result in a discernible change from baseline conditions **Low** A discernible impact that is not expected to materially alter the socio-economic feature in question **Medium** A discernible impact that is potentially detrimental but manageable, or potentially beneficial to the socio-economic feature in question **High** A discernible impact that is expected to substantially interfere with or enhance the socio-economic feature in question	**Local** AoI stakeholders / local communities Areas adjacent to the Project site (Figure 7.12-1) **Regional** Counties **National (Economics)** Kenya	**Short-term** Impact is reversible during a phase of construction **Medium-term** Impact is reversible at the end of the two-year construction period **Long-term** Impact is reversible during operations or at closure **Permanent** Impact is not reversible

AoI: Communities within 25 km of the Project. This includes 49 formal communities as well as informal settlements potentially impacted by the Project within the 25 km regional area that will be targeted for benefits.

[1] Additional information on the AoI communities is found in Section 6.13.

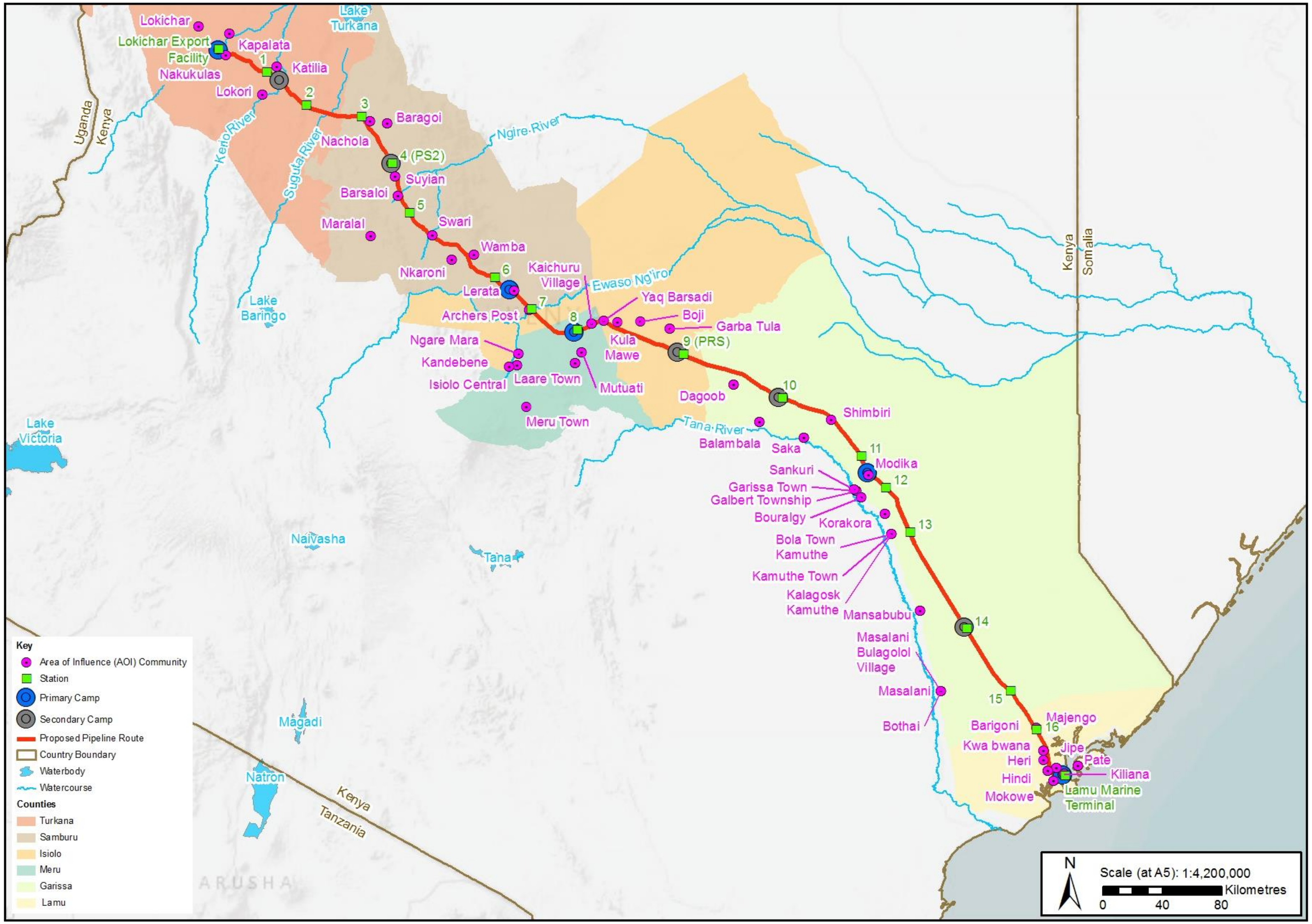

Figure 7.12-1: Location of Area of Influence communities (within 25 Kilometres of the Project)

7.12.2 Issues and Concerns Raised by Stakeholders During Consultation

Consultation activities to inform the ESIA were held in each of the 49 AoI communities near the pipeline RoW. The meetings identified stakeholder issues and concerns relating to livelihoods and other topics. Targeted consultation using focus group discussions with pastoralists, fishers, and women) were also held in communities to obtain specific information regarding land and resource- based livelihoods. Mapping exercises were undertaken so that participants could draw and point out where livelihood activities occur and needed resources are located, relative to the pipeline. Focus group discussions took place between October 2018 and January 2019 and involved 161 separate meetings with groups of participants who could speak on topics such as pastoralism, bee keeping, fishing, women's roles and other socio-economic topics such as community infrastructure, education and employment. Focus group write ups and discussion guides can be found in the Annex II of the ESIA. This section below summarises issues and concerns expressed during consultation with AoI communities and in focus groups in relation to the Project's potential impacts on livelihoods beginning with pastoralism and then lists issues related to fishing and agriculture (including bee keeping). Much of the information contributed in focus groups is common to all communities, as were many of the issues raised. Where information is specific to a particular group or community, this is noted.

Pastoralism

Several common issues and concerns related to pastoralism were expressed during focus group discussions with pastoralists and elders from the AoI communities and during consultation meetings with community members and stakeholders. The key issues and concerns that were raised in AoI communities in most counties crossed by the Project related to pastoral livelihoods include the following:

- The loss of land used for pastoralism, including traditional grazing areas and travel routes and adverse impacts on grazing patterns and livestock and milk production;
- The loss or alteration of important natural resources along the Project corridor and impact on the livelihoods of people and their livestock who depend on them (e.g. pasture, food/medicinal/shade trees, salt deposits, etc.);
- The potential for land degradation and loss of future grazing quality because of Project construction activities, pipeline trenching (i.e. loss of nutrients) and potential pollution from the Project (i.e. contaminants);
- The potential impact of an accident, such as an oil spill or fire on land and subsequent impacts to livestock health and livelihoods;
- The potential adverse impacts of Project activities on water resources (e.g. water catchment areas, water pans, wells, boreholes, etc.) and water flow that livestock depend on;
- Disruption to pastoral movements for people and livestock during Project construction activities because of obstructions from open trenches and other construction activities and during operations; and
- The potential displacement of livestock and risk of injuries or fatalities from Project activities to both livestock and people (e.g. trenches and project construction traffic).

These concerns were used to inform the potential impacts of the Project on pastoral livelihoods.

Fishing

Several issues and concerns related to fishing were expressed during focus group discussions with fishers from the AoI communities and during consultation meetings with community members and stakeholders about the proposed Project. All concerns related to marine fishing or the marine environment. No concerns regarding the Project's potential impacts on fishing were expressed in the AoI communities outside of Lamu County. The key issues and concerns that were raised related to fishing include the following and are addressed in this chapter:

- the potential adverse impacts of oils spills, including fish mortality, drying up of mangroves which will in turn affect fish numbers, and of pollution of water from spills;
- the potential for bioaccumulation in the ecosystem – raised by fishers in Mokowe, Lamu County;
- the potential adverse impacts of noise pollution on fish – raised by fishers in Kililana, Lamu County;
- the potential for decreased fish harvest/catches because of the Project;
- changes in fish migration from the Project, resulting in depleted fish stocks in the area – raised by fishers in Pate, Lamu County;
- the Project may restrict access to the water/fishing areas for fishermen; and,
- the Project may make it difficult to fish with boats at the current levels in those areas – raised in Pate, Lamu County.

These concerns were used to inform the assessment of the Project's potential impacts on fishing livelihoods.

Agriculture

The following issues and concerns related to agriculture were identified during focus groups, and were raised by most communities within the counties traversed by the Project:

- Potential for loss of livelihood, farmland or land for garden crops and animal husbandry if the pipeline crosses their homestead or land;
- Potential for the Project to affect water pans or other water sources (e.g. dams, water catchment areas) used for watering animals; and
- Potential impacts on farming areas used for livestock grazing, crop irrigation and on growth of miraa[2] [3]and on the overall livelihoods of people if they are displaced.

7.12.3 Potential Sources of Impacts

This section identifies Project works and activities that have the potential to generate impacts on livelihoods or jeopardise their continuation. Through identifying the source of potential impacts, this section establishes the "*pathways*" of effect through which the Project could interact with livelihoods in the six counties it traverses. In some cases, it is difficult to separate the Project out from other contributing sources of similar impacts (e.g. dust from Project traffic in a context where local gravel and dirt roads already generate significant dust). Overall, limited agricultural land is affected by the Project, and where agricultural land overlaps with the Project RoW, the land is to be identified by the National Land Commission (NLC). Where these issues arise, this section notes the potential for the Project to act as a source of impact. Later, impacts are classified qualitatively based on contextual knowledge of general conditions along the RoW, and in consideration of the results of consultation

[2] a flowering plant native to the Horn of Africa and the Arabian Peninsula; the addictive herb is chewed for its stimulant effect

[3] Raised specifically in Meru County

and focus group interviews. The level of concern expressed in consultations is considered in assigning significance or importance.

Pastoralism

The Project has the potential to impact pastoralism in direct and indirect ways during Project construction, operations and decommissioning. Direct impacts include the disturbance to, and loss of land and resources resulting in those areas no longer being available for pastoral use (i.e. grazing and browsing areas, salt deposits). Direct impacts can also include obstructions to movement for pastoralists and livestock, affecting their ability to access traditional grazing areas or travel routes, and the impacts of Project noise on pastoralists.

Indirect impacts include changes in the quality of resources used for pastoral activities, such as changes in the quality of vegetation and water which could affect the health and productivity of livestock. The socio-economic context and factors currently affecting pastoralism are also considered in the impact analysis, and how the Project could interact with these existing factors and further impact pastoral livelihoods. The key Project activities and potential impacts on pastoral livelihoods include the following:

Direct impacts:

- Loss of land and resources available for pastoral use (i.e. vegetation, salt licks) during construction and operations;
- Decreased water availability (e.g. abstraction) for pastoralists and livestock during construction and operations;
- Disruptions to pastoral movements from obstructions during construction (e.g. open trenches, security fences);
- Injuries or fatalities to livestock and pastoralists during construction (e.g. road traffic, open trenches); and
- Noise disturbance to pastoralists, including at temporary and permanent settlements, or homesteads (e.g. bomas) during construction and operations (e.g. machinery and generators).

Indirect impacts:

- Decreased grazing and browsing vegetation quality from changes to soils and vegetation during construction and operations (e.g. land degradation, invasive vegetation species, and contaminants); and,
- Decreased water quality during construction and operations (e.g. sedimentation, leaks and spills)

Fishing

The Project has the potential to impact marine fishing during pipeline construction and operations through changes in the availability of fish and other marine resources (i.e. crabs, lobsters and prawns) due to Project effects on their abundance and distribution, and changes in physical access to preferred fishing areas (e.g. marine fishing grounds; see Figure 7.12-3 and Figure 7.12-4). The Project will terminate at an export load-out facility at the Lamu Marine Terminal, where in-shore fishing occurs. While only two fisher focus groups in Lamu (Mokowe and Pate) identified their fishing grounds, which do not overlap with the Project RoW, it is possible that the others in Lamu fish in this area. One Suez max-sized oil tanker vessel is expected to travel through the marine waters in Lamu County about once every ten days, however the port has existing vessels that travel through the area. Changes in the availability of marine resources could occur through changes in their abundance and distribution because of habitat loss and alteration, direct mortality or injury, sensory disturbance, changes in marine water quality and the introduction of invasive or alien species because of the Project, which are discussed below.

The Project also has the potential to affect freshwater fishing in watercourses during pipeline construction through changes in physical access to preferred fishing areas (e.g. local fishing sites) and through changes in the availability of fish because of changes in their abundance and distribution. The Project will cross through the Kerio, Ewaso Ng'iro, and Suguta Rivers, where freshwater fishing occurs. Focus group participants in Lokori and Katilia (Turkana County) reported fishing for tilapia, Nile perch, Labeo, King Fish, carp and catfish in the Kerio River and Suguta River. In Kaichuru, Meru County, respondents reported that tilapia fishing occurs in the Ewaso Ng'iro. Open-cut trenches will be used for the installation of the pipeline. Changes in the availability of freshwater fish could occur from habitat loss and alteration, fish mortality and changes in water quality.

Based on the project description and the understanding of the baseline aquatic flora and fauna and marine flora and fauna conditions, there are aspects of the Project that have been identified as having the potential to present sources of impact to fishing during the construction and operation phases. The potential Project impacts on fishing livelihoods are as follows:

- Changes in the availability of fish in watercourses crossed by the Project during construction (e.g. habitat loss and alteration, mortality from dewatering and changes in water quality);
- Changes in the availability of marine resources (i.e. fish, lobsters, crabs and prawns) during Project construction (e.g. habitat loss and alteration, sensory disturbance, injury or mortality, decreased marine water quality) and during Project operations (e.g. potential pollution, sensory disturbance and introduction of invasive species); and
- Changes in physical access to preferred fishing areas (e.g. marine fishing grounds, local fishing sites) during Project construction.

While noise disturbance to fishers in the Port of Lamu is expected during construction and operations and was raised as a concern by a fisher's focus group in Kililana, this is assessed in the Noise and Vibration assessment (Section 7.2).

Agriculture

The Project has the potential to impact agricultural activities through direct land take and the associated loss of agricultural land for those impacted along the Project's route. The extent of the ability for the Project to impact agricultural livelihoods is limited by the general lack of suitable cultivated land along the route. Other, indirect impacts could also result from changes in water availability, flooding, and soil erosion as a result of changes to surface and groundwater flows from Project water requirements.

7.12.4 Impact Classification

Impacts on pastoralism, fishing, and agriculture-based livelihoods are classified below based on the criteria defined in Section 7.11.1. Impact direction (positive, negative), magnitude, geographic extent, and duration are considered when classifying the overall significance of impacts. Potential impacts are initially classified without the application of mitigation. Where potential impacts are expected to be of beyond negligible significance, mitigation is recommended. The Project's residual impact on livelihoods is then assessed, and final determination of significance is made.

Under each livelihood topic below (i.e. pastoralism, fishing and agriculture), a brief overview of each livelihood is first presented to provide context in relation to the Project, followed by each potential impact on that livelihood. Summary tables are provided at the end of this section outlining the results of each assessment (Table 7.12-2 and Table 7.12-3).

7.12.4.1 Pastoralism

Mobile pastoralism is the dominant livelihood for the arid counties overlapped by the Project, with livestock being the main economic driver. Of the counties traversed by the Project, Turkana, Samburu, Isiolo and Garissa are classified as arid, and Meru and Lamu are classified as semi-arid (Njoka et al. 2016). Kenya's arid-and semi-arid lands (ASAL) comprise more than 80% of the country and supports approximately 4 million pastoralists or 16% of Kenya's population (Repcon, 2017). These ASALs, or rangelands, are characterised by low and irregular rainfall, reoccurring droughts and variations in vegetation growth leading to highly dynamic environments. The unpredictable nature of these arid environments require that herders and their livestock must constantly move over extensive areas and large distances to find available pasture and water. For example, the pastoralists from Masalani, Garissa, indicated that during the rainy season their animals are kept at home or at permanent structures and in the dry season the herders move their animals to other areas, sometimes up to 30 km away, where pasture is available and the community settles temporarily (Focus Group, Pastoralists, Masalani 2018). Pastoralists from the AoI communities in all six counties crossed by the Project indicated that pastoral mobility varies year to year depending on pasture and water resource availability, and different geographic areas are exploited during different periods of the year (Focus Group, Pastoralists, Lokichar, Lokori, Kalapata, Katilia, Baragoi, Barsaloi, Nachola, Suyian, Swari, Masalani, Kandebene 2018). Pastoral mobility is viewed as the most effective strategy to sustain pastoralism as a livelihood in these rangeland environments and to make use of constantly shifting resources.

The context of pastoralism in Kenya has changed over the years because of the impacts of past land use change and access control in pastoral areas, particularly in Samburu, and the viability of pastoral livelihoods is threatened because of the loss of rangelands and restrictions in access to forage and water resources (Lesorogol 2017, Pas 2018). Historically, land use was managed communally, but in some areas of Samburu and Isiolo, there is increased enforcement of boundaries by private landowners and group ranches. For example, in Isiolo County, there continues to be conflict between the traditional grazing systems and the more closed boundary systems that conservancies promote to manage rangelands (NRT 2017). Competition for scarce resources has led to conflict and violence among pastoral communities in northern Kenya, which is in the form of cattle rustling, ethnic violence and displacements (Sharamo 2014). The pastoralists from some of the AoI communities indicated that their migration patterns are driven in part by security concerns (Focus Group, Pastoralists, Ngare Mara, Suyian 2018).

Pastoralists require flexible access to pasture with natural vegetation used for livestock grazing and browsing, as well as for medicinal and other purposes. In addition to pasture, pastoralists from the AoI communities in all six counties crossed by the Project described a variety of natural resources they depend on for their livelihoods and that livestock exploit, including shrubs, larger forage trees and seed pods for animal feed, herbs and medicines, shade trees, water sources, forests and salt/minerals deposits. Access to and availability of these key resources determines the seasonal movements of pastoralists and is central to their livelihood security. The pastoralism impact analysis therefore relies on and integrates the results of the impact analysis of several other technical disciplines to capture the potential impacts on these key resources (e.g. vegetation and water) and to ensure a more robust analysis and holistic approach is taken. The results of the following technical disciplines have been integrated into the pastoralism impact assessment:

- Noise and Vibration (Section 7.2);
- Water Resources (Surface Water and Groundwater) (Section 7.3);
- Soils, Geology and Geohazards (Section 7.4);
- Ecological Impacts - Terrestrial Flora and Fauna (Habitats and Species of Concern) (Section 7.5); and
- Ecosystems Services (Section 7.13).

Construction Phase

Loss of Grazing Land and Natural Resources

Project construction activities will result in the direct disturbance to land and potential loss of traditional grazing areas and other natural resources used by pastoralists and their livestock. The variety in livestock species reared by pastoralists have different nutritional requirements and in addition to pasture with grasses, the pastoralists depend on other natural resources to sustain their herds, including shrubs, larger forage trees and seed pods for animal feed. In general, cows, goats, sheep, camels and donkeys are reared, with cows, goats and sheep being the predominant species managed in most counties. Detailed information regarding specific vegetation species used by pastoralists and their livestock was not provided during focus groups discussions in the AoI communities; however, the *Acacia tortilis* tree was identified as a critical and culturally significant resource by pastoralists and elders in general, and in Samburu, pastoralists indicated they use its seed pods and leaves for animal feed (Focus Group, Elders Baragoi 2018; Focus Group, Pastoralists, Baragoi, Barsaloi and Swari 2018). Trees also provide shade, fruit, herbs and medicines which are utilised by both livestock and herders, and firewood is also used by pastoralists.

The Project working width of 26 meters is dominated by Somalia-Masai Acacia-Commiphora deciduous bushland and thicket (64.0%), followed by Acacia-Commiphora stunted bushland (15.7%), and also comprises Somalia-Masai semi-desert grassland and shrubland (5.6%) and edaphic grassland on drainage-impeded or seasonally flooded soils (4.4%) vegetation communities (Table 7.5-5) that pastoralists can access and their livestock can exploit. Salt deposits are also used by livestock to obtain minerals in their diet. Concerns were raised by pastoralists and other community members in AoI communities in all six counties crossed by the Project about the loss of traditional grazing lands and vegetation, and the loss of other important natural resources (e.g. food/medicinal/shade trees, salt deposits, etc.) because of the Project and resulting impacts on the livelihoods of people and their livestock who depend on them.

The potential loss of grazing land and other natural resources will occur because of Project clearing and construction. Wherever possible, the Project will utilise existing tracks and roads that already comprise modified habitat. Permanent land disturbance will occur because of the construction of stations along the route and could potentially result in the permanent loss of grazing land within the fenced areas of each station.

The dominant land tenure overlapped by the Project that spans all six counties is community lands, which is predominantly used communally for grazing under ranches, conservancies or Elder controlled grazing use (Social Baseline Report 2019). Pastoralists have some access to community conservancies, which are managed for both wildlife conservation and rangelands and also community nature reserves, but they do not have access to National Parks, National Reserves, or private nature reserves, private protected areas and private ranches (Figure 7.12-2). Loss of communal land used for grazing during Project construction may exacerbate existing pressures experienced by pastoralists as discussed below, assuming that pastoralists interviewed from the AoI communities would use much of the land available in the counties crossed by the Project for herding due to their requirements for large distance travel to find available pasture and water.

Existing Pressures on Pastoralist Livelihoods

Pastoralist livelihoods continue to be threatened by the loss of access to grazing land to ranching, conservancies, agriculture and settlements. In Samburu, there has been a rapid growth in the formation of community-based wildlife conservancies that limit livestock access to large areas of pasture. As a strategy to diversify the economy, land is slowly being converted to agriculture and large-scale irrigation schemes in many areas. Human population growth and increased settlements and sedenterisation in general have also reduced the amount of lands available for livestock use. Remaining pastoral lands have become degraded from increased exploitation pressure and overgrazing and several grazing areas in Samburu and Turkana are undergoing accelerated degradation, limiting their capacity to support livestock production for pastoralists.

Pastoralists in general are also facing reduced land productivity because of more frequent droughts and unpredictable rainfall in Kenya in recent years (SCG and WFP 2015, Orindi et al. 2007). In times of drought, pastoralists move into neighbouring counties and compete for limited resources, particularly from neighbouring counties into Isiolo County's Ewaso Ng'iro riverbed region, from Garissa into Lamu County, and from Samburu to parts of Marsabit and Isiolo. Access to grazing land has also been constrained due to security threats and conflict within and between pastoral communities driven by competition for scarce natural resources. In Samburu, several grazing areas are not used because of insecurity and violent conflict from neighbouring communities and many Samburu herders have moved to neighbouring Laikipia County where land tenure is insecure (Lesorogol 2017).

Pastoralists from the AoI communities in all six counties crossed by the Project indicated during the focus group discussions that they use different traditional grazing and browsing areas throughout the year and during the dry and rainy seasons.

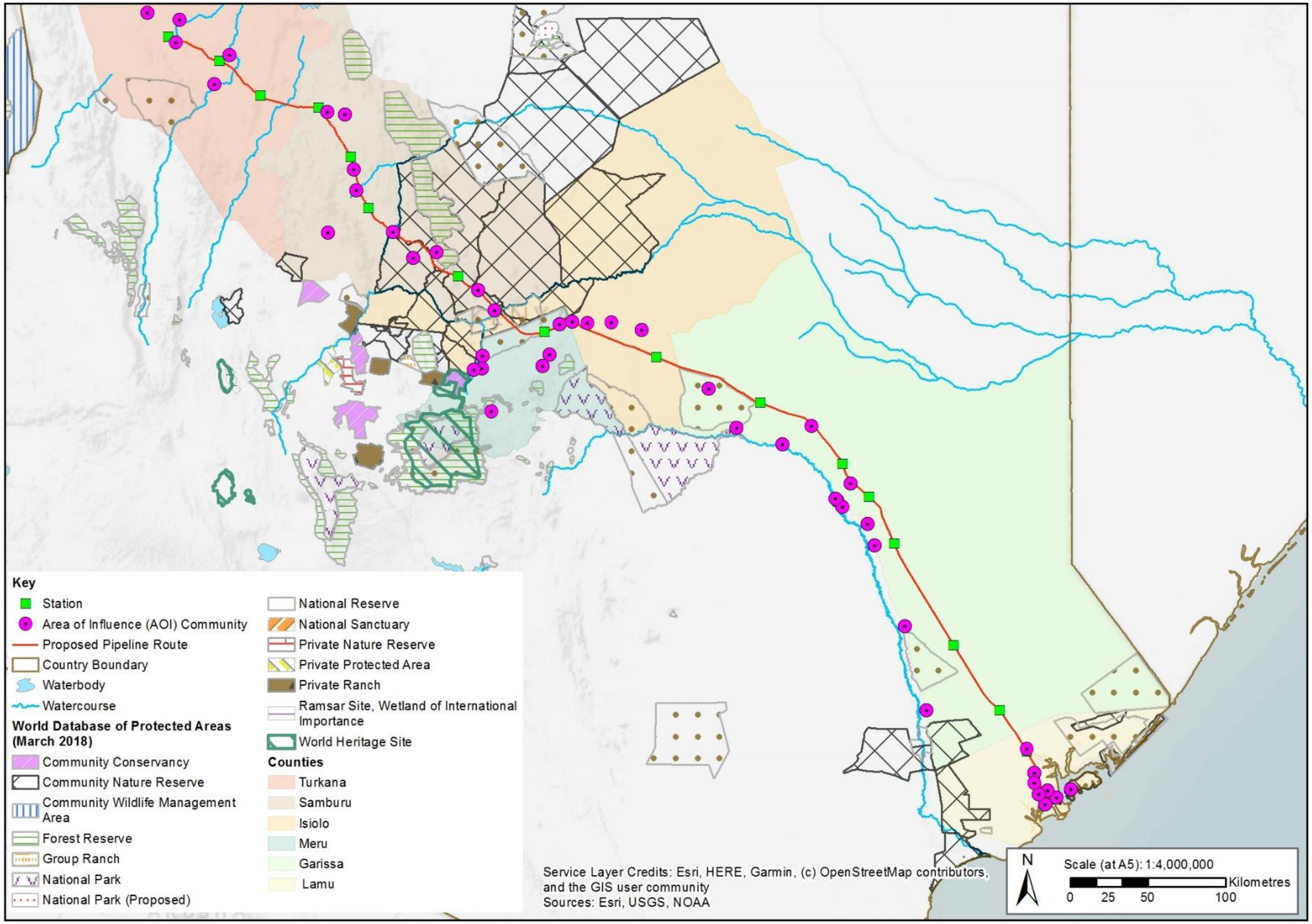

Figure 7.12-2:Protected Areas in the vicinity of the Project

Although the total area of land that will be temporarily unavailable during Project construction is relatively small, the impacts to pastoral livelihoods will vary, depending on how pastoralists manage risk. In general, pastoralists have strategies to manage risk, including diversifying their income and keeping large herd sizes, and livestock herders and families in the AoI communities who have access to different strategies may be more resilient to land use changes than those who have fewer risk management strategies (Ashiba 2018, Shaughnessy 2018). During focus group discussions with pastoralists from the AoI communities in Samburu, they reported that herd size varies based on factors such as climate and wealth, with poorer families managing smaller herd sizes. For some pastoralists, the loss of land as a factor of production has the potential to reduce food and livelihood resilience and make them and their families more vulnerable to poverty, particularly families who lost livestock during the 2017 drought in Kenya and still face considerable food gaps (Repcon, 2017; GOK, 2018).

Women from the AoI communities in Samburu and Isiolo reported that they generally view their households as food insecure (Focus Group, Women, Archers Post, Baragoi, Barsaloi, Lerata, Nachola, Nkaroni, Suyian, Swari, Wamba 2018; Focus Group, Women, Boji, Garba Tula, Isiolo Central, Ngare Mara, Yaq Barsadi 2018). The additional loss of grazing land and other natural resources during Project construction may increase the vulnerability of some pastoralists and their families, particularly those still recovering from the effects of the 2017 drought, and with few strategies to manage risk. However, the impact on pastoral livelihoods in general is expected to be small given the relatively small Project footprint that will result in both permanent and temporary disturbance to grazing lands.

Prior to mitigation, the Project's potential impact of the loss of grazing lands and natural resources during construction is of low magnitude, given the small amount of vegetation disturbance that would occur. The impact would be experienced locally in each county and grazing lands and natural resources along the RoW during Project construction would be unavailable for pastoral use in the medium-term[4] for the working width of 26 m, but permanent for the stations. The Project's pre-mitigation potential impact on grazing land and resource availability is, therefore, assessed as a **minor (negative)**.

The following mitigation measures will be implemented to minimise the impacts of potential loss of grazing lands during construction:

- The construction schedule will be communicated to county and local leadership;
- All work and disturbance will be restricted to the approved working width, approved camp and laydown areas, and approved access roads; and,
- A livelihood restoration plan will be implemented to ensure no adverse impacts to livelihoods at a community level.

Mitigation measures that will be implemented to minimise the impacts on terrestrial biodiversity during construction also apply to potential loss of grazing lands during construction and can be found in Section 7.5.8.3.

The Project's residual impact to pastoral livelihoods from loss of grazing land and other natural resources during construction is assessed as negative and low in magnitude, given effective implementation of livelihood restoration activities. The impact will be localised to the Project RoW and be medium-term (i.e. working width) to permanent (i.e. stations). The Project's residual impact on pastoralism from loss of grazing land and other natural resources, therefore, is assessed as unchanged at **minor (negative)**.

[4] For the purpose of social impact assessment, the two-year construction period is defined as medium-term (Table 7-11-1).

Quality of Grazing and Browsing Resources

The Project has the potential to adversely affect the quality of vegetation during construction due to a number of factors, including changes in soil quality, invasive vegetation species, and habitat degradation from contaminant spills or accidents. These impacts may affect the quality of grazing and browsing resources along the pipeline route, and subsequently potentially affect the health of livestock. Pastoralists and other stakeholders from several AoI communities in all six counties raised concerns about the potential impacts from the Project on grazing lands and other natural resources and subsequent impacts on the production of livestock and pastoral livelihoods (Focus Group, Pastoralists, Kalapata 2019, Suyian 2018; Lorakora, 2018; Meeting, Garba Tula 2018). Pastoralists interviewed in Lokichar, Turkana also expressed concerns about the potential degradation of the environment because of the Project (Focus Group, Pastoralists, Lokichar 2019).

The materials used in the construction of access roads have the potential to influence natural vegetation and affect grazing quality. Surface water run-off from new or upgraded service roads and tracks may alter the soil or substrate quality, potentially altering natural vegetation communities to modified ones (Section 7.5.6.1; Terrestrial and Aquatic Biodiversity). Vegetation degradation could also occur in the event of a construction fire from re-fuelling of equipment and machinery, the storage of fuel and third-party vandalism, contributing to decreased grazing quality and loss. The potential impacts of environmental risks and accidents are assessed in Section 7.14

During construction, there is the potential for the introduction or spread of exotic and invasive species on or near the Project footprint, which may alter natural vegetation and change the quality of grazing for livestock (Section 7.5.6.1). Invasive species can cause severe detrimental impacts to local ecosystems. Seven invasive plant species were recorded in the AoI, including *Opuntia vulgaris, Datura stramonium, Prosopis juliflora, Setaria verticillate, Solanum campylacanthum, Tagetes minuta and Xanthium strumarium* (Section 7.5.8). Riparian vegetation communities appeared to host more invasive plant species than other habitat communities. There is also the potential for impacts to soil quality or soil loss due to erosion during the construction phase, which could also impact grazing quality (Section 7.4.8.1 Soils, Geology and Geohazards).

Changes in soil quality because of ground disturbance during construction was assessed as medium magnitude, while topsoil handling and storage (admixing, organic carbon loss, salinity changes) was assessed as a low magnitude impact on soil quality (Table 7.4-7; Soils, Geology and Geohazards). Potential impacts on habitat types in community conservancies was assessed as medium magnitude, and potential impacts on other habitat types where livestock grazing is permitted was assessed as low magnitude (Table 7.5-8, Terrestrial and Aquatic Biodiversity).

Prior to mitigation, and considering the results of the Terrestrial and Aquatic Biodiversity impact assessment related to invasive plant species, and the results of the Soils Geology and Geohazards impact assessment related to changes in soil quality, the Project's potential impact of changes in the quality of grazing and browsing resources during Project construction is of low magnitude. Given the mobile and temporary nature of the construction Project, any impacts to the quality of vegetation because of invasive species during construction are unlikely to contribute measurably to vegetation degradation and impact livestock health or productivity, particularly because much of the habitat within the Project footprint is already degraded and under competitive pressure from non-native and invasive species. The impact would be localised and would be medium-term during Project construction. The Project's pre-mitigation potential impact on the quality of grazing and browsing vegetation resources is, therefore, assessed as a **minor (negative)**.

The following mitigation measures will be implemented to minimise the impacts of potential changes in the quality of grazing and browsing resources during construction:

- All work and disturbance will be restricted to the approved working width, approved camp and laydown areas, and approved access roads; and,

In addition, mitigation measures that will be implemented to minimise the impacts on terrestrial biodiversity and soils during Project construction also apply to potential changes in the quality of grazing and browsing resources and can be found in Section 7.5.7 and 7.5.8.1.

The Terrestrial Biodiversity impact assessment determined that, during construction, the magnitude of residual impacts to different habitat types from the introduction and spread of invasive vegetation species was low for community conservancies (i.e. Nakuprat-Gotu, Namunyak Meibae, Kalama, Sera and West Gate) and negligible for other habitats where livestock grazing is permitted along the Project route (Table 7.5-8). The Soils, Geology and Geohazards impact analysis determined that residual impacts on soil quality during construction from topsoil handling and storage was low magnitude for all soil types along the pipeline route (Section 7.4-7).

Considering these results, and with the implementation of mitigation measures, the Project's residual impact to pastoral livelihoods from decreased quality of grazing and browsing resources is assessed as negative and low in magnitude, since the potential introduction or spread of invasive species and changes in soil quality is expected to be small and not materially alter pastoral livelihoods. Decreased quality of vegetation resources is expected to be localised during construction and would occur over the medium-term. The Project's residual impact on pastoral livelihoods from changes in the quality of grazing and browsing resources is assessed as unchanged as **minor (negative)**.

Availability and Quality of Water

The Project has the potential to affect water availability or quality through direct and indirect impacts during construction activities, and subsequently affect the health and productivity of livestock (Section 7.4.8.1). Concerns were expressed by pastoralists and other stakeholders in AoI communities in all six counties crossed by the Project about the potential adverse impacts of Project activities on water sources (e.g. rivers, water catchment areas, traditional water points, springs, wells, boreholes, etc.) and water flow that livestock depend (Focus Group, Pastoralists, Lokori 2019, Nachola 2018, Laare Town 2018, Kamuthe 2018, Barigoni 2018).

Surface watercourses and waterbodies (e.g. main rivers, seasonal rivers and luggas) may be impacted directly or indirectly because of activities in or near them during construction. Direct impacts could result from discharging a substance into surface water, directly impacting surface water quality, or taking groundwater from a borehole, which would directly impact groundwater availability. Indirect impacts on water quality could result from discharges, leaching, leaks or spills to the ground that are then transported to surface water or groundwater (Section 7.3.8.1).

Alongside rangelands, sources of potable water for both people and livestock are the second most important resource for pastoralism, and the availability of water determines the level of utilisation of resources, with herds moving as soon as water sources are depleted (Repcon, 2017). The pastoralists from the AoI communities reported during focus group discussions that they migrate with their livestock in search of pasture or water, depending on the seasons and in response to the intermittent rainfall distribution and patchy vegetation productivity.

The main sources of water utilised by pastoralists and their livestock from the AoI communities include directly from local rivers (permanent and seasonal), dams, springs, water pans, shallow hand dug wells in luggas, hand pumped wells and boreholes (Focus Group, Pastoralists, Lokori, Kalapata, Katilia, Lokichar, Nachola 2018; Suyian,; Baragoi, Barsaloi 2018; Swari, Kaichuru, Laare, Kandabene, Bouralgy, Garissa Town, Korakora, Sankuri, Kamuthe, Saka, Masalani, Dagoob, Mokowe, Jipe and Hindi 2018). The Water Resources impact assessment identified primary receptors that could be impacted by changes in water quality and quantity/availability as main permanent/perennial rivers (Kerio, Suguta and Ewaso Ng'iro), seasonal rivers and the extensive network of ephemeral streams and luggas, as well as groundwater in aquifers (Table 7.3-3). Site-specific information for water sources or points used for pastoralism was not provided during focus groups discussions, and sources are variable from year to year depending on several factors; therefore, any impacts to surface water or groundwater or surface water are considered possible sources of impact to pastoralists and livestock along the Project route.

The source (or sources) of water for commissioning (hydrotesting) activities and water demand is currently unconfirmed. Water could be taken from surface watercourses which could directly impact flows. If water is taken from the ground, this could impact existing water levels (Section 7.3.8.1). If water is taken from surface watercourses or flow is blocked to allow in-channel construction, it could directly impact the availability and quality of water for pastoralists and their livestock. Further characterisation of the water environment and water use by pastoralists at the selected abstraction location(s) would be required prior to construction. The incorporated mitigation means that hydrostatic test water will be obtained in accordance with applicable regulations and abstraction and discharge will occur in the same catchment, where possible. Water demand will also be reduced by water reuse where possible.

The Water Resources impact assessment determined that during construction, the magnitude of potential indirect impacts to water users from changes in water quality was medium because of increases in suspended solids, discharge of pipeline testing water, and low because of trench backfilling with non-inert materials (Table 7.3-4). The magnitude of potential indirect impacts to water users from changes in water quantity/availability was medium because of abstraction for pipeline hydrotesting water and for construction water needs (including construction camp water), and low for work in watercourses, or discharges of large volumes, leading to changes in the flow regime and flooding (Table 7.3-4). The magnitude of potential indirect impacts to water users from changes in water quality was medium for ground disturbance leading to increased suspended solids and discharge of pipeline testing water, and low for trench backfilling with non-inert materials (Table 7.3-4). All other potential impacts to water users from changes in water quality or quantity during construction were assessed as negligible.

Pastoralists are already facing water scarcity in Kenya's ASALs which are characterised by recurrent droughts, hot and dry climates with low and erratic rainfall patterns. Water availability typically varies throughout the year and depends on the seasons, but there are severe shortages of surface water during times of drought. Water shortages are anticipated to worsen because of the effects of climate change and increasing demand for water because of human population growth and increase in withdrawals for agriculture. Changes in the availability of water during Project construction may compound existing impacts experienced by some pastoralists and their families and threaten the productivity of livestock.

Prior to mitigation and considering the results of the Water Resources impact assessment related to potential changes in the quality and quantity/availability of water for pastoral use, the Project's potential impact to water quality and availability for pastoral use during Project construction is of medium magnitude. Depending on the sources of water that are impacted, changes in the quality or availability of water for some pastoralists are expected to be potentially detrimental but manageable. The impact would be felt locally but occur across all counties where water resources that are used pastoralists are impacted, and would occur through Project construction, and therefore would be medium-term. The Project's potential impact on water availability and quality is, therefore, assessed as a **moderate (negative).**

The following mitigation measures will be implemented to minimise the impacts of changes in the quality and quantity/availability of water before and during construction:

- Pre-construction hydro-census work specific to the area where abstractions are proposed. Abstraction will be within location specific consented volumes and rates, and testing will be undertaken in accordance with the guidelines provided in IFC (2007). The testing procedures and controls will be detailed in a hydrostatic testing plan.
- Prior to construction, local hydro-census work will be undertaken to identify and characterise local water users. The details of this will be presented in the Water Management Plan, but will include the locations of the water sources, the source of the water, details of how the water is collected, how many people rely on the water, the depth to groundwater sources, when the water is used and what the water is used for. If impact on local water supplies could occur, an alternative, equivalent water supply will be provided to users throughout the construction period.
- When working in water courses and in riparian areas adjacent to watercourses, suspended solid management techniques (such as settlement ponds/traps, silt fences, and water treatment) will be used. The procedures being followed will be inspected and monitored throughout construction.
- A hydrostatic testing plan for each spread of pipeline construction will be developed. This will include details of the permitted sources of water, licensed abstraction rates (if applicable), required source water quality, required discharge water quality and rates, the discharge locations, treatment methods (if required), monitoring.
- Monitoring of water quality, water flows and participatory environmental monitoring.
- A complaints and grievance management procedure will be implemented.
- Implementation of the Livelihoods Restoration Framework.

In addition, mitigation measures that will be implemented to minimise the impacts on water resources during Project construction also apply to potential changes in the quality and quantity/availability of water for pastoralists and can be found in Table 7.3-4.

The Water Resources impact assessment determined that, during Project construction, the magnitude of residual impacts to water users from changes in the quality and quantity/availability of water was negligible for all potential impacts (Tables 7.3-4). With consideration of these results, and with the implementation of the mitigation measures described above, the Project's residual impact to pastoral livelihoods from changes in the quality and availability of water are assessed as negative and low in magnitude, since there will be a discernible impact of changes in water quality and quantity, but it is not expected to materially alter pastoral livelihoods. The residual impacts of changes in water will be localised. The Project's residual impact on pastoral livelihoods from changes in the quality and availability of water, therefore, is assessed as **minor (negative)** with additional mitigation.

Disruption to Pastoral Movements

Project construction activities, including the open trench and Project equipment has the potential to create barriers to movement for pastoralists and their livestock to access and/or traverse traditional grazing areas and water points. Pastoralists and other stakeholders from some of the AoI communities in all six counties raised concerns about the potential disruption to pastoral movements during Project construction activities because the open trenches and other activities (Focus Group, Pastoralists, Lokichar 2019, Baragoi 2018, Barsaloi 2018, Dagoob 2018; Hindi 2018; Meetings, Yaq Barsadi 2018; Kaichuru Village 2018). Herders in Isiolo County follow routes to places such as Daaba and Hillout which are approximately 20 kilometres from the community of Ngare Mara (Focus Group, Pastoralists, Ngare Mara 2018). Areas such as Kinna, Kulamawe, Magado and Rapsu are more than 100 km away. Pastoralists in Garissa County reported that during the dry season, they move their animals to areas where pasture is available, up to 30 km away (Focus Group, Pastoralists, Masalani 2018).

The length and duration of open trench segments will vary in each county and is determined by several factors, including scheduling, terrain and road access. Pipeline construction will be broken into manageable lengths consisting of six spreads, which will be constructed concurrently. The construction rate is estimated to be approximately 1 km per day, and the maximum period of an open trench in any given location will be approximately two weeks. Pastoralists affected by construction activities will be required to navigate around the open trenches to access resources, potentially using non-traditional travel routes, which may increase the time it takes to reach traditional grazing areas or water. Pastoralists may also be affected by construction traffic on new roads if they frequently use or cross local roads that are used by construction traffic.

Pastoralists require flexible access to large areas of grazing land in search of pasture, water and sometimes security (Repcon 2017). However, pastoral mobility patterns in northern Kenya, including the Project area, has changed dramatically over the last few decades because of decreased pasture and water availability, and the enforcement of boundaries by private landowners and group ranches. The growth of community-based wildlife conservancies also limits livestock access to large areas of pasture (Lesorogol 2017). In some areas, particularly in Samburu County, the need for long distance pastoral mobility is increasing because of a shrinking grazing resource base and new rules of access. Pastoral movement is also determined by security concerns related to increasing conflict between communities and cattle rustling driven by competition over limited resources, as indicated by pastoralists from some of the AoI communities during focus group discussions (Focus Group, Pastoralists, Ngare Mara, Suyian 2018)..Pastoralists from Suyian, Samburu County indicated during focus groups discussions that they are required to graze their livestock far from their communities as a security measure against threats from other hostile communities. These factors restricting seasonal migration to reach pasture and water have contributed to the decline in viability of pastoral livelihoods in northern Kenya (Repcon, 2017).

Impacts to pastoral movement imposed during Project construction are not expected to be experienced by all pastoralists equally and will depend on the construction schedule within each spread and how it coincides with traditional travel routes used by livestock herders to access seasonal grazing areas and water. The pastoralists from the AoI communities in all six counties indicated during focus group discussions that pastoral mobility varies year to year depending on pasture and water resource availability, and different geographic areas are exploited during different periods of the year (Focus Group, Pastoralists, Lokichar, Lokori, Kalapata, Katilia, Baragoi, Barsaloi, Nachola, Suyian, Swari, Masalani, Kandebene 2018). Pipeline construction is expected to commence during the beginning of the dry season, and the open trench will present a barrier to pastoral movement at specific locations during the short construction period. Post construction, the open trench will be covered with excavated material and the area rehabilitated, and the movement of pastoralists and their livestock will no longer be limited.

Prior to mitigation, the potential impact of disruptions to pastoral movements as a result of Project construction is of low magnitude, since the open trench will impose a temporary barrier to pastoralists who require flexible access to large tracts of land. The impact will be experienced locally, and open trenches are expected to be open approximately two weeks in any given area, but disruptions to pastoral movements will occur over the entire construction period and therefore will be medium-term. The Project's pre-mitigation potential impact on the movement of pastoralist movements is, therefore, assessed as a **minor (negative)**.

The following mitigation measures will be applied to minimise the impact of disruption to pastoral movements during construction:

- The construction schedule will be communicated to county and local leadership;
- The length and duration of open trench segments will be minimised at any given time; and
- All work and disturbance restricted to approved working width, approved camp and laydown areas, approved access roads.

The residual impact to pastoral livelihoods from disruptions to pastoral movements will be negative and low in magnitude, given the mobile and localised nature of Project construction. Given the short-term period that pastoral movements will be disrupted at any given location, the Project's residual impact to pastoralism is, therefore unchanged and assessed as **minor (negative)**.

Livestock Injuries or Fatalities

Pastoralists from several AoI communities in Turkana, Samburu, Meru and Garissa counties expressed concerns about the potential displacement of livestock and risk of injuries or fatalities to livestock and herders from Project activities (e.g. trenches and road traffic) (Focus Group, Pastoralists, Kalapata 2019; Baragoi, Barsaloi, Suyian, Kaichuru Village, Saka 2018). Potential injuries or fatalities to people, including herders because of Project accidents are addressed in Community Health, Safety and Security (Section 7.10.4). During construction activities, there will be an open trench and increased vehicle traffic which has the potential to cause injury or fatalities to livestock. Trenches excavated during construction will remain open for approximately two weeks during which time livestock may be at risk of becoming injured.

The local road system will be used when transporting goods to storage areas and local roads and the RoW will be utilised to transport goods from the primary storage facilities to the secondary storage facilities wherever possible to minimise the amount of new access roads that are required to be built. When combined with existing daily traffic, this increase in traffic on local roads and new access roads during construction may result in injuries or fatalities to livestock because of vehicle collisions.

As part of their livelihood strategy, mobile pastoralists use flexible mechanisms including rearing large and diverse herd sizes and practicing herd separation and splitting. According to pastoralists, household herd size varies in the AoI communities based on numerous factors, including wealth and climate; for example, in Turkana, the average household herd size ranged from 50-500 goats/sheep, 5-220 cows, and 10-700 camels (Focus Group, Pastoralists, Lokori, Kalapata, Katilia 2019). These numbers were relatively similar in Meru, with household herd size ranging from 500-800 goats/sheep, 200-400 cows and up to 700 camels. In contrast, household herd size in Samburu was lower, ranging from 100-200 goats/sheep, 30-50 cows and 30-40 camels (Focus Group, Pastoralists, Barsaloi, Swari, Suyian, Baragoi 2018), and in Isiolo ranged from 30-150 cows (Focus Group, Pastoralists, Ngare Mara 2018). In Garissa, pastoralists reported the average household herd size as ranging from 20-700 goats/sheep, 30-100 cows and 80-100 camels (Focus Groups, Pastoralists, Korara, Kamuthe, Masalani 2018. Livestock herders typically travel together in large groups with their livestock, according to lineage or family ties. In Isiolo, on average a group of between five to ten herders travel together with approximately 600 to 1,000 cows. The risk of an injury or fatality for individual animals is expected to increase as the herd size increases and the number of herders managing the herd decreases.

Several different travel routes were reported to be used by pastoralists in the AoI communities to access traditional grazing areas, which typically extend from homesteads and sometimes parallel rivers or roads. While it is unknown whether these travel routes cross the pipeline route, herders and livestock that use travel routes that parallel or cross local roads are already at greater risk of collisions, and this is expected to increase because of Project construction traffic. The loss of livestock can have devasting consequences for pastoralists and families who rely on livestock for sustenance and to generate income. As discussed under *Loss of grazing land and other natural resources* above, pastoralists manage risk by diversifying their income and keeping large herd sizes, among other strategies. It is expected that wealthier families who own greater numbers of livestock and have diverse income sources would be more resilient to the loss of individual animals. Conversely, households that own only 10 to 30 animals and rely on pastoralism as their sole source of income would be more vulnerable to the impacts of livestock injury or fatality.

Prior to mitigation, the potential impact of livestock injuries or fatalities as a result of Project construction is of medium magnitude, since the impact is expected to potentially be detrimental to the livelihoods of pastoralists but manageable. The impact would be experienced locally, and the potential risk of livestock injuries or fatalities would be medium-term during the construction period, however, the loss of one or more animals would be permanent. The Project's pre-mitigation potential impact on pastoral livelihoods because of livestock injury or fatality is, therefore, assessed as a **moderate (negative)**.

The following mitigation measures will be implemented to minimise the impact of livestock injuries or fatalities during Project construction:

- The length of open trench will be minimised in all areas;
- All areas of open trench will have safety signs;
- Regular safety patrols will occur along construction areas and the open trench;
- Trenches will be provided with escape ramps for animals (i.e. wildlife and livestock);
- Project traffic to comply with Project speed and safety requirements, including restrictions on night-time driving;
- To reduce interference with public traffic and transportation, the pipeline RoW will be used where practical and safe for the transportation of goods and equipment between storage yards and the site;
- Road safety will be managed through a traffic management plan; and
- A complaints and grievance management procedure will be implemented to compensate pastoralists for livestock injury or fatality due to the Project.

Working areas which create a potential hazard to the public will be cordoned off to prevent access by the general public (including herders and livestock) during construction. Injuries or fatalities to livestock from vehicle collisions will be minimised with the implementation of a traffic management plan and appropriate vehicle speed limits. However, even with mitigation measures, the potential for accidents from vehicle collisions during construction activities still exists, given the increase in traffic on local roads required for the Project, combined with the large-scale movements of pastoralists and their livestock.

The impact of losing one or more animals due to vehicle collisions will not be experienced equally among pastoral households depending on their resilience to risk; However, these impacts will be minimised with the implementation of a grievance management procedure which will be communicated with pastoral communities and compensation rates for loss of livestock, depending on the circumstance. The residual impact to pastoral livelihoods from injuries or fatalities to livestock during Project construction is therefore considered to be of low magnitude. The residual impact will be localised. The Project's overall residual impact to pastoral livelihoods because of livestock injuries or fatalities, therefore, is assessed as **minor (negative).**

Noise Disturbance

Pastoralists from AoI communities in Samburu, Meru and Garissa counties expressed concerns during focus groups discussions about the potential adverse impacts of noise pollution because of Project construction activities (Focus Group, Pastoralists, Baragoi, Kaichuru Village, Laare Town, Korakora 2018). Noise levels during construction are expected to increase during pipeline and station construction activities (Section 7.2.9; Noise and Vibration).

Noise levels are expected to increase, on occasion, because of construction activities, and may disturb pastoralists within the vicinity of the Project footprint, but construction noise will be temporary, intermittent, and limited to the vicinity of construction activities (Section 7.2.9.1; Noise and Vibration). The range in increased noise levels associated with construction activities will depend primarily on the number and type of noise sources and their proximity to pastoralists (i.e. the Project noise levels in the environment generally decrease as the distance between the receptor and construction activities increases).

The Kenya Noise Regulations set out a construction daytime average noise level limit of 60 dBA and a night-time average noise level of 35 dBA at health facilities, educational institutions, and residential type receptors (Table 7.2-4; Noise and Vibration). In the absence of mitigation, the Noise and Vibration impact assessment determined that noise levels during construction would exceed Kenya's Noise regulations limit of 60 dBA for the AoI communities of Archer's Post (Samburu) and Lamu Port (Lamu), resulting in high magnitude impacts (Table 7.2-11). Archer's Post is approximately 50 meters from the construction corridor, where there is the potential for pastoral activities to occur, but no pastoral activities are expected near Lamu Port. Medium magnitude impacts were identified for the AoI communities of Kaichuru (Meru), Kiliana (Lamu) and Majengo (Lamu) because of predicted changes in noise levels from baseline conditions. Pastoral activities (i.e. communal grazing) were reported to occur near Kaichuru Village in Meru (Focus group, Pastoralists, Kaichuru Village 2018)

Pastoralists using grazing lands or travel routes close to Archer's Post and Kaichuru Village in particular, and within 1.5 km of the RoW are expected to experience increased noise levels during Project construction that exceed the daytime noise level limits set by Kenya Noise Regulations. However, pastoralists should be able to move away from construction noise, given their large distance movement patterns and access to extensive areas. Furthermore, noise disturbance during construction is expected to be temporary, since construction activities will be sequentially staggered and therefore will not take place concurrently at the same location. Construction activities will also be intermittent, depending on the type of activity (Section 7.2.4.2). Pastoralists who settle near the Project footprint with their livestock at night should not be impacted, since construction activities will occur during the daytime period only.

Prior to mitigation, and considering the results of the Noise and Vibration impact assessment above, the Project's potential impact of noise disturbance as a result of Project construction is of medium magnitude, since pastoralists in the vicinity of Project construction, especially near Archer's Post and Kaichuru Village, will experience increased noise levels relative to baseline conditions; however noise disturbance is expected to be manageable since pastoralists are mobile, have access to large areas, and therefore should be able to move away from Project noise. In addition, construction is only scheduled to occur during daytime hours, therefore pastoralists that have temporary or permanent settlements are not expected to be disturbed at night. The geographic extent will be localised during construction (i.e. within 1.5 km of the RoW), but the impacts will be experienced by pastoralists across all six counties.

The duration of construction noise at any given location along the pipeline route will be temporary and intermittent but extend into the medium-term for the entire construction period. Pastoralists will experience a range of Project noise levels, depending on the variability of noise emission levels, location of equipment and the distance from the construction activity, but impacts are expected to generally decrease with distance from the Project footprint. The Project's potential impact on pastoral livelihoods because of noise disturbance is, therefore, assessed as **moderate (negative)**.

The following mitigation measures will be applied to minimise the impact of noise disturbance during Project construction:

- The construction schedule will be communicated to county and local leadership; and
- A livelihood restoration plan will be implemented to ensure no adverse impacts to livelihoods at a community level.

In addition, mitigation measures that will be implemented to minimise the impacts of noise and vibration during Project construction also apply to potential changes in noise disturbances to pastoralists and can be found in Section 7.2.7.

With the implementation of mitigation measures, the Noise and Vibration impact assessment determined that the magnitude of predicted noise levels was medium for the AoI communities of Archer's Post (Samburu), Lamu Port (Lamu), Kaichuru (Meru), Kiliana (Lamu), Majengo (Lamu) and Swari (Samburu), and low for the AoI communities of Barsaloi (Samburu), Lengusaka (Samburu), Nakukulas (Turkana), Shimbiri (Garissa), Modika (Garissa), based on the change in noise levels from baseline conditions. Pastoralists using grazing lands close to these communities in particular and within 1.5 km of the pipeline RoW and 5 km from the station fence lines are expected to experience increased noise levels during Project construction. The Project's residual impacts on pastoral livelihoods from noise disturbance during construction will be negative and low in magnitude. The duration of noise disturbance at any given location will be short-term but extend into the medium-term for the entire construction period. The Project's residual impact on pastoral livelihoods because of noise disturbance is assessed as **minor** (**negative)**.

Operations Phase

Loss of Grazing Land and Natural Resources

Project operations will result in the temporary loss of traditional grazing areas and other natural resources used by pastoralists and their livestock. The majority of vegetation loss in the Project footprint will be temporary in nature and will occur along the length of the Project Right of Way within the working width of 26 m. Much of the habitat in the Project RoW is already highly modified and degraded by overgrazing, erosion, and is under competitive pressure from non-native and invasive species. Areas of Wamba, Archer's post and Garissa in particular are overgrazed with high rates of soil erosion and low vegetation diversity (Section 7.5.6). After pipeline installation disturbed areas will be restored as closely as possible to their original contours and allowed to re-vegetate naturally. The restoration of the Project spreads is likely to result in the re-colonisation of vegetation within 5 years, which is considered long-term[5].

[5] For the purpose of social impact assessment, a period greater than the construction phase is defined as long term (Table 7-11-1).

The long-term disturbance to grazing lands during Project operations may impact some pastoralists where the Project footprint overlaps with their traditionally used areas. The impact on pastoral livelihoods in general is expected to be relatively small since a large majority of the habitat along the Project RoW is already highly modified and degraded by overgrazing and erosion, particularly in areas of Wamba, Archer's Post and Garissa (Section 7.5.6; Terrestrial Biodiversity). Moreover, given the relatively small Project footprint that will result in long-term disturbance to grazing lands, the overall impact is expected to be low.

Prior to mitigation, the Project's potential impact of the loss of grazing lands and natural resources during operations is of low magnitude, given the small amount of vegetation disturbance that would occur, and that the majority of the habitat along the Project route is already highly modified and degraded. The impact would be experienced locally in each county and the loss of grazing lands and natural resources along the RoW would be unavailable for pastoral use in the long term, since revegetation of temporarily disturbed areas post-construction is expected to take up to five years. The Project's pre-mitigation potential impact on grazing land and resource availability is, therefore, assessed as a **minor (negative)**.

The following mitigation measures will be implemented to minimise the impacts of potential loss of grazing lands during operations:

- Disturbed areas will be regraded and rehabilitated; and
- A livelihood restoration plan will be implemented to ensure no adverse impacts to livelihoods at a community level.

Mitigation measures that will be implemented to minimise the impacts on terrestrial biodiversity during operations also apply to potential loss of grazing lands during operations and can be found in Section 7.5.8.3.

The Project's residual impact to pastoral livelihoods from loss of grazing land and other natural resources during operations is assessed as negative and low in magnitude, given effective implementation of livelihood restoration activities. The impact will be localised to the Project RoW and long-term. The Project's residual impact on pastoralism from loss of grazing land and other natural resources, therefore, is assessed as unchanged at **minor (negative)**.

Quality of Grazing and Browsing Resources

The Project has the potential to adversely affect the quality of vegetation during operations because of changes in soil quality, invasive vegetation species, and impacts associated with hydrocarbon spills and contaminants. These impacts may affect the quality of grazing and browsing resources along the pipeline route. Pastoralists and other stakeholders from several AoI communities in all six counties raised concerns about the potential impacts from the Project on grazing lands and other natural resources, including from a pipeline leak or oil spill, and subsequent impacts on the production of livestock and pastoral livelihoods (Focus Group, Pastoralists, Kalapata 2019, Suyian 2018; Lorakora, 2018; Meeting, Garba Tula 2018). Pastoralists interviewed in Lokichar, Turkana also expressed concerns about the potential degradation of the environment because of the Project (Focus Group, Pastoralists, Lokichar 2019).

The issue of hydrocarbon spills and contaminants is addressed within the Emergency, Accidental and Non-Routine Events section 7.14 of the ESIA. Invasive species may also colonise the Project footprint during operations and post-restoration of habitat, introduced through construction equipment or vehicle movements within the RoW (Section 7.5.6.2). There is also the potential for ground disturbance leading to increased exposure to soil erosion risk which could impact grazing quality, however changes in soil quality during operations is expected to be low magnitude (Table 7.4-8; Soils, Geology and Geohazards). Potential impacts to habitat types in community conservancies and other habitat types where livestock grazing is permitted was assessed as low magnitude (Table 7.5-9, Terrestrial and Aquatic Biodiversity).

Prior to mitigation, and considering the results of the Terrestrial and Aquatic Biodiversity impact assessment related to invasive plant species, and the results of the Soils, Geology and Geohazards Impact Analysis related to changes in soil quality, the Project's potential impact of changes in the quality of grazing and browsing resources during Project operations is of low magnitude. Since much of the habitat within the Project footprint is already highly modified, any impacts to the quality of vegetation because of invasive species and changes in soil quality are unlikely to contribute measurably to vegetation degradation and impact livestock health or productivity. The impact would be localised and would occur through Project operations, and therefore would be long-term. The Project's pre-mitigation potential impact on the quality of grazing and browsing vegetation resources is, therefore, assessed as a **minor (negative)**.

Mitigation measures that will be implemented to minimise the impacts on terrestrial biodiversity and soils during Project operations also apply to potential changes in grazing and browsing resources and can be found in Section 7.5.7 and 7.5.8.2 (Terrestrial and Aquatic Biodiversity) and Section 7.4.7, 7.4.8.2 and 7.4.10 (Soils, Geology and Geohazards), respectively.

The Terrestrial Biodiversity impact assessment determined that, during operations, the magnitude of residual impacts to different habitat types was negligible for community conservancies (i.e. Nakuprat-Gotu, Namunyak Meibae, Kalama, Sera and West Gate) and for other habitats where livestock grazing is permitted along the Project route (Table 7.5-9). The Soils, Geology and Geohazards impact assessment determined that residual impacts on soil quality during construction from topsoil handling and storage was low magnitude for all soil types along the pipeline route (Section 7.4-8).

Considering these results, and with the implementation of mitigation measures, the Project's residual impact to pastoral livelihoods from decreased quality of grazing and browsing resources is assessed as negative and low in magnitude, since the potential introduction or spread of invasive species and changes in soil quality is expected to be small and not materially alter pastoral livelihoods. Decreased quality of vegetation resources is expected to be localised and reversible during operations, and so would occur over the long-term. The Project's residual impact on pastoral livelihoods from changes in the quality of grazing and browsing resources is assessed as unchanged as **minor (negative)**.

Availability and Quality of Water

The Project has the potential to affect water availability or quality through direct and indirect impacts during operations, and subsequently affect the health and productivity of livestock (Section 7.4.8.1). Concerns were expressed by pastoralists and other stakeholders in AoI communities in all six counties crossed by the Project about the potential adverse impacts of Project activities on water sources (e.g. rivers, water catchment areas, traditional water points, springs, wells, boreholes, etc.) and water flow that livestock depend (Focus Group, Pastoralists, Lokori 2019, Nachola 2018, Laare Town 2018, Kamuthe 2018, Barigoni 2018).

Abstracting water for operational needs could result in changes to surface water flows and groundwater levels, and therefore, water availability. As discussed in Section 7.3.8.2, it is possible that the abstractions used during the construction phase will remain in use so no additional new abstractions will be required during operations; however, water demand will extend throughout the length of the operational period into the future where climate change predictions suggest that water scarcity and demand will increase. Further characterisation of the water environment and local users at the selected abstraction location(s) would be required. There is also the potential for changes in riverbed morphology, flow patterns and associated erosion rates and flood risk (Section 7.3.8.2). Changes in water quality could occur from minor (non-emergency) oil leaks and/or spills from the pipeline and station facilities, or leaks during the storage, transport or use of chemicals or fuel. Changes to water quality could also occur from the discharge of captured/intercepted and redirected water, or any other non-effluent water, at inappropriate locations, quality and rates.

The Water Resources impact assessment determined that during operations, the magnitude of potential indirect impacts to water users from changes to water quality was medium because of discharges of wastewater, and low because of oil leaks and/or spills from pipeline, stations or other facilities, and leaks or spills during storage, transfer, transport or use of substances (Table 7.3-5). The magnitude of potential indirect impacts to water users from changes in water quantity/availability was medium because of abstraction for operational water needs, and low because of changes in riverbed morphology leading to change to river flows and flood risk (Table 7.3-5). All other potential impacts to water users from changes in water quality or quantity during operations were assessed as negligible.

Prior to mitigation and considering the results of the water resources impact analysis related to potential changes in the quality and quantity/availability of water for pastoral use, the Project's potential impact to water quality and availability during Project operations is of medium magnitude. Depending on the sources of water that are impacted, changes in the quality or availability of water for some pastoralists are expected to be potentially detrimental but manageable. The impact would be felt locally but occur across all counties where water resources that are used pastoralists are impacted and would occur through Project operations, into the long-term. The Project's potential impact on water availability and quality is, therefore, assessed as a **moderate (negative)**.

The following mitigation measures will be implemented to minimise the impacts of changes in the quality and quantity/availability of water during operations:

- Monitoring of water quality, water flows and participatory environmental monitoring.
- A leak detection system will be implemented, and regular monitoring and inspection of the pipeline.
- A complaints and grievance management procedure will be implemented.

  Implementation of the Livelihoods Restoration Framework.

In addition, mitigation measures that will be implemented to minimise the impacts on water resources during Project operations also apply to potential changes in the quality and quantity/availability of water for pastoralists and can be found in Table 7.3-5.

The Water Resources impact assessment determined that, during Project operations, the magnitude of residual impacts to water users from changes in the quality and quantity/availability of water was negligible for all potential impacts (Table 7.3-5). With consideration of these results, and with the implementation of the mitigation measures described above, the Project's residual impact to pastoral livelihoods from changes in the quality and availability of water are assessed as negative and low in magnitude, since there will be a discernible impact of changes in water quality and quantity, but it is not expected to materially alter pastoral livelihoods. The residual impacts of changes in water will be localised. The Project's residual impact on pastoral livelihoods from changes in the quality and availability of water, therefore, is assessed as **minor (negative)** with additional mitigation.

Noise Disturbance

Pastoralists from AoI communities in Samburu, Meru and Garissa counties expressed concerns during focus groups discussions about the potential adverse impacts of noise pollution because of the Project (Focus Group, Pastoralists, Baragoi, Kaichuru Village, Laare Town, Korakora 2018). Noise will result during operations associated with pipeline maintenance and inspection activities, and station operations (Section 7.2.9; Noise and Vibration).

Noise emissions associated with station operation have the potential to increase ambient noise levels at receptors in the vicinity of the stations (Section 7.2.9.2.1). The primary noise sources associated with the operation of each of station configuration are expected to be LEF/Station PS1, Station S4/PS2, and Stations S6, S8, S9, S10, S14 (Section 7.2.8.1.2). During the operation of LEF/PS1, the distance to the IFC Noise Guideline daytime limit of 55 dBA is approximately 100 m and to the IFC Noise Guideline night-time limit of 45 dBA is approximately 325 m. During operation of S4/PS2 the distance to the IFC Noise Guideline daytime limit is approximately 225 m and to the IFC Noise Guideline night-time limit is approximately 675 m. During operation of S6, S8, S9, S10, and S14, the distance to the IFC Noise Guideline daytime limit is approximately 300 m and to the IFC Noise Guideline night-time limit is approximately 850 m. As operations are expected to be continuous for 24 hours per day, pastoralists within these ranges of the stations during the daytime or night-time are expected to experience noise disturbance.

The noise and vibration impact assessment determined that LEF/PS1 and S10 have the most significant noise generating equipment, and the magnitude of noise emissions is a function of distance from the station fence-lines; therefore, in the absence of mitigation, the magnitude of noise emissions ranged from negligible to high based on the change in predicted noise levels from baseline conditions (Section 7.2.9.2.1).

Prior to mitigation, and considering the results of the noise and vibration impact assessment above, the Project's potential impact of noise disturbance as a result of Project operations is of medium magnitude, since pastoralists in the vicinity of Project stations will experience increased noise levels relative to baseline conditions; however noise disturbance is expected to be manageable since pastoralists are mobile, have access to large areas, and therefore should be able to move away from Project noise. The geographic extent will be localised during operation, however the impacts will be experienced by pastoralists across all six counties.

The duration of operations noise will be long-term, since it will be reversible at closure. The Project's potential impact on pastoral livelihoods because of noise disturbance during Project operations is, therefore, assessed as **moderate (negative)**.

The following mitigation measures will be applied to minimise the impact of noise disturbance during Project operations:

- A livelihood restoration plan will be implemented to ensure no adverse impacts to livelihoods at a community level.

In addition, mitigation measures that will be implemented to minimise the impacts of noise and vibration during Project operations also apply to potential changes in noise disturbances to pastoralists and can be found in Table 7.2.7.

With the implementation of mitigation measures, the magnitude of predicted noise levels is low for pastoralists in the vicinity of the Project stations based on the change in noise levels from baseline conditions. The geographic extent will be localised, and pastoralists should be able to move away from Project noise. The duration of noise disturbance will be long-term during the entire operations phase. The Project's residual impact to pastoral livelihoods because of noise disturbance during operations is assessed as **minor (negative)**.

7.12.4.2 Fishing

The Project crosses three watercourses (the Kerio, Suguta, Ewaso Ng'iro River rivers) where nearby AoI communities' fish. The Kerio and Suguta are largely perennial and are semi-permanent; the lower courses of these rivers are seasonal. The Project will terminate at the marine off-loading facility at the Port of Lamu in Lamu County, where marine and in-shore fishing occurs (Figure 7.12-3 and Figure 7.12-4).

Fishing is less important inland where riverine fishing is more commonly practiced to supplement pastoral activities, as evidenced by the few fishers identified in communities outside of Lamu County. Focus groups conducted in the 49 communities as well as nearby informal settlements found that riverine fishing is not a common activity in the vast majority of AoI communities and were not the dominant livelihoods in the communities outside Lamu where fishing does occur (Focus Group, Pastoralists, Sankuri[6], Kaichuru 2018; Focus Group, Pastoralists, Lokori, Katilia, 2019). Pastoralists from Kaichuru, indicated that fishing occurs along the Ewaso Ng'iro River (Focus Group, Pastoralists, Kaichuru 2018). In Turkana County, pastoralists from Katilia and Lokori reported that fishing occurs along the Kerio River and Suguta River (Focus Group, Pastoralists, Katilia 2019; Focus Group, Pastoralists, Lokori 2019). Outside of Lamu County, only one fisher was identified and interviewed in Saka, Garissa County, and this individual fishes in a watercourse not crossed by the Project and did not express any concerns regarding the Project (Focus Group, Fishers, Saka, 2018).

Fishing is a dominant livelihood in the Port of Lamu. Income derived from fishing varies among the fishers in the AoI communities within Lamu County. Fishers from Kililana reported that fish can fetch between 120 to 150 Ksh per kilogram, depending on the type of species (Focus Group, Fishers, Kililana 2018). Crab, lobster and prawns attract higher prices between 400 to 450 Ksh per kilogram. However, in Mokowe, fishers reported that crab and lobsters often sell for 1,000 Ksh per kilogram. In Mokowe, focus group respondents reported that a fisher can make up to 2,000 Ksh per day (Focus Group, Fishers, Mokowe 2018). For fishers in the more inland community of Barigoni, fishers reported making around 500 Ksh per day (Focus Group, Fishers, Barigoni 2018).

In-shore fishing is more commonly practiced by the fishers from the AoI communities as they do not have the equipment (e.g. boats, engines, nets) and means (e.g. ability to preserve and process products and infrastructure to market the resources to international markets) to pursue the vast offshore marine resources (Rodden, 2014; Heddon, 2006). The majority of fishing crafts used in 2014 were for shallow waters, with non-motorised sail boats, constituting 80.1% of all craft types. Within Lamu County, fisher groups were identified and interviewed in the communities of Mokowe, Kililana, Barigoni, and Pate which are near the Port of Lamu (Figure 7.12-4). While the fishers in Lamu live in AoI communities, the fishing grounds identified by the focus groups do not overlap with the Project pipeline or Lamu Marine Terminal. Fishers in Lamu County currently fish in Beach Management Units[7]. There are 39 villages in Lamu that have BMU sites, two of which are located in two AoI communities, Mokowe and Pate. The remaining are not registered with the Ministry of Fisheries and have not met the requirements to be acknowledged by the government (Rodden, 2014).

[6] While fishing occurs in Saka and Sankuri , Garissa County, the watercourse used for fishing, the Tana River, is not crossed by the Project.

[7] Beach Management Units are co-management structures between the fishing community in Lamu County, NGOs and the private sector that are found at fish landing sites (Republic of Kenya 2015). Fishers pay a registration fee for their fishing vessels as well as a fisherman's license to access specific areas of the coast.

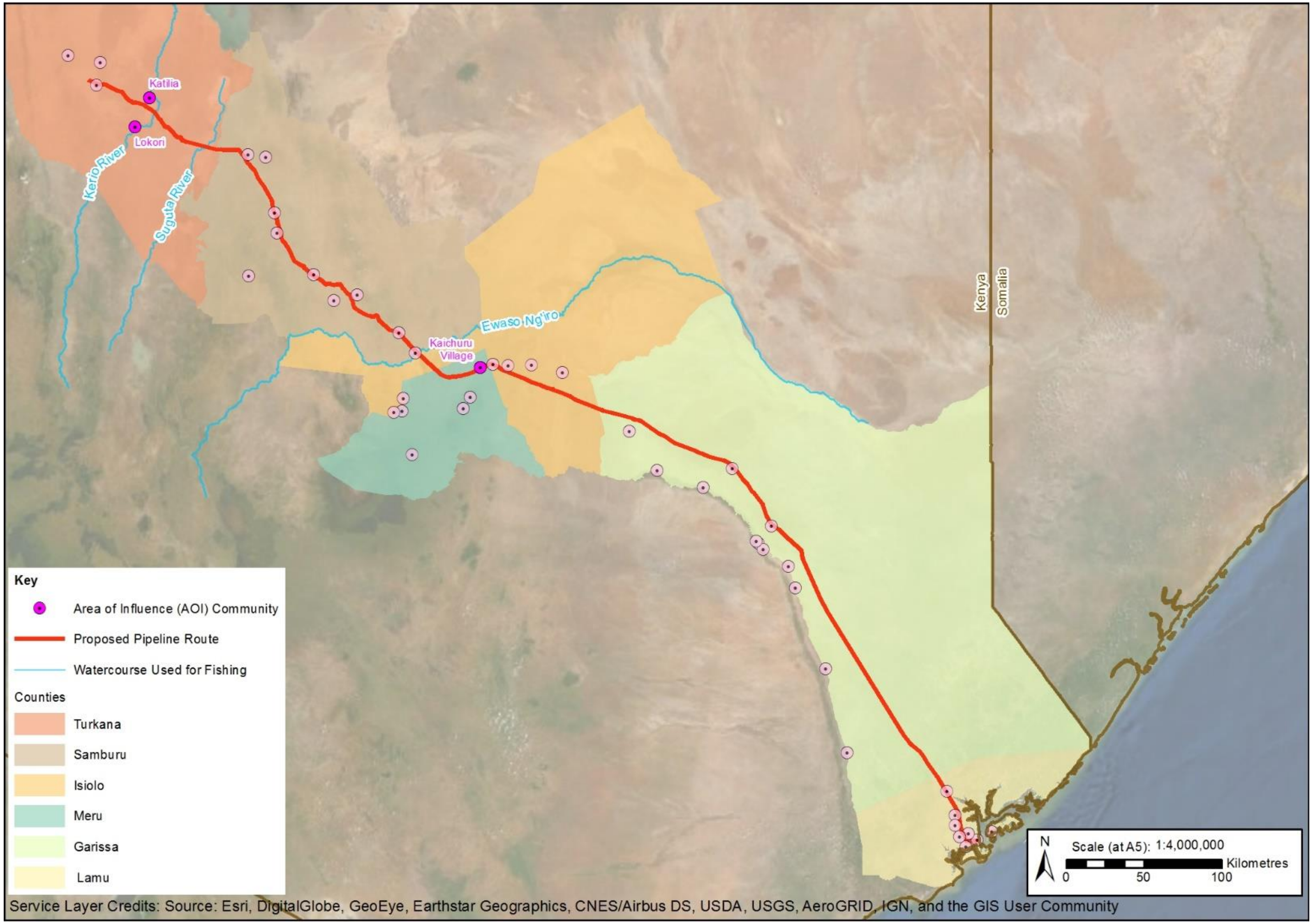

Figure 7.12-3: Watercourses used for fishing that are crossed by the Project

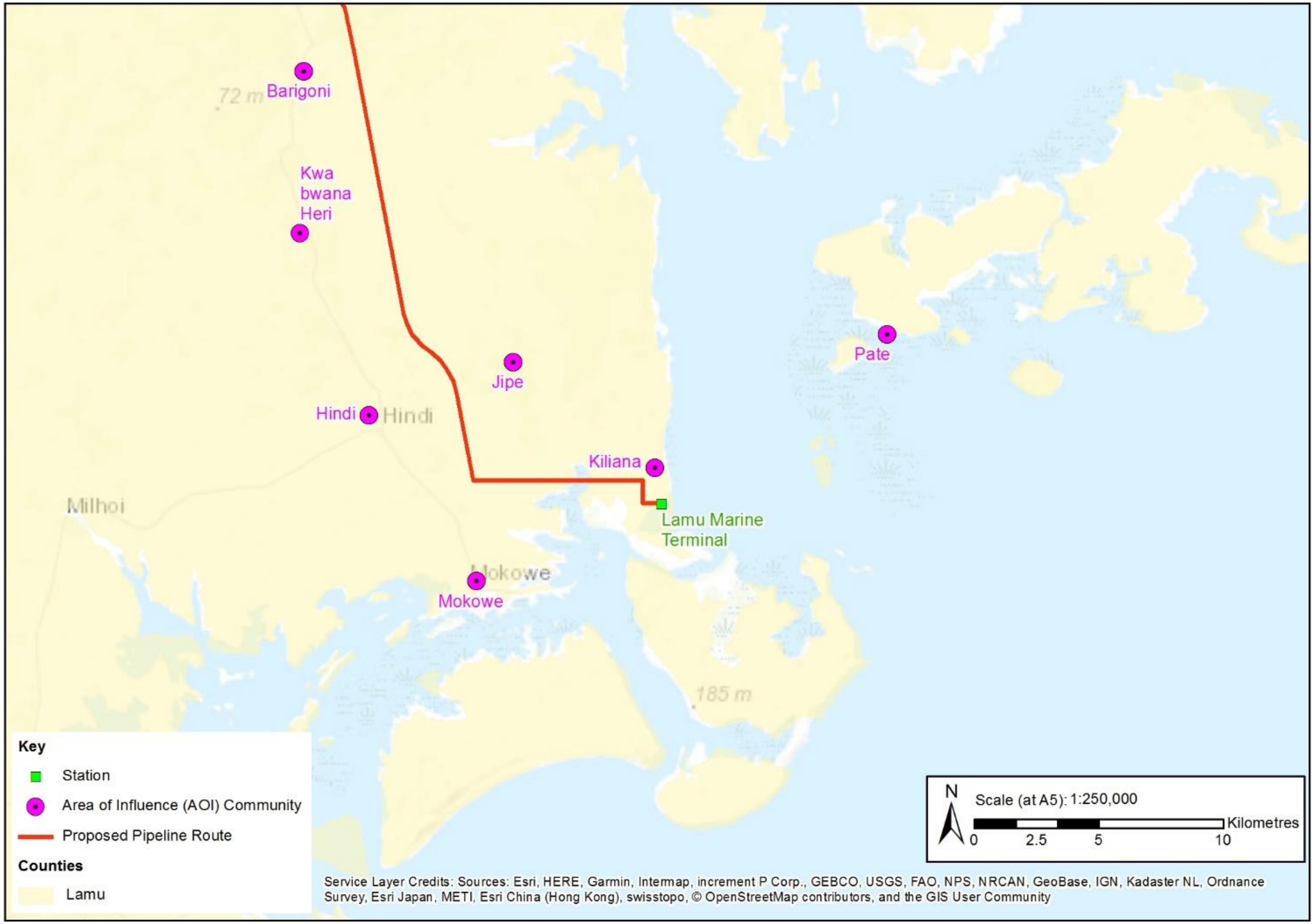

Figure 7.12-4: Area of Influence communities near the Port of Lamu

Most small-scale fishing occurs during the North East monsoon season (November to February) when sea conditions are calm. During the South East monsoon season (March to October), the rough currents from the strong winds make the sea inaccessible to local fishing craft, rendering 80% of the population destitute (Repcon Associates, 2017). The main types of seafood caught by the fishing groups in the AoI communities in Lamu are Tafi/Tasi (White-spotted spinefoot), Mkizi (Flathead grey mullet), Tewa (Peacock hind), Changu (Spotcheek emperor), Tazanda (Mangrove snapper), Jodari (Skipjack tuna), Fumi (Blacktip sea catfish), Kaa (Indo-Pacific swamp crab), prawns, and lobster. Mangrove habitats along the Lamu marine coast provide complex ecosystem functions for fish (e.g. spawning, nursery and foraging) and are found where Project footprint impacts are proposed (Refer to Marine Flora and Fauna Section 7.6 for details).

Access to fishing grounds in Lamu West, where AoI communities are located, is currently affected by construction of the Lamu Port. As part of the LAPSSET project, the first three berths of the 32-berth port are under construction in the Lamu marine area with the first berth scheduled to open by the end of 2019 (Construction Kenya, 2019). Many of the artisanal fisherman in Lamu West have abandoned the trade due to the ongoing dredging activities for the port project which resulted in the closure of the majority of fishing channels in the Lamu port site in Kiliana. Approximately 4,600 fishermen are affected and displaced (Daily Nation 2018a; Business Daily Africa, 2018). As the boats employed by artisanal fishermen are not equipped for deep waters, moving out of the port area is not an option (Rodden, 2014). Affected fishermen have called for the Kenya Marine Fisheries Research Institute (KMFRI) to provide specialised training that would allow them to pursue alternative ventures such as seaweed farming (Business Daily, 2018a).

Construction Phase

Availability of Freshwater Fish

The Project has the potential to affect the availability of freshwater fish during construction in watercourses (e.g. Kerio River, Suguta River, and Ewaso Ng'iro River) crossed by the Project that are fished by resource users in nearby AoI communities in Turkana County and Meru County. Construction activities have the potential to adversely impact fish and fish habitat through mortality from dewatering activities, changes in water quality and the temporary loss of connectivity (refer to Terrestrial and Aquatic Biodiversity, Section 7.5.8.1).

Permanent rivers will be crossed by the Project using open cut construction methods which will occur during times of low flow or no flow. In times of low flow dissolved oxygen is likely to decrease, and fish could become trapped in shallow water during construction activities (Section 7.5.8.1). Direct impacts on water quality or quantity from discharging a substance into surface water, or abstractions from groundwater or surface water may adversely impact fish species that fishers depend on. Fish may also be impacted by ground excavation within rivers (leading to mobilisation of suspended solids), storage of materials and/or waste, maintenance activities, leaks/spills, discharges, abstractions and backfilling (Section 7.5.8.1). To minimise the potential impacts of construction on watercourses, activities are planned to occur in the dry season where the width of permanent rivers is least; however, discharges of suspended solids or other contaminants could be greater when flow is lowest, and consequently, fish may be more impacted (Section 7.3.8.1).

The source (or sources) of water for construction activities, construction worker camps, and hydraulic testing is currently unconfirmed (Section 7.4). If water is taken from surface watercourses it could directly impact flows and have an indirect secondary impact on fish. The temporary blocking of rivers during pipeline crossing activities could also directly impact water flow. These changes could also result in indirect secondary impacts on the availability and quality of water to fish. Fishing activities could therefore potentially be disrupted due to the adverse impacts on the quantity and quality of fish resources. Fish and fishing activities are not expected to be affected during operations, since the pipeline will be buried. Potential impacts on fish during construction was assessed as low magnitude in the Terrestrial and Aquatic Biodiversity impact assessment (Table 7.5-8).

Prior to mitigation, the Project's potential impact on the availability of freshwater fish as a result of construction is of low magnitude, given that intervention and targeted management will not likely be required to prevent impacts on livelihoods. The impact would be felt locally by the AoI communities that fish in the watercourses crossed by the Project footprint and would be limited to the short-term periods during construction. The Project's pre-mitigation potential impact on the availability of freshwater fish is, therefore, assessed as a **minor (negative)**.

The following mitigation measures will be applied to minimise the impact of the Project on the availability of freshwater fish during Project construction:

- Communicate construction schedule to county and local leadership;
- Disturbed areas will be regraded and rehabilitated;
- Sediment management;
- Water flow and quality monitoring;
- Participatory environmental monitoring;
- Source hydrotest water in a sustainable way through consultation with stakeholders and statutory agencies. Hydrotest water abstraction and disposal to avoid/minimise impacts to local water users;
- Hydro-census to identify local water users (commitment to continuity of supply & water quality);
- Pipeline will be installed with minimum depths of cover to reduce impacts to river flows;
- River crossings will occur in the dry season; and
- BO to supervise river crossings. For seasonal rivers, the minimum depth of cover will be 2 m below the lowest point of the riverbed (below the true cleaned bottom of the river), which will offer additional protection to the pipeline at the crossing point.

Mitigation measures that will be implemented to minimise the impacts on aquatic biodiversity during construction also apply to potential changes in the availability of freshwater fish and can be found in Section 7.5.7 and 7.5.8.1.

The Terrestrial and Aquatics Biodiversity impact assessment determined that, during construction, the magnitude of residual impacts to fish was negligible (Table 7.5-8). Considering these results, and with the implementation of mitigation measures, the Project's residual impact on fishing activities in watercourses during construction is assessed as negligible in magnitude since it is not expected to result in a discernible change relative to baseline conditions. The impact will be local since only the fish-bearing watercourses used by local AoI communities for fishing (i.e. Kaichuru, Katilia, and Lokori) may be impacted. The impact is short-term as it will only occur during the watercourse crossing phase of construction. Given the impact classification of the criterion, the residual impact significance is assessed as negligible.

Availability of Marine Resources

The Project has the potential to impact marine resources that fishers near the Port of Lamu depend on during Project construction through impacts on mangrove habitat, direct mortality or injury, and changes in marine water quality (Marine Flora and Fauna Section 7.6.8.1). Several fishers in Lamu expressed concern about the Project's potential adverse impact on mangroves and fish quantity, resulting in decreased fish harvests. In addition, fishers in Pate expressed concern about changes in fish migration because of the Project.

The Project will directly impact mangrove habitat during construction caused by the temporary and permanent habitat loss because of trenching of the pipeline and subsequent filling. Mangroves serve as habitat for fish, crabs and molluscs, species that fishers depend on for their livelihood. They also act as important foraging, spawning and nursery grounds for a range of marine species. The Project will result in the permanent loss of 0.4 ha of mangrove habitat, and the temporary habitat loss, fragmentation and degradation of mangrove habitat is estimated as a maximum of 1.6 ha, which represents <0.01% of the 37,350 ha of mangrove habitat in the Lamu-Kiunga seascape (Marine Flora and Fauna Section 7.6.8.1).

Vegetation clearing, trenching and infilling within the mangrove area has the potential to lead to injury or mortality of intertidal and subtidal species that are present, and subsequently reduce the availability of marine resources for fishers (Section 7.6.8.1). Highly mobile species may be able to move out of the working width, away from active works.

Marine water quality may be impacted from disturbance, suspension and dispersal of sediments from trenching and infilling works in intertidal mangrove areas and discharges to marine waters, potentially impacting marine resources that fishers depend on (Section 7.6.8.1). Marine resources are likely tolerant to temporary fluctuations in suspended sediments that would occur until sediments settle. There is the potential for the release of waste into the marine environment from construction activities, which could impact resources that fishers depend on.

The Marine Flora and Fauna impact assessment determined that potential impacts to mangrove habitat, coral reef and seagrass bed subtidal habitats during construction was assessed as medium in magnitude, and potential impacts to crustacea and marine macroinvertebrates in intertidal mangrove zone and adjacent subtidal habitats was assessed as low in magnitude (Table 7.6-4).

Any adverse impact on the availability of marine resources as a result of Project construction, either temporarily or permanently, is expected to have a greater impact on fishers and their families from the AoI communities in Lamu County because fishing is the primary economic activity in these communities. However, the impact on fishing livelihoods is expected to be relatively small given the temporary loss and degradation of habitat; therefore, the overall impact is expected to be low.

Prior to mitigation and considering the results of the Marine Flora and Fauna impact assessment the Project's potential impact on the availability of marine resources as a result of construction is of low magnitude. The impact would be experienced locally in waters around the port of Lamu and would occur in the short-term during a phase of Project construction. The Project's pre-mitigation potential impact on the availability of marine resources is, therefore, assessed as a **minor (negative)**.

The following mitigation measures will be applied to minimise the impact of the Project on the availability of marine resources fish during Project construction:

- Implementation of the Livelihood Restoration Framework that contributes to improvement of marine fishing livelihoods;
- Communicate construction schedule to county and local leadership. Having ongoing liaison with local fisheries communities to help monitor impacts on fish populations and ecosystem services; potentially creating a system for monitoring of fish population decline. This needs to be delivered in coordination with wider port operations;
- All construction activities in the following habitats will be overseen by the BO:
  - Mangrove habitat;
  - Coral reef and seagrass bed subtidal habitats area; and

  - Intertidal mangrove zone and adjacent subtidal habitats.
- Implementation of sediment management;
- Implementation of water quality monitoring;
- Clearly demarcated exclusion zones; and
- Participatory environmental monitoring.

Mitigation measures that will be implemented to minimise the impacts on marine flora and fauna during construction also apply to potential changes in the availability of marine resources and can be found in Section 7.6.7 and 7.6.8.1.

The Marine Flora and Fauna impact assessment (Section 7.6.8) assessed the Project's residual impact on mangrove habitat as negligible magnitude and on crustacea and marine macroinvertebrates as low magnitude (Table 7.6-4).

Considering these results, and with the implementation of mitigation measures, the Project's residual impact of changes in the availability of marine resources during Project construction is assessed as negative and low in magnitude, since there will be a discernible impact on marine resources, but it is not expected to significantly alter the livelihoods of fishers. Residual impacts to marine resources will be localised to the Project construction area and experienced by the local AoI communities. The impacts will be short-term since it will be during a phase of construction, Given the impact classification of the criterion, the residual impact significance is assessed as **minor (negative)**.

Physical Access to Preferred Fishing Areas

Changes in physical access to fishing resources in the watercourses crossed by the Project could occur during Project construction as fishers might be prevented from accessing preferred fishing areas during water crossing activities. This potential effect will not occur during Project operations as the pipeline will be buried and access restrictions to the watercourse and fishing resources will not occur.

Several fishers' focus groups in Lamu County expressed concern that the Project may restrict access to the water and fishing areas in the marine environment. In Pate in particular, fishers noted that the Project may make it difficult to fish with boats at the current water levels in those areas. Changes in physical access to marine fishing grounds crossed by the Project are expected during construction. During operations, the marine vessel will be docked in a berth and small fishing vessels are unlikely to come within the vicinity of the large marine vessel, therefore changes in physical access to marine fishing areas are not expected.

Prior to mitigation, the Project's potential impact of changes in physical access to preferred freshwater and marine fishing areas as a result of construction is of low magnitude, given that the impact would be felt locally in areas of access restriction but would occur sporadically in the short-term periods during construction. The Project's pre-mitigation potential impact on physical access to preferred freshwater and marine fishing areas is, therefore, assessed as a **minor (negative)**.

The following mitigation measures will be applied to minimise the impact of the Project on changes in physical access to preferred fishing areas during Project construction:

- Communicate construction schedule to county and local leadership;
- Clearly demarcated exclusion zones; and
- Implementation of the Livelihood Restoration Framework.

With the implementation of mitigation measures, the Project's residual impact of changes in physical access to preferred freshwater and marine fishing areas during construction is assessed as negative and low in magnitude given the short period of access restriction (four to five weeks) during the open-cut pipeline installation. The residual impact to freshwater fishing areas is local as it will occur only in the watercourses crossed by the Project that are used by fishers, and short-term in duration, occurring during the watercourse crossing phase of construction. Likewise, changes in physical access to preferred marine fishing areas during Project construction is assessed will be localised and short-term during a phase of construction at the Lamu Port. Given the impact classification of the criterion, the residual impact significance is assessed as **minor (negative).**

Operations Phase

Availability of Marine Resources

The Project has the potential to impact marine resources that fishers near the Port of Lamu depend on during Project operations through sensory disturbance and changes in marine water quality (Marine Flora and Fauna Section 7.6.8.2). Several fisher focus-groups in Lamu County expressed concern about the potential adverse impacts of oil spills on fish and fish harvests (Focus Group, Fishers, Mokowe, Pate, Kililana, Barigoni 2018).

Potential impacts to marine resources during operations are associated with unplanned oil spill events which could adversely affect marine species, increases in noise from vessel movements and also the potential for the introduction of alien and invasive species (Section 7.6.8.2). Vessels may release pollutants from deck drainage, ballast water, contaminants from machinery, fuel, cable oils and grey water etc. In addition, vessels produce wastewater that could be discharged to the marine environment. The introduction of invasive species through discharge of ballast water from vessels containing invasive species can have devasting consequences on the marine environment and native species; however, the probability of this occurring is considered low based on the low number of vessels during operations.

Fish are sensitive to sound and may be impacted by vessel noise during operations which could be generated from movement of the storage tanker to the site, and the ongoing movement of tankers to and from the port. Vessels will be moving through an area with mangrove, seagrass and coral habitat, as well as general open sea habitat, that provide ecosystem functions for many fish, including spawning and nursery areas. Underwater sound from large vessels could lead to temporary physical and behavioural impacts on fish. Changes in fish behaviour may include avoidance, or altered swimming speed and direction, which could subsequently impact their availability for fishers, if fish are dispersed to areas outside of preferred fishing grounds because of Project operations. The low frequency and volume of vessel movements for the Project will minimise the potential impacts of Project operations to fish and other marine resources, and to fishing livelihoods.

The Marine Flora and Fauna impact assessment determined that potential impacts to fish during operations was assessed as low in magnitude, and potential impacts to crustacea and marine macroinvertebrates in intertidal mangrove zone and adjacent subtidal habitats was assessed as medium in magnitude (Table 7.6-5).

Prior to mitigation and considering the results of the Marine Flora and Fauna impact assessment the Project's potential impact on the availability of marine resources as a result of operations is of low magnitude. The impact would be experienced locally in waters around the port of Lamu and would occur through Project operations into the long-term. The Project's pre-mitigation potential impact on the availability of marine resources is, therefore, assessed as a **minor (negative)**.

The following mitigation measures will be applied to minimise the impact of the Project on the availability of marine resources during Project operations:

- Clearly demarcated exclusion zones;
- Participatory environmental monitoring; and
- Implementation of the Livelihood Restoration Framework that contributes to improvement of marine fishing livelihoods.

Mitigation measures that will be implemented to minimise the impacts on marine flora and fauna during operations also apply to potential changes in the availability of marine resources and can be found in Section 7.6.7 and 7.6.8.2.

The Marine Flora and Fauna impact assessment (Section 7.6.8.2) assessed the Project's residual impact on fish as negligible, and on crustacea and marine macroinvertebrates as low magnitude (Table 7.6-5). Considering these results, and with the implementation of mitigation measures, the Project's residual impact of changes in the availability of marine resources during Project operations is assessed as negative and low in magnitude, since there will be a discernible impact on marine resources, but it is not expected to significantly alter the livelihoods of fishers. Residual impacts to marine resources will be localised and extend into the long-term during the operations phase. Given the impact classification of the criterion, the residual impact significance is assessed as **minor (negative)**.

7.12.4.3 Agriculture

The Project has undertaken extensive routing studies with an aim to minimise impacts to settlements, including those with agricultural plots on or near the pipeline right of way. Agricultural land used for livelihood activities along the RoW are therefore sparse. The National Land Commission is undertaking work to identify agriculturalists that either farm or manage forestry plantations on the RoW. There are known agricultural plots on the RoW in Lamu, and a review of satellite imagery suggests that there may be cultivated agricultural land crossed by the Project in Turkana near KP 48. The Project will cross the Kerio, Suguta, Ewaso Ng'iro River rivers. Areas adjacent to these rivers are highly suitable for agricultural purposes where irrigation schedules often occur, and some agricultural activities are to be expected.

Small-scale agriculture is the main economic activity in Meru and Garissa and an important economic activity in Lamu. Farmers in the AoI communities of these counties engage primarily in subsistence farming (e.g. beans, cow peas, maize, sorghum, watermelon) with some growing cash crops such as Miraa, mangoes, coconut, cotton, and *Bixa Orellana* ('annatto'). Most farmers are unable to farm on a larger scale as they lack access to enough land and rainfall is erratic, with the majority of farms rain-fed. Farmers in these counties typically practice mixed farming where they grow many types of crops and keep livestock on the same plot(s) of land. In Garissa County, several AoI communities located near the Tana River practice irrigation farming with the support of various government schemes. In Lamu, 85% of the land is arable, with around 57,000 ha being used for farming food crops (approximately 21,000 ha), cash crops (approximately 23,000 ha), and forest products (13,000 ha).

Farming also occurs in the arid lands of Turkana, Samburu, and Isiolo but can be challenging due to unreliable rainfall, however in recent years micro drip irrigation has boosted food production in places. In Turkana County, irrigation farming occurs along Kerio River where food crops (e.g. bananas, pawpaws, oranges, kales, green grams) and cash crops (e.g. sorghum) are grown. In Samburu County, small-scale and large-scale farming occurs with maize and beans as the most commonly grown crops. In Isiolo County, irrigation farming is practiced along the Ewaso Ng'iro River, which is crossed by the Project footprint, and also practiced in the AoI community of Isiolo Central. Crops that are produced in these areas include maize, sorghum, beans, green grams, cassava, sweet potatoes, nerica rice, cowpeas, dolicos, kales, tomatoes, onions and watermelons. In addition to small scale agricultural activities, the Aweer people of Lamu (Section 6.13 baseline summary) undertake bee keeping, using traditional means in forested areas. Initial discussions with Aweer Chiefs and Elders have occurred and information about Aweer livelihoods is captured in the socio-economic baseline presented in Annex 2.

Major challenges to the agricultural sector in this part of Kenya include erratic and unreliable rainfall and in some AoI communities land is not available for farming (Lamu AoI communities: Pate, Jipe, and Kiliana). Without title deeds of legal ownership, farmers are also limited in investment options. Coupled with low financial means and access to credit, farmers in the AoI communities face barriers in adopting new technologies that increase productivity and enhance market access.

Construction Phase

Disruption of Agricultural Activities from Land Take

Land required for the Project will be acquired by the Government of Kenya (National Lands Commission, supported by Ministry of Lands and Physical Planning) by compulsory acquisition under the terms of the *Land Act* (2012) and transferred to LAPSSET Corridor Development Authority who will then lease land required for the pipeline corridor to the Project. Stakeholders throughout all counties traversed by the Project have noted concern regarding the Project's large land acquisition requirements relative to land taken from agriculturalists. The Project RoW will require a 26 m working width during construction, and the RoW will be cleared of vegetation to make way for construction activities (e.g. trenching) that will prevent access to the RoW. Agricultural activities therefore will be disrupted during construction as farmers will no longer have access to this land. Although the Project RoW has been refined to avoid areas of agricultural use, some farms will still overlap with the Project, particularly where the Project will cross the Kerio, Suguta, Ewaso Ng'iro River rivers. Areas adjacent to these rivers are highly suitable for agricultural purposes where irrigation schedules often occur, and some agricultural activities might occur here. Current use of land for agricultural purposes will be confirmed through the land acquisition process.

Prior to mitigation, the Project's potential impact of removing of agricultural land and resources during construction is of medium magnitude, considering the importance of agricultural land for agriculturalists' livelihoods, but also in reflection of the refinement of the route to avoid areas of occupation as much as possible, including areas where agricultural activities occur. The impact would be felt locally along the pipeline RoW and would occur through Project construction and is permanent. The Project's pre-mitigation potential impact on land and resource availability is, therefore, assessed as a moderate (negative) for agriculturalists whose land is impacted by Project land take along the RoW.

Land will be acquired by and landowners and land users compensated by NLC under the terms of the Land Act. As an additional non-statutory and voluntary measure, a Livelihood Restoration Framework will also be implemented where appropriate.

The Project's adverse residual impact on agricultural activities due to land take is assessed to be minor given effective implementation of land acquisition and livelihood restoration activities. The impact is highly localised to the area of the Project RoW, and permanent as the land will not be returned. Given the low numbers of farms expected to be affected and the mitigation employed, the magnitude is assessed to be low as farmers will be compensated for their land and crops. Given the impact classification of the criterion, the residual impact significance is assessed to be **minor (negative).**

Indirect Impacts on Agricultural Activities

In Mutuati, Laare Town, and Masalani concern has been expressed about the Project's impacts on environmental conditions that could in turn affect agricultural activities. Beekeepers in Barigoni, Hindi, and Mqanarafa have also expressed concern over impacts on their livelihoods. Farms located along the main rivers (Kerio, Suguta, Ewaso Ng'iro River) that overlap with the Project RoW will be relocated and compensated. However, there is the potential for decreased water quantity in areas due to project works and activities related to changes to watercourse crossings. To limit impacts, construction at watercourse crossings will be scheduled during the dry season and will be based on when the river is at its narrowest to limit the length of excavation work that must take place in the water environment. At the time of report writing, the water intake source for hydrostatic testing had not been identified but if the source is a watercourse used for agricultural purposes, appropriate mitigation measures as discussed in Water Resources (Section 7.3.7 and 7.3.8.1) will be implemented to minimise adverse effects on water quantity. Indirect impacts on agricultural activities are not expected to result in changes to associated livelihoods.

Downstream flooding risks to agricultural activities as a result of the Project was considered but is unlikely as discussed in Water Resources (Section 7.3.8.1). The results of the Water Resources assessment found that the Project will not change the likelihood of flooding in the watercourses crossed by the Project, and thus disruption to downstream agricultural activities through flooding is not predicted.

Erosion issues which may have an effect on agricultural potential were assessed by the soils assessment (Section 7.4) to be of negligible to minor significance, and not occurring at a scale impactful of agricultural activities.

Given that, with mitigation, potential indirect impacts on agricultural activities during construction are not expected to result in changes to livelihoods for agriculturalists, this potential impact has not been carried forward for further mitigation and residual impact assessment.

Operations Phase

Disruption of Agricultural Activities from Land Take

As indicated under Section 7.11.4.3.1, stakeholders throughout all counties traversed by the Project have noted concern regarding the Project's large land acquisition requirements relative to land taken from agriculturalists. The Project RoW will require a permanent land easement of 6 m that will be leased from LCDA within the LAPSSET Corridor for operational access and maintenance for the lifetime of the Project. During operation, the 6 m permanent easement will be used by the Project and no agricultural activities will be permitted on this land. Agricultural activities therefore will be disrupted during operations as farmers will no longer have access to this land. Although the Project RoW has been refined to avoid areas of agricultural use, some farms will still overlap with the Project, in particular areas adjacent to the Kerio, Suguta, Ewaso Ng'iro Rivers, which are highly suitable for agricultural purposes where irrigation schedules often occur, and some agricultural activities are to be expected.

Prior to mitigation, the Project's potential impact of removing of agricultural land and resources during operations is of medium magnitude, considering the importance of agricultural land for agriculturalists' livelihoods, but also in reflection of the refinement of the route to avoid areas of occupation as much as possible, including areas where agricultural activities occur. The impact would be felt locally along the pipeline RoW and would occur through Project operations indefinitely into the future (i.e. permanent). The Project's pre-mitigation potential impact on land and resource availability is, therefore, assessed as a moderate (negative) for agriculturalists whose land is impacted by Project land take along the RoW.

Land will be acquired by and landowners and land users compensated by NLC under the terms of the Land Act. As an additional non-statutory and voluntary measure, a Livelihood Restoration Framework will also be implemented where appropriate.

The Project's adverse residual impact on agricultural activities due to land take is assessed to be minor given effective implementation of land acquisition and livelihood restoration activities. The impact is highly localised to the area of the Project RoW, and permanent as the land will not be returned. Given the low numbers of farms expected to be affected and the mitigation employed, the magnitude is assessed to be low as farmers will be compensated for their land and crops. Given the impact classification of the criterion, the residual impact significance is assessed to be **minor (negative).**

Indirect Impacts on Agricultural Activities

There is the potential for decreased water quantity in areas during Project operations related to changes to surface water flows and groundwater levels from water abstraction. As discussed in Section 7.3.8.2, it is possible that the abstractions used during the construction phase will remain in use during operations, so no additional new abstractions will be required; however, water demand will extend throughout the length of the operational period into the future where climate change predictions suggest that water scarcity and demand will increase. There is also the potential for changes in riverbed morphology, flow patterns and associated erosion rates and flood risk (Section 7.3.8.2). At the time of report writing, the water intake source for hydrostatic testing had not been identified but if the source is a watercourse used for agricultural purposes, appropriate mitigation measures as discussed in Water Resources (Section 7.3.7 and 7.3.8.2) will be implemented to minimise adverse effects on water quantity. Indirect impacts on agricultural activities are not expected to result in changes to associated livelihoods.

Erosion issues which may have an effect on agricultural potential were assessed by the soils assessment (Section 7.4) to be of negligible to minor significance, and not occurring at a scale impactful of agricultural activities.

Given that, with mitigation, potential indirect impacts on agricultural activities during operations are not expected to result in changes to livelihoods for agriculturalists, this potential impact has not been carried forward for further mitigation and residual impact assessment.

Table 7.12-2: Construction phase impact classification and impact significance

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Pastoralism	Loss of grazing land and other natural resources	Low - medium-term (working width of 26 m) and permanent (stations) - local	Minor (negative)	■ Consultation and notification of construction schedule and activities to county and local leadership for dissemination to local communities prior to commencement of construction activities. ■ All work and disturbance will be restricted to the approved RoW, approved camp and laydown areas ■ and approved access roads. ■ A livelihood restoration plan will be implemented to ensure no adverse impacts to livelihoods at a community level. ■ The implementation of mitigation measures used to minimise the impacts on terrestrial biodiversity during construction (Section 7.5.8.3).	Low – medium - term (working width of 26 m) and permanent (station) - local	Minor (negative)
	Quality of grazing and browsing resources	Low - medium-term - local	Minor (negative)	■ All work and disturbance will be restricted to the approved RoW, approved camp and laydown areas, and approved access roads ■ The implementation of mitigation measures used to minimise the impacts on terrestrial biodiversity during construction (Section 7.5.8.3) ■ The implementation of mitigation measures used to minimise the impacts on soils during construction (Section 7.5.8.3)	Low - medium-term - local	Minor (negative)
	Availability and quality of water	Medium - medium-term - local	Moderate (negative)	■ Pre-construction hydro-census work will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit	Low - medium-term - local	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				impacts on communities (pastoralists). Abstraction will be within location specific consented volumes and rates. ■ Sediment management procedures to be developed and implemented. ■ If considered appropriate, either to address risks identified by the EPC Contractor and/or PipeCo, or to address concerns raised by local stakeholders, participatory environmental monitoring of relevant parameters will be undertaken in conjunction with affected communities. ■ Implementation of a Grievance Management Procedure and maintain effective communication procedures, enabling the recording and follow up of complaints related to Project activities. ■ Implementation of the Livelihoods Restoration Framework. ■ The implementation of mitigation measures used to minimise the impacts on water resources during construction (Section 7.3.7. 7.3.8.1 and 7.3.9)		
	Disruption to pastoral movements	Low - medium-term - local	Minor (negative)	■ Consultation and notification of construction schedule will be communicated to county and local leadership for dissemination to local communities prior to commencement of construction activities ■ The length and duration of open trench segments will be minimised at any given time	Low - medium-term - local	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				■ All work and disturbance will be restricted to approved RoW, approved camp and laydown areas, approved access roads ■ Replacement of immoveable traditional beehives that will be lost due to construction with new hives		
	Livestock injuries or fatalities	Medium – permanent - local	Moderate (negative)	■ The length of open trench will be minimised in all areas to limit disturbed areas which could impact pastoralist movement. ■ All areas of open trench will have safety signs. ■ Regular safety patrols will occur along construction areas and the open trench. ■ Trenches will be provided crawl boards/fauna ramps for animals (i.e. wildlife and livestock). Crossing points will be provided at regular interval. ■ Project traffic to comply with Project speed and safety requirements, including restrictions on night-time driving. ■ To reduce interference with public traffic and transportation, the pipeline RoW will be used where practical and safe for the transportation of goods and equipment between storage yards and the working areas. ■ Road safety will be managed through a traffic management plan. ■ Implementation of a Grievance Management Procedure and maintain effective communication	Low – permanent - local	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				procedures, enabling the recording and follow up of complaints related to Project activities.		
	Noise disturbance	Medium - medium-term - local	Moderate (negative)	■ Consultation and notification of construction schedule will be communicated to county and local leadership for dissemination to local communities prior to commencement of construction activities. ■ A livelihood restoration plan will be implemented at a community level to ensure no adverse impacts to pastoralists. ■ The implementation of mitigation measures used to minimise the impacts of noise during construction (Section 7.2.7, 7.2.9.1 and 7.2.10)	Low - medium-term - local	Minor (negative)
Fishing	Availability of freshwater fish	Low - short-term - local	Minor (negative)	■ Consultation and notification of construction schedule and activities to county and local leadership for dissemination to local communities prior to commencement of construction activities, to reduce disruption to fishing. Reinstatement of disturbed areas. Sediment management procedures to be developed and implemented Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures. Hydrotest water abstraction and disposal to avoid/minimise impacts to local water users ■ A pre-construction hydro-census will be undertaken specific to the area where abstractions are	negligible - short-term - local	Negligible (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities (fishing). Abstraction will be within location specific consented volumes and rates. Pipeline construction at river crossings will occur in the dry season ■ Undertake open cut river crossings at times of minimal flow with method statements reviewed and approved by BO The implementation of mitigation measures used to minimise the impacts on Aquatic Biodiversity during construction (Section 7.5.7 and 7.5.8.1)		
	Availability of marine resources	Low - short-term - local	Minor (negative)	■ Livelihood Restoration Plan that contributes to maintenance of marine fishing livelihoods, if applicable. ■ The implementation of mitigation measures used to minimise the impacts on Marine Flora and Fauna during construction (Section 7.6.7 and 7.6.8.1)	Low - short-term - local	Minor (negative)
	Physical access to preferred fishing areas	Low - short-term - local	Minor (negative)	■ Livelihood Restoration Plan that contributes to maintenance of marine fishing livelihoods, if applicable.	Low - short-term - local	Minor (negative)
Agriculture	Disturbance to agricultural activities during Project construction	Medium - permanent - local	Moderate (negative)	■ Land will be acquired and landowners and land users compensated by the National Land Commission under the terms of the Land Act	Low – permanent - local	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
	due to land take			■ A Livelihood restoration plan implemented at a community level to ensure no adverse impacts to agriculture.		

Table 7.12-3: Operations phase impact classification and impact significance

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
Pastoralism	Loss of grazing land and other natural resources	Low - long-term - local	Minor (negative)	■ A livelihood restoration plan will be implemented at a community level to ensure no adverse impacts to pastoralists. ■ The implementation of mitigation measures used to minimise the impacts on terrestrial biodiversity during operations (Section 7.5.8.3)	Low - long-term - local	Minor (negative)
	Quality of grazing and browsing resources	Low - long-term - local	Minor (negative)	■ The implementation of mitigation measures used to minimise the impacts on terrestrial biodiversity during operations (Section 7.5.8.3) ■ The implementation of mitigation measures used to minimise the impacts on soils during operations (Section 7.5.8.3)	Low - long-term - local	Minor (negative)
	Availability and quality of water	Medium - long-term - local	Moderate (negative)	■ A leak detection system will be implemented, and regular monitoring and inspection of the pipeline. ■ Implementation of a Grievance Management Procedure and maintenance of effective	Low - long-term - local	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
				communication procedures, enabling the recording and follow up of complaints related to Project activities. A Livelihood Restoration Plan will be implemented at a community level to ensure no adverse impacts to pastoralists. Implementation of the mitigation measures used to minimise the impacts on water resources during Project operations (Section 7.3.7, 7.3.8.2 and 7.3.9)		
	Noise disturbance	Medium - long-term - local	Moderate (negative)	■ A livelihood restoration plan will be implemented at a community level to ensure no adverse impacts to pastoralists ■ Implementation of mitigation measures to minimise the impacts of noise and vibration during Project operations (Section 7.2.7, 7.2.9.2 and 7.2.10)	Low - long-term - local	Minor (negative)
Fishing	Availability of marine resources	Low - long-term - local	Minor (negative)	■ Clearly demarcated exclusion zones ■ Participatory environmental monitoring ■ Livelihood Restoration Plan that contributes to improvement of marine fishing livelihoods ■ Implementation of mitigation measures to minimise the impacts on Marine Flora and Fauna during Project operations (Section 7.6.7 and 7.6.8.2)	Low - long-term - local	Minor (negative)
Agriculture	Disturbance to agricultural activities during Project operations	Medium - permanent - local	Moderate (negative)	■ Land will be acquired, and landowners and land users compensated by NLC under the terms of the Land Act.	Low – permanent - local	Minor (negative)

Topic	Potential Impact	Impact Classification (excluding mitigation)	Impact Significance (excluding mitigation)	Mitigation or Benefit Enhancement	Residual Impact Classification (including mitigation)	Residual Impact Significance (including mitigation)
	due to land take			■ Livelihood Restoration Plan implemented at a community level		

7.12.5 Summary of Mitigation and of Monitoring Commitments

The following key mitigation measures will be implemented to reduce the residual impact of the Project on livelihoods. These are specified in Table 7.12-2 and Table 7.12-3 and will be expanded upon in the Environmental and Social Management Plans.

7.12.5.1 Pastoralism

Construction Mitigation Measures

- Consultation and notification of construction schedule and activities to county and local leadership for dissemination to local communities prior to commencement of construction activities;
- All work and disturbance will be restricted to the approved RoW, approved camp and laydown areas, and approved access roads;
- The length and duration of open trench segments will be minimised at any given time;
- A Livelihood Restoration Plan will be implemented to ensure no adverse impacts to livelihoods at a community level;
- A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities (pastoralists). Abstraction will be within location specific consented volumes and rates.;
- If considered appropriate, either to address risks identified by the EPC Contractor and/or PipeCo, or to address concerns raised by local stakeholders, participatory environmental monitoring of relevant parameters will be undertaken in conjunction with affected communities;
- Implementation of a Grievance Management Procedure and maintain effective communication procedures, enabling the recording and follow up of complaints related to Project activities;
- Implementation of the Livelihood Restoration Plan;
- Replacement of immoveable traditional beehives that will be lost due to construction with new hives
- The length of open trench will be minimised in all areas to limit disturbed areas which could impact pastoralist movement
- All areas of open trench will have safety signs;
- Regular safety patrols will occur along construction areas and the open trench;
- Trenches will be provided with crawl boards/ramps for animals (i.e. wildlife and livestock). Crossing points will be provided at regular intervals;
- Project traffic to comply with Project speed and safety requirements, including restrictions on night-time driving;
- To reduce interference with public traffic and transportation, the pipeline RoW will be used where practical and safe for the transportation of goods and equipment between storage yards and the working areas;
- Road safety will be managed through a traffic management plan; and
- The implementation of mitigation measures used to minimise the impacts on water resources (Section 7.3.7. 7.3.8.1 and 7.3.9), terrestrial biodiversity (Section 7.5.8.3), soils (Section 7.5.8.3) and noise (Section 7.2.7, 7.2.9.1 and 7.2.10).

Operations Mitigation Measures

- A livelihood restoration plan will be implemented at a community level to ensure no adverse impacts to pastoralists;
- A leak detection system will be implemented, and regular monitoring and inspection of the pipeline;
- Implementation of a Grievance Management Procedure and maintain effective communication procedures, enabling the recording and follow up of complaints related to Project activities. The implementation of mitigation measures used to minimise the impacts on terrestrial biodiversity (Section 7.5.8.3), soils (Section 7.5.8.3), water resources (Section 7.3.7, 7.3.8.2 and 7.3.9) and noise and vibration (Section 7.2.7, 7.2.9.2 and 7.2.10).

7.12.5.2 Fishing

Construction Mitigation Measures

- Consultation and notification of construction schedule and activities to county and local leadership for dissemination to local communities prior to commencement of construction activities, to reduce disruption to fishing;
- Implementation of a Grievance Management Procedure and maintain effective communication procedures, enabling the recording and follow up of complaints related to Project activities;
- Reinstatement of disturbed areas;
- Sediment management procedures to be developed and implemented;
- Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures. Hydrotest water abstraction and disposal to avoid/minimise impacts to local water users;
- A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities (fishing). Abstraction will be within location specific consented volumes and rates;
- Pipeline construction at river crossings will occur in the dry season;
- Undertake open cut river crossings at times of minimal flow with method statements reviewed and approved by BO;
- Livelihood Restoration Plan that contributes to maintenance of marine fishing livelihoods, if applicable;
- The implementation of mitigation measures used to minimise the impacts on Aquatic Biodiversity (Section 7.5.7 and 7.5.8.1) and on Marine Flora and Fauna (Section 7.6.7 and 7.6.8.1).

Operations Mitigation Measures

- Implementation of mitigation measures to minimise the impacts on Marine Flora and Fauna (Section 7.6.7 and 7.6.8.2).

7.12.5.3 Agriculture

Construction and Operations Mitigation Measures

- Land will be acquired, and landowners and land users compensated by the National Land Commission under the terms of the Land Act;

- A Livelihood Restoration Plan implemented at a community level to ensure no adverse impacts to agriculture

7.12.6 Summary of Residual Impacts

The Project has the potential to impact livelihoods in the following main ways:

7.12.6.1 Pastoralism

- The permanent and temporary loss of grazing lands and other natural resources (e.g. trees, salt licks) because of Project clearing activities;
- Reduced quality of grazing or browsing resources because of changes in soil quality, invasive vegetation species, and habitat degradation from contaminant spills or accidents;
- Reduced availability and quality of water because of sediment transport, changes to flows, and water abstraction;
- Disruption to pastoral movements from barriers created during construction activities; and
- Injuries or fatalities to livestock during construction because of the open trench or vehicle collisions.

7.12.6.2 Fishing

- Reduced availability of freshwater fish in the watercourses crossed by the Project because of sediment transport, spills or discharges to watercourses during construction, and water abstraction during construction activities;
- Reduced availability of marine resources (e.g. fish, crabs, lobsters, etc.) because of impacts to mangrove habitat, direct mortality or injury, changes in marine water quality, sensory disturbance and the introduction of invasive species; and
- Reduced physical access to preferred freshwater fishing and marine fishing areas because of barriers during construction.

7.12.6.3 Agriculture

- Loss of agricultural land because of land take during Project construction and operations

With mitigation that has been incorporated into the design, or will take place as incorporated mitigation during pre-construction, construction or operational phases, it is considered that the sources of potential impacts to livelihoods are manageable, and of minor or negligible significance. Most impacts to livelihoods are considered to be local in geographic extent given the mobile nature of the Project. Impacts to pastoralism are considered to be medium-term during the construction period, extending into the long-term during operations. Impacts to freshwater and marine fishing are considered short-term during construction given the temporary nature of construction in the watercourses and marine environment, but long-term during operations for marine fishing only. Disturbance to agricultural activities because of land take is permanent.

The initial impacts that are moderate (negative) and require additional mitigation are associated with water quality and availability, livestock injuries or fatalities, noise disturbance and agricultural land take. Additional mitigations for water include managing abstractions sustainably in a water stressed environment and changing climate. Managing compensation to pastoralists for livestock injury or fatality and to landowners or farmers for land acquired for the Project, and the implementation of the livelihood restoration plan will ensure no adverse impacts to livelihoods at a community level. After additional mitigation is applied, the associated residual impact significance for water quality and availability, livestock injuries or fatalities, noise disturbance and agricultural land take is classified as minor, and therefore considered not significant.

7.13 Ecosystem Services

7.13.1 Introduction

The Project aims to ensure that adverse environmental impacts on ecosystem services as a result of the Project's development, operation and decommissioning are avoided or minimised, thereby sustaining the supply of priority ecosystem services to beneficiaries. This will be achieved via the preservation and maintenance of the condition of the ecosystems that supply priority ecosystem services, throughout all phases of the Project and limiting the potential for an increase in demand for priority services from the Project and the project from achieving planned operational performance.

Definition of Ecosystem Services

Ecosystem services consist of all the natural products and processes that contribute to human well-being, and the personal and social enjoyment derived from nature (Landsberg, *et al*., 2014). They are the benefits that people and/or a project (the beneficiaries) obtain from ecosystems. The benefits gained can be either physical or psychological and can be obtained actively or passively, directly or indirectly. The local scale ecosystem services may be the basis for rural livelihoods and subsistence; for example, grasses and shrubland in an otherwise arid landscape are an important grazing resource for livestock, which provides both cash income and food for low-income families. Ecosystem services whose beneficiaries are at the global or regional scale are not covered by this assessment.

Ideally, the Project should maintain the value and functionality of priority ecosystem services[1] to those beneficiaries directly dependent upon them, through pro-active mitigations and management controls.

7.13.2 Priority Ecosystem Services

To identify priority ecosystem services in the Project's AoI, the scale of relative importance presented in Table 7.13-1 was used with reference to the information collated in the baseline (Section 6.14) to classify the selected ecosystem service.

Table 7.13-1: Criteria for Determining Importance/Sensitivity of Ecosystem Services

Ecosystem Service Importance	Description
Very high	■ Ecosystem service is fundamental to communities in the AoI and is rare locally and regionally, with little or no potential for substitution/replacement.
High	■ Ecosystem service is in high demand and has limited potential for substitution/replacement.
Medium	■ Ecosystem service is widely used by beneficiaries; they have the possibility to substitute with alternatives, but these may not be readily available.
Low	■ Ecosystem service is in low demand and/or is readily substitutable or replaceable.

7.13.3 Magnitude of Impact

The characterisation of the magnitude of the impact considers the description of Project processes and how the Project could result in a change to supply and demand for each of the ecosystem services. The potential for an impact to occur to an ecosystem service has been determined using the understanding of the baseline

[1] Type I priority ecosystem services are those services upon which the local beneficiaries (including the Project) depend for their livelihoods, health, safety, and/or culture, and which project impacts are most likely to impact; Type II priority ecosystem services are those services upon which the Project is directly dependent or that could prevent the Project from achieving planned operational performance.

environment (Section 6.14), and consideration of whether there is a feasible linkage between a source of the potential impact and each ecosystem service. The magnitude of each potential impact has then been classified between 'negligible' and 'high', as described in Table 7.13-2.

Each potential impact can be either adverse or beneficial to the ecosystem service of interest and vary in its duration (i.e. can be long term, medium or short term and either permanent or temporary). For the purposes of this assessment, the following durations apply:

- A short-term impact is defined as up to 38 months (the maximum anticipated construction period);
- A medium-term impact is defined as between 3 and 25 years (anticipated duration of operations); and
- A long-term impact is defined as one that is predicted to last beyond the end of operations (>25 years).

A permanent impact is defined as a change to the baseline that would not reverse itself naturally. A temporary impact is defined as a change to the baseline conditions that would reverse naturally once the source of the impact is exhausted or has stopped.

Potential impacts are also assigned descriptors to identify whether the impact is direct or indirect. For the purposes of this assessment, a direct impact is one that occurs as a direct result of the Project and is likely to occur within the AoI. Indirect impacts (or secondary/tertiary impacts) are those where a direct impact on one ecosystem service has another knock-on impact on one or more other related ecosystem service(s); these impacts may be experienced at a wider scale.

Table 7.13-2: Criteria for Assessing Magnitude of Impact

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
High	Complete loss of a priority ecosystem service, loss of quality and integrity of the priority ecosystem service, severe damage to key characteristics, features or elements. Where the impact affects the ecosystems in such a way that the system's capacity to supply priority services is substantially affected to the extent that they will temporarily or permanently cease to be supplied. The demand for ecosystem services is noticeably elevated from baseline. Demand for services outstrips supply. Limited or no substitutability.	Large scale or major improvement to ecosystem service quality and supply, extensive restoration or enhancement.
Medium	Partial loss of a priority ecosystem service, but not adversely affecting the integrity, partial loss or damage to key characteristics, features or elements of the service. Where the impact affects the ecosystems in such a way that the system's capacity to supply priority services is moderately affected. Measurable changes could occur. The demand for priority ecosystem services is elevated from baseline. Limited or no substitutability.	Some benefit to key characteristics, features or parameters describing ecosystem service quality and supply.
Low	Some measurable change in/damage to attributes, quality or vulnerability of the priority ecosystem service. Minor loss of, or alteration to, key characteristics, features or elements. Where the impact affects the ecosystems in such a way that the system's capacity to supply priority services is slightly affected. Measurable, but small changes could occur.	Minor benefit to, or addition of, one or more key characteristics, features or parameters

Magnitude of Impact	Description Criteria	
	Adverse	Beneficial
	The demand for priority ecosystem services is slightly elevated from baseline. Some potential for substitutability, but alternatives may not be readily available	describing ecosystem service quality and supply.
Negligible	No, or very minor (immeasurable), change to characteristics, features or parameters describing priority ecosystem service quality. Supply of priority ecosystem services will not be affected. Demand for priority ecosystem services will not increase.	

7.13.4 Key Guidance and Standards

The guidance provided in the below-listed documents was followed in conducting the impact assessment for ecosystem services. These documents represent international good practice in ecosystem services review and impact assessment:

- IFC (2012): Performance Standards on Environmental and Social Sustainability;
- Landsberg *et al.* (2013): Weaving ecosystem services into impact assessment. World Resources Institute; and
- IPIECA (2011): Ecosystem services guidance – Biodiversity and ecosystem services guide and checklists.

7.13.5 Ecosystem Services of Interest and Importance

The Project's AoI hosts a wide range of ecosystem services, and communities in the AoI use these in a variety of ways. The assessment of the impacts of the Project on priority ecosystem services (services are those upon which local beneficiaries depend for livelihoods, health, safety, or culture and which the project may affect (Type I); and those services that could prevent the project from achieving planned operational performance (Type II) involved the following steps:

- Identifying ecosystem services supplied within the AoI, and the priority services within this group by identifying ecosystems that supply services, and their capacity to supply services (Section 6.14); and identifying the beneficiaries who use those services, i.e. the demand for the services;
- Prioritisation of ecosystem services for impact assessment. Establishing the baseline for the priority ecosystem services; and
- The impact assessment process (aligned with the World Resources Institute's (WRI) approach (Landsberg *et al.,* 2013) assesses the impacts of the Project on ecosystem services used, or depended on by others, and the dependence of the Project on ecosystem services. This in turn provides an assessment of impact on beneficiaries.

For the purposes of this assessment, ecosystem services considered include priority *provisioning*, *cultural* and *regulating* ecosystem services and their beneficiaries (defined as people and/or a project which are the users of ecosystem services derived from the surrounding environment/ecosystem). Benefits gained can be either physical or psychological, and can be obtained actively or passively, directly or indirectly. *Supporting* ecosystem services have no specific/direct beneficiaries for a pipeline project of this scale and because impacts to these are captured within the *provisioning, regulating* and *cultural* categories for this Project, supporting ecosystem services are not included in the impact analysis for impact assessment.

Table 7.13-3 presents the assigned importance for the identified ecosystem services following the criteria presented in Section 7.13.2.

Table 7.13-3: Ecosystem Services and Importance: Services upon which the Project could impact

Ecosystem Service	Importance	Comment
Provisioning		
Browsing/grazing resources for livestock	High	Livestock raised for meat, milk, and as wealth rely on grazing/browsing resources.
Soils, water, pollinators and other services supporting honey production by bees	Medium	Honey is produced for a food source, and in small-scale sales/trade.
Soils, water, pollinators and other services supporting arable, fruit, and vegetable production	High	Local communities grow crops, vegetables and fruit, for a food source, and in sales/trade.
Fish	Medium	Freshwater fish and sea food are captured and used as a source of food and income.
Wild foods	Medium	Wild foods harvested/hunted by people (e.g. naturally occurring edible plants, bushmeat).
Trees	Medium	Source of shade for people and livestock, and trees also important for social and religious reasons (meetings and ceremonies).
Biomass: 1) fuel 2) timber	Medium	1) Firewood and charcoal are the primary energy source for cooking and has the potential for substitution. 2) Timber harvested for building and furniture making, and beehive construction, is likely to have limited substitutability.
Freshwater (Type I)	High	Water is required for human and animal (including livestock) consumption. People are traditionally reliant on drinking water obtained from hand-dug wells in areas of shallow groundwater (such as, luggas). Installed wells for drinking water supply are located in or near settlements. Other uses of freshwater include for irrigation (supporting arable, fruit, and vegetable production), washing and recreational use.
Medicinal plants	High	Numerous plant species (including herbs and trees) with medicinal uses are used by local people in the AoI and used in small-scale trade.

Ecosystem Service	Importance	Comment
Cultural		
Ethical and spiritual values	High	Sacred sites and intangible cultural heritage, evident within the AoI, are intrinsically linked with natural ecosystems such as wetlands, rivers, lakes and forests. May include sacred trees[2] (shade trees, ceremonial trees) beneath which the men of the community and elders gather to discuss community issues, politics, marriages, general affairs, and trees used for marriages, ceremonies, and initiation rites.
Erosion control (prevention of soil loss)	Medium	Current vegetative cover plays an important part in soil retention on steep slopes and managing scour and soil erosion throughout the year.
Regulating of water flows and timing	Medium	The local hydrological systems regulate water run-off, influence groundwater recharge, and maintain water storage potential of the landscape. Current vegetation establishment controls suspended sediments and regulates water flows and quality.
Mangroves	High	Mangrove habitats along the Lamu marine coast provide regulating services (e.g. flood and erosion control), and complex ecosystem functions for fish (e.g. spawning, nursery and foraging).

Table 7.13-4: Ecosystem Services and Importance: Services upon which the Project is dependent

Ecosystem Service	Importance	Comment
Freshwater (Type II)	High	The Project is reliant on the supply of adequate freshwater, for processes such as hydrotesting.
Regulating of water flows and timing (Type II)	Medium	Regulation of water flows and timing: The Project is reliant on the hydrological system regulation of water run-off and groundwater recharge, particularly for freshwater supply (e.g. for hydrotesting).

7.13.6 Potential Sources of Impact

Potential sources of impacts have been interpreted with other technical disciplines to ensure that a coherent and holistic approach has been applied. As such, the ecosystem services impact assessment has used results from impacts analysis from the following Project disciplines:

- Air Quality (Section 7.1);
- Noise and Vibration (Section 7.2);
- Water Resources (Section 7.3);

[2] Sacred trees have not been exhaustively mapped within the AoI.

- Soils, Geology and Geohazards (Section 7.4);
- Terrestrial and Aquatic Biodiversity (Section 7.5);
- Livelihoods (Section 7.11);
- Cultural Heritage (7.8);
- Physical and Social Infrastructure (Section 7.9); and
- Emergency, Accidental and Non-Routine Events (Section 7.14).

7.13.6.1 Construction Phase

Based on the Project description, and the understanding of the baseline ecosystem services conditions that have been developed, there are aspects of the Project that have been identified as having the potential to present sources of impact to either ecosystem services quality or availability during the construction phase. The potential sources of impact and routes by which they could impact ecosystem services quality and/or quantity are:

- Loss of land and resources available for ecosystem services, including production of biomass fuel and timber, pastoral and agricultural use (i.e. vegetation, salt licks);
- Vegetation clearance leading to reduction in supply of ecosystem services, including felling of trees of cultural importance, felling of shade trees, loss of medicinal plants, and loss of wild foods;
- Abstraction of water (e.g. for hydrotesting) leading to impact on overland flows, erosion, decreased water availability for people, agricultural irrigation, and livestock;
- Changes in water quality, affecting humans and livestock that use it for drinking, and affecting the ability of watercourses to support fish species (a source of food and income);
- Short-term disruption to pastoral access to grazing resources from the barrier effect of pipeline spreads;
- The introduction and spread of invasive pests and diseases;
- Land degradation, air emissions, dust deposition, and/or contaminants, leading to decreased vegetation quality);
- Discharge of contaminants (e.g. hydrotesting water) due to failure of Project infrastructure or poor working practice; and
- Population influx to nearby settlements and subsequent increases in competition for natural resources and grazing/browsing pressure on vegetation.

7.13.6.2 Operation Phase

Based on the Project description, the following aspects of the Project have been identified as presenting potential sources of impact to either ecosystem services quality or availability during the operational phase of the Project:

- Permanent loss of land and resources within Stations and the permanent easement. Losses of biomass fuel and timber, pastoral and agricultural use (i.e. vegetation, salt licks);

- Discrete oil leaks and/or spills (from pipeline, station facilities, tanks, or during transfer between facilities (re-fuelling). Damage could be human error, corrosion of pipework or joints that could lead to loss of integrity and spills[3]. Spills or leaks of oil could impact ecosystem services;
- Water requirements – permanent operational facilities will have limited water requirements for worker welfare and maintenance. Extraction of surface water or groundwater could have a localised impact on water availability for existing users;
- Discharge of wastewater from Project facilities (e.g. staff accommodation, workshops, stations) - discharges of untreated wastewater have the potential to change water quality in receiving watercourses; and
- Increased access for people and vehicles.

7.13.7 Incorporated Environmental Measures

The Project has been designed and planned to include a range of incorporated environmental measures that are either inherent to the design or are GIIP. The following incorporated environmental measures are specifically relevant to ecosystem services.

7.13.7.1 Inherent Design Measures

The inherent mitigation that has been incorporated into the Project design to reduce or avoid impacts on priority ecosystem services during construction and/or operation include:

- The buried pipeline will not impede access and movement across the pipeline Right of Way once it has been installed;
- Selection of pipeline design and routing options that will:
  - Bury the pipeline at depths that will minimise the risk of third-party interference and accidental damage, and consequent oil spill contamination of resources that provide ecosystem services (e.g. soils); and
  - Narrow sections of rivers have been selected for the pipeline crossing to reduce the distance of trenching in the base of rivers that will be required.

7.13.7.2 Good International Industry Practice

The following measures are applicable to the construction phase of the Project: All construction activities will use good practice techniques to minimise the risk of impacts arising from construction disrupting ecosystem services supply and demand. The measures that will be used to reduce construction impact magnitudes, or reduce the potential for creating impacts on ecosystems services, are:

- The pipeline and its facilities will be designed to comply with all applicable Kenyan Laws and Regulations, and applicable international design codes and HSE standards, as well as international good practice. These include, but are not limited to, the following:
  - Defects in the pipeline will be limited through use of QA/QC procedure and testing to reduce the potential for leaks, in line with the guidelines provided in IFC[4].
  - Works in, or within watercourses will not take place without consent from NEMA (as per the EMCA (Water Quality) Regulations, 2006).

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[3] Emergency, Accidental and non-routine events such as erosion leading to pipeline exposure and damage; earthquakes, landslides, vandalism, or accidental damage through later groundworks could lead to pipeline damage, which are addressed in Section 7.14.

[4] International Finance Corporation, 2007. Environmental, Health and Safety Guidelines for Onshore Oil and Gas development

- All construction waste will be handled, stored and managed through the good practice outlined in the Waste Management section of the Construction Environment Management Plan.
- Hydrotest water will be obtained and discharged in accordance with applicable regulations. Where discharges take place, this will be at a controlled rate at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures.
- The use of biocides and corrosion inhibitors in hydrotest water will be minimised and avoided where possible.
- Minimisation and reuse of water and materials where feasible to avoid unnecessary impacts on resources that support priority ecosystem services (e.g. the pipeline hydrotest procedure will aim to store and reuse water to reduce volume required from water abstractions).
- Existing road infrastructure has been identified for use where possible to reduce the need for creation of new roads and minimise area which would have led to increased land take (e.g. of pasture used by livestock).
- The length and duration of open trench segments will be minimised at any given time, minimising disruption to local communities and wildlife.
- Construction activities in perennial rivers and wetland areas will take place during the dry seasons when flows and levels in watercourses are low; timings of constructions activities will be selected based on when the watercourse is at its lowest anticipated level.
- Once the pipeline is installed, areas are to be rehabilitated as soon as possible based on a Site Restoration Procedure; e.g. agricultural lands that were disrupted will be reinstated so that farmers may once again start to cultivate them.

The following measures are applicable to the operational phase of the Project:

- The pipeline will be regularly inspected, and maintenance programmes will be followed to maintain pipeline integrity to reduce the potential to leaks that could otherwise lead to soil or water contamination;
- Operational waste will be handled in a way that follows environmental legislative requirements and reduces pollution potential.

7.13.8 Impact Classification

7.13.8.1 Introduction

This section assesses the impacts that the Project could have on priority ecosystem services (Table 7.13 3) in both the construction and operation phases, taking into account the baseline ecosystem services setting and identification of priority services (Section 6.14), the potential sources of impact on those priority services (Section 7.13.6) and the relevant incorporated environmental measures (Section 7.13.8). The implementation of operational mitigations to mitigate or avoid impacts on ecosystem services is then considered, and the residual impact reported.

A discussion regarding feasible impact linkages during each of the Project's phases is presented in the sub-sections below. Each discussion is followed by a table where the potential sources of impact and relevant incorporated mitigation, applicable to each ecosystem service, are summarised. The magnitude, direction, timescale and significance of each impact linkage is assigned following the method presented in Sections 7.13.2 and 7.13.3.

7.13.8.2 Construction Phase

The assessment of impacts on ecosystem services during construction is presented in Table 7.13-5. Impacts on ecosystem services that were of negligible magnitude (prior to mitigation), and not significant, have been omitted in the table, to ensure sufficient focus on those impacts requiring attention to ensure effective mitigation.

Vegetation clearance and loss of land and resources

There will be some potential loss of grazing land, agricultural land, shade trees, medicinal plants, and other ecosystem services because of Project clearing and construction. The majority of vegetation loss in the Project footprint will be temporary in nature. A total of 1,645.7 ha of vegetation will be temporarily lost along the length of the Project RoW of 26 m (not including the permanent easement station footprints) (Table 7.5-6, Section 7.5-6). Much of the habitat in the Project corridor is already highly modified and degraded by overgrazing, erosion, and is under competitive pressure from non-native and invasive species. Areas of Wamba, Archer's post and Garissa in particular are overgrazed with high rates of soil erosion and low vegetation diversity. In addition, the route was designed to avoid areas of occupation as much as possible, including areas where agricultural activities occur (while the number of farms crossed by the Project is currently unknown, it is expected to be low). After trenching, pipe-laying, backfilling, and testing disturbed areas will be rehabilitated. The rehabilitation of the Project spreads is likely to result in the re-colonisation of vegetation within 5 years.

Due to the quality of the habitats within the Project footprint, and temporary nature of these works, prior to mitigation the magnitude of reduction in supply of any ecosystem services due to vegetation clearance and loss of land and resources is predicted to be **low (adverse)**.

Water quality and availability

The Project has the potential to affect water availability or quality, and subsequently affect the supply of services that are directly or indirectly reliant on water (including people, fish, arable, fruit, and vegetable production, livestock, and other services reliant on water).

Direct impacts on water quality in surface watercourses and waterbodies (e.g. main rivers, seasonal rivers and luggas) could result from discharging untreated wastewater or release of contaminants into surface water. Indirect impacts on water quality could result from discharges, leaching, leaks or spills to the ground that are then transported to surface water or groundwater. Other impacts could include disruption to flows downstream of the pipeline installation works and potential alterations to water availability immediately downstream. This could then lead to adverse effects on those services that water supports, such as water resources in local hand-dug wells, grazing/browsing resources for livestock, production of honey (apiculture), and arable, fruit, and vegetable production. Accordingly, prior to mitigation such discharges are predicted to have a **medium magnitude (adverse)** impact on services which have some reliance on water.

The source (or sources) of water for construction and hydrotesting activities and water demand is currently unconfirmed. Water could be taken from surface watercourses which could directly impact flows. If water is taken from the ground, this could impact existing water levels (Section 7.3). If water is taken from surface watercourses or flow is blocked to allow in-channel construction, it could directly impact the availability (and quality) of water. Further characterisation of the water environment and water use at the selected abstraction location(s) would be required prior to construction. Changes to surface water flow and quality could also result in indirect impacts to shallow groundwater recharge and quality. Conversely, impacts on shallow groundwater levels could indirectly impact surface water baseflows. The incorporated mitigation means that hydrostatic test water will be obtained in accordance with applicable regulations and abstraction and discharge will occur in the same catchment, where possible. Water demand will also be reduced by water reuse where possible.

Prior to mitigation, changes in the availability of water as a result of Project construction is potentially of **medium magnitude (adverse)**.

Disruption to pastoral access to grazing/browsing resources

Project construction activities, including the open trench and equipment has the potential to create barriers to movement for pastoralists and their livestock to access traditional grazing areas and water points. Access to grazing land has also been constrained due to security threats and conflict within and between pastoral communities driven by competition for scarce natural resources.

Accordingly, disruption of pastoral access to grazing resources is predicted to have a **low magnitude (adverse)** impact on the provision of grazing/browsing resources for livestock.

Wildlife mortality

During construction activities, there will be an open trench and increased vehicle traffic which has the potential to cause injury or fatalities to animals used for bushmeat. Inherent mitigation will reduce the potential impacts to livestock to some extent. Soil extracted from the trench will form a barrier, and a Wildlife Access Control Procedure will be implemented in some areas where it is required to deter ingress of animals and livestock to the open trench. Exit ramps will be installed into the trench to allow animals that accidently fall in to safely egress the trench and crossing points will be in place that are clearly signed. Speed limits will follow national limits on public roads, and limits will be established on Project and access roads.

Accordingly, wildlife mortality is predicted to have **negligible** impacts on the provision of wild foods in the AoI.

The introduction and spread of invasive pests and diseases;

During construction, there is the potential for the introduction or spread of exotic and invasive species on or near the Project footprint, which may alter natural vegetation and change the quality of ecosystem services (such as fish, wild food, medicinal plants) (Section 7.5.6.1). Soil handling and management techniques will limit these impacts to some extent. Invasive species may also colonise the Project footprint during operations and post-restoration of habitat, introduced through construction equipment or vehicle movements within the RoW (Section 7.5.6.2). Accordingly, prior to mitigation the introduction and spread of invasive pests and diseases is predicted to have a **low magnitude (adverse)** impact on relevant ecosystem services.

Land degradation, air emissions, dust deposition

The Project has the potential to adversely affect the quality of vegetation during construction due to a number of factors, including soil erosion, invasive species, air emissions, dust deposition, and hazards (e.g. oil and chemical spills and accidents) (Section 7.5.6). Given the length of the pipeline Project, it is assumed that at least in some places, ecosystem services (such as grazing/browsing resources for livestock, arable, fruit, and vegetable production, wild foods, and trees) are provided in the vicinity of the working width and roads.

The materials used in the construction of haul and access roads have the potential to influence natural vegetation. Surface water run-off from new or upgraded service roads and tracks may alter the soil or substrate quality, potentially altering natural vegetation communities to modified in nature. There is also the potential for soil erosion and changes in topsoil quality and arable land, if the topsoil isn't properly separated from trench soil during salvaging, which could also impact grazing quality. During operations, the monitoring and maintenance of the Project will largely be undertaken remotely using automated systems, which will limit vehicle and foot traffic, thus minimising the potential for vegetation impacts. Given that the construction will be moving along spreads as work progresses, impacts related to construction deposition of NO_x and SO_x are likely to be **negligible**.

Dust deposition on vegetation can reduce the quality of habitats or degrade it to a point where it is no longer impactive. A clear guideline value to protect vegetation from dust is not available. The guideline value for the loss of human amenity value is based on a threshold of 350 mg/m^2/day. Given that the construction will be moving along spreads as work progresses, impacts related to construction dust deposition are likely to be **negligible**.

Hazards, such as oil and chemical spills and accidents, have the potential to impact vegetation and reduce grazing quality. However, oil and chemical handling, storage, and spill response are expected to be part of the Projects standard policies, Environmental Management Plans, and emergency procedures. Vegetation degradation could also occur in the event of a construction fire from re-fuelling of equipment and machinery, the storage of fuel and third-party vandalism, contributing to decreased vegetation quality and loss. The potential impacts of environmental risks and accidents are assessed in Section 7.14

Prior to operational mitigation, changes in the quality of ecosystem services as a result of Project construction is predicted to be **negligible**, given the mobile and temporary nature of the construction Project. Any changes in vegetation quality are expected to be small and to not materially alter the ecosystem services that support pastoral livelihoods.

Population Change

The Project may lead to population changes to nearby communities during construction, and subsequent increases in competition for ecosystem services. Some rural to rural migration is anticipated as people move closer to the Project route to take advantage of potential job opportunities associated with construction activities. In addition, ad hoc settlements and trading could occur along the Project route. Influx of opportunity seekers could stimulate increased hunting activity for fish and wild fauna meat supply in the vicinity of the AoI.

The Project has the potential to impact grazing pressure in some of these areas if pastoralists are faced with increasing competition for land driven by population influx and the establishment of ad hoc settlements, or if pastoralists are displaced from their traditional grazing areas, which could deflect pressure to remaining resources with competing groups striving to gain control. Remaining pastoral land may become more degraded, ultimately eroding their capacity to recover and support livestock production and livelihoods. Competition for resources may escalate particularly where the Project crosses the borders of Turkana, Samburu and Isiolo, areas that are already prone to competition for land and resources.

Prior to operational mitigation, increased competition for natural resources as a result of Project construction is predicted to have **low magnitude (adverse)** impacts on relevant ecosystem services.

The construction phase impact assessment with respect to ecosystem services is presented in Table 7.13-5. Further details of the summary mitigation include in the table are presented in Section 7.13.9.

Specific regard is made for the mitigation measures set out in the following chapters, and cross-reference should be made to these when considering the ecosystem services impact assessment:

- Water Resources (Section 7.3);
- Terrestrial and Aquatic Biodiversity (Section 7.5);
- Cultural heritage (Section 7.8); and
- Livelihoods (Section 7.11).

Table 7.13-5: Construction Phase Impact Classification and Impact Significance

Ecosystem Service (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Grazing/ browsing provision for livestock (High)	Loss of land and resources available for pastoral use	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: ■ Disturbed areas will be restored and natural regrowth of vegetation will occur; ■ A Livelihood Restoration Plan will be implemented to ensure no adverse impacts to livelihoods at a community level; ■ Existing roads and the RoW will be utilised where possible to minimise the amount of new access roads that are required to be built; and ■ Temporary Project tracks will be removed once construction activities have been completed.	Negligible – Short term – Temporary	Negligible
	Short-term disruptions to pastoral access to grazing resources from barriers during construction	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: ■ Pre-mobilisation engagement with local communities to explain the short duration of construction activities and limited time camps will remain in any one area; and ■ Develop and implement adequate and appropriate site access control procedures, together with signs in local languages to be placed along active construction areas and lengths of open trench.	Low – Short term – Temporary	Minor (adverse)

Ecosystem Service (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	Population influx to nearby settlements and subsequent increases in competition for natural resources and grazing/browsing pressure on vegetation	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: ▪ Pre-mobilisation engagement with local communities to explain short duration of construction activities and limited time camps will remain in any one area; and ▪ Develop and implement adequate and appropriate site access control procedures, together with signs in local languages to be placed along active construction areas and lengths of open trench. ▪ Influx management measures as described in section 7.11 to mitigate Project-associated in-migration impacts; ▪ All non-local workers to be housed in designated accommodation camps except where local impacts can be demonstrated to be negligible, to help reduce risk of influx putting pressure on grazing. ▪ Implement employment policy forbidding informal labour hire and no “at gate/camp” hiring to help reduce risk of influx putting pressure on grazing.	Low – Short term – Temporary	Minor (adverse)
	Discharge of contaminants	Medium – Short term – Temporary	Moderate (adverse)	No additional measures beyond those described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)

Ecosystem Service (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Soils, water, pollinators and other services supporting honey production by bees (Medium)	Loss of land and resources/ ecosystem services supporting natural pollination	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7.	Negligible – Short term – Temporary	Negligible
Arable, fruit, and vegetable production (High)	Loss of land and resources available for agricultural use	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)
	Population influx to nearby settlements and subsequent increases in competition for soil resources	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: Influx management, non-local workers accommodated in construction camps (as above).	Low – Short term – Temporary	Minor (adverse)
	Abstraction of Project water leading to decreased water availability for water users during construction	Medium – Short term – Temporary	Moderate (adverse)	Measures described in Section 7.13.7. Additional measures include: A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates.	Low – Short term – Temporary	Minor (adverse)

Ecosystem Service (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Fish (Medium)	The introduction and spread of invasive pests and diseases	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: ■ Develop and implement an Invasive Species Management Procedure, to include hygiene specifications for vehicles and cargo, site clearance and rehabilitation.	Negligible – Short term – Temporary	Negligible
	Temporary population increase to nearby settlements and subsequent increases in competition for fish resources, namely in Lamu	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: Influx management, non-local workers accommodated in construction camps (as above). ■ A no hunting or fishing policy will be developed and implemented. Disturbance to the environment and natural resources will only be permitted when required for the specific purpose of the Project, e.g. vegetation clearance in the RoW prior to trenching.	Low – Short term – Temporary	Minor (adverse)
Wild food (Medium)	Vegetation clearance, including loss of wild foods	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)
	The introduction and spread of invasive pests and diseases	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: Key mitigation measures include: Invasive Species Management Procedure (as above).	Low – Short term – Temporary	Minor (adverse)

Ecosystem Service (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	Population increase to nearby settlements and subsequent increases in competition for natural resources and grazing/browsing pressure on vegetation	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: Influx management, non-local workers accommodated in construction camps (as above).	Low – Short term – Temporary	Minor (adverse)
	Discrete or low discharge of contaminants e.g. hydrocarbons	Medium – Short term – Temporary	Moderate (adverse)	No additional measures beyond those described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)
Trees of cultural or social importance to communities (Medium)	Vegetation clearance, including felling of shade trees	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: ■ Identified sacred sites close to construction/operation areas will be protected through demarcation of no-go areas for vehicles and Project personnel; ■ Consultation and engagement with local communities prior to commencement of construction activities to identify any cultural heritage sites within the RoW, which may be avoided by micro-routing where appropriate. Where encountered and avoidance is not possible, relocation of sacred site, resource or activity if technically feasible, in consultation with local communities.	Low – Short term – Temporary	Minor (adverse)

Ecosystem Service (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
Biomass fuel and timber (Medium)	Loss of land available for production of biomass fuel and timber	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)
	Population influx to nearby settlements and subsequent increases in competition for natural resources	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: Key mitigation measures include: Influx management, non-local workers accommodated in construction camps, no hunting or fishing policy (as above).	Negligible – Short term – Temporary	Negligible
Freshwater (High)	Changes in water quality, affecting people that use it for drinking and watering livestock	Low – Short term – Temporary	Minor (adverse)	No additional measures beyond those described in Section 7.13.7.	Negligible – Short term – Temporary	Negligible
	Population influx to nearby settlements and subsequent increases in competition for natural resources	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: Key mitigation measures include: Influx management, non-local workers accommodated in construction camps (as above).	Negligible – Short term – Temporary	Negligible
	Abstraction of water (including for hydrotesting) leading to decreased water availability for people	Medium – Short term – Temporary	Moderate (adverse)	Measures described in Section 7.13.7. Additional measures include: Key mitigation measures include: Local hydro-census work (as above).	Low – Short term – Temporary	Minor (adverse)

Ecosystem Service (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	and livestock during construction					
	Discharge of contaminants	Medium – Short term – Temporary	Moderate (adverse)	No additional measures beyond those described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)
Soil formation and retention (Medium)	Vegetation clearance, including vegetative cover providing soil retention on steep slopes	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: Prior to vegetation clearing and grading activities, temporary erosion control measures will be installed where necessary	Negligible – Short term – Temporary	Negligible
Regulating the water cycle and timing (Medium)	Clearance of vegetation that controls runoff and erosion and regulates the water cycle	Low – Short term – Temporary	Minor (adverse)	No additional measures beyond those described in Section 7.13.7.	Negligible – Short term – Temporary	Negligible
Medicinal plants (Medium)	Vegetation clearance, including loss of medicinal plants	Medium – Short term – Temporary	Minor (adverse)	No additional measures beyond those described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)
	The introduction and spread of invasive pests and diseases	Low – Short term – Temporary	Minor (adverse)	Measures described in Section 7.13.7. Additional measures include: Invasive Species Management Procedure (as above).	Low – Short term – Temporary	Minor (adverse)

Ecosystem Service (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including mitigation)	Residual Impact Significance
	Discharge of contaminants	Medium – Short term – Temporary	Moderate (adverse)	No additional measures beyond those described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)
Ethical and spiritual values (High)	Vegetation clearance, including felling of trees of cultural importance	Medium – Short term – Temporary	Moderate (adverse)	■ Measures described in Section 7.13.7. ■ Demarcation of no-go areas (as above); ■ Consultation and engagement with local communities prior to commencement of construction activities (as above)	Low – Short term – Temporary	Minor (adverse)
Mangroves (High)	Discharge of contaminants	Medium – Short term – Temporary	Moderate (adverse)	No additional measures beyond those described in Section 7.13.7.	Low – Short term – Temporary	Minor (adverse)

7.13.8.3 Operational Phase

The assessment of impacts on ecosystem services during operation is presented in Table 7.13-6. The following section details potential impacts considered during the operational phase of the project. Of these, impacts predicted to have impact magnitudes of low or above, are presented in table 7.13-6.

Oil leaks

Oil leaks that may be discrete in nature, potentially arising from poor maintenance of vehicles, or poor working practice could lead to water quality changes. The pipeline route is designed to avoid areas of high flood risk and scouring, and, therefore, erosion potential. It will be buried, have a protective coating, be tested before use, and will have a leak detection system and inspection regime with associate procedures and actions plans that will be detailed in the Operational Environment Management Plan. All oil transport and storage facilities, including tanks, will be designed to appropriate earthquake standards. Oil volume monitoring will take place and all oil storage tanks will have secondary containment. All transfer of oil will take place in areas of hardstanding with appropriate segregated drainage systems. The predicted impact to surface watercourses, shallow aquifers, the marine environment and human water users is predicted to be **minor (adverse)**.

This assessment does not consider large-scale emergency situations and non-routine events, which are addressed in Section 7.14.

The following operational related impacts have been evaluated but are considered of negligible significance pre-mitigation and therefore require no further analysis:

- Permanent loss of land and resources within stations and along the permanent easement. Losses of biomass fuel and timber, pastoral and agricultural use (i.e. vegetation, salt licks);
- Water requirements – permanent operational facilities will have limited water requirements for worker welfare and maintenance. Extraction of surface water or groundwater could have a localised impact on water availability for existing users;
- Discharge of wastewater from Project facilities (e.g. staff accommodation, workshops, stations) - discharges of untreated wastewater have the potential to change water quality in receiving watercourses; and
- Increased access for people and vehicles.

The operational phase impact assessment with respect to ecosystem services is presented in Table 7.13-6. Further details of the summary mitigation include in the table are presented in Section 7.13.9.

Specific regard is made for the mitigation measures set out in the following chapters, and cross-reference should be made to these when considering the ecosystem services impact assessment:

- Water Resources (Section 7.3);
- Terrestrial and Aquatic Biodiversity (Section 7.5);
- Cultural heritage (Section 7.8); and
- Livelihoods (Section 7.11).

Table 7.13-6: Operational Phase Impact Classification and Impact Significance

Receptor (Importance)	Source of Potential Impact	Impact magnitude (excluding mitigation)	Impact significance (excluding mitigation)	Mitigation	Residual Impact Classification (including all mitigation)	Residual Impact Significance
Grazing/ browsing provision for livestock (High)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short term - Temporary	Minor (adverse)	Measures described in Section 7.13.7.	Negligible – Short term - Temporary	Negligible
Arable cropping, fruit, and vegetable production (High)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short term - Temporary	Minor (adverse)		Negligible – Short term - Temporary	Negligible
Fishing – freshwater (Medium)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short term - Temporary	Minor (adverse)		Low – Short-term - Temporary	Minor (adverse)
Fish – marine (Medium)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short term - Temporary	Minor (adverse)		Low – Short term - Temporary	Minor (adverse)
Wild food (Medium)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short term - Temporary	Minor (adverse)		Negligible – Short term - Temporary	Negligible
Biomass fuel and timber (Medium)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short term - Temporary	Minor (adverse)		Negligible – Short term - Temporary	Negligible

Freshwater (High)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short term - Temporary	Minor (adverse)		Negligible – Short term - Temporary	Negligible
Ethical and spiritual values (High)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short term - Temporary	Minor (adverse)		Negligible – Short term - Temporary	Negligible
Mangroves (High)	Discrete oil leaks (e.g. from poor maintenance of vehicles, or poor working practice)	Low – Short-term - Temporary	Minor (adverse)		Low – Short term - Temporary	Minor (adverse)

7.13.9 Summary of Mitigation

In addition to the inherent mitigation measures that will be put in place during construction and operation to avoid impacts on ecosystem services or reduce their magnitude, the following mitigation or monitoring will be applied. These measures are detailed in the residual significance impact tables previously presented. The measures include key measures reiterated from relevant specialist studies within the ESIA that contribute to mitigation of impacts on ecosystem services, as well as additional, ecosystem service-specific mitigation measures based on the guidance provided by IFC, and IPIECA/OGP for oil and gas project impacts and dependencies (IPIECA, 2011). These mitigation measures follow the mitigation hierarchy to ensure the minimum possible impacts on priority ecosystem services and the communities that depend on them.

This section collates and presents further detail relating to those mitigation commitments, which will be detailed in one of the following management plans:

- Construction Environment Management Plan;
- Influx Management Plan;
- Biodiversity Management Plan; or
- Operation Environment Management Plan.

Summary of Key Mitigation Measures

The additional construction mitigation measures that will be undertaken to reduce construction impact magnitudes, or reduce the potential for creating the impact, include the following:

- Existing roads and the RoW will be utilised wherever possible to minimise the amount of new access roads that are required to be built;
- Disturbed areas will be restored and natural regrowth of vegetation will occur;
- Temporary Project tracks will be removed once construction activities have been completed;
- Pre-mobilisation engagement with local stakeholders to explain the short duration of construction activities and limited time camps will remain in any one area;
- A Livelihood Restoration Plan will be implemented to ensure no adverse impacts to livelihoods at a community level.;
- Develop and implement adequate and appropriate site access control procedures, together with signs in local languages to be placed along active construction areas and lengths of open trench;
- All non-local workers to be housed in designated accommodation camps except where local impacts can be demonstrated to be negligible, to help reduce risk of influx putting pressure on grazing;
- Implement employment policy forbidding informal labour hire and no "at the gate/camp" hiring to help reduce risk of influx putting pressure on grazing;
- A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates.;
- Develop and implement an Invasive Species Management Procedure, to include hygiene specifications for vehicles and cargo, site clearance and rehabilitation;

- A no hunting or fishing policy will be developed and implemented. Disturbance to the environment and natural resources will only be permitted when required for the specific purpose of the Project, e.g. vegetation clearance in the RoW prior to trenching.;
- Identified sacred sites close to construction/operation areas will be protected through demarcation of no-go areas for vehicles and Project personnel;
- Consultation and engagement with local communities prior to commencement of construction activities to identify any cultural heritage sites within the RoW, which may be avoided by micro-routing where appropriate. Where encountered and avoidance is not possible, relocation of sacred site, resource or activity if technically feasible, in consultation with local communities; and
- Once the pipeline is installed, areas are to be rehabilitated as soon as possible based on a Site Restoration Procedure; e.g. agricultural lands that were disrupted will be reinstated so that farmers may once again start to cultivate them.

In areas of natural land use (i.e. non-cultivated), land will be allowed to naturally revert to its pre-disturbed state,

7.13.9.1 Project Dependencies on Ecosystem Services

As discussed in Section 7.13.1 it is necessary not only to assess potential impacts of the Project on ecosystem services, but also the key dependencies that the Project may have on ecosystem services. The most significant dependency, occurring during construction, is the need to make use of water resources.

The raw water demand for the Project originates primarily from the requirements for large volumes of water for hydrotesting of the integrity of sections of the pipeline after it has been laid. The source (or sources) of water for commissioning (hydrotesting) activities and the water demand is currently unconfirmed at the time of writing; sources will be confirmed during the EPC process. The requirement for hydrotesting water likely constitutes a very high proportion of the overall Project water demand during construction; it likely requires a large volume, to source securely and sustainably in a mostly semi-arid climatic zone, with markedly seasonal (and variable) precipitation.

7.13.10 Summary of Residual Impacts

With mitigation that has been incorporated into the design, or will take place during pre-construction, construction or operational phases, it is considered that most sources of potential impacts to ecosystem services are manageable. Most impacts are associated with the construction phase and, by their nature are considered to be temporary. The associated impact significance that results from the combination of resource importance and predicted impact magnitude, post mitigation, are all classified as minor or negligible.

7.14 Emergency, Accidental and Non-routine Events

7.14.1 Introduction

This Emergency, Accidental and Non-routine Events Risk assessment includes an evaluation of Natural and Industrial Hazards and the probability of their occurrence to assess the risk to and from the LLCOP Project and to public safety.

This assessment does not consider potential impacts on workers from natural or industrial hazards. These relate to occupational health and are not addressed as part of this ESIA.

7.14.2 Hazards to be Considered

The following sections describe the Natural and Industrial Hazards considered in this assessment and provides an indication of how they will be assessed herein, including whether they have been scoped in or out.

7.14.2.1 Natural Hazard Scenarios

- Natural seismicity (earthquakes) activity which may lead to loss of containment or pipeline integrity (potential for contamination via surface water or groundwater pathways), and to vibration-sensitive built structures or equipment which may lead to operational failure – **scoped in** to be addressed with procedures in an Emergency Preparedness Response Plan;
- Geohazards, including landslide or mass movement activity which may lead to loss of containment or pipeline integrity (potential for contamination via surface water or groundwater pathways) - **scoped in** to be addressed with procedures in a Construction Environmental Management Plan and an Emergency Preparedness Response Plan;
- Heavy rainfall, high wind speeds, flooding or other extreme weather leading to damage to containment structures or storage of hazardous, combustible or explosive materials – **scoped out** due to the potential low resulting impact. The response to such an unplanned event will be covered in an Emergency Preparedness Response Plan;
- Lightning strikes causing fires and damage to project infrastructure, for example, generators, storage tanks and pumps – **scoped out** due to the expected low frequency of occurrence and potential low resulting impact. The response to such an unplanned event will be covered in an Emergency Preparedness and Response Plan;
- Dust storms which may lead to damage to site infrastructure and potential operational failure – **scoped out** due to the expected low frequency of occurrence and potential low resulting impact. This will form part of management of natural hazards in this environment;

7.14.2.2 Industrial Hazard Scenarios

- Loss of containment in a storage tank on the VLCC acting as an FSO vessel. This may lead to a significant oil spill into the marine environment – **scoped in** to be addressed with procedures in the oil spill response section of an Emergency Preparedness Response Plan;
- Leakage of oil from the VLCC acting as an FSO vessel. This may lead to an oil spill into the marine environment – **scoped in** to be addressed with procedures in the Oil Spill Contingency Plan;
- Leakage of oil from the loading arm in the LMT which may lead to a minor oil spill into the marine environment – **scoped in** to be addressed with procedures in the Oil Spill Contingency Plan;
- Risk of explosion/thermal radiation at Station 7 (where there is a source-pathway-receptor link) from a Pool fire – **scoped in** to be addressed with procedures in an Emergency Preparedness Response Plan;

- Leakage of oil from a pipeline perforation or rupture which may lead to an oil spill onto land or at a river/ lugga crossing **- scoped in** to be addressed in the Operations Environmental Management Plan and with procedures in the oil spill response section of an Emergency Preparedness Response Plan;
- Collision of VLCC and marine wildlife within the LLCOP AoI which may result in injury or mortality – **scoped out of this assessment but** considered in the Marine Flora and Fauna impact analysis (Chapter 7.6);
- A structural or mechanical failure of vehicle or plant which may lead to a collision resulting in damage to the pipeline or containment structures – **scoped out** due to the potential low resulting impact and expected low frequency due to the pipeline being buried. The response to such an unplanned event will be covered in an Emergency Preparedness Response Plan;
- Spillages of diesel or contaminants which may lead to contamination of the local environment and possible damage to ecological receptors or water sources **- scoped out** due to the potential low resulting impact and expected low frequency. This will be addressed in Operations Environmental Management Plan and an Emergency Preparedness Response Plan;
- Road traffic accidents on access roads which may lead to injury or death of human or ecological receptors **- scoped out** due to the expected low frequency as these roads should not be used by the public. This will be addressed in Construction Environmental Management Plan and Operations Environmental Management Plan;
- Road traffic accidents on public roads which may lead to a spillage of hazardous materials, injury or death of human or ecological receptors or damage to public infrastructure **- scoped out**, as laws on public roads will be adhered to. This will be addressed in Operations Environmental Management Plan and an Emergency Preparedness Response Plan; and
- Uncontrolled releases of waste materials into the environment **- scoped out** due to the potential low resulting impact. This will be addressed in Construction Environmental Management Plan and Operations Environmental Management Plan.

7.14.3 Legislative Context

According to paragraphs 67 and 68 of the Petroleum Act 2019:

- A contractor and any other participant in upstream[1] petroleum operations shall, at all times, maintain efficient measures for emergency preparedness with a view to dealing with incidents which may lead to loss of life or personal injury, pollution or damage to property.
- The contractor shall ensure that the measures taken to prevent or reduce harmful effects, include measures to ensure that the environment is restored as much as possible to its original condition prior to commencement of operations
- The contractor shall initiate and maintain emergency preparedness measures to prevent and mitigate against any hazards occurring within facilities and shall, at all times, have contingency plans to deal with such emergencies.
- The contractor shall place facilities at the disposal of the relevant authorities for emergency and security drills and shall, where necessary, participate in such drills.
- The contractor shall take all reasonable measures to:

[1] For the purposes of this study, it is assumed that where the Act refers to upstream, these requirements are also valid for LLCOP.

- Identify the hazards and evaluate the risks associated with any work performed in the course of upstream petroleum operations carried out under the license which constitute a hazard to the health of persons employed for the purposes of that work and the steps to be taken to comply with the provisions of this Act and Regulations made herein; and
- As far as practicable, prevent the exposure of the persons referred to in paragraph (a) to the hazards.

- As far as is practicable, the contractor shall involve the Authority, National Environment Management Authority, the Council of Governors and the relevant local communities in the preparation of emergency preparedness measures

In addition to the Petroleum Act and national ESIA requirements which specify that the environmental and social management measures emerging from the assessment process should incorporate measures for “emergency preparedness and response”.

IFC Performance Standard 1, Assessment and Management of Environmental and Social Risks and Impacts (2012) outlines the requirement for an Environmental and Social Management Plan which incorporates emergency preparedness and response. In order to formulate the ESMP, this risk assessment is required to identify which, if any, risks there are regarding emergency preparedness and response.

7.14.4 Assessment Methodology

7.14.4.1 Introduction

For each of the hazards listed in Section 7.14.2, a consequence rating and its probability of occurring have been assigned according to the definitions given in Figure 7.14-1. Hazard consequence and probability are then combined to give the risk level of each hazard (Table 7.14-2).

7.14.4.2 Natural Hazards

Natural hazards have been qualitatively assessed and the risk rating and proposed method of management and response is presented in Table 7.14-1. These consider hazards which have the potential to impact soils, water, air, human health, ecosystems and biodiversity.

7.14.4.3 Industrial Hazards

Industrial hazards have been qualitatively assessed and the risk rating and proposed method of management and response is presented in Table 7.14-2, except for the assessment of oil spills and major accidents including leaks and pool fires, for which specific quantitative risk assessments have been undertaken by third parties. Modelling outputs are described in Section 7.14.5.

Emergency, Accidental and Non-routine Events- RISKS AND ASSOCIATED CONSEQUENCES	CONSEQUENCE				
	INSIGNIFICANT	MINOR	MODERATE	HIGH	MAJOR
Environment	Lasting days or less; limited to very small area; no environmentally sensitive receptors	Lasting weeks; limited to small area; no environmentally sensitive receptors	Lasting months; impact on an extended area (kilometres); area with some environmental sensitivity	Lasting years; impact on an extended area (kilometres); environmently sensitive habitat	Permanent impact; affects a whole basin or region; highly sensitive habitats
Reputation / Stakeholder / public	awareness/ concern from specific individuals; Minor disturbance of local culture/ social structures	concern/ complaints from certain groups/ organizations; Some reversible impacts on local population.	Isolated complaints from community members/ stakeholders; reversible impacts on local population	local/ regional public concern and reactions; irreversible impacts on local population (health, property)	national/ international public attention and repercussions; irreversible impacts on local/regional population (fatality)

PROBABILITY			RISK RATING				
ALMOST CERTAIN		The unwanted event occurs in order of one or more times per year & is likely to reoccur within 1 year	M	M	H	H	H
LIKELY		The unwanted event occurs less than once per year & is likely to reoccur within 5 years	M	M	M	H	H
POSSIBLE		The unwanted event can occur during the life of the porject & is unlikely to reoccur with any more frequency that every 10 years	L	M	M	M	H
UNLIKELY		The unwanted event is unlikley to occur during the lifetime of the project & is unlikely to reoccur with any more frequency that every 25 years	L	L	M	M	H
RARE		The unwanted event has never been known to occur in the business: or it is highly unlikely that it will occur within 25 years	L	L	L	M	M

	Risk Level	GUIDELINES FOR RISK MATRIX
	H - High	A high risk exists, appropriate mitigation strategy to be devised immediately.
	M - Medium	A moderate risk, appropriate mitigation strategy to be devised as part of the normal management process.
	L - Low	A low risk,A5:H18 monitor risk, no further mitigation required.

Figure 7.14-1: Risk matrix for the assessment of emergency, accidental and non-routine events

7.14.5 Risk Assessment

7.14.5.1 Introduction

The following hazards are scoped into the assessment in section 5.14.2 and are assessed:

- Natural seismicity (earthquakes) activity which may lead to loss of containment or pipeline integrity (potential for contamination via surface water or groundwater pathways), and to vibration-sensitive built structures or equipment which may lead to operational failure;
- Geohazards, including landslide or mass movement activity which may lead to loss of containment or pipeline integrity (potential for contamination via surface water or groundwater pathways);
- Loss of a storage tank from the Very Large Crude Carrier (VLCC) acting as a Floating, Storage and Offloading (FSO) vessel. This may lead to a significant oil spill into the marine environment;
- Leakage of oil from the Very Large Crude Carrier (VLCC) acting as a Floating, Storage and Offloading (FSO) vessel. This may lead to an oil spill into the marine environment;
- Leakage of oil from the loading arm in the Lamu Marine Terminal (LMT) which may lead to a minor oil spill into the marine environment;
- Risk of thermal radiation at Station 7 (where there is a source-pathway-receptor link) from a pool fire; and
- Leakage of oil from a pipeline perforation or rupture which may lead to an oil spill onto land or at a river/ lugga crossing**.**

7.14.5.2 Marine Oil Spill Events

The LLCOP Project could give rise to unplanned oil spill events. If such events were to occur, the most likely locations would be at the berthing location or relating to accidental vessel collisions with the berth or other vessels. Therefore, it is prudent to undertake computer modelling of oil spill events to assist in the development on Emergency Response procedures and development of an Oil Spill Contingency Plan (OSCP.) Initial oil spill modelling has been undertaken and is reported in this assessment, detailed oil spill modelling will be undertaken and the results of this will inform the emergency planning and procedures.

All marine species present in the AoI could potentially be adversely affected by an oil spill event with the scale of impact dependent upon the extent of spill and also the behaviour of the oil once discharged. The adoption of oil spill management procedures within an Emergency Preparedness Response Plan will ensure that impacts are minimised, and any effects on sensitive biodiversity receptors avoided wherever possible. The outcome of initial oil spill modelling has been undertaken and the results are presented below.

Three oil spill scenarios were modelled to consider a range of possible events from large operational spills to large- scale events. The modelled scenarios are defined in Table 7.14-1.

Table 7.14-1:Oil spill scenarios

Scenario	Release Volume (bbl)	Oil Type	Seasons	Tidal State	Number of Cases Assessed	Comment
1) Loss of two compartments	246,500	Waxy Crude	SW Monsoon NE Monsoon Transition	N/A due to spill size and release time	3	This scenario assumes that each tank is of equal volume, then the maximum VLCC compartment volume is 146,000 bbl (15 compartments in a total of 2 Mbbl capacity). Furthermore, it is assumed that the compartments are most likely to be filled to 85%. Therefore, the potential release volume is: 2 x 146,000 x 0.85 = 246,500 bbl
2) Partial loss of one compartment	36,000	Waxy Crude	SW Monsoon NE Monsoon Transition	N/A due to spill size and release time	3	This scenario assumes a potential release volume of 25% of one VLCC compartment. Therefore, the potential release volume is: 146,000 x 0.25 = 36,000 bbl
3) Offloading Spill	5,000	Waxy Crude	SW Monsoon NE Monsoon Transition	Spring Ebb & Spring Flood	6	This scenario assumes that in the event of one of the loading arms (each 500,00 bbl/d) becoming disconnected, it is envisaged that a rapid response would be in place, as such intervention would be within 15 mins. Therefore, the potential release volume is: 500,000 bbl/d/24 hr x 15 min/60 min = 5,000 bbl

The modelling of the project scenarios supports the theory that any spilled oil will emulsify quickly and will be largely unaffected by weathering processes such as evaporation and dispersion. Due to its physio- chemical properties, the waxy oil associated to this project behaves in such a way that is solidifies on contact with water and is therefore unlikely to behave and spread in the same way as a conventional crude. All scenarios modelled show oiling on both a local and regional scale, with all scenarios having some impact in Kenyan and Somalian waters.

In each of the three seasons simulated (SW Monsoon, NE Monsoon and Transition between SW and NE Monsoon) heavy oiling in the Manda Channel and local mangroves is expected. For the scenarios modelled, shoreline oiling is likely to occur in less than three days from release, regardless of the season.

The heaviest localised oiling is expected during the NE Monsoon and the transition period due to the onshore winds that help keep oil in the embayment. It should be noted that vegetation such as mangroves are not represented in the model.

Upon entry into the open waters of the Indian Ocean, oil generally travels northwards in all three seasons. For Scenarios 1 and 2 (loss of two compartments, partial loss of one compartment) during the SW Monsoon, oil is transported northwards by a significant residual current and some oil components could reach as far north as Mogadishu within 30 days assuming there is no response to contain or recover any oil. However, it should be noted that once oil reaches the open ocean it will be subject to more intensive weathering, from factors such as an increased wave climate. It is known from the oil composition (Wood, 2018) and laboratory tests (Kernow Analytical Technology, 2018) that the oil is likely to solidify once it enters the marine environment and laboratory tests have also shown wave activity to break up the solidified oil into smaller particles. A high-resolution wave model has been developed to attempt to capture this process. However due to the unusual oil composition some far-field processes may be underrepresented.

The northern extent of oiling is predicted to be much smaller during the NE Monsoon and Transition period with oil being forced offshore between Buur Gaabo and Jamame where northerly and southerly currents meet forcing a lateral current to occur.

Scenarios 3 and 4 (offloading spill on ebb and flood flows respectively) consider a potential transfer spill occurrence and illustrate the impact of spilling oil at different states of tide. Scenario 4 occurs during a flood tide where water is flowing into the Manda Channel. This inward flow forces the oil to mainly stay within the localised area, whereas an ebb tide takes oil out of the estuary and hence has a larger northward coastal/offshore extent.

The scenarios modelled cover a range of significant spills from the loss of two compartments to a worst-case offloading spill during the three key seasons. Mitigation such as containment and recovery, chemical dispersion and shoreline clean-up have not been modelled and therefore the scenarios can be considered as worst case that will be mitigated through further modelling and development of an OSCP prior to operations commencing.

Oil spill response equipment will need to be available in the local area to help minimise damage caused by an incident, should one occur. As the spill is likely to be transboundary it may be necessary to co-ordinate any spill responses accordingly. For the larger spills, prioritisation of the most sensitive areas would need to be undertaken.

7.14.5.3 Major Accidents – Pool Fire

A Qualitative Risk Assessment (QRA) was undertaken for the stations associated with the pipeline which demonstrate the tolerability risk at the stations in the event of a release and subsequent ignition. The primary purpose of the QRA is to inform the design process but the results have been considered in this assessment to understand any potential residual risk which may be present. For the majority of the stations the potential risk is only present in the vicinity off the station fence-lines, and due to the lack of receptors in these areas all stations, excluding station 7 have been scoped out of the assessment.

Station 7 is addressed in this chapter, due to the location of properties and receptors at Archer’s Post. The properties of the crude oil are such that the only major accident event with significant potential for risk to third parties for this project are pool fires. The indicative hazard ranges are demonstrated on the tolerability/ risk contour resulting from the QRA for Station 7, which is presented in Figure 7.14-2. The contours are defined through an assessment of the pool fire consequence and frequency results, meteorological data and the location of the potential hazards.

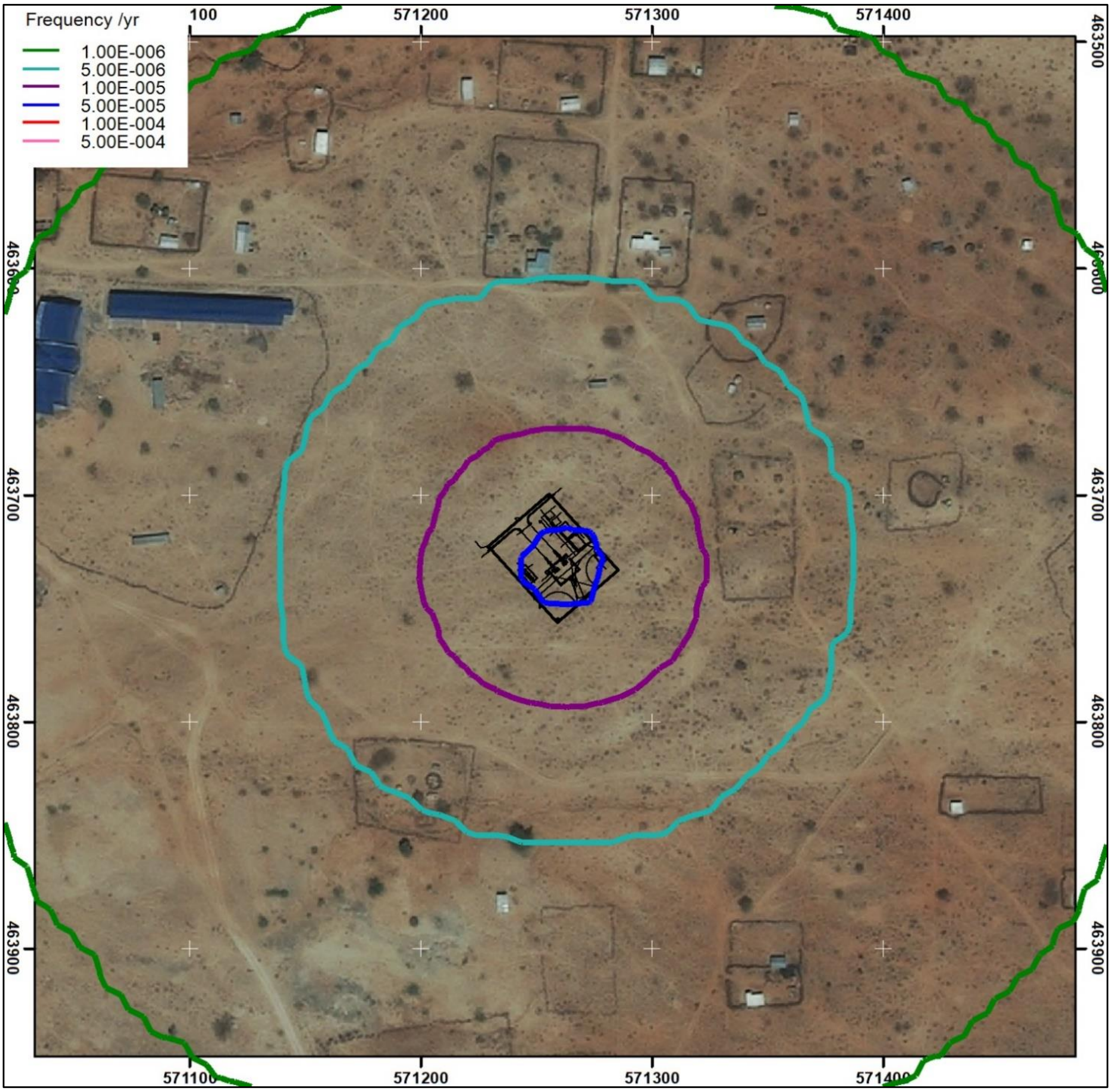

Figure 7.14-2: Station 7 – Pool fire risk contours

The contour plot for Station 7 demonstrates that the highest risk levels are confined to the area within the station fence-line, with the risk levels decreasing to a probability of occurrence of 1 in 100,000 per year immediately outside of the station fence-line and decreasing further to 5 in 1,000,000 per year where receptors appear to be located. It is considered by the UK Health and Safety Executive (HSE) that any risk less than 1 in 1,000,000 (for workers and public) is a very low level of risk and is classified as the boundary between broadly acceptable and tolerable (HSE, 2001[2]).

[2] HSE, 2001. Reducing Risks Protecting People HSE's Decision- Making Process

7.14.5.4 Risk Assessment – Summary

A summary of all Emergency, Accidental and Non-routine Events that have been identified through the ESIA process that are associated with the LLCOP project, their potential consequences and proposed mitigation are given in Table 7.14-2 below.

Table 7.14-2: Risk assessment of Emergency, Accidental and Non-routine Events

Haz No.	Hazard	Consequence	Receptor	Consequence rating	Probability	Risk	Mitigation measures	Relevant Management Plan
Natural Hazards								
1	Natural seismicity (earthquakes) on built structures, pipeline, vibration-sensitive built structures or equipment	Damage to pipeline or containment structures for storage of materials	Soil, surface water and/or groundwater contamination	Moderate	Rare	Low	Spill response kits should be available at each station and used as soon as possible following an event	■ Emergency Response Plan ■ Operations Environment Management Plan
2	Geohazards (e.g. Landslide/mass movement activity) on pipeline construction and as-built structures in landslide/mass movement prone areas	Damage to pipeline or containment structures for storage of materials, or human safety during construction.	Project facilities, project infrastructure, workforce, with a consequence of Soil, surface water and/or groundwater contamination	Moderate	Unlikely	Medium	Spill response kits should be available at each station and used as soon as possible following an event	■ Emergency Response Plan ■ Operations Environment Management Plan

Haz No.	Hazard	Consequence	Receptor	Consequence rating	Probability	Risk	Mitigation measures	Relevant Management Plan
Industrial hazards								
3	Oil spill from loss of 2 compartments – 246,500 bbl	Oil entering the marine environment and local habitats	Coastal, marine and biodiversity environments	Major	Unlikely	High	n/a	■ Emergency Response Plan ■ Oil Spill Contingency Plan
4	Oil spill from partial loss of 1 compartment – 36,000 bbl	Oil entering the marine environment and local habitats	Coastal, marine and biodiversity environments	High	Unlikely	Medium	n/a	■ Emergency Response Plan ■ Oil Spill Contingency Plan
5	Oil spill during offloading- 5,000 bbl	Oil entering the marine environment and local habitats	Coastal, marine and biodiversity environments	High	Unlikely	Medium	n/a	■ Emergency Response Plan ■ Oil Spill Contingency Plan
6	Thermal Radiation / Pool fire	Oil entering the environment and fire	Soil, surface water, groundwater, biodiversity, human health	High	Rare	Medium	n/a	■ Emergency Response Plan

7.14.6 Conclusions

This Emergency, Accidental and Non-Routine Events assessment includes an evaluation of Natural and Industrial Hazards and the probability of their occurrence to assess the risk of unplanned natural and industrial events which could cause environmental or social impacts by adversely affecting the environment or public safety. A quantitative assessment of oil spills and risk to individual receptors has been undertaken alongside a qualitative assessment of natural and industrial events.

The risk of the unplanned events occurring range from Low to High, depending on the consequence and probability of occurrence. The following management plans are required to respond to the unplanned events detailed in this assessment:

- Emergency Preparedness Response Plan;
- Oil Spill Contingency Plan;
- Construction Environmental Management Plan, including Waste Management, Traffic Management, Water Management and Hazardous Materials Management; and
- Operational Environment Management Plan, including Waste Management, Traffic Management, Water Management and Hazardous Materials Management.

7.15 Cumulative Impacts

7.15.1 Introduction

Cumulative impacts, as defined by IFC (2013), are those that may result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned, or reasonably defined planned developments, at the time the risks and impact identification process is undertaken. Some planned projects are understood fairly-well both spatially and temporally e.g. Foundation Stage Development for Upstream oil production; whereas for other planned developments, there is limited technical and temporal information available (e.g. other elements of LAPSSET).

While a standalone activity may itself result in an impact that is not significant, when combined with other impacts (significant or not significant) in the same geographical area and occurring simultaneously, it may result in a significant cumulative impact.

This cumulative impact assessment identifies areas where impact interactions may arise from cumulative impacts of existing developments, the proposed LLCOP Project and anticipated future developments.

The assessment has incorporated the following steps:

- Defining spatial and temporal boundaries;
- Identifying groups of receptors[1] which include environmental and social attributes that may be important to assessing risks);
- Identifying potential Project-generated (residual) effects that may combine to act incrementally (i.e. as 'combined effects') upon receptor(s);
- Identify how new activities and developments may generate impacts that could act cumulatively, together with potential combined effects; and
- Where relevant, outline mitigation and management strategies to address any potential cumulative impacts.

7.15.2 Spatial and Temporal Boundaries

The cumulative impact assessment will focus largely on developments located within the LLCOP Project AoI, which comprises a composite study and assessment area based on the combined technical discipline scope, as well as from concurrent development projects. The AoI used for the impact assessment is illustrated in Figure 7.15-1.

While the majority of potential cumulative effects may be manifest locally, some effects (e.g. socio-economic) may extend beyond the local area. This is particularly true of positive economic and employment effects. Therefore, where appropriate, regional cumulative impacts have been considered.

7.15.3 Identification of Receptors

The receptors identified within each technical chapter in Section 7 of this ESIA remain relevant to the cumulative assessment, including physical, biological or social (e.g. villages, dwellings, areas of cultural importance, watercourses, flora and fauna) depending on the technical discipline.

[1] Termed "Value Added Components" (VECs) by the IFC (IFC 2013). The term "receptors" is used throughout this Chapter, in place of VECs, in order to maintain consistency throughout the ESIA.

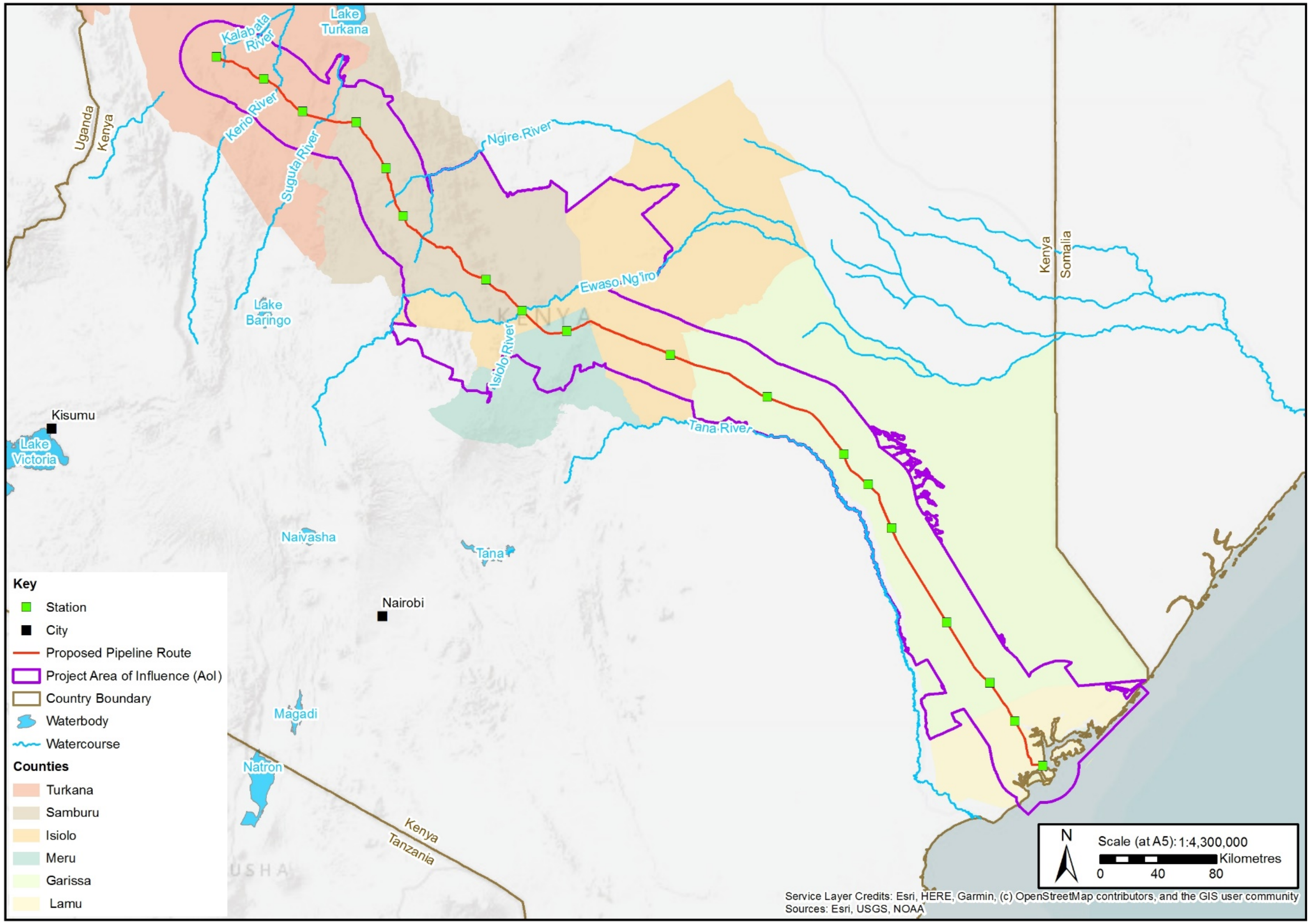

Figure 7.15-1: Project AoI for Cumulative Impact Assessment

7.15.4 LAPSSET Infrastructure Corridor

7.15.4.1 Introduction to the LAPSSET Corridor

The Lokichar to Lamu Crude Oil Pipeline (LLCOP) will be located for its entire length within the LAPSSET Corridor, a linear multi-spoke land corridor identified by the Government of Kenya for strategic infrastructure development as part of the Vision 2030 process and a major initiative for Kenya and the East African region. The third Medium Term Plan supporting this programme commenced in 2017.

Land required for the LAPSSET Corridor will be acquired by the Government of Kenya (National Lands Commission, supported by Ministry of Lands and Physical Planning) by compulsory acquisition under the terms of the Land Act (2012) and transferred to the LAPSSET Corridor Development Authority (LCDA) who will then lease land required for the pipeline corridor to the Project.

The entire LAPSSET Corridor spans over 2,000 km in length from Lamu to Isiolo to Moyale and Isiolo to Lodwar to Nakodok. The corridor is comprised of two core elements:

- A 500 m wide Infrastructure Corridor which will accommodate new roads, a railway, LLCOP and utilities (water and power transmission lines); and
- A 50 km wide Economic Corridor spanning either side of the Infrastructure Corridor where industrial investments will be situated.

Within the 500 m wide Infrastructure Corridor, the proposed pipeline will require a 26 m working width for construction and a permanent 6 m easement width for operations during the life of the Project, in addition to other land required for temporary construction facilities and a number of permanent pumping and other Stations along the length of the pipeline.

During the course of the iterative design process, the LLCOP route has been refined. The LAPSSET Corridor route has therefore reacted and has been altered accordingly and ultimately, the LAPSSET Corridor and LLCOP have coalesced onto a single corridor to minimise development impacts and to simplify the land acquisition process.

7.15.4.2 LAPSSET Components

The LAPSSET Corridor comprises the following key components:

- Roads;
- Standard Gauge Railway (SGR);
- Oil pipeline;
- 32 Berth sea port at Lamu;
- International Airports;
- Resort Cities; and
- High Grand Falls Dam.

Additional components comprise:

- Electricity/Power Transmission;
- Fibre Optic Connectivity; and
- Water Supply.

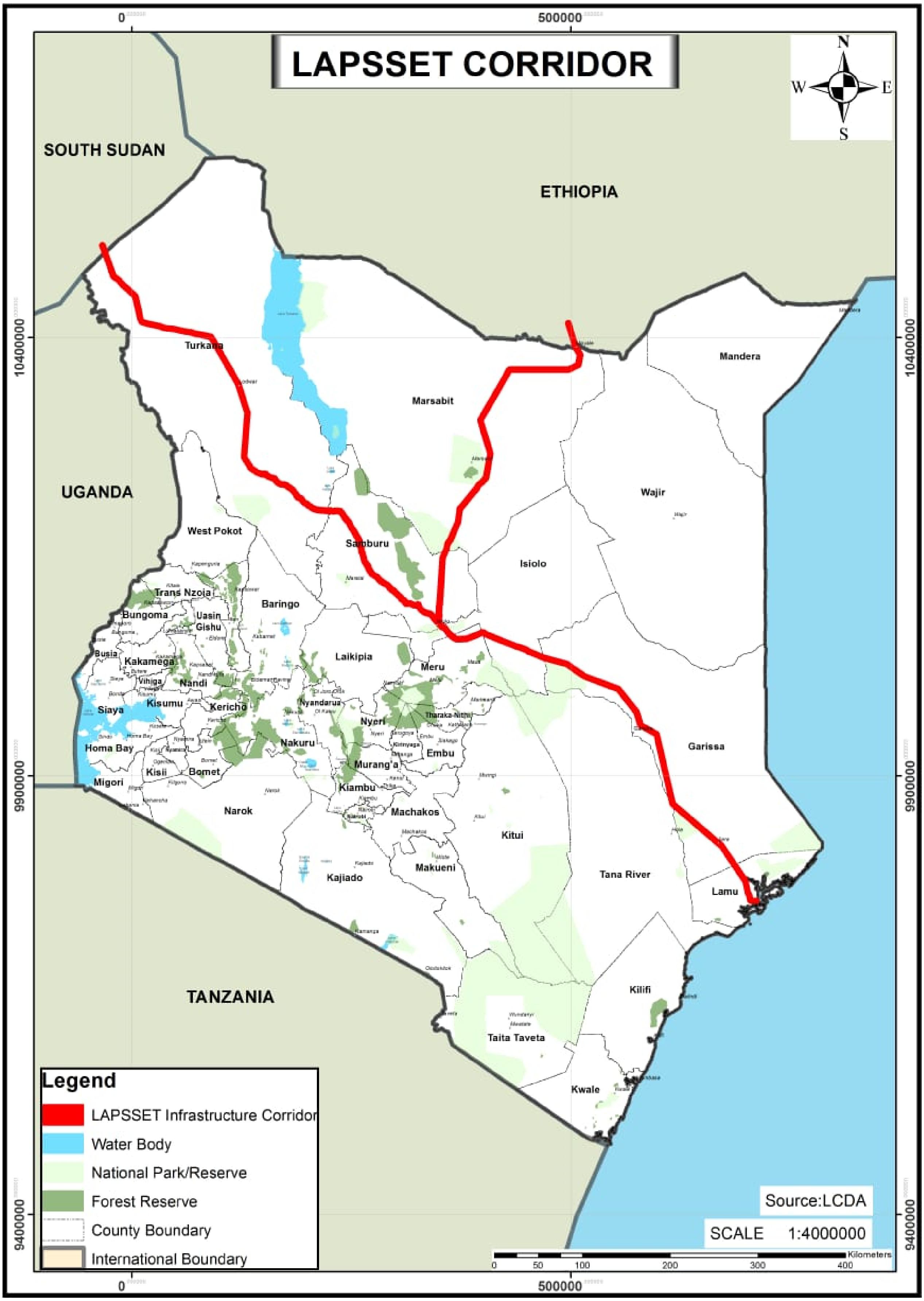

Figure 7.15-2: LAPSSET Infrastructure Corridor route

7.15.4.3 LAPSSET Corridor and LLCOP Cumulative Impacts

With regard to cumulative impacts between LAPSSET Corridor and the LLCOP Project, a number of factors need to be considered in the assessment process.

As the LLCOP route largely passes through remote unpopulated areas, there is generally no major historical developments or planned infrastructure likely to give rise to cumulative impacts. The most prominent cumulative impacts are associated with components of the LAPSSET Infrastructure Corridor, of which a number of components share a common corridor with the LLCOP Project. In addition, as the LLCOP Right of Way (RoW) is fully embedded in the LAPSSET 500 m corridor, cumulative impacts outside of this area are largely minor.

Land required for the LAPSSET Corridor will be acquired by the Government of Kenya by compulsory acquisition under the terms of the Land Act (2012) and the LCDA will then lease land required for the pipeline corridor to the Project. As part of this process, all residents situated within the corridor will require resettlement; however, the LLCOP component of LAPSSET has not identified any physical resettlement required, in order, for construction to proceed.

It should be noted that, although the LAPSSET Corridor has been realigned to follow the LLCOP route, LAPSSET retains the option to use the original “southern” route through Samburu. It is therefore not certain at this stage whether or not the full LAPSSET Corridor will adopt the LLCOP route from Isiolo to Lokichar and this needs to be acknowledged for this cumulative impact assessment.

It should also be noted that no formal assessment has been done as part of this ESIA on the other components that form part of the LAPSSET Corridor, or other pertinent third-party developments.

7.15.4.4 Scope of Assessment

For the purpose of this ESIA, the resort cities, airports and the High Grand Falls Dam have been excluded from this cumulative impact assessment, due to their relative likely distance from the Project AoI and with no direct cumulative impacts identified that are associated with these developments.

The section of the LAPSSET Corridor that the LLCOP Project is located within similarly comprises the LAPSSET highway, railway and cable (fibre optic) components, hereafter referred to as the ‘LAPSSET Transport Corridor’, and as such there may be some cumulative impacts. As the different components are anticipated to be constructed separately, with construction phases unlikely to overlap, there are not anticipated to be significant cumulative impacts associated with construction phases for these LAPSSET components. Cumulative impacts from the coal-fired power station (also planned to be operated as part of LAPSSET) are also considered below.

7.15.4.5 LAPSSET SEA

A Strategic Environmental Assessment (SEA) was prepared for the LAPSSET Corridor for submission to, and approval by, NEMA[2]. The SEA process was undertaken to conform to requirements of the National Guidelines for SEA as issued by NEMA.

The SEA identified a number of pre-existing and emergent concerns of relevance to infrastructure development within the LAPSSET Corridor. A stakeholder engagement process was undertaken along the length of the LAPSSET Corridor to obtain the views of stakeholders on the potential impacts and benefits of the overall LAPSSET Corridor development.

[2]Strategic Environmental Assessment of the LAPSSET Corridor Infrastructure Development Project, Repcon Associates, January 2017.

The SEA identified five general concerns within the Counties through which the LAPSSET Corridor passes, including:

- Increasing structural poverty as households continue losing assets to drought;
- Declining land productivity on account of accelerated erosion;
- Declining productivity of other livelihood systems;
- The declining water resource base; and
- Escalating loss of wildlife populations.

In overall terms, the SEA identified a range of general potential impacts related to the development of the LAPSSET Corridor including:

- Realignment of the land resource base to the disadvantage of pastoral livelihoods and wildlife;
- Continued habitat loss and threatened survival of wildlife;
- Escalated pressure on water resources at the expense of pre-existing livelihoods and downstream ecosystems;
- Marginalisation of fishing-based livelihoods and aquatic habitats; and
- Loss of cultural heritage.

The SEA provides an evaluation of the key component projects envisaged within the LAPSSET Corridor programme. Summaries of the key projects that have the potential for cumulative impacts with the LLCOP project are described in the following sections.

7.15.5 Lamu Port Project (ESIA approved – under construction)

7.15.5.1 Introduction to Lamu Port Project

The GOK through the Ministry of Transport is building a port at Manda Bay in Lamu. An ESIA for the project was submitted to NEMA in 2013 for the construction of the first three berths of the proposed Lamu Port, as well as associated infrastructure. The port development is considered a flagship project in the country's Vision 2030 Strategy of Growth and Development.

Project activities include dredging, land reclamation, construction of a port and cargo handling facility and construction of an access road. Dredging began in October 2016 and is currently ongoing.

The construction of the initial three berths is ongoing and the first berth is expected to be operational by the end of 2019. At the same time, the government is implementing a concession programme for the remaining 29 berths to the private sector for construction and operations.

7.15.5.2 Potential Impacts Identified in the Lamu Port ESIA

Potential adverse impacts identified in the ESIA, which are relevant to the LLCOP Project include:

- Water quality: significant impacts during the construction stage due to dredging and dumping of dredged material, including sedimentation, deterioration in water quality, potential fish population decline and impacts to tourism and leisure activities. During the operation stage there is the risk of oil spills from ships:
  - Mitigation measures proposed include the use of less intrusive dredging techniques for construction and the implementation of an effective oil spill preparedness and response plan for operation;

- Biodiversity (Mangroves): significant impacts on mangroves associated with the clearing of approximately 2 ha of mangroves, population influx and pollution risks:
  - Mitigation measures include restricting mangrove clearance to the project footprint, restoration of sites adjacent to project site, monitoring programmes and contingency measures (i.e. stop work and rehabilitation subsequently).
- Social (Fisheries): impacts on livelihoods by project encroaching on fishing grounds – in a more indirect manner via dredging and disturbance of water quality affecting fish stock, and changes to fishers' access routes;
- Cultural Heritage: impacts associated with influx and dilution of local culture in Lamu, and chance of encountering archaeological artefacts whilst undertaking construction works at the port; and
- Social (Induced risks): impacts associated with influx of migrant workers including increased risk of HIV/AIDS and sexually transmitted infections (STIs):
  - Mitigation measures include contractor-implemented HIV/AIDS Prevention Program.

7.15.5.3 Potential Cumulative Impacts of Lamu Port

No cumulative impacts associated with the interaction of the LLCOP project and Lamu Port are anticipated during the construction of the LLCOP project. It is recognised that there is a cumulative impact on mangrove habitat loss, but the same rehabilitation commitments are made in both ESIAs and the construction of the Port is anticipated to be completed by the time the construction phase of the LLCOP Project begins.

Cumulative impacts anticipated during operations are likely to include the following:

- Cumulative water quality impacts may occur at the marine environment. There is the risk of oil spills from ships, associated with both Lamu Port and LLCOP marine operations. A risk assessment for unplanned events is presented in Section 7.14 and identified the potential for significant implications at the marine environment associated with oil spills.
- Habitat loss impacts on mangrove during operation of LLCOP and other activities relating to Lamu port associated with marine discharges contaminated with oils/direct spillage of oil. The wider Lamu Port development has also led to impacts on mangrove habitats. However, the Project will undertake mangrove restoration programmes, and the Lamu Port ESIA has outlined similar commitments. Therefore, cumulative impacts on mangrove areas are considered to be manageable.
- Sensory disturbance: Vessel noise may be generated by vessels relating to LLCOP and other activities in the Lamu Port. Whilst volumes and frequency of vessel movements may be low at this time for the Port, they will increase over time as the new port infrastructure increases with more traffic, and larger vessels.
- Vessel collisions with marine wildlife: The risk of vessel collisions with marine wildlife causing injury and mortality will occur as a result of the weekly tanker transits through the AoI, to and from the berthing area in the port.
- Economics and Employment: cumulative increase in job opportunities near Lamu Port (also related to construction jobs). County Government of Lamu to benefit considerably from tolls, permits etc. associated with the Port expansion.

- Community Health and Safety: impacts associated with influx of workers including increased risk of HIV/AIDS and sexually transmitted infections (STIs).
- Tourism: Tourism is a major economic activity in Lamu county. Disturbances to localised areas around facilities, including the presence of the VLCC and increased marine traffic associated with the Port, will impact on tourism activities in a relatively tranquil environment.
- Livelihoods: potential negative social impacts from disturbance of marine environmental and water quality, include loss of livelihood, such as fishing and tourism, and possible further impacts associated with influx and population growth on local infrastructure.
- Potential impacts on the marine life in the Manda Bay area, as well as on livelihoods linked to fisheries and fishing grounds are the primary cumulative impacts for ecosystem services.

7.15.6 LAPSSET Transport Corridor – Roads and Railway

7.15.6.1 Introduction to LAPSSET Transport Infrastructure

New and refurbished sections of road in the LAPSSET Transport Corridor, as illustrated in Figure 7.16-2 include:

- Lamu to Garissa to Isiolo;
- Isiolo to Lokichar to Nadapal/Nakodok to Juba (South Sudan); and
- Isiolo to Moyale to Addis Ababa (Ethiopia).

Works on the 505 km Isiolo to Moyale section of road is complete. The 320 km section from Isiolo to Lokichar is under review.

The 338 km section between Lokichar and Nakodok is under construction and is expected to be complete by end of 2020, however as this is outside of the LLCOP Project AoI, cumulative impacts are not considered in this assessment.

Detailed engineering design of the Lamu to Garissa and Garissa to Isiolo road is complete, with two separate ESIA's being produced for each section. Further information on the impacts identified is outlined in the below sections.

It should be noted that there is the potential for additional minor road upgrades/works to occur within the LAPSSET Corridor during the construction period of the LLCOP pipeline.

The scope of the LAPSSET Railway is largely aligned to the road network for three railway sections, namely:

- Lamu to Garissa to Isiolo;
- Southern Sudan Section (i.e. Isiolo to Nginyang to Nakodok); and
- Ethiopia Section (Isiolo to Moyale).

The railway project preliminary designs are complete for the Kenyan and Ethiopian route and are currently at the detailed engineering design stage.

7.15.6.2 Lamu-Garissa Road Section (ESIA submitted)

An ESIA was submitted in 2014 for the construction of the Lamu-Garissa road section of approximately 250 km, forming part of the LAPSSET corridor.

Potential Impacts Identified in the ESIA

The main anticipated positive impacts identified in the ESIA, which are relevant to the LLCOP Project, include:

- Social: reduced travel time and improved accessibility to administrative, healthcare and commercial centres and improved road safety and comfort.

The main anticipated adverse impacts identified include:

- Noise and air quality: generation of dust and noise emissions;
- Biodiversity: loss of vegetation from the road corridor and increased risk of faunal fatalities along the road; and
- Social: increased road traffic accidents and communicable diseases, as well as social disruption due to re-alignment of the road.

7.15.6.3 Garissa-Isiolo Road Section (ESIA submitted)

An ESIA was submitted in 2017 for the construction of the Garissa to Isiolo road section (via Kulamawe) of approximately 305 km, forming part of the LAPSSET Corridor.

Potential Impacts Identified in the ESIA

The main anticipated positive impacts identified in the ESIA, which are relevant to the LLCOP Project, include:

- Social: link between Garissa and Isiolo and other counties thus improving local communication, ease of travel and enhanced social and economic development.

The main anticipated adverse impacts identified include:

- Occupational safety and health related: increased traffic accidents and injuries as a result of building and works of engineering construction;
- Socio-cultural: creation of tension and conflicts between locals, contractor and migrants concerning natural resources, land and employment opportunities;
- Biodiversity: impeding the free movement of wildlife and vegetation clearance (it should be noted that the movement of fauna in the area is already impacted on by the existing road); and
- Additional impacts are associated with air and noise pollution and impacts to water resources due to discharge of effluent from worker camps.

7.15.6.4 Potential Cumulative Impacts of LAPSSET Transport Corridor

Minor cumulative impacts associated with the interaction of the LLCOP project and the LAPSSET Transport Corridor are anticipated during the construction of the LLCOP project, as LAPSSET Transport Corridor road construction/repair activities are likely to take place before or after the LLCOP Project construction period. However, there is the potential for concurrent works to occur along some sections of the route.

Cumulative impacts anticipated during construction and operations are likely to include the following:

- Potential decline in air quality through construction induced dust and vehicle exhaust emissions, when combined with LLCOP construction activities. However, minimal construction/repair activities are likely to take place simultaneously with the LLCOP Project construction period. The identified residual impacts are regarded as negligible.

- Potential decline in air quality through operational vehicle exhaust emissions, when combined with LLCOP station emissions (generator exhaust) and traffic emissions (although these will be low). Cumulative impacts on air quality are therefore anticipated at stations with generators, located adjacent to roads along the LAPSSET and LLCOP route, however these are predicted to be minor.
- Noise and vibration impacts associated with heavy equipment used during construction and truck noise may have implications on local communities and construction workers.
- Noise and vibration impacts during operation may occur where LLCOP stations are situated adjacent to roads along the LAPSSET and LLCOP route, associated plant noise emissions at station locations. These are however predicted to be minor.
- Terrestrial biodiversity impacts during construction include temporary impingement of ecological connectivity, and habitat severance.
- Once the Pipeline Project is buried and restored, within a reasonably short timeframe, operational cumulative impacts will be negligible or minor. Terrestrial biodiversity impacts include relatively minor disturbance and changes to fauna and flora species receptors as a result of increases in vehicular movements, noise and light around LLCOP stations.
- Infrastructure upgrades to the LLCOP project access roads and the LAPSSET and third-party road upgrades is a long-term beneficial cumulative impact, which will enhance access to the national road network and thus provide easier access to health care and reduce travel times including response times in emergency situations.
- Community health and safety impacts associated with influx of workers including increased risk of HIV/AIDS and sexually transmitted infections (STIs).
- Impacts related to disposal of solid and liquid waste e.g. associated with LAPSSET transient road users and maintenance personal along LLCOP route or at stations.

7.15.7 Lamu Coal-fired Power Station Project (ESIA submitted – approval overturned)

7.15.7.1 Introduction to the Coal-fired Power Station Project

A proposal has been submitted to develop a 1050 MW coal-fired power plant in Lamu. The proposed power plant will be situated approximately 21 km north of Lamu town, within the LAPSSET Corridor.

The development was approved in 2017, however a petition was filed at the National Environmental Tribunal court of Kenya following protests, and it is understood that the projects license has been suspended since June 2017.

An additional independent study has been undertaken for an overhead double circuit 400 kV transmission line (TL) of approximately 520 km in length (associated facility), which will transport the generated power from the power station to Nairobi East Control Centre. The power line will be developed by the Kenyan electricity transmission company (KETRACO). The proposed development has been approved and financial negotiations are ongoing.

7.15.7.2 Potential Impacts Identified in the ESIA

The main positive impacts identified in the power station ESIA, which are relevant to the LLCOP Project, include:

- Employment opportunities: predicted to generate 1,800 jobs;
- Economic growth: enhanced markets for local products and services; and

- County revenue and development: County Government of Lamu to benefit via license fees, land rates etc.

The main negative impacts identified include:

- Marine ecology: impacts include habitat loss within the marine environment. Water (wastewater) discharge of thermal effluent into the sea from power station process water systems, which may impact Manda Bay's marine biodiversity.
- Community and occupational health and safety: potential impacts on worker and community health and safety from hazardous air emissions.
- Social: potential negative social impacts include loss of livelihood, such as fishing and tourism, and possible further impacts associated with influx and population growth on local infrastructure and changes in land use from agricultural to residential in the surrounding area.
- Greenhouse gases: significant impact on Kenya's greenhouse gas emissions, releasing 8.8 million tons of CO_{2e} annually, with an unmitigated development projected to raise national emissions levels by up to 10% compared to 2010 levels.

It should be noted that other estimates have put the increase in greenhouse gas emissions as far higher.

7.15.7.3 Potential Cumulative Impacts of the Coal-fired Power Station

Despite the fact detailed timescales for the power plant development are not known at this time, it is not anticipated that construction related impacts will occur concurrently with the LLCOP Project. However, a number of cumulative impacts may occur during operation, as follows:

- Cumulative increase in job opportunities near Lamu (also related to construction jobs). Potential negative impact on livelihoods from disturbance of marine, environmental and water quality, include loss of livelihood, such as fishing and tourism, and possible further impacts associated with influx and population growth on local infrastructure.
- Tourism is a major economic activity in Lamu county. Disturbances to localised areas around facilities, including the presence of the VLCC and increased marine traffic associated with the Port, will impact on tourism activities in a relatively tranquil environment.
- Discharge of thermal effluent into the sea from the coal-fired power station may impact Manda Bay's marine biodiversity (including mangroves, coral reefs and sea grass beds).
- Potential for oil leaks and/or spills from the pipeline, tanks, or during transfer between facilities such as VLCC to export tanker which could lead to water quality changes.

7.15.8 Wamba Zoned Rockfill Dam Project (ESIA submitted – pending approval)

7.15.8.1 Introduction to Wamba Dam Project

Wamba Rockfill Dam, being developed by Northern Water Services Board, is a proposed 15 m high zoned rock fill dam with a nominal capacity of 257,335 m^3 which will submerge 6.17 hectares of Samburu National Reserve. A reviewed ESIA was submitted in 2018. It is understood that the proposed development has been approved with some initial site works completed and financial negotiations for the main construction are ongoing.

7.15.8.2 Potential Impacts Identified in the ESIA

The main construction-related impacts identified in the ESIA which are relevant to the LLCOP Project, include:

- Water: waste discharge from construction camps and waste oil from machinery maintenance could create new pollution sources; and

- Social: provision of skilled and unskilled labour for these activities and business opportunities.

The main anticipated operation-related impacts identified in the ESIA include:

- Water: water abstraction from the impounded runoff affecting environmental, hydro-geological and ecological functions in the project area. Water supply services will be increased due to development of a new water source.

7.15.8.3 Potential Cumulative Impacts of the Wamba Dam Project

The Wamba Dam will be located less than 5 km from the LLCOP RoW and approximately 20 km from Station 6. Due to the relatively unknown timescales for the dam development, there is the potential that construction related impacts may occur concurrently with the LLCOP Project. A number of cumulative impacts may also occur during operation. All potential cumulative impacts are as follows:

- Abstraction of water for use in hydrotesting and construction camps for the LLCOP Project may coincide with water use as part of the Dam development. This may also have cumulative implications for the proposed location of the Primary Camp and Storage Facility located at KP 281 in Samburu County, particularly with regard to impacts on water resources (abstraction, hydrotest water and discharge of waste water), as this has the potential to coincide with activities at the Dam.
- Use/abstraction water for use in LLCOP station facility operations coinciding with water use as part of the Dam development.
- Terrestrial biodiversity impacts during construction include temporary impingement of ecological connectivity and habitat severance.
- Employment opportunities through cumulative increases in job opportunities near Wamba from the LLCOP route construction and from the Dam.

7.15.9 South Lokichar Foundation Stage Upstream Development Project (ESIA - in progress)

7.15.9.1 Introduction to the South Lokichar Foundation Stage Upstream Project

A project is currently being developed for the abstraction and processing of waxy crude oil from a number of oil fields situated in the South Lokichar Basin. The Foundation Stage Development (FSD) will form the "*Upstream*" component of the overall project with LLCOP being the "*Midstream*" component, with the scope of the LLCOP terminating at the LEF (the CPF forms the limit of the Upstream component with the LEF/CPF interface being the interface of the Upstream and Midstream components).

An ESIA is being prepared for the upstream activities of the Lokichar project in line with Kenyan environmental regulations. A cumulative impact assessment will be undertaken to ensure that, with appropriate inherent design mitigation measures and additional mitigation in place, cumulative impacts are clearly identified and addressed.

7.15.9.2 Potential Cumulative Impacts

There are potential cumulative impacts relating to all technical areas of an ESIA. Including, in particular, cumulative Air Quality and Noise issues at the LEF/CPF which are identified in this ESIA,and shall form part of the combined modelled impact analysis to be completed in the Upstream FSD ESIA. The same will be the case for other socio-economic, health and bio-physical cumulative impacts, which where relevant will be addressed as a combined impact in the FSD ESIA.

7.15.10 Summary of Cumulative Impacts

Cumulative impacts have been identified for areas where impact interactions may arise from cumulative impacts of existing developments, the proposed LLCOP Project and anticipated future developments. The most significant potentially adverse cumulative impacts include:

- Local air quality impacts;
- Local noise impacts;
- Local water resource impacts;
- Local impacts on marine environment (water quality and marine ecology);
- Local and regional community health and safety impacts;
- Local traffic impacts; and
- Impacts on local livelihoods.

As identified, cumulative impacts associated with the LAPSSET Infrastructure Corridor present the greatest cumulative impacts. Generally, cumulative impacts are expected to occur during the operation phase associated with Lamu Port, LAPSSET Transport Corridor, Lamu Coal-fired Power Plant, Wamba Dam and the Lokichar Upstream development. Significant cumulative impacts relate to the use and operation of Lamu Port, and potential implications on the marine environment associated with marine traffic and the risk of oil spills. However, appropriate mitigation measures and management procedures will be in place to prevent significant residual cumulative impacts occurring during the LLCOP operations phase. Additional adverse cumulative impacts on tourism in the area are anticipated in Lamu.

Lamu County is likely to experience a general economic boost due to the beneficial cumulative impacts from employment, training, infrastructure and purchasing associated with the LLCOP Project and LAPSSET component facilities, in particular the Lamu Port development, as well as other third-party developments.

Potential construction-related activities from other developments are only anticipated for relatively minor road construction works and the Wamba Dam. Therefore, cumulative residual impacts during the LLCOP construction phase of the LLCOP Project are predicted to be not significant with appropriate mitigation in place.

It should be noted that there is the potential for other, as yet, undefined developments to be present within the LLCOP AoI, which could present cumulative impacts. These are however expected to be minor and where necessary, appropriate stakeholder engagement will be undertaken. In addition, these developments will be required to undertake their own ESIA and cumulative impact assessment to identify cumulative risks, some of which may be associated with the LLCOP Project.

The mitigation measures described above identify where the LLCOP Project should seek to coordinate management of the identified environmental and social risks with other developments. Ultimately, the Project will endeavour to engage with other developers concerned as well as with the relevant authorities, in order to work concurrently towards the minimisation of the cumulative impacts identified.

8.0 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 Introduction

The LLCOP Project will be implemented by a pipeline company (PipeCo) to be formed by the JDA Partners for the purpose of building and operating the pipeline.

The Kenyan Environmental (Impact Assessment and Audit) Regulations (2003), requires Projects to set out '*an environmental management plan proposing the measures for eliminating, minimizing or mitigating adverse impacts on the environment; including the time frame and responsibility to implement the measures'*

This section:

- Describes the PipeCo Environmental and Social Management System (ESMS) that will be developed to meet PipeCo objectives, to implement the requirements of the approved Environmental and Social Management Plan (ESMP) and to meet Kenyan regulatory requirements; and
- Sets out the key impacts and mitigations defined in the ESIA and allocates responsibilities for implementation and performance monitoring in an Environmental and Social Management Plan format.

8.2 Project Standards

Project Standards are the standards to which the LLCOP project will be designed, built and operated and against which compliance will be audited and assessed.

Project Standards will go beyond Kenyan regulatory requirements (which form the basis for the ESIA) and comprise the more stringent of:

- Kenyan regulatory requirements;
- Requirements set out in the IFC Performance Standards and World Bank Group EHS Guidelines; and
- Any other voluntary commitments made by PipeCo.

8.3 Approach

The Environmental and Social Management Plan set out in this section will be supported by detailed operating procedures. For this ESIA, the detailed ESMPs present overarching mitigations and commitments, whilst supplementary assessments will be undertaken once the engineering, procurement and construction (EPC) Contractor is selected, who, under the framework presented in the section, will define refined commitments and procedures for implementation.

These will be developed by PipeCo and the EPC Contractor to implement the requirements of the Environmental and Social Management Plan. Procedures related to construction activities will be prepared prior to the commencement of construction. Procedures related to operational activities will be prepared prior to the commencement of project commissioning and hand-over. All these will be referred to NEMA for review.

The implementation of the Environmental and Social Management Plan will be supported by an Environmental and Social Management System (ESMS). The objective is to have a single, consistent and simple approach to the planning and management of environmental and social risks, whilst retaining flexibility to manage specific issues in the most appropriate manner.

Implementation is undertaken at a functional level, with separately-implemented Environmental and Social plans and procedures, all coordinated within a single Management System, valid for all phases of the Project, as outlined in Figure 8.3-1.

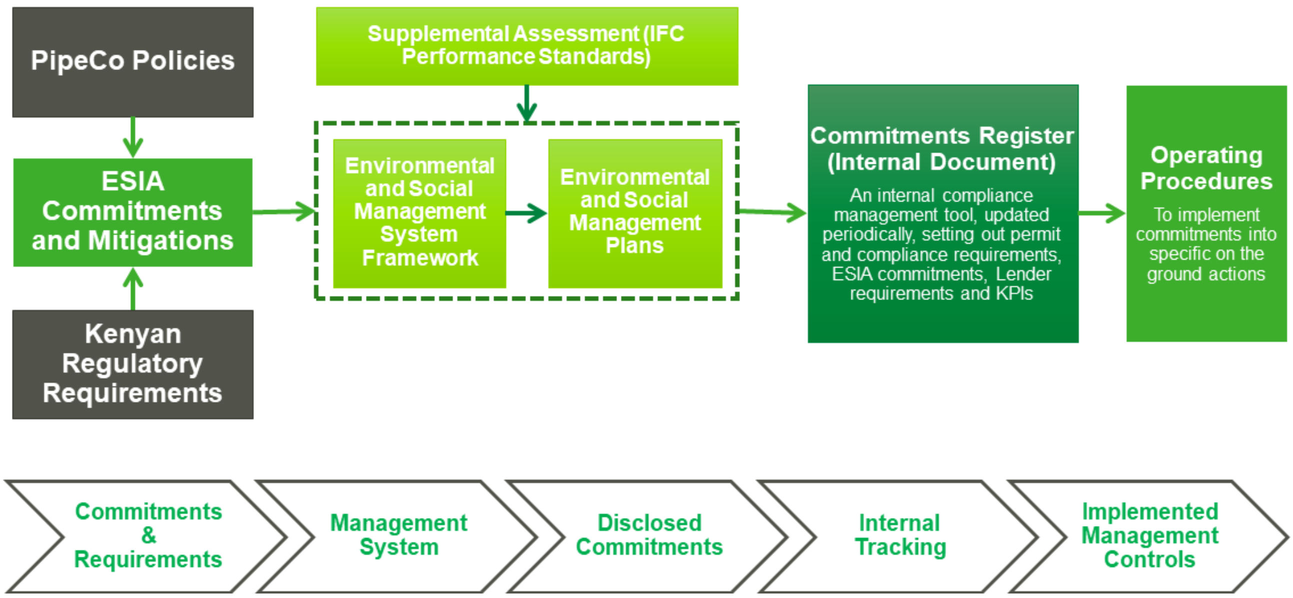

Figure 8.3-1: LLCOP Implementation of ESIA Commitments and Mitigations

8.4 Purpose of the Management System

The LLCOP ESMS will be based on the principle of continuous improvement and is designed to:

- Define LLCOP objectives and provide a tool to meet those objectives;
- Manage Environmental and Social risks effectively during construction, operation and closure;
- Comply with relevant Kenyan legislation and good international industry practice;
- Implement PipeCo Policies, Procedures, Guidelines and Standards;
- Assign responsibilities to functions and personnel for Management System implementation; and
- Provide a process for identifying opportunities for improvement and to review and update the Management System.

8.5 Structure of the Management System

8.5.1 Introduction

The LLCOP ESMS is divided into 13 components, some of which are inter-related. Each component addresses a specific objective that enables PPMT/PipeCo to manage Environmental and Social risks. Each component sets out the minimum requirements to meet each objective and refers to implementing procedures or processes. The Management System is designed as a continual improvement cycle and adopts the methodology of “plan do-check-act”. The basic structure of the Management System is set out in Figure 8.5-1.

8.5.2 Structure of the ESMS Framework

The LLCOP ESMS Framework is implemented through:

- **Environmental and Social Management Plan** – which combines the mitigations and management controls set out in the ESIA and which will also incorporate PipeCo policies and other commitments to be set out in the associated Supplemental Assessment (to meet IFC Performance Standards), and define key actions and monitoring measures to comply with Project Standards; and
- **Implementing Policies and Procedures** – set out the detailed actions and processes to be implemented by PipeCo and its contractors in order to achieve commitments set out in the ESMP.

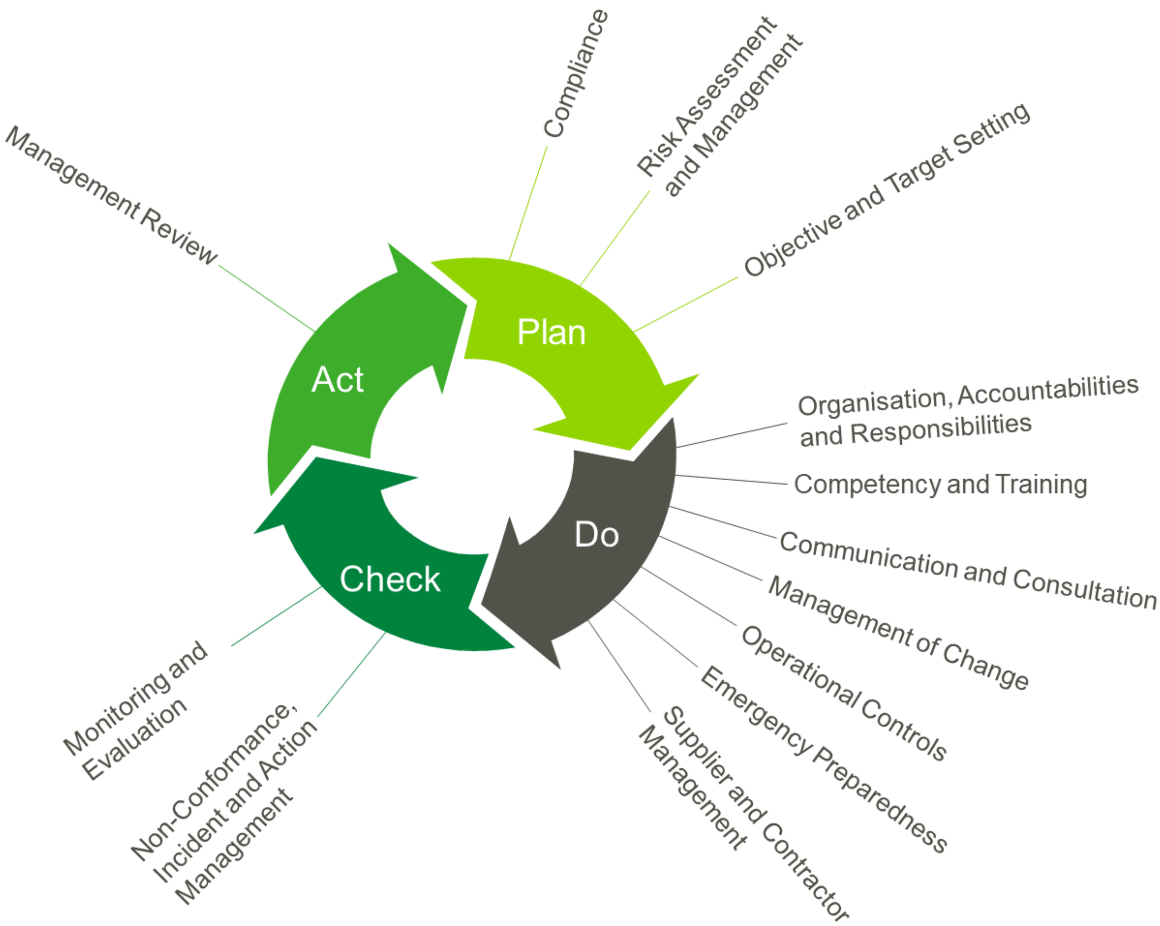

Figure 8.5-1: Management System Structure

8.6 Environmental and Social Management Plan Components

8.6.1 Introduction

The Environmental and Social Management Plan set out in this section bring together the mitigations set out in the impact assessment sections of the ESIA into a single set of auditable management controls. This addresses the following topics:

- Air quality;
- Noise and vibration;
- Water resources;
- Soil, geology and geohazards;
- Terrestrial and aquatic biodiversity;
- Marine flora and fauna;
- Landscape and visual;
- Cultural heritage;
- Physical and social infrastructure;
- Community health, safety and security;

- Livelihoods;
- Economics and employment; and
- Ecosystem services.

In addition, strategies and frameworks are set out for the follow key issues:

- Waste management;
- Emergency preparedness and response; and
- Decommissioning.

The commitments, mitigations and management controls set out will be used by PPMT/PipeCo and the EPC Contractor to develop detailed implementing procedures for construction and operations.

8.6.2 ESIA Mitigations

The ESIA mitigations set out in this ESMP are clear instructions to the EPC Contractor and the pipeline operating team for management systems and working practices, the implementation of which will be audited by PipeCo and by NEMA.

8.6.3 Additional Environmental & Social Management Controls and Commitments

In addition to the ESIA that has been developed to meet Kenyan regulatory requirements, a Supplemental Assessment will be developed to meet the additional requirements of the IFC Performance Standards. The Supplemental Assessment will be developed to support the financing of the LLCOP project by international lenders and will promote Good International Industry Practice (GIIP).

The ESIA mitigations (set out in this ESIA) will be combined with the additional measures set out in the Supplemental Assessment to develop a consolidated set of Management Controls. The PipeCo will require Management Controls to be adopted by the EPC Contractor (and sub-contractors) as part of their management plans and procedures. These plans and procedures will be reviewed and audited by the PipeCo who will also supervise the activities of the EPC contractor to ensure compliance with all applicable requirements.

All Commitments and associated Management Controls will be set out in a Commitments Register. This is an internal management tool used to ensure that all commitments have been identified and implemented via appropriate mechanisms. This will be reviewed and updated (by the PipeCo) on a periodic basis in response to any changes to the Project or commitments.

8.6.4 Review and Updating of the ESMS

The ESMS which will be used to implement the Environmental and Social Management Controls and will be maintained and updated to reflect the project life cycle. The ESMS will be reviewed at least once a year or when significant changes deem it necessary, whichever is soonest.

8.6.5 Document Control

Until such time as PipeCo is established, the PPMT Project Director will be accountable for the effective implementation of the Environmental and Social Management System and as such must approve all revisions and updates to this document.

8.7 Roles and Responsibilities

8.7.1 Introduction – The Key Players

Once the PipeCo has been established, responsibilities will be transferred to defined individuals within the PipeCo organisation. Organisational roles and responsibilities are as follows:

- **PPMT** – Define commitments and management controls through the ESIA;
- **PipeCo** – Develop detailed management systems and procedures, define requirements for the EPC contractor, monitor compliance by the EPC contractor, report compliance to NEMA and other authorities and implement and enforce corrective actions;
- **EPC Contractor** – develop systems and procedures to implement PipeCo Environmental and Social Requirements; monitor and report on compliance to PipeCo, implement corrective actions; and
- **All Contractors** – comply with PipeCo Environmental and Social Requirements, Policies and Kenyan legal requirements.

8.7.2 Construction Contractors

The detailed design and construction will be undertaken by an EPC contractor. The EPC contractor will be required to comply with, and implement, all relevant environmental and social Management Controls and to comply with Project Standards – together referred to as PipeCo Environmental and Social Requirements. All commitments, requirements and management controls will be applicable to all sub-contractors employed by the EPC contractor.

The EPC contractor will:

- Use its own management systems and procedures to manage construction activities;
- Revise its management systems and procedures to ensure compliance with PipeCo Environmental and Social Requirements;
- Ensure that relevant PipeCo Environmental and Social Requirements are included in sub-contractor contracts; and
- Develop and implement appropriate performance monitoring and corrective action procedures to monitor and audit sub-contractor performance and compliance.

8.8 Role of Engagement

Engagement is integral to social management implementation, monitoring and adjustment. There are expectations from the affected communities for participation in processes to monitor Project impacts and to monitor EPC contractor compliance with conditions under which the Project may be approved.

Information disclosure provides the information people need to engage and participate in the Project from an informed position. There is clear interest on the part of affected people for ongoing information on the Project, its potential impacts, and proposed socio-economic management measures.

The implementation of a consultation program, inclusive of counties and communities in the Project Area of Influence (AoI) and other stakeholder groups, throughout the construction, operation and decommissioning phases of the Project will be fundamental. It will be the responsibility of PipeCo/PPMT to implement and will be later detailed within the ESMP.

During implementation and operation of the Project, channels of engagement between the Project and the stakeholders will be maintained. An LLCOP Community Relations Plan will set out how LLCOP will engage with local communities and will include a grievance procedure. The plan will ensure that the process is credible and transparent and maintains simplicity in information comprehension, is as accessible as practically possible and maintains accuracy of information. This is especially the case where local communities are concerned.

PipeCo. will implement the grievance procedure to manage instances over the life of the Project where people feel they have grounds for complaint as a result of LLCOP construction or operational activities or the behaviours of EPCM contracted employee(s). Principles of the LLCOP Grievance Procedure and general approach is described in the Stakeholder Engagement Plan (Annex III).

In addition to ongoing consultation and engagement, PipeCo has an ongoing commitment to Vulnerable and Marginalised groups that are potentially impacted by the project and have commenced consultation with representatives of such groups (Social Baseline, Annex II).

8.9 Environmental & Social Management Mitigations and Management Controls

8.9.1 Introduction

The tables below set out the key aspects/impacts, mitigations, implementation timeframes and responsibilities as defined in the impact assessment section of the ESIA (Section 7). These are presented for both construction (including pre-construction) and operational project phases.

These are presented, where relevant, for each technical discipline based on the Environmental and Social Management Plan Components presented in Section 8.6.

Following the tables are sections summarising the approach to waste management, emergency response and decommissioning. These are broad-ranging issues which will require further development by the EPC Contractor and as a result, over-arching plans and frameworks are set out describing how the Project will address these issues.

8.9.2 Budgets for ESIA Mitigations

Budgetary provisions for the implementation of ESIA mitigations will be developed as part of the EPC process and will be agreed with PPMT/PipeCo and will be available for review by NEMA.

Table 8.9-1: Air Quality – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
AQ-1	Air Quality Management	Vehicle and equipment exhaust	Construction/ Operations	Where reasonable and practical, vehicles and equipment will be turned off when not in use, leaving vehicles idling for extended periods will be avoided unless weather and/or safety conditions dictate the need for them to remain turned on.	EPC Contractor	Daily inspections	See NV-2, CHSS-31
AQ-2	Air Quality Management	Training	Construction/ Operations	All personnel will be appropriately trained to use relevant equipment.	EPC Contractor/ PipeCo	Training Registers and Permits to Work Registers	See CHSS-31, CHSS-37
AQ-3	Air Quality Management	Machine / vehicle emissions	Construction/ Operations	All equipment will be operated and maintained in line with manufacturer's recommendations, using appropriate fuel and will be monitored with periodic inspection and audits.	EPC Contractor/ PipeCo	Daily inspections	See CHSS-31
AQ-4	Air Quality Management	Dust from vehicular movement	Construction/ Operations	Applicable national and Project speed limits will be adhered to by Project vehicles on all roads.	EPC Contractor/ PipeCo	Daily inspections	See LV-1, CHSS-17, CHSS-31
AQ-5	Air Quality Management	Dust	Construction	Stored materials that have the potential to produce dust (including spoil) will be covered or promptly removed, unless being re-used on site.	EPC Contractor	Daily inspections	See LV-4, CHSS-31
AQ-6	Air Quality Management	Dust and debris	Construction	Where practical, trucks transporting dusty material associated with the project will be covered to prevent escape of materials during transport.	EPC Contractor	Daily inspections	See CHSS-31
AQ-7	Air Quality Management	Dust	Construction	Daily site inspections will be undertaken by the PipeCo Site Representative when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	PipeCo	Daily inspections	See LV-5, CHSS-31

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
AQ-8	Air Quality Management	Particulate matter / dust	Construction	If dust is either observed or is considered likely to cause a nuisance to adjacent settlements, dust suppression will be undertaken using recycled grey water as a first preference. Where this is not available, water from other sources may be used provided abstraction of the water is appropriately permitted.	EPC Contractor	Daily inspections	See LV-6, CHSS-31, CHSS-37
AQ-9	Air Quality Management	Emissions from burning waste	Construction	Uncontrolled burning of waste materials will be prohibited.	EPC Contractor	Daily inspections	See LV-8, CHSS-31
ID	**Topic/Activity**	**Impact**	**Applicable Activity**	**Monitoring Measures**		**Periodicity**	**Location**
AQM-1	Air Quality Management	Traffic	Construction/ Operations	Compliance with Project Driver Code of Behaviour and Journey Management Plans.		Weekly and Monthly EHS reports	At all work locations
AQM-2	Air Quality Management	Community complaints	Construction/ Operations	All grievances, and any actions arising from a grievance, will be recorded in a grievance register.		Grievance Register	At all work locations
AQM-3	Air Quality Management	Emissions at generator stations	Construction/ Operations	Volumes of fuel consumed (diesel and crude oil) will be recorded to support emissions calculations.		Weekly and Monthly EHS reports	At all work locations
AQM-4	Air Quality Management	Dust	Construction	Visual monitoring for the presence of dust recorded in daily EHS inspection reports by the EPC Contractor.		Daily	At all work locations
AQM-5	Air Quality Management	Emissions at generator stations	Operations	Define frequency and spatial extent of ambient air quality monitoring; this ambient air quality monitoring will include for NO_X, SO_X, PM_{10} and PM_{25} and will be undertaken at sensitive receptor locations identified in ESIA to confirm effectiveness of emissions dispersion. After two rounds of monitoring showing no material exceedance of air quality standards, confirmatory monitoring will only be undertaken thereafter in response to a complaint or at the request of NEMA.		Monitoring reports, prepared	At Stations with generators (Stations 4, 6, 8, 9, 10,12, 14)

Table 8.9-2: Noise and Vibration – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
NV-1	Noise Management	Construction noise	Construction	At locations where construction noise will temporarily exceed statutory limits, NEMA will be notified. The EPC Contractor will liaise with local residents and will implement appropriate measures (such as work times and phasing of work etc) to limit the impact of noise. Monitoring will be carried out prior to and during construction to confirm baseline levels and maintain impacts as acceptable during construction.	EPC Contractor	Noise monitoring completed Review of records	
NV-2	Noise Management	Vehicle and equipment noise	Construction	Where reasonable and practical, vehicles and equipment will be turned off when not in use, leaving vehicles idling for extended periods will be avoided unless weather and/or safety conditions dictate the need for them to remain turned on.	EPC Contractor	Daily inspections	See AQ-1
NV-3	Noise Management	Noise from power generations	Construction	The shelters designed to house the generators located at S4/PS2 will have provision for acoustic barriers to meet applicable standards.	EPC Contractor	Site inspection reports	
ID	**Topic/Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
NVM-1	Noise Management	Construction noise	Construction	Undertake noise monitoring at the edge of the Right of Way and at adjacent settlements within 200m of edge of the Right of Way. Monitoring to be undertaken by appropriately trained workers. Monitoring equipment to be appropriately calibrated and maintained.		Daily	At all work locations
NVM-2	Noise Management	Operational noise	Operations	Define frequency and spatial extent of noise monitoring. Such noise monitoring will be undertaken at sensitive receptor locations identified in ESIA to confirm effectiveness of noise mitigation. After two rounds of monitoring showing no material exceedance of noise standards, confirmatory monitoring will only be undertaken thereafter in response to a complaint or at the request of NEMA.		Monitoring reports	At Stations with generators (Stations 4, 6, 8, 9, 10,12, 14)

Table 8.9-3: Water Resources – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
WR-1	Water Resource Management	Changes to river flows by pipeline construction	Construction / Operations	Post construction, monitoring of riverbed morphology and sediment transport will continue until at least the end of the first complete wet season after construction, with further inspections following any extreme event rainfall/flood events.	EPC Contractor PipeCo	Review of records Site inspections	See CHSS-35, CHSS-40, L-19
WR-2	Water Resource Management	Impact to water resources by abstraction	Construction / Operations	Water will be reused where possible to reduce demand on resources.	EPC Contractor PipeCo	Review of records Site inspections	See CHSS-35
WR-3	Water Resource Management	Changes in riverbed morphology – direct change to river flows	Construction / Operations	Post construction, excavated areas will be reinstated to reflect the original riverbed geomorphology. Any maintenance or operational activities will not take place in ephemeral rivers or watercourses without relevant permissions.	EPC Contractor PipeCo	Review of records Site inspections	
WR-4	Water Resource management	Contamination of water resources	Construction / Operations	The pipeline and its facilities will be designed to comply with all applicable Kenyan Laws and Regulations, and applicable international design codes and HSE standards, as well as international good practice – specifically the World Bank Group EHS Guidelines and IFC Performance Standards. These include, but are not limited to, the following: ▪ Works within watercourses shall not take place without consent from NEMA (as per the EMCA (Water Quality) Regulations, 2006). ▪ Defects in the pipeline will be identified and rectified through use of QA/QC procedures and testing to reduce the potential for leaks in accordance with	EPC Contractor PipeCo	Review of records	See ES-16

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
				Project specifications and in line with the guidelines provided in IFC[1]. ■ The pipeline hydrotesting will be completed in accordance with Project specifications and the guidelines provided in IFC EHS Guidelines for Onshore Oil and Gas Development (April 2017).			
WR-5	Water Resource management	Contamination of water resources by discharges	Construction / Operations	Water management and drainage will be incorporated in the design to ensure discharges will meet applicable environmental standards (including from temporary and permanent sanitation facilities) to reduce the potential impact to water quality. These measures will be detailed in a Construction Environmental Management Plan (CEMP) for the construction phase and in an Operational Environmental Management Plan (OEMP) and/or Water Management Plan (WMP) for the operations phase.	EPC Contractor PipeCo	Review of records Site inspections	
WR-6	Water Resource management	Contamination of water resources by poor waste management	Construction / Operations	All waste will be disposed of to an appropriate NEMA licenced facility.	EPC Contractor PipeCo	Review of records Site inspections	See SG-2
WR-7	Water Resource management	Contamination of water resources by hazardous substances	Construction / Operations	Handling, storage, treatment and disposal of hazardous substances will be in line with appropriate standards to reduce potential contamination of water resources. The procedures for all stages of hazardous substance handling, storage, use and disposal will be defined in the CEMP.	EPC Contractor PipeCo	Review of records Daily and weekly EHS reports	See SG-1
WR-8	Water Resource management	Contamination of water	Construction / Operations	The Emergency Preparedness and Response Plan will identify procedures (including for protecting the water environment from contamination) in the event of	EPC Contractor PipeCo	Review of records	See SG-3

[1] International Finance Corporation, 2007. Environmental, Health and Safety Guidelines for Onshore Oil and Gas development

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
		resources by emergencies		emergencies such as leaks, fires and ruptures. They will include how to manage and dispose of firefighting chemicals to reduce contamination potential.			
WR-9	Water Resource management	Contamination of water resources by discharges	Construction / Operations	The Project will apply spill prevention, control and response procedures for non-emergencies to control releases that could pollute the water environment. Provision, and training in use, of spill containment equipment will be implemented where they are required.	EPC Contractor PipeCo	Review of records Daily and weekly EHS reports	See SG-4
WR-10	Water Resource management	Contamination of water resources by hazardous substances	Construction / Operations	When selecting chemicals and materials, where practicable, aim to avoid or minimise the use of hazardous materials. Consideration will be given to selecting the items with the least potential for harm / lowest toxicity to the water environment without loss of effectiveness.	EPC Contractor PipeCo	Review of records	See SG-5
WR-11	Water Resource management	Contamination of water resources by hazardous substances	Construction / Operations	Appropriate secondary containment structures (to hold at least 110% of the maximum volume of storage) will be used where there is storage of hazardous materials. Hazardous materials will be stored inside roofed buildings and on impervious surfaces to reduce potential contamination of water resources.	EPC Contractor PipeCo	Review of records Site inspections	See SG-6
WR-12	Water Resource management	Contamination of water resources due to poorly maintained equipment	Construction / Operations	Regular management, inspection and maintenance regimes for all operating equipment, vehicles and machinery will be followed to limit the potential of wear, damage or corrosion leading to leaks or spills which could enter the water environment. All operators will receive adequate and appropriate training.	EPC Contractor PipeCo	Review of records Daily and weekly EHS reports	See SG-9
WR-13	Water Resource management	Contamination of water resources by fuel and oil spills	Construction / Operations	Oil water separators and grease traps will be installed and maintained as appropriate at refuelling facilities, workshops, parking areas, fuel storage and containment areas to reduce potential contamination risk to water resources.	EPC Contractor PipeCo	Site inspections	See SG-10

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
WR-14	Water Resource management	Abstraction of water for project use	Construction / Operations	For any Project phase, abstractions will not exceed the permitted abstraction rates. If new abstractions are required from any water source, the Project will apply for an abstraction permit for which potential impacts to environment will be assessed and presented in the application. Monitoring will be undertaken in accordance with permit conditions.	EPC Contractor PipeCo	Review of permits and monitoring records	
WR-15	Water Resource management	Abstraction of water for project use	Construction / Operations	Should additional boreholes be required for monitoring or water supply, drilling of boreholes will be undertaken following good practice methods: ■ Boreholes will, where possible, be located away from areas of potential contamination (e.g. areas used for storage of waste or hazardous substances, or near septic tanks or effluent discharge points). ■ Drilling techniques (including drilling fluids) and grouting methods will be selected to limit the potential for introducing contamination or allowing cross-contamination. The material used for casing and screening will be made from steel or well-grade plastic. The top sections will be lined to seal off possible contamination at the near surface. ■ Headworks/covers will, where possible, be raised above the ground surface to avoid surface contamination collecting around the top of the borehole and will be clearly marked and be located away from high traffic areas to limit the potential for damage. Headworks will be secured. ■ Abandoned/decommissioned boreholes will be securely sealed or backfilled with non-polluting materials.	EPC Contractor PipeCo	Review of records Site inspections	

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
WR-16	Water Resource management	Contamination of water resources by discharges	Construction / Operations	Wastewater from welfare facilities (e.g. toilets) will be discharged to an appropriately permitted wastewater treatment facility or septic tank prior to transport for treatment. If wastewater is collected in a septic tank system, the tanks will be properly designed, installed and maintained to prevent contamination of groundwater.	EPC Contractor PipeCo	Site inspections	
WR-17	Water Resource management	Contamination of water resources by discharges	Construction / Operations	No discharge of any effluent into the water environment will take place without a valid effluent discharge license issued by NEMA (as per the Environmental Management and Co-ordination (Water Quality) Regulations).	EPC Contractor PipeCo	Review of records Site inspections	
WR-18	Water Resource Management	Impact to water resources by abstraction and discharge of hydrotest water	Construction	A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates.	EPC Contractor	Review of records Site inspections	See PSI-8, CHSS-35, CHSS-39, L-5, L-21, ES-9
WR-19	Water Resource Management	Contamination of water resources by stored soils	Construction	Appropriate management of excavated materials will be implemented. Suspended solid management techniques will be used for run-off. The procedures being followed will be audited and monitored throughout construction.	EPC Contractor	Review of records Site inspections	
WR-20	Water Resource Management	Contamination of water resources by construction works	Construction	If construction works take place in a previously developed area and contamination of the ground is suspected or encountered, an investigation and risk assessment will be completed to identify the source of potential contamination and the risk to the water environment.	EPC Contractor	Review of records Site inspections	
WR-21	Water Resource Management	Changes to river flows by pipeline construction	Construction	Drainage channels and ditches will be designed to limit changes to natural flows and reduce the potential for flood risk.	EPC Contractor	Review of records Site inspections	

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
WR-22	Water Resource Management	Changes to drainage patterns by pipeline construction	Construction	Analyses will be completed before the design is finalised and construction starts, to assess the scale of potential changes to sediment flow and flood risk.	EPC Contractor	Review of records Site inspections	CHSS-40, L-19
WR-23	Water Resource management	Contamination of water resources by pipeline construction	Construction	Temporary erosion control measures will be installed prior to earth-moving activities to limit the likelihood of sediment mobilisation to the water environment. Suspended solid management techniques will be used. The procedures being followed will be audited and monitored throughout construction.	EPC Contractor	Daily and weekly EHS reports Site inspections	See SG-13, CHSS-40, L-19
WR-24	Water Resource management	Contamination of water resources by pipeline construction	Construction	The amount of time the trenches will be open will be minimised, reducing the time per location when excavated soils are exposed to limit the likelihood of sediment mobilisation to the water environment. Any materials, which could lead to contamination, placed in trenches by third parties or otherwise, will be removed before trenches are backfilled to remove potential sources of contamination.	EPC Contractor	Review of records Site inspections	See SG-14, CHSS-40, L-19
WR-25	Water Resource management	Contamination of water resources by pipeline construction	Construction	Work on ephemeral rivers, smaller streams/luggas and wetland crossings will take place during the dry seasons when watercourse flows and levels are low.	EPC Contractor	Review of records Site inspections	See SG-16 L-22, L-23
WR-26	Water Resource management	Contamination of water resources by waste materials	Construction	All construction waste, which could be a source of water contamination, will be handled, stored and managed as outlined in the Waste Management section of the CEMP.	EPC Contractor	Review of records	See SG-19
WR-27	Water Resource management	Impact to water resources by abstraction and	Construction	Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control	EPC Contractor	Review of records	See L-20, CHSS-32, CHSS-35,

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
		discharge of hydrotest water		measures. Hydrotest water abstraction and disposal will be planned so as to avoid/minimise impacts to local water users. A hydrotest plan will be developed for each spread.		Site inspection	CHSS-39, CHSS-41, ES-23
WR-28	Water Resource management	Impact to water resources by abstraction and discharge of hydrotest water	Construction	The pipeline hydrotesting procedure will aim to store and reuse water to reduce volume required from water abstractions.	EPC Contractor	Review of records	See ES-18
WR-29	Water Resource management	Contamination of water resources by pipeline construction	Construction	The use of biocides and corrosion inhibitors in hydrotest water will be minimised and avoided where possible to limit potential sources of contamination.	EPC Contractor	Review of records	See ES-20
WR-30	Water Resource Management	Impact to water resources by pipeline leaks	Operations	Oil volume monitoring and management in the pipeline will be used to identify losses as soon as is practicable. The leak detection system will be used to determine if an emergency response team needs to be mobilised. Action plans will be followed if leaks are detected to reduce the potential for water contamination. Details of the leak monitoring procedure, monitoring locations, monitoring frequency and action plans will be included in the OEMP.	PipeCo	Review of records	
WR-31	Water Resource Management	Impact to water resources by pipeline leaks	Operations	The pipeline will be regularly inspected and maintenance programmes will be followed to maintain pipeline integrity to reduce the potential for leaks that could otherwise lead to water contamination.	PipeCo	Review of records	See SG-22
WR-32	Water Resource Management	Contamination of water resources by waste materials	Operations	Operational waste will be handled in a way that follows environmental legislative requirements and reduces water contamination potential, in line with the Waste Management section of the OEMP.	PipeCo	Review of records	See SG-23, ES-25

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
WR-33	Water Resource Management	Contamination of water resources by leakages	Operations	Use of underground storage tanks for fuels and lubricants will be avoided to reduce the potential for leaks that are harder to identify, which could lead to contamination of soil.	PipeCo	Review of records Site inspection	See SG-11
ID	**Topic/ Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
WRM-1	Water Resource Management	Volumes of water used	Construction / Operations	Volumes of water abstracted during construction and operations.		Weekly and monthly EHS reports	All working locations
WRM-2	Water Resource Management	Water abstraction	Construction / Operations	Compliance with water abstraction permit requirements.		Weekly and monthly EHS reports	At all water abstraction boreholes and monitoring locations
WRM-3	Water Resource Management and water quality	Discharge of water (quantity and quality)	Construction / Operations	Compliance of discharged water with applicable standards, at discharge location and monitoring locations downstream of septic tanks and monitoring of identified water use (from hydro-census) potentially affected by discharges.		Weekly and monthly EHS reports	At all water discharge locations boreholes and monitoring locations
WRM-4	Water Resource Management and water quality	Contamination of water resources	Construction	Where construction work occurs adjacent to, or in water courses which may be flowing during the construction period, procedures for inspection and monitoring will be implemented throughout the construction period, including upstream and downstream water quality monitoring pre and post construction, where applicable.		Weekly and monthly EHS reports	All working locations

Table 8.9-4: Soils, Geology and Geohazards – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
SG-1	Soil Management	Contamination of soils by hazardous waste	Construction/ Operations	Handling, storage, treatment and disposal of hazardous substances will be in line with appropriate standards to reduce the potential of soil contamination. The procedures for all stages of hazardous substance handling, storage, use and disposal will be defined in the CEMP.	EPC Contractor PipeCo	Review of records Daily and weekly EHS reports	See WR-7, CHSS-36
SG-2	Soil Management	Contamination of soils by waste disposal	Construction/ Operations	Waste disposal will be to a NEMA licensed facility to reduce potential for soil contamination. Transportation of such wastes will be by a NEMA licenced contractor.	EPC Contractor PipeCo	Review of records	
SG-3	Soil Management	Contamination of soils by emergency events	Construction/ Operations	The Emergency Preparedness and Response Plan will identify procedures (including for protecting soil resources from contamination) in the event of emergencies such as leaks, fires and ruptures. They will include how to manage and dispose of firefighting chemicals to reduce potential for contamination.	EPC Contractor PipeCo	Review of records	See WR-8
SG-4	Soil Management	Contamination of soils by spills and releases	Construction/ Operations	The Project will apply effective spill prevention, control and response procedures for non-emergencies to control releases that could pollute the soil environment. Provision of, and training in the use of spill containment equipment will be implemented where they are required.	EPC Contractor PipeCo	Review of records	See WR-9
SG-5	Soil Management	Contamination of soils by hazardous materials	Construction/ Operations	When selecting chemicals and materials this will, where practicable, aim to avoid or minimise the use of hazardous materials. Consideration will be given to selecting the items with the least potential for harm / lowest toxicity to the soil and water environment without loss of effectiveness.	EPC Contractor PipeCo	Review of records	See WR-10

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
SG-6	Soil Management	Contamination of soils by hazardous materials	Construction/ Operations	Appropriate secondary containment structures (to hold at least 110% of the maximum volume of storage) will be used where there is storage of hazardous materials. Hazardous materials will be stored inside roofed buildings and on impervious surfaces to reduce potential contamination of soils.	EPC Contractor PipeCo	Review of records Site inspections	See WR-11
SG-7	Soil Management	Contamination of soils by hazardous materials	Construction/ Operations	Transfer of hazardous materials from tanks to storage facilities will take place in areas with surfaces sufficiently impervious to avoid loss to the soil environment. The surface will be sloped to a collection or a containment structure not connected to municipal wastewater/storm water collection system.	EPC Contractor PipeCo	Review of records Site inspections	
SG-8	Soil Management	Contamination of soils by hazardous materials	Construction/ Operations	The Project will limit the volume of hazardous substances stored at any one site to only what is required to reduce potential contamination risk to soil.	EPC Contractor PipeCo	Review of records	See CHSS-36
SG-9	Soil Management	Contamination of soils by poor maintenance	Construction/ Operations	Regular management, inspection and maintenance regimes for all operating equipment, vehicles and machinery will be followed to limit the potential of wear, damage or corrosion leading to leaks or spills which could contaminate soils. All operators will receive adequate and appropriate training.	EPC Contractor PipeCo	Review of records Site inspections	See WR-12
SG-10	Soil Management	Contamination of soils by fuel and oils	Construction/ Operations	Oil water separators and grease traps will be installed and maintained as appropriate at refuelling facilities, workshops, parking areas, fuel storage and containment areas to reduce potential contamination risk to soil.	EPC Contractor PipeCo	Review of records Site inspections	See WR-13
SG-11	Soil Management	Contamination of soils by leakages	Construction/ Operations	Use of underground storage tanks for fuels and lubricants will be avoided to reduce the potential for leaks that are harder to identify, which could lead to contamination of soil.	EPC Contractor PipeCo	Review of records Site inspections	See WR-33

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
SG-12	Soil Management	Contamination of soils by poor construction practices	Construction	The pipeline will be constructed to comply with relevant laws/regulations and with environmental permits in place to reduce likelihood of contamination risk to soils.	EPC Contractor PipeCo	Review of records	
SG-13	Soil Management	Erosion of excavated soils	Construction	Temporary erosion control measures will be installed prior to earth-moving activities to minimise movement of soils.	EPC Contractor	Review of records Site inspections	See WR-23
SG-14	Soil Management	Erosion of excavated soils	Construction	The amount of time the trenches are open will be minimised, reducing the time per location when excavated soils are exposed. Any materials, which could lead to contamination, placed in trenches by third parties or otherwise, will be removed before trenches are backfilled to remove any source of potential soil contamination.	EPC Contractor	Review of records Site inspections	See WR-24
SG-15	Soil Management	Erosion of riverbeds	Construction	Construction activities in perennial rivers and wetland areas will take place during the dry seasons when flows and levels in watercourses are low; timings of constructions activities will be selected based on when the watercourse is at its lowest anticipated level to limit the potential for sediment mobilisation.	EPC Contractor	Review of records Site inspections	See WR-25, SG-16, ES-19
SG-16	Soil Management	Erosion of riverbeds	Construction	There will be no construction in small streams and seasonal rivers/luggas when there is flow. Construction activities in small streams and seasonal rivers/luggas will be scheduled for dry season periods when no flow is anticipated.	EPC Contractor	Review of records Site inspections	See WR-25, SG-15
SG-17	Soil Management	Erosion of soils due to rainfall	Construction	Works in periods of extreme rainfall will be limited, as far is it is practicable, to limit soil loss due to erosion.	EPC Contractor	Review of records Site inspections	

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
SG-18	Soil Management	Degradation of excavated soils	Construction	Topsoil will be salvaged along the length of the pipeline trench, stored separately and replaced following pipeline installation and trench backfilling. In identified agricultural areas, the duration of topsoil storage will be minimised to reduce degradation of soil quality.	EPC Contractor	Review of records Site inspections	See CHSS-27
SG-19	Soil Management	Contamination of soils by poor waste management practices	Construction	All construction waste will be handled, stored and managed in accordance with the Waste Management section of the CEMP to reduce potential sources of soil contamination.	EPC Contractor	Review of records Site inspections	See WR-26, ES-17
SG-20	Soil Management	Degradation of excavated soils	Construction	Identification of high value agricultural land prior to construction through mapping and engagement with local land users. Topsoil will be left in windrows, in line with soils erosion management/control in the CEMP.	EPC Contractor	Review of records Site inspections	
SG-21	Soil Management	Erosion of excavated soils	Construction	Site-specific erosion control plans will be prepared for construction work mountainous/high relief areas.	EPC Contractor	Review of records Site inspections	
SG-22	Soil Management	Contamination of soil by leaks	Operations	The pipeline will be regularly inspected, and maintenance programmes will be followed to maintain pipeline integrity to reduce the potential to leaks that could otherwise lead to soil contamination.	PipeCo	Review of records Site inspections	See WR-31, ES-24
SG-23	Soil Management	Contamination by improper waste management	Operations	Operational waste will be handled in a way that follows environmental legislative requirements and reduces soil contamination potential, in line with the Waste Management section of the OEMP.	PipeCo	Review of records	See WR-32

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
SG-24	Soil Management	Erosion and subsidence of land by construction	Operations	The pipeline will be inspected on an ongoing basis throughout its operational life to identify any areas of erosion and subsidence.	PipeCo	Review of records Site inspections	
SG-25	Soil Management	Contamination of soils by fuel and oils	Operations	Drainage water from process areas that could be contaminated with oil (closed drains) and drainage water from non-process areas (open drains) will be separated to the extent practical from storm water drainage to limit potential to contaminate soil.	EPC Contractor PipeCo	Review of records Site inspections	
ID	**Topic/ Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
SGM-1	Soil Management	Topsoil stripping	Construction	Where soils are identified as valued or agricultural land is identified during the soil stripping process, records will be made of all soil stripped and stockpiled for each working area. This will include soil type and the date of stripping/removal and date of backfilling.		Daily records maintained	All working areas
SGM-2	Soil Management	Soil contamination	Construction	In the event of discovery of contaminated soils, volumes of contaminated soils, cause of contamination, type of contamination, treatment/disposal option, and records of any transfer to a NEMA registered waste disposal location will be maintained.		Daily and weekly EHS reports	All working areas
SGM-3	Soil Management	Soil erosion	Construction	Define frequency and spatial extent of erosion control monitoring. The procedures being followed will be audited and monitored throughout construction.		As developed.	All working areas
SGM-4	Soil Management	Soil contamination	Construction	Define frequency and spatial extent of soil sampling to be conducted at suitable depth to assess any possibility of contamination. The procedures being followed will be audited and monitored throughout construction.		As developed.	All working areas

Table 8.9-5: Terrestrial and Aquatic Biodiversity – Mitigations, Implementation and Monitoring

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
TAB-1	Biodiversity	Construction activities facilitate spread of invasive species	Construction/ Operations	Develop and implement an Invasive Species Management Procedure, to include hygiene specifications for vehicles and cargo, site clearance and rehabilitation.	EPC Contractor PipeCo	Review of records Site inspections	See ES-10
TAB-2	Biodiversity	Wildlife enters the working areas and open trench	Construction/ Operations	Develop and implement a Wildlife Access Control Procedure.	EPC Contractor PipeCo	Review of records Site inspections	See CHSS-19. ES-6
TAB-3	Biodiversity	Worker-animal interactions	Construction/ Operations	Develop and implement a wildlife awareness component to worker induction and driver training programmes.	EPC Contractor PipeCo	Review of records Site inspections	
TAB-4	Biodiversity	Spread of Invasive Species	Construction/ Operations	All staff receive training on avoiding introduction or spread of invasive species.	EPC Contractor PipeCo	Review of training records	
TAB-5	Biodiversity	Construction impacts sensitive species and ecosystems	Construction	PipeCo to employ a Biodiversity Officer (BO) to supervise all activities, with a focus on areas of biodiversity sensitivity and implementation of biodiversity-related management controls. BO to prepare location specific Biodiversity Management Plasn to address local biodiversity management issues. BO to have "stop work" authority exercised where there is imminent risk to SoCC. The BO will liaise with key stakeholders such as KWS and conservation institutions to consider all biodiversity issues, including species presence and/or movement in relation to construction schedules and associated activities.	EPC Contractor	Review of records Site inspections	
TAB-6	Biodiversity	Construction impacts	Construction	Develop and implement area-specific (for each spread) biodiversity management procedures including pre-	EPC Contractor	Review of records	

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
		sensitive species and ecosystems		construction surveys. Working in collaboration with relevant Conservancies and/or KWS to guide site clearance, pipeline installation and rehabilitation activities. Procedures to be approved by PipeCo prior to commencement of site activities.		Site inspections	
TAB-7	Biodiversity	Wildlife enters the open trench	Construction	Develop and implement Wildlife Rescue Procedure for animals becoming trapped within open trench e.g. use crawl boards/fauna ramps at regular intervals along the length of open trench. In areas where potential animal migration/ movement across the open trench is considered to be a high risk, species-specific measures will be developed and implemented to minimise the length of open trench, discourage wildlife from approaching the open trench, and to monitor the open trench to ensure that any animals trapped are rescued as quickly as possible.	EPC Contractor	Review of records Site inspections	See L-2, L-9, L-12
TAB-8	Biodiversity	Wildlife adopt avoidance behaviour near Stations	Construction	Stations adjacent to conservancy boundaries to be designed to blend in with the surrounding topography. If possible, this should include being painted in natural colours and landscaping with trees and scrub (natural planting of endemic species) and minimisation of sensory disturbance by no night-time construction and the use of timers and cowls on external lighting/flood lighting during construction. No night working in areas adjacent to National Reserves or Community Conservancies unless agreed and supervised by PipeCo BO.	EPC Contractor	Review of records Site inspections	See TAB-18, LV-2, LV-9
TAB-9	Biodiversity	Pipeline construction disrupts natural environment	Construction	Once the pipeline is installed, areas are to be rehabilitated as soon as possible based on a Site Restoration Procedure.	EPC Contractor	Review of records Site inspections	See ES-14
TAB-10	Biodiversity	Pipeline construction	Construction	BO to inform relevant Conservancies and KWS of poaching threats identified in the vicinity of construction activities in the pipeline corridor.	EPC Contractor PipeCo	Review of records	See TAB-19

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
		facilitates poaching				Site inspections	
TAB-11	Biodiversity	Construction of river crossings causes wildlife impacts	Construction	Undertake open cut river crossings at times of minimal flow with method statements reviewed and approved by BO.	EPC Contractor	Review of records Site inspections	See L-23
TAB-12	Biodiversity	Construction of river crossings causes wildlife impacts	Construction	Undertake fish rescue as required and directed by the BO.	EPC Contractor	Review of records Site inspections	
TAB-13	Biodiversity	Abstraction of water for project use	Construction	Ensure that biodiversity considerations are taken into account in the selection of sources for hydrotest water.	EPC Contractor	Review of records Site inspections	
TAB-14	Biodiversity	Spread of invasive species	Construction	Additional area-specific control measures to be developed, in consultation with BO, in identified invasive species “hotspot” areas along pipeline corridor (e.g. areas of major prosopis infestation in southern Samburu, and in the region of Garissa Town).	EPC Contractor	Review of records Site inspections	
TAB-15	Biodiversity	Spread of Invasive Species	Construction	Invasive Species to be identified and destroyed during vegetation clearance of pipeline RoW and areas designated for other permanent and temporary facilities.	EPC Contractor	Review of records Site inspections	
TAB-16	Biodiversity	Lighting affects animal behaviour	Operations	Minimise sensory disturbance in stations within conservancies. No night-time driving and avoid light spill by using timers and cowls.	PipeCo	Review of records Site inspections	

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
TAB-17	Biodiversity	Spread of Invasive Species	Operations	Maintenance of invasive species-free environment within all fenced Project facilities (e.g. stations, LMT) through regular inspections to identify, remove and safely dispose of invasive species.	PipeCo	Review of records Site inspections	
TAB-18	Biodiversity	Wildlife adopt avoidance behaviour near Stations	Operations	Maintain landscaping at stations to minimise visual impact.	PipeCo	Review of records Site inspections	See TAB-8
TAB-19	Biodiversity	Pipeline operations facilitates poaching	Operations	BO to provide poaching threat dialogue to Conservancies, NGO's and KWS.	PipeCo	Review of records Site inspections	See TAB-10
ID	**Topic/ Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
TABM-1	Biodiversity	Construction impacts sensitive species and ecosystems	Construction	Area-specific biodiversity management procedures developed by PipeCo and implemented by EPC Contractor.		As developed	All working areas
TABM-2	Biodiversity	Worker-animal interactions	Construction	Wildlife awareness training completed for all workers.		Monthly	Review of training records
TABM-3	Biodiversity	Pipeline construction disrupts natural environment	Construction	Site Restoration Procedure developed and implemented.		Daily and Weekly	Daily and weekly EHS reports
TABM-4	Biodiversity	Spread of AIS	Construction	Records will be maintained on the occurrence and spread of invasive species.		As required	

Table 8.9-6: Marine Flora and Fauna – Mitigations, Implementation and Monitoring

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
MFF-1	Marine Flora and Fauna	Hazardous materials and waste management	Construction/ Operations	The Project and all its contractors will maintain strict compliance with all relevant Kenyan legislation and regulations that are relevant to protection of the natural environment and biodiversity, including but not limited to: i) Disposal of all liquid and solid wastes using approved disposal pathways, and where appropriate employment of licensed waste disposal operators; and ii) All materials required for construction, including but not limited to chemicals, cement and fuel, will be stored in compliance with Kenyan regulations relating to the prevention of contamination and contamination of soils and water.	EPC Contractor PipeCo	Review of records Site inspection	
MFF-2	Marine Flora and Fauna	Presence of construction workers	Construction/ Operations	A no hunting or fishing policy will be developed and implemented. Disturbance to the environment and natural resources will only be permitted when required for the specific purpose of the Project, e.g. vegetation clearance in the RoW prior to trenching.	EPC Contractor	Review of records Site inspection	See ES-11
MFF-3	Marine Flora and Fauna	Mobilisation of sediment	Construction	Sediment management procedures to be developed and implemented.	EPC Contractor	Review of records Site Inspection	See WR-1, WR-22, WR-23, WR-24, CHSS-40, L-19
MFF-4	Marine Flora and Fauna	Waste management	Construction	Solid waste management plan will be developed and implemented for activities within or adjacent to marine environments to minimise likelihood of sources of contamination.	EPC Contractor	Review of records Site inspection	

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
MFF-5	Marine Flora and Fauna	Wastewater disposal	Construction	Wastewater treatment and management plan, contaminant management and control procedures will be developed and implemented to minimise likelihood of sources of contamination to the marine environment.	EPC Contractor	Review of records Site inspection	
MFF-6	Marine Flora and Fauna	Construction in inter-tidal areas	Construction	Construction activities in the mangrove zone (c. 500m in length) at the head of tidal creeks on the approach to the Port to be overseen and monitored by the BO, in accordance with a biodiversity method statement. This will set out procedures for: i) Pre-construction surveys; ii) Monitoring and implementation of necessary actions during clearance, pipelaying and reinstatement of the RoW; iii) Supervision of mangrove habitat planting at agreed location to achieve no net loss of mangrove habitat from Project activities; and iv) It will also address unforeseen impacts on biodiversity by describing procedures for emergency response and mitigation on site (e.g. accidental spills).	EPC Contractor	Review of records Site inspection	
MFF-7	Marine Flora and Fauna	Lighting disrupts mangrove areas	Construction	No night-time working in the mangrove area.	EPC Contractor	Review of records Site inspection	
MFF-8	Marine Flora and Fauna	Community interaction with Project activities	Construction	Local community access to the mangrove zone RoW during construction will be controlled.	EPC Contractor	Review of records Site inspection	

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
MFF-9	Marine Flora and Fauna	Hazardous materials affect mangrove areas	Construction	No storage of materials or storage/discharge of solid and liquid wastes in the mangrove zone; and no refuelling or chemical handling within mangrove areas.	EPC Contractor	Review of records Site inspection	
MFF-10	Marine Flora and Fauna	Loss of mangrove habitat	Construction	No net loss of mangrove habitat as a result of land take for construction; since the land taken will subsequently be lost to the port development this will be achieved by investigating opportunities for further mangrove enhancement at other locations around Lamu Port, in consultation with for example KFS, KEMFRI and the Lamu Port Authority.	PipeCo	Review of records Site inspection	
MFF-11	Marine Flora and Fauna	Construction activities in mangrove areas impact bird breeding	Construction	No construction in the mangrove zone during the main bird-nesting season (May and June).	EPC Contractor	Review of records Site inspection	
MFF-12	Marine Flora and Fauna	Lighting disrupts mangrove areas	Construction	Use of directional lighting and cowls to prevent excessive light spill into mangrove areas adjacent to the RoW.	EPC Contractor	Review of records Site inspection	See LV-2
MFF-13	Marine Flora and Fauna	Invasive species	Operations	To manage the risk of introduction of invasive species, PipeCo will include contractual provisions such that all third party export tankers berthing to load crude from the VLCC will be required to follow the International Maritime Organisation (IMO) International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM).	PipeCo	Review of records	

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
MFF-14	Marine Flora and Fauna	Pollution of Lamu Port	Operations	All activities within the Port Area will be required to comply with all regulations established by the Lamu Port Authority, including those relating to vessel speeds within the buoyed channel, and discharge of solid and liquid wastes.	PipeCp	Review of records	
MFF-15	Marine Flora and Fauna	Pollution of Lamu Port	Operations	To mitigate pollution from tanker vessels, PipeCo will require all vessels (including third party export tankers) to comply with the requirements of MARPOL 73/78, including Annex I, IV and V requirements relating to: 1) drainage and bilge water; 2) liquid sewage wastewater; and 3) food waste.	PipeCo	Review of records	
MFF-16	Marine Flora and Fauna	Vessel collision in Lamu Port	Operations	Marine traffic collision risk assessment, covering all Project vessels, third party export tankers other vessels using the port and local fishing vessels operating in and around Lamu Port; implementation of appropriate operational mitigation based on the risk assessment's conclusions.	PipeCo		
MFF-17	Marine Flora and Fauna	Operation of Project facilities	Operations	Ongoing adaptive management of risks and impacts to marine and mangrove biodiversity, with reference to relevant monitoring data and *ad hoc* sightings and reports; this will be carried out by the designated Project staff member with responsibility for Project interactions with biodiversity.	PipeCo		
MFF-18	Marine Flora and Fauna	Loss of mangrove habitat	Operations	Monitoring of areas of mangrove restored after construction (i.e. vegetation re-establishment and health, and water flows). Continue consultation to investigate and where appropriate implement opportunities for further mangrove enhancement in and around Lamu Port, in consultation with KFS and the Lamu Port Authority.	PipeCo		See MMF-10

ID	Topic/ Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
MFF-19	Marine Flora and Fauna	Pollution of Lamu Port	Operations	Coastal oil spill dispersion modelling will be updated, and an oil spill contingency plan will be developed for operations.	PipeCo		
ID	**Topic/ Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
MFFM-1	Marine Flora and Fauna	Construction activities	Construction	Area-specific biodiversity management procedures developed and implemented.		As required	All working areas
MFFM-2	Marine Flora and Fauna	Worker wildlife interactions	Construction	Wildlife awareness training completed for all workers.		As required	
MFFM-3	Marine Flora and Fauna	Impacts from pipeline construction	Construction	Working areas reinstated in accordance with site reinstatement procedures.		As required	All working areas

Table 8.9-7: Landscape and Visual – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
LV-1	Visual Impact	Dust generation by vehicles	Construction/ Operations	Applicable national and Project speed limits will be adhered to by Project vehicles to on all roads to reduce dust generation which may cause visual impacts.	EPC Contractor PipeCo	Review of records Site Inspection	See AQ-4, See CHSS-17
LV-2	Visual Impact	Lighting from project facilities	Construction/ Operations	Use of lighting, including at stations, will be minimised and light spill controlled where possible, with floodlighting installed with cowls to minimise light spillage, as outlined in the CEMP and the OEMP.	EPC Contractor	Review of records Site inspection	See TAB-8, MFF-12
LV-3	Visual Impact	Changes to local views	Construction/ Operations	Implementation of a Grievance Management Procedure, enabling the recording and follow up of complaints related to Project activities which could contribute to visual impacts.	EPC Contractor PipeCo	Review of Grievance Management Procedure records	See LV-3, CHSS-20, CHSS-33, L-7, L-16
LV-4	Visual Impact	Dust generation by excavated material	Construction	Prompt removal or covering of stored materials that have a potential to produce dust (including spoil) which may cause visual impacts, unless being re-used on site.	EPC Contractor	Daily and weekly EHS reports Site Inspection	See AQ-5
LV-5	Visual Impact	Dust generation by excavated material	Construction	Daily site inspections will be undertaken by the PipeCo Site Representative when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions, which could cause visual impacts.	EPC Contractor	Daily and weekly EHS reports Site Inspection	See AQ-7
LV-6	Visual Impact	Dust generation	Construction	If dust is either observed or is considered likely to cause a nuisance to adjacent settlements, dust suppression will be undertaken using recycled grey water as a first preference.	EPC Contractor	Daily and weekly EHS reports	See AQ-8

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
		by excavated material		Where this is not available, water from other sources may be used provided this is appropriately permitted. Dust suppression will minimise dust generation which may cause visual impacts.		Site Inspection	
LV-7	Visual Impact	Dust generation by vehicles	Construction	Dampening down of roads will be undertaken if dust is being re-suspended, which may cause visual impacts.	EPC Contractor	Daily and weekly EHS reports Site Inspection	See AQ-6
LV-8	Visual Impact	Burning of waste	Construction	Uncontrolled burning of waste materials will be prohibited.to reduce associated visual impacts.	EPC Contractor	Daily and weekly EHS reports Site Inspection	See AQ-9
LV-9	Visual Impact	Changes to local views	Operations	Subject to site specific conditions, including vegetation type and density and where appropriate, planting of endemic natural vegetation should be considered to act as screening of the Project infrastructure.	EPC Contractor PipeCo	Review of records Site inspection	See TAB-8, TAB-18
ID	**Topic/ Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
LVM-1	Visual Impact	Visual impacts	Construction/ Operations	No specific monitoring measures proposed.		n/a	

Table 8.9-8: Cultural Heritage – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
CH-1	Cultural Heritage	Disturbance to cultural heritage sites	Construction/ Operations	Develop system or protocol for reporting illicit activities (i.e. looting) at cultural heritage sites adjacent to active construction areas to government authorities.	EPC Contractor PipeCo	Review of records Daily and weekly EHS Reports	
CH-2	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Construction activities and all site-related vehicle movements will be limited to the pipeline RoW to minimise potential impacts on cultural heritage sites.	EPC Contractor	Review of records Daily and weekly EHS Reports Site Inspection	See L-3
CH-3	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Micro-alignment of Project components to avoid cultural heritage sites.	EPC Contractor	Review of records Daily and weekly EHS Reports Site Inspection	
CH-4	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Existing road infrastructure has been identified for use where possible to reduce the need for creation of new roads and minimise area which could have potential impacts on cultural heritage sites.	EPC Contractor	Review of records Site Inspection	See ES-21
CH-5	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Implementation of Cultural Heritage Management Plan and Chance Finds Procedure.	EPC Contractor	Review of records Daily and weekly EHS Reports Site Inspection	

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
CH-6	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Consultation and engagement with local communities prior to commencement of construction activities to identify any cultural heritage sites within the RoW, which may be avoided by micro-routing where appropriate.	EPC Contractor	Review of records Site Inspection	
CH-7	Cultural Heritage	Disturbance to cultural heritage sites	Construction	The pipeline routing design has used satellite imagery and site visits to identify and avoid known cultural heritage sites. Appropriate mapping and documentation will be developed for any additional cultural heritage sites identified in consultation with local communities prior to construction or found during construction.	EPC Contractor	Review of records	
CH-8	Cultural Heritage	Disturbance to cultural heritage sites	Construction	If micro-alignment cannot avoid graves/burial sites, exhumation and re-interments of burials at a location acceptable to local communities and government authorities will be undertaken in accordance with procedures agreed with local communities.	EPC Contractor	Review of records Daily and weekly EHS Reports Site Inspection	
CH-9	Cultural Heritage	Disturbance to cultural heritage sites	Construction	In areas identified as being of cultural heritage significance, monitoring of vegetation clearance, surface stripping, excavation and construction will be undertaken by a suitably qualified Cultural Heritage (CH) professional appointed by PipeCo. All such activities will be documented and approved by the CH professional when all required mitigation has been completed.	EPC Contractor	Review of records Daily and weekly EHS Reports Site Inspection	
CH-10	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Periodic surveillance of known cultural heritage sites (e.g. burial sites) in proximity to the Project during the period of construction activity.	EPC Contractor	Review of records Daily and weekly EHS Reports Site Inspection	

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
CH-11	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Facilitate legitimate site access by local community members with ties to those locations during the period of construction activity in vicinity of identified sites.	EPC Contractor	Review of records Site Inspection	
CH-12	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Where sacred sites are encountered and avoidance is not possible, relocation of sacred site, resources or activity if technically feasible, in consultation with local communities.	EPC Contractor	Review of records Site Inspection	See ES-13
CH-13	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Surface collection of artefacts shall be carried out under supervision of a suitably qualified cultural heritage professional as set out in the Chance Finds Procedure. Sampling and archiving protocol to be agreed with the NMK.	EPC Contractor	Review of records Site Inspection	
CH-14	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Identified sacred sites close to construction/operation areas will be protected through demarcation of no-go areas for vehicles and Project personnel.	EPC Contractor	Review of records	ES-12
ID	**Topic/Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
CHM-1	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Review records on implementation of Chance Finds Procedure to confirm issues effectively addressed.		As required	All working areas
CHM-2	Cultural Heritage	Disturbance to cultural heritage sites	Construction	Review records to confirm that micro-routing and relocation of cultural heritage sites has been undertaken with documented agreement of affected communities.		As required	All working areas

Table 8.9-9: Physical and Social Infrastructure – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
PSI-1	Project induced influx	Project induced influx	Construction/ Operations	Implement employment policy forbidding informal labour hire and no "at the gate/camp" hiring to help reduce risk of influx putting pressure on local infrastructure.	EPC Contractor PipeCo	Review of records	See CHSS-52, ES-8
PSI-2	Project induced influx	Project induced influx	Construction/ Operations	Deploy signage in relevant local languages related to Project hiring in relevant locations to help reduce risk of influx putting pressure on local infrastructure.	EPC Contractor PipeCo	Site inspection	
PSI-3	Project induced influx	Project induced influx	Construction/ Operations	Develop and implement communications plans on project employment policies in areas identified as potential sources of in-migration, to help reduce risk of influx putting pressure on local infrastructure.	EPC Contractor PipeCo	Review of records	See CHSS-20
PSI-4	Project induced influx	Project induced influx	Construction/ Operations	Preferential local recruitment of non-skilled workers and employment of local/regional workforce as outlined in Project local content plans, to help reduce risk of influx putting pressure on local infrastructure.	EPC Contractor PipeCo	Review of records	See CHSS-51, EE-4
PSI-5	Project induced influx	Project induced influx	Construction/ Operations	Regular meetings (quarterly) with County administration to identify and address any emerging issues, to help manage influx which could put pressure on local infrastructure.	EPC Contractor PipeCo	Review of records	See CHSS-20
PSI-6	Project induced influx	Project induced influx	Construction/ Operations	Advertising of recruitment and hiring procedures, together with jobs specifications and requirements, to help manage influx which could put pressure on local infrastructure.	EPC Contractor PipeCo	Review of records	See CHSS-53

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
PSI-7	Project induced influx	Project induced influx	Construction/ Operations	All non-local workers to be housed in designated accommodation camps except where local impacts can be demonstrated to be negligible, to help reduce pressure on local infrastructure and local inflation.	EPC Contractor PipeCo	Review of records	See CHSS-54, ES-7
PSI-8	Project induced influx	Project induced influx increasing resource demand	Construction	A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates. Should there be any potential for changes in water supply, the Project will provide water to communities, to help reduce risk of influx putting pressure on local infrastructure.	EPC Contractor	Review of records	See WR-18, CHSS-39, L-5, L-21, ES-9
PSI-9	Roads and Traffic	Degradation of road infrastructure	Construction	EPC Contractor will develop a Traffic Management Plan to identify which (if any) non-major roads will need to be rehabilitated for use during the Project. Regular inspection of these roads will be undertaken throughout the Project, and repairs will be carried out as required in consultation with the appropriate Government Agency (KeNHA/ Regional Roads Authority).	EPC Contractor	Review of records	See L-15, CHSS-17

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
PSI-10	Roads and Traffic	Changes to traffic volume and composition	Construction	Major roads will be identified by the EPC Contractor from both Mombasa and Lamu ports to ascertain the most appropriate route to transport pipe and equipment to the selected storage yards along the pipeline route.	EPC Contractor	Review of records	
ID	**Topic/Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
PSIM-1	Physical and Social Infrastructure	Project induced influx	Construction/ Operations	Monitor the amount of at-gate or informal hiring requests received and note changes over time.		Daily	At site
PSIM-2	Physical and Social Infrastructure	Project induced influx	Construction/ Operations	Track the uptake of unskilled and semi-skilled positions by the Project.		Monthly	At site
PSIM-3	Physical and Social Infrastructure	Emerging issues	Construction	Regular meetings with County administration to identify and address any emerging issues (e.g. in-migration).		Quarterly	County administrative offices
PSIM-4	Physical and Social Infrastructure	Project induced influx	Construction	Periodically report progress against local content plan to County government.		Quarterly	All working areas
PSIM-5	Roads and Traffic	Degradation of roads	Construction	Monitor and document road repair and upgrade activities.		Quarterly	All working areas
PSIM-6	Roads and Traffic	Degradation of roads	Construction	All grievances relating to roads and traffic, and any actions arising from a grievance, will be recorded in a grievance register.		All grievances recorded in register	All working areas

Table 8.9-10: Community Health, Safety and Security – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
CHSS-1	CHSS	Worker and community health and safety	Construction/ Operations	PipeCo to develop and implement a Worker Code of Conduct, to include all workers employed by PipeCo.	PipeCo	Review of records	See CHSS-6
CHSS-2	Security – Conflict Management	Community engagement on project benefits	Construction/ Operations	Ensure PipeCo stakeholder messaging sets out project benefits.	EPC Contractor PipeCo	Review of records	
CHSS-3	Security – Conflict Management	Management of security providers	Construction/ Operations	Activities will be planned and implemented in line with good international industry practice related to security and human rights.	EPC Contractor PipeCo	Review of records	See CHSS-22
CHSS-4	Security – Conflict Management	Community security monitoring	Construction/ Operations	Coordinate with County and National police authorities in accordance with PipeCo security procedures.	EPC Contractor PipeCo	Review of records	
CHSS-5	Communicable diseases	Spread of diseases	Construction/ Operations	Develop and implement appropriate Project and Operational Workplace Health and Safety plans, and awareness training, that consider: ▪ Health Design Specifications of Project infrastructure; ▪ Project Medical Services; ▪ Medical Emergency Response Plan; ▪ Health Management Plans; ▪ Malaria and other Vector Control Management; ▪ HIV and TB Management; ▪ Vaccine-preventable Diseases Management; ▪ Infectious Disease Outbreak Management;	EPC Contractor PipeCo	Review of records	See CHSS-14, CHSS-23, CHSS-24, CHSS-48

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
				■ Non-Communicable Disease Management; ■ Drug and alcohol abuse (substance); ■ STIs; and ■ Designate construction camps as having “closed” status to prevent interactions between the workforce and local communities.			
CHSS-6	Communicable diseases	Spread of diseases	Construction/ Operations	PipeCo to develop and implement a Worker Code of Conduct, to include all workers employed by PipeCo, to help prevent the spread of disease.	PipeCo	Review of records	See CHSS-1
CHSS-7	Communicable diseases	Spread of diseases	Construction	Develop and/or maintain pandemic preparedness policies and plans for Project workforce.	EPC Contractor	Review of records	
CHSS-8	Communicable diseases	Vector management	Construction	Develop and maintain strict environmental controls around earth works and related construction activities to reduce risk of standing water and associated risks of communicable diseases.	EPC Contractor	Review of records	
CHSS-9	Communicable diseases	Vector management	Construction	Develop, implement and maintain a workplace malaria and vector control program that includes: ■ Vector control (environmental and chemical); ■ Awareness and education; ■ Bite prevention (including bed nets and insect repellent); ■ Chemoprophylaxis for non-immune workers; ■ Effective diagnosis and case management; and ■ Effective reporting/ stewardship of program interventions.	EPC Contractor	Review of records	

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
CHSS-10	Communicable diseases	Vector management	Construction	Develop and implement larval and source control management plans for both malaria and potential arboviral diseases.	EPC Contractor	Review of records	
CHSS-11	Communicable diseases	Spread of diseases	Construction	Periodic meetings with County health authorities to share information on health issues during construction.	EPC Contractor	Review of records	See CHSS-20
CHSS-12	Communicable diseases	Spread of diseases	Construction	Ensure appropriate pre-deployment health screenings in the recruitment procedure. Ensure screenings are relevant to expatriates and Kenyan workers.	EPC Contractor	Review of records	
CHSS-13	Communicable diseases	Spread of diseases	Construction	Ensure that designated rest stops for long distance truck drivers are identified and used.	EPC Contractor	Review of records	
CHSS-14	Communicable diseases	Spread of diseases	Construction	Appropriate medical facilities, water and sanitation services for workers available at worker camps.	EPC Contractor	Review of records	See CHSS-5
CHSS-15	Community Accidents and Injuries	Emergency response	Construction	Develop and implement an emergency response plan for Project-related incidents.	EPC Contractor	Review of records	
CHSS-16	Community Accidents and Injuries	Road safety	Construction	Develop and implement community road safety awareness initiatives in areas adjacent to Project working areas.	EPC Contractor	Review of records	See CHSS-17
CHSS-17	Community Accidents and Injuries	Road safety	Construction	Develop and implement a Project traffic and transport management plan that includes: ■ In-Vehicle Monitoring System (IVMS) in designated vehicles; ■ Driver training; ■ Speed limits; ■ Fitness to drive (fatigue policy); ■ Zero alcohol and drugs policy; ■ Drivers trained in emergency response procedures;	EPC Contractor	Review of records	See CHSS-16, CHSS-37, L-13, L-15

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
				■ Drivers to use approved and designated overnight stops; ■ Emergency response plan; ■ Daylight driving wherever possible (restrictions on night-time driving); ■ Community/wildlife crossing points clearly identified and signage installed; and ■ Policy on reversing and needs for trained and competent Traffic Marshal/ Banksman.			
CHSS-18	Community Accidents and Injuries	Worker and community interaction with wildlife	Construction	Develop and implement worker and community education and awareness initiatives relating to the risks of wildlife interaction during Project scrub clearing and construction activities.	EPC Contractor	Review of records	See MFFM-2
CHSS-19	Community Accidents and Injuries	Safety of working areas	Construction	Develop and implement adequate and appropriate site access control procedures, together with signs in local languages to be placed along active construction areas and lengths of open trench.	EPC Contractor	Review of records	See TAB-2, ES-6
CHSS-20	Community Accidents and Injuries	Community coordination	Construction	Develop and implement a community communication process. Include a process through which monthly meetings will be held with local community representatives, when construction is active in their area, to: ■ Update communities on the construction progress; ■ Communicate risks to the communities associated with construction; ■ Communicate the measures that have been, or will be, implemented to protect their health and safety (e.g., provision of safe access); ■ To receive comments, grievances or queries; and ■ To provide feedback on previous grievances	EPC Contractor	Review of records	See CHSS-11, CHSS-29, CHSS-30, CHSS-33, CHSS-38, PSI-3, PSI-5, EE-6

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
CHSS-21	Community Accidents and Injuries	Supply chain	Construction	A health, safety and environmental audit will be included in the project procurement process for local suppliers. Significant shortfalls to appropriate standards will rule out procurement of goods and services from such suppliers.	EPC Contractor	Review of records	See EE-7
CHSS-22	Community Accidents and Injuries	Security providers	Construction	Due diligence will be applied to selecting private security providers, rules of engagement will be devised. Performance will be monitored and audited periodically. Activities will be planned and implemented in line with good international industry practice related to security and human rights.	EPC Contractor	Review of records	See CHSS-3
CHSS-23	Occupational Health and Safety	Worker health and safety	Construction	Develop and implement occupational health and safety training programmes for Project workers that are culturally and linguistically appropriate	EPC Contractor	Review of records	See CHSS-5
CHSS-24	Occupational Health and Safety	Worker health and safety	Construction	Develop an effective occupational health recording, reporting and monitoring system for Project workers	EPC Contractor	Review of records	See CHSS-5
CHSS-25	Occupational Health and Safety	Worker health and safety	Construction	Ensure job-specific risk assessments are undertaken.	EPC Contractor	Review of records	
CHSS-26	Occupational Health and Safety	Worker conditions of employment	Construction	Develop and implement labour management plan.	EPC Contractor	Review of records	
CHSS-27	Occupational Health and Safety	Site safety	Construction	All activities within RoW clearly delineated by topsoil stockpile on one boundary, and pipe string or excavated trench spoil mound on opposite boundary. Outside working hours, equipment stored along RoW to be secured by provision of site security.	EPC Contractor	Review of records	See SG-18

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
CHSS-28	Community Health and safety	Site safety	Construction	Access routes/crossing points across the pipeline RoW during construction activities are identified, made safe and clearly signposted.	EPC Contractor	Review of records	
CHSS-29	Community Health and safety	Community coordination	Construction	Community relations staff to provide regular updates to local communities about potential Project hazards and changing activities during construction activities.	EPC Contractor	Review of records	See CHSS-20
CHSS-30	Community Health and safety	Community coordination	Construction	Prior notice given to all adjacent communities for all construction activities in an area.	EPC Contractor	Review of records	See CHSS-20
CHSS-31	Community Health and safety	Air quality	Construction	Verify identified air quality mitigation is implemented and monitoring ambient air quality during construction.	EPC Contractor	Review of records Site inspections	See AQ-1 to AQ-9, AQM-1 to AQM-5
CHSS-32	Environmental health determinants	Water management	Construction	Develop and implement site-specific water management plans as part of the CEMP to avoid project water use impacting on the local population's water supply.	EPC Contractor	Review of records Site inspections	See WR-27, ES-9
CHSS-33	Environmental health determinants	Community coordination	Construction	Implementation of a Grievance Management Procedure and maintain effective communication procedures, enabling the recording and follow up of complaints related to Project activities which could contribute to air quality, water quality and quantity, visual and noise exposure.	EPC Contractor	Review of Grievance Management Procedure Records	See LV-3, CHSS-20, L-7, L-16
CHSS-34	Environmental health determinants	Supply chain	Construction	Ensure that a health, safety, social and environmental assessment based on appropriate standards and national regulations will be included in the project procurement process for primary contractors and suppliers.	EPC Contractor	Review of records	

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
CHSS-35	Environmental health determinants	Vulnerable water resources	Construction	As part of the development and implementation of site-specific water management plans, ensure more frequent monitoring of vulnerable community water sources in vulnerable and marginalised communities during project activities that could affect such water supplies.	EPC Contractor	Review of records	See WRM-1, WRM-2, WR-18, WR-27
CHSS-36	Environmental health determinants	Hazardous materials	Construction	Ensure appropriate procedures in place for the procurement, storage, handling and disposal of hazardous chemical substances.	EPC Contractor	Review of records	See SG-1, SG-8
CHSS-37	Environmental health determinants	Vehicle speed	Construction	Control vehicle speeds on loose surface roads to reduce dust generation.	EPC Contractor	Review of records Site inspections	See AQ-2, AQ-8, CHSS-17
CHSS-38	Environmental health determinants	Blasting and community coordination	Construction	Develop and implement procedures to inform local communities prior to any blasting activities.	EPC Contractor	Review of records Site inspections	See CHSS-20
CHSS-39	Environmental health determinants	Water abstraction and water users	Construction	A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates.	EPC Contractor	Review of records Site inspections	See WR-18, WR-27, PSI-8, L-5, L-21, ES-9
CHSS-40	Environmental health determinants	Sediment management	Construction	Sediment management procedures to be developed and implemented to minimise the risk of contamination of domestic water sources.	EPC Contractor	Review of records Site inspections	See WR-1, WR-22, WR-23, WR-24, MFF-3, L-19

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
CHSS-41	Environmental health determinants	Water abstraction and water users	Construction	Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures. Hydrotest water abstraction and disposal to avoid/minimise impacts to local water users.	EPC Contractor	Review of records Site inspections	See WR-27, L-20, ES-23
CHSS-42	Environmental health determinants	Community engagement in environmental monitoring	Construction	If considered appropriate, either to address risks identified by the EPC Contractor and/or PipeCo, or to address concerns raised by local stakeholders, participatory environmental monitoring of relevant parameters will be undertaken in conjunction with affected communities.	EPC Contractor	Review of records	See L-6
CHSS-43	Infrastructure management	Site selection for Project facilities	Construction	Ensure site selection for construction-phase Project infrastructure considers potential community health impacts.	EPC Contractor	Review of records Site inspections	
CHSS-44	Infrastructure management	Worker and community health and safety	Construction	Ensure that the design of all construction-phase Project facilities consider the development of adequate and appropriate sewerage treatment facilities (for the management of sewerage and wastewater generated by the Project.	EPC Contractor	Review of records Site inspections	
CHSS-45	Infrastructure management	Management of water at Project facilities	Construction	Develop, implement and monitor processes to ensure that there is sound management of water resources to avoid wastage and leakage of water on all Project construction sites. Ensure that processes can accommodate expected ramp-up of required resources.	EPC Contractor	Review of records Site inspections	
CHSS-46	Infrastructure management	Management of waste at Project facilities	Construction	Develop, implement and monitor effective waste management processes that addresses all waste streams generated by the Project (including contractors) and reduces the risk of ground and surface water	EPC Contractor	Review of records Site inspections	

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
				contamination. Ensure that processes can accommodate expected ramp-up during the construction phase.			
CHSS-47	Infrastructure management	Worker awareness of workplace hygiene	Construction	Ensure workers are appropriately trained in water and waste management.	EPC Contractor	Review of records	
CHSS-48	Infrastructure management	Vector management	Construction	Ensure that vector management on all project sites (camps and construction) align with national vector control programmes and strategies.	EPC Contractor	Review of records	See CHSS-5
CHSS-49	Project induced in-migration	Influx management	Construction	When camp locations are finalised, undertake a social risk assessment and if required, develop a site-specific Influx Management Plan.	EPC Contractor	Review of records Site inspections	
CHSS-50	Project induced in-migration	Worker and community health and safety	Construction	Evaluate supporting the development and implementation of monitoring systems that track population influx.	EPC Contractor	Review of records Site inspections	
CHSS-51	Project induced in-migration	Worker and community health and safety	Construction	Preferential local recruitment of non-skilled workers and employment of local/regional workforce as outlined in Project local content plans, to help manage impacts on communicable diseases and other influx related impacts on community health.	EPC Contractor	Review of records	See PSI-4EE-4
CHSS-52	Project induced in-migration	Worker and community health and safety	Construction	Implement employment policy forbidding informal labour hire and no "at the gate/camp" hiring to help manage impacts on communicable diseases and other influx related impacts on community health.	EPC Contractor	Review of records	See PSI-1, ES-8

ID	Topic/Aspect	Impact	Project Phase	Control Description	Responsible Party	Means of Verification	Comments
CHSS-53	Project induced in-migration	Worker and community health and safety	Construction	Advertising of recruitment and hiring procedures, together with jobs specifications and requirements, to help manage influx which could put pressure on community health.	EPC Contractor	Review of records	See PSI-6
CHSS-54	Project induced in-migration	Worker and community health and safety	Construction	All non-local workers to be housed in designated accommodation camps except where local impacts can be demonstrated to be negligible, to help manage influx related impacts on community health.	EPC Contractor	Review of records	See PSI-7, ES-7
CHSS-55	Project induced in-migration	Worker health facilities	Construction	Plan and design an appropriate site based medical service to cater for most health-related conditions for the workforce so that referral into the public health sector is not required.	EPC Contractor	Review of records	
CHSS-56	Project induced in-migration	Worker health facilities	Construction	Ensure hiring of human resources required for the Project medical services considers the potential impacts on the local, regional and national public health sector.	EPC Contractor	Review of records	
ID	**Topic/Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
CHSSM-1	CHSS	General CHSS management	Construction/ Operations	Review of daily and weekly EHS reports.		Daily and weekly	All working locations
CHSSM-2	CHSS	Spread of diseases	Construction/ Operations	Monitor, record and report all cases of recordable diseases in the workforce.		Quarterly	All worker camps
CHSSM-3	CHSS	Worker and community health and safety	Construction/ Operations	Monitor, record and report all notifiable incidents and accidents in the workplace.		Daily and Monthly	All working sites

Table 8.9-11: Economics and Employment – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
EE-1	Economics and Employment	Local businesses	Construction	Local business development and skills training as outlined in Local Content Plan.	EPC Contractor	Review of records	
EE-2	Economics and Employment	Affected land users	Construction	A Livelihood Restoration Plan will be implemented which will outline livelihood support activities.	PipeCo	Review of records	See L-4 L-24, L-26, L-28, ES-2
EE-3	Economics and Employment	Local employment	Construction	Pre-mobilisation engagement with stakeholders to explain short duration of construction activities and limited time camps will remain in any one area.	EPC Contractor	Review of records	See EE-9, ES-5
EE-4	Employment and Training	Local employment	Construction	Recruitment processes to promote opportunities for employment of local and national personnel as outlined in the Local Content Plan including details of end of contract and demobilisation process.	EPC Contractor	Review of records	See PSI-4, CHSS-51
EE-5	Employment and Training	Local employment	Construction	Develop and implement a competency and skills development programme as outlined in the Local Content Plan.	EPC Contractor	Review of records	
EE-6	Employment and Training	Local employment	Construction	Develop a communication plan which promotes awareness in local communities of the labour requirements and recruitment approach.	EPC Contractor	Review of records	See CHSS-20

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
EE-7	Local Procurement	Local procurement	Construction	Goods and Services procurement processes that promote opportunities for local contractors as outlined in the Local Content Plan.	EPC Contractor	Review of records	See CHSS-21
EE-8	Tourism	Disturbance to local Conservancies	Construction	Consultation and notification of construction schedule and activities with adjacent conservancies and/or KWS prior to commencement of construction activities to allow time for planning alternate destinations for wildlife viewing.	EPC Contractor	Review of records	See L-1, L-17
EE-9	Tourism	Disturbance to tourism activities	Construction	Engagement during construction with stakeholders to explain short duration of construction activities and limited time camps will remain in any one area (including KWS and Conservancies).	EPC Contractor	Review of records	See EE-3, ES-5
EE-10	Tourism	Impacts to wildlife related businesses	Construction	Factor seasonal wildlife movements into construction planning to minimise negative impacts.	EPC Contractor	Review of records	
EE-11	Social determinants of health	Worker recruitment and non-discrimination	Construction	Develop and implement a transparent, non-discriminatory recruitment procedure that includes: ▪ Is transparent and open to all regardless of race, political opinion, colour, creed, sexuality or gender; ▪ a local recruitment strategy; ▪ considers social and cultural sensitivities; ▪ describes the employment criteria for the recruitment of professional, semi-skilled and unskilled labour; and	EPC Contractor	Review of records	

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigation	Responsible Party	Means of Verification	Comments
				■ prohibits discrimination or harassment of job applicants.			
ID	**Topic/ Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
EEM-1	Economics and employment	Local employment	Construction/ Operations	Maintenance of an employment database that tracks the point of origin of workers hired, duration of employment, and category of employment during the Project.		Monthly	All working sites
EEM-2	Economics and employment	Local employment	Construction/ Operations	Periodic roll-up of employment statistics measured in accordance with the Local Content Plan key performance indicators.		Quarterly	All working sites
EEM-3	Economics and employment	General impact management	Construction	Periodic review of implementation of plans and mitigations via monthly workforce reports.		Monthly	All working locations
EEM-4	Economics and employment	Local procurement	Construction	Maintenance of a procurement database that tracks the source of goods and services procured during the Project.		Quarterly	All working sites
EEM-5	Economics and employment	Local procurement	Construction	Periodic roll-up of procurement statistics measured in accordance with the Local Content Plan key performance indicators.		Quarterly	All working sites
EEM-6	Economics and employment	Local training	Construction	Maintenance of a local/national workforce training database as outlined in the Local Content Plan.		Quarterly	All working sites
EEM-7	Economics and employment	Local businesses/ industry	Construction	Track concerns expressed by communities or local/national contractor regarding through the Project's grievance mechanism.		Monthly	All working sites

Table 8.9-12: Livelihoods – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
L-1	Pastoralism	Disruption to pastoralists	Construction	Consultation and notification of construction schedule and activities to county and local leadership for dissemination to local communities prior to commencement of construction activities.	EPC Contractor	Review of records	See EE-8, L-17
L-2	Pastoralism	Disruption to pastoralists	Construction	The length and duration of open trench segments will be minimised at any given time.	EPC Contractor	Review of records	See TAB-7, ES-22
L-3	Pastoralism	Disruption to pastoralists	Construction	All work and disturbance will be restricted to the approved RoW, approved camp and laydown areas, and approved access roads.	EPC Contractor	Review of records	See CH-2
L-4	Pastoralism	Disruption to pastoralists	Construction	A Livelihood Restoration Plan will be implemented to ensure no adverse impacts to livelihoods at a community level.	PipeCo	Review of records	See EE-2, L-24, L-26, L-28, ES-2
L-5	Pastoralism	Disruption to pastoralists	Construction	A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities (pastoralists). Abstraction will be within location specific consented volumes and rates.	EPC Contractor	Review of records	See WR-18, PSI-8, CHSS-39, L-21, ES-9
L-6	Pastoralism	Disruption to pastoralists	Construction	If considered appropriate, either to address risks identified by the EPC Contractor and/or PipeCo, or to address concerns raised by local stakeholders, participatory environmental monitoring of relevant parameters will be undertaken in conjunction with affected communities.	EPC Contractor	Review of records	See CHSS-42

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
L-7	Pastoralism	Disruption to pastoralists	Construction/Operation	Implementation of a Grievance Management Procedure and maintain effective communication procedures, enabling the recording and follow up of complaints related to Project activities.	EPC Contractor	Review of Grievance Management Procedure records	See LV-3, CHSS-20, CHSS-33, L-16
L-8	Pastoralism	Disruption to pastoralists	Construction	Implementation of the Livelihoods Restoration Framework.	PipeCo	Review of records	See L-26, L-28
L-9	Livestock injuries	Disruption to pastoralists	Construction	The length of open trench will be minimised in all areas to limit disturbed areas which could impact pastoralist movement.	EPC Contractor	Review of records	See TAB-7
L-10	Livestock injuries	Disruption to pastoralists	Construction	All areas of open trench will have safety signs.	EPC Contractor	Review of records	
L-11	Livestock injuries	Disruption to pastoralists	Construction	Regular safety patrols will occur along construction areas and the open trench.	EPC Contractor	Review of records	
L-12	Livestock injuries	Disruption to pastoralists	Construction	Trenches will be provided with crawl boards/fauna ramps for animals (i.e. wildlife and livestock). Crossing points will be provided at regular intervals.	EPC Contractor	Review of records	See TAB-7
L-13	Livestock injuries	Disruption to pastoralists	Construction	Project traffic to comply with Project speed and safety requirements, including restrictions on night-time driving.	EPC Contractor	Review of records	See CHSS-17
L-14	Livestock injuries	Disruption to pastoralists	Construction	To reduce interference with public traffic and transportation, the pipeline RoW will be used where practical and safe for the transportation of goods and equipment between storage yards and the working areas.	EPC Contractor	Review of records	

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
L-15	Livestock injuries	Disruption to pastoralists	Construction	Road safety will be managed through a traffic management plan.	EPC Contractor	Review of records	See CHSS-17
L-16	Fishing	Disruption to fishing	Construction	Implementation of a Grievance Management Procedure and maintain effective communication procedures, enabling the recording and follow up of complaints related to Project activities.	EPC Contractor	Review of Grievance Management Procedure records	See LV-3, CHSS-20, CHSS-33, L-7
L-17	Fishing	Disruption to fishing	Construction	Consultation and notification of construction schedule and activities to county and local leadership for dissemination to local communities prior to commencement of construction activities, to reduce disruption to fishing.	EPC Contractor	Review of records	See EE-8, L-1
L-18	Fishing	Disruption to fishing	Construction	Reinstatement of disturbed areas.	EPC Contractor	Review of records	
L-19	Fishing	Disruption to fishing	Construction	Sediment management procedures to be developed and implemented.	EPC Contractor	Review of records	See WR-1, WR-22, WR-23, WR-24, MFF-3, CHSS-40
L-20	Fishing	Disruption to fishing	Construction	Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures. Hydrotest water abstraction and disposal to avoid/minimise impacts to local water users.	EPC Contractor	Review of records	See WR-27, CHSS-41, ES-23

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
L-21	Fishing	Disruption to fishing	Construction	A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities (fishing). Abstraction will be within location specific consented volumes and rates.	EPC Contractor	Review of records	See WR-18, PSI-8, CHSS-39, L-5, ES-9
L-22	Fishing	Disruption to fishing	Construction	Pipeline construction at river crossings will occur in the dry season	EPC Contractor	Review of records	See WR-25
L-23	Fishing	Disruption to fishing	Construction	Undertake open cut river crossings at times of minimal flow with method statements reviewed and approved by BO.	EPC Contractor	Review of records	See WR-25
L-24	Marine Resources	Disruption to fishing	Construction	Livelihood Restoration Plan that contributes to maintenance of marine fishing livelihoods, if applicable.	PipeCo	Review of records	See EE-2, L-4, L-26, L-28, ES-2
L-25	Agriculture	Disruption to agriculture	Construction	Land will be acquired, and landowners and land users compensated, by the National Land Commission under the terms of the Land Act	PipeCp	Review of records	
L-26	Agriculture	Disruption to agriculture	Construction	A Livelihood Restoration Plan will be implemented at a community level to ensure no adverse impacts to agriculture.	PipeCo	Review of records	See EE-2, , L-4, L-24, L-28, ES-2
L-27	Pastoralism	Disruption to pastoralists (permanent loss of beehives)	Construction	Replacement of immoveable traditional beehives that will be lost due to construction with new hives.	EPC Contractor	Review of records	

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
L-28	Pastoralism	Disruption to pastoralists	Operations	A Livelihood Restoration Plan will be implemented at a community level to ensure no adverse impacts to pastoralists.	PipeCo	Review of records	See EE-2, L-4, L-24, L-26, ES-2
L-29	Pastoralism	Disruption to pastoralists	Operations	A leak detection system will be implemented, and regular monitoring and inspection of the pipeline.	PipeCo	Review of records	
ID	**Topic/Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
LM-1	Livelihoods	Effectiveness of plans	Construction	Periodic review of implementation of plans and mitigations via monthly reports.		Monthly	All working locations

Table 8.9-13: Ecosystem Services – Mitigations, Implementation and Monitoring

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
ES-1	Grazing areas	Grazing land resource	Construction	Disturbed areas will be restored with natural regrowth of vegetation.	EPC Contractor	Review of records	See ES-14, ES-15, TAB-9
ES-2	Grazing areas	Grazing land resource	Construction	A Livelihood Restoration Plan will be implemented to ensure no adverse impacts to livelihoods at a community level.	PipeCo	Review of records	See EE-2, L-4 L-24, L-26, L-28L-28
ES-3	Grazing areas	Grazing land resource	Construction	Existing roads and the RoW will be utilised wherever possible to minimise the amount of new access roads that are required to be built.	EPC Contractor	Review of records	
ES-4	Grazing areas	Grazing land resource	Construction	Remove temporary Project tracks once construction activities have been completed.	EPC Contractor	Review of records	
ES-5	Grazing areas	Grazing land resource	Construction	Pre-mobilisation engagement with local communities to explain short duration of construction activities and limited time camps will remain in any one area.	EPC Contractor	Review of records	See EE-3, EE-9
ES-6	Grazing areas	Grazing land resource	Construction	Develop and implement adequate and appropriate site access control procedures, together with signs in local languages to be placed along active construction areas and lengths of open trench.	EPC Contractor	Review of records	See CHSS19, TAB-2, ES-6
ES-7	Grazing areas	Population influx puts pressure on grazing resources	Construction	All non-local workers to be housed in designated accommodation camps except where local impacts can be demonstrated to be negligible, to help reduce risk of influx putting pressure on grazing.	EPC Contractor	Review of records	See PSI-7, CHSS-54-

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
ES-8	Grazing areas	Population influx puts pressure on grazing resources	Construction	Implement employment policy forbidding informal labour hire and no "at the gate/camp" hiring to help reduce risk of influx putting pressure on grazing.	EPC Contractor	Review of records	See PSI-1, CHSS-52
ES-9	Water resources	Water abstraction decreases water availability	Construction	A pre-construction hydro-census will be undertaken specific to the area where abstractions are proposed, to fully understand likely receptors. Water abstraction locations will be selected to limit impacts on communities. Abstraction will be within location specific consented volumes and rates.	EPC Contractor	Review of records	See WR-18, PSI-8, CHSS-39, L-5, L-21
ES-10	Invasive Species	Invasive species	Construction	Develop and implement an Invasive Species Management Procedure, to include hygiene specifications for vehicles and cargo, site clearance and rehabilitation.	EPC Contractor	Review of records	See TAB-1
ES-11	Wildlife	Hunting and Fishing	Construction	A no hunting or fishing policy will be developed and implemented. Disturbance to the environment and natural resources will only be permitted when required for the specific purpose of the Project, e.g. vegetation clearance in the RoW prior to trenching.	EPC Contractor	Review of records	See MFF-2
ES-12	Cultural Values	Damage to cultural sites	Construction	Identified sacred sites close to construction/operation areas will be protected through demarcation of no-go areas for vehicles and Project personnel.	EPC Contractor	Review of records	See CH-14

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
ES-13	Cultural Values	Damage to cultural sites	Construction	Consultation and engagement with local communities prior to commencement of construction activities to identify any cultural heritage sites within the RoW, which may be avoided by micro-routing where appropriate. Where encountered and avoidance is not possible, relocation of sacred site, resource or activity if technically feasible, in consultation with local communities.	EPC Contractor	Review of records	See CH-12
ES-14	Land use	Farmland	Construction	Once the pipeline is installed, areas are to be rehabilitated as soon as possible based on a Site Restoration Procedure; e.g. agricultural lands that were disrupted will be reinstated so that farmers may once again start to cultivate them.	EPC Contractor	Review of records Site Inspection	See TAB-9
ES-15	Land use	Natural land	Construction	In areas of natural land use (i.e. non-cultivated), land will be allowed to naturally revert to its pre-disturbed state.	EPC Contractor	Site inspection	ES-1
ES-16	Resource management	Contamination of resources	Construction	The pipeline and its facilities will be designed to comply with all applicable Kenyan Laws and Regulations, and applicable international design codes and HSE standards, as well as international good practice – specifically the World Bank Group EHS Guidelines and IFC Performance Standards. These include, but are not limited to, the following: ▪ Works within watercourses shall not take place without consent from NEMA (as per the EMCA (Water Quality) Regulations, 2006). ▪ Defects in the pipeline will be identified and rectified through use of QA/QC procedures and testing to reduce the potential for leaks in	EPC Contractor PipeCo	Review of records	See WR-4

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
				accordance with Project specifications and in line with the guidelines provided in IFC[2].			
ES-17	Resource Management	Contamination of resources by poor waste management practices	Construction	All construction waste will be handled, stored and managed in accordance with the Waste Management section of the CEMP.	EPC Contractor	Review of records Site inspections	See WR-26, SG-19
ES-18	Resource management	Impact to water resources by abstraction and discharge of hydrotest water	Construction	Minimisation and reuse of water and materials where feasible to avoid unnecessary impacts on resources that support priority ecosystem services (e.g. the pipeline hydrotesting procedure will aim to store and reuse water to reduce volume required from water abstractions).	EPC Contractor	Review of records	See WR-28
ES-19	Resource management	Erosion of riverbeds	Construction	Construction activities in perennial rivers and wetland areas will take place during the dry seasons when flows and levels in watercourses are low; timings of constructions activities will be selected based on when the watercourse is at its lowest anticipated level.	EPC Contractor	Review of records Site inspections	See WR-25, SG-15, SG-16
ES-20	Water Resource management	Contamination of water resources by pipeline construction	Construction	The use of biocides and corrosion inhibitors in hydrotest water will be minimised and avoided where possible to limit potential sources of contamination.	EPC Contractor	Review of records	See WR-29
ES-21	Cultural Heritage	Disturbance to pastoral land	Construction	Existing road infrastructure has been identified for use where possible to reduce the need for creation of new roads and minimise area which would have	EPC Contractor	Review of records	See CH-4

[2] International Finance Corporation, 2007. Environmental, Health and Safety Guidelines for Onshore Oil and Gas development

ID	Topic/Aspect	Impact	Project Phase	ESIA Mitigations	Responsible Party	Means of Verification	Comments
				led to increased land take (e.g. of pasture used by livestock).		Site Inspection	
ES-22	Pastoralism	Disruption to pastoralists	Construction	The length and duration of open trench segments will be minimised at any given time, minimising disruption to local communities and wildlife.	EPC Contractor	Review of records	See TAB-7, L-2
ES-23	Environmental health determinants	Water abstraction and water users	Construction	Hydrotest water will be obtained and discharged in accordance with applicable regulations at locations agreed with the Regulator. Disposal to land will incorporate erosion control measures. Hydrotest water abstraction and disposal to avoid/minimise impacts to local water users.	EPC Contractor	Review of records Site inspection	See WR-27, L-20, CHSS-32, CHSS-35, CHSS-39, CHSS-41
ES-24	Resource Management	Impact to resources by pipeline leaks	Operations	The pipeline will be regularly inspected, and maintenance programmes will be followed to maintain pipeline integrity to reduce the potential to leaks that could otherwise lead to soil or water contamination.	PipeCo	Review of records Site inspections	See WR-31, SG-22
ES-25	Water Resource Management	Contamination of water resources by waste materials	Operations	Operational waste will be handled in a way that follows environmental legislative requirements and reduces pollution potential.	PipeCo	Review of records	See SG-23
ID	**Topic/Activity**	**Impact**	**Project Phase**	**Monitoring Measures**		**Periodicity**	**Location**
ESM-1	Ecosystem Services	Effectiveness of plans	Construction	Periodic review of implementation of plans and mitigations via monthly reports		Monthly	All working locations

8.10 Waste Management Framework

8.10.1 Introduction

Waste materials will be generated by the construction and to a much lesser extent, operation of the Project. This will include both non-hazardous and hazardous wastes. A waste management study was undertaken by the FEED Contractor in 2017 and provides key information on waste management. Based on this information, a preliminary review of existing waste management facilities has been undertaken to determine the ability of exiting waste management facilities to handle waste generated by the Project. This information will be updated and developed in more detail as part of the EPC process.

8.10.2 Construction Waste

Construction waste will be generated from a range of activities including:

- Preparation and transportation of pipe and other equipment and facilities;
- Clearance of vegetation within pipeline RoW;
- Pipeline installation through cut and fill trenching;
- Pipeline welding and finishing;
- Pre-commissioning and commissioning, including hydrotesting;
- Construction camps for pipeline workers; and
- Offices, storage and other facilities.

Initial estimates of waste streams and waste volumes have been prepared as part of the Pre-FEED process. This is described in the Project Description (Section 4). These volumes will be further refined during the detailed design process.

Construction waste will comprise:

- Earthworks waste (e.g. debris, rock, dust, stockpiles, vegetative matter);
- Metal waste e.g. (pipe cuttings and filings, machinery parts, building material);
- General solid waste (e.g. domestic refuse, packaging);
- Wastewater (e.g. domestic use in camps, industrial use in construction areas and hydrotesting); and
- Hazardous waste (e.g. use of pipeline treatment and coating chemicals, used oil and healthcare waste).

Operational waste will comprise small quantities:

- General solid waste (e.g. office wastes, packaging, domestic and industrial refuse etc);
- Sanitary wastewater (e.g. grey and black water from operation facilities); and
- Hazardous waste (e.g. used oil and empty chemical cans).

8.10.3 Sources of Impact

The potential impacts associated with waste, if poorly managed, include:

- Contamination of soil and water resources;
- Resource wastage due to poor segregation of recyclable wastes;

- Visual impact/unsightly areas;
- Impact to animals (if allowed to scavenge);
- Human health impacts (if the site is either unsecure or hazardous wastes are not properly contained); and
- Air emissions from the waste disposal activities.

Wastes from campsite have the potential for spiral effects such as attraction of wild animals and resultant conflicts with neighbouring communities, contamination of nearby water sources and impacts on community livelihoods, security and health.

8.10.4 Waste Management Strategy

The Waste Management Strategy defined by the FEED process is based on the waste management hierarchy as follow:

- Minimise waste produced at the site;
- Reuse or recycle any waste generated at the site, for either on-site use of off-site local communities' use;
- Waste which cannot be reused or recycled will be relocated to Project owned (or controlled) waste handling facilities; and
- Waste which cannot be handled and disposed of using Project owned (or controlled) waste handling facilities, will be removed from the site and transported to appropriately licenced third-party waste handling facilities.

Anticipated waste streams have been evaluated against the requirements of the Environmental Management and Coordination (Waste Management) Regulations 2006 and the disposal methods and options have been identified in this ESIA Report. The current understanding of waste streams, which will be developed through the EPC process, can be summarised as follows:

During construction:

- Earthworks waste:
  - Pipeline – minimal, only in rocky areas and will be mixed and spread within the RoW; and
  - Stations – neutral, no waste anticipated.
- Metal waste:
  - Pipeline - 260 - 425 tonnes of steel.
- General solid waste:
  - Paper, plastics, non-recyclable materials, food waste and other non-hazardous waste materials:
    - 460 kg/day/camp (construction accommodation camps and compounds): and
    - 160 kg/day (offices).
- General construction waste:
  - Sacks/Plastic bags, 2,500 - 3,000 No.;
  - Wooden pallets, approximately 4,000 No.;

  - Cable drums (wooden), approximately 800 No.;
  - Pipe end caps/bevel protectors, approximately 135,000 No.; and
  - Grit (Garnet) from blasting operations, approximately 2,000 tonnes.
- Wastewater:
  - Sanitary wastewater:
    - Sewage estimated, based on 100 ltr/person/day; and
    - Grey water estimated, based on 200 ltr/person/day.
- Hazardous waste will include:
  - Waste oils and filters from mobile plant and equipment and generators;
  - Oily rags;
  - Waste solvents;
  - Used chemical drums;
  - Used lubricants; and
  - Paint waste and hot insulation waste (both used for tanks, vessels and piping at stations).
- Pipeline:
  - Waste epoxy (approx. 30 to 40 l/km), approximately 25 to 30 m³;
  - Waste PUF (approx. 45 kg/km), approximately 37 tonnes; and
  - Epoxy containers (200 l drums), with residual epoxy, approximately 1000 to 1500 drums.

Operation

- Small quantities of general solid waste, sanitary wastewater and hazardous waste, mainly at manned stations and the Lamu Marine Terminal.

Based on the FEED process, the above key waste streams and volumes have been identified together with appropriate treatment methods for each waste stream. This information will be used in the EPC process to determine final details related to the use and upgrading of existing waste management facilities and the development of new facilities where existing facilities are not adequate.

Where a waste disposal facility/landfill is not present within close proximity of significant waste generator locations (e.g. main accommodation camps), or of sufficient size to handle to additional quantity, a Project owned (or controlled) and NEMA licenced disposal facility may be set up, where required, along the pipeline route.

When final locations have been identified and the risk assessment and consultation processes set out have been implemented, approval for the construction and use of any additional waste management facilities required will be sought from NEMA and other appropriate authorities as a Variation under the EIA Licence for the project.

Waste Management Plans will entail clear directives on monitoring and auditing to ensure compliance in line with national standards as a minimum. Personnel employed for the Project will also complete a formal waste management awareness training at on-boarding and periodically throughout the Project cycle. Such training will focus on waste segregation, recycling, storage and transfer, as well as monitoring.

8.10.5 Construction Camps

This ESIA recognises the fact that waste management is a critical function during the construction phase of the project. It also recognises that pinpoint locations for construction teams (i.e. construction camps) will greatly influence how waste management is carried out.

The drive of this assessment is in providing and overarching approach to various facets of impacts while management plans developed during and through contractor on-boarding (with approval sought from NEMA) will form the enforceable templates for compliance.

The proposed waste management approach observes generic wastes from similar undertakings and activities in similar environments. It then provides a broad synopsis of wastes expected from construction activities and the minimum requirements for best practice as well as the national legislations regarding waste management.

In this case the report looks at sewerage, solid wastes, liquid wastes and hazardous wastes. Waste management will be a significant concern where construction camps and hydrotesting are concerned. Specific campsite procedures will observe waste management protocols and will be approved by NEMA together with camp development and operation plans before implementation. They will be reflective of appointed sites, technologies adopted, project commitments and standards set by law.

8.11 Emergency Response Framework

The approach to emergency, accidental and unplanned events is set out in Section 7.14. As part of the EPC process, the EPC Contractor will build on the assessment set out in this ESIA and define emergency response procedures for construction and commissioning involving the full range of scenarios for both terrestrial and marine locations.

This Framework provides protocols to manage risks associated to emergency, accidental and unplanned events including fires, oil releases, natural disasters, security issues, and medical cases among others. As such, management procedures under other plans such as the Construction Environmental Management Plan (CEMP) as well as the Operations Environmental Management Plan (OEMP) will be designed, at determined thresholds, to trigger the Emergency Preparedness and Response Plan.

The EPC Contractor will also work with PipeCo and other relevant stakeholders (Kenya Ports Authority, Kenya Maritime Authority, Department of Fisheries, the Oil Spill Mutual Aid Group (OSMAG) etc) to define further the approach to responding to marine spills and uncontained release scenarios. Based on the oil spill dispersion modelling, this will include the pre-positioning of sufficient spill response equipment (booms, boats, trained staff) to enable a reasonable worst-case scenario spill event to be contained sufficiently quickly to minimise impacts to a defined level.

The Project will be able to draw on national, regional and international oil spill response resources to support its initial containment response.

Emergency Response Plans developed will include but not necessarily be limited to;

- Detailed response checklists for the various possible emergency conditions/scenarios;
- Appointed response teams clearly identifying, roles, organisation, deployment and escalation procedures for decision making;
- Operation centre with appropriate equipment available;
- Personnel and, where necessary, public evacuation procedures;
- Notification/communication techniques and procedures; and

- Documentation and review procedures.

The site-specific procedures and plans will feed into the overall Emergency Preparedness Response Plan which will be the responsibility of PipeCo.

8.12 Project Decommissioning Framework

8.12.1 Introduction

The LLCOP Project has a design life of 25 years. At this stage it is not possible to anticipate the situation at that time. This ESIA presumes that within this period both the recipient environment as well as technology available then will significantly be different to present day. As a result, it is not possible to set out a detailed decommissioning plan. The most effective approach to this issue is to set out the broad principles that, at this time, are anticipated to be adopted or relevant to Project closure and decommissioning.

8.12.2 Decommissioning Philosophy

In line with good international industry practice, the following Decommissioning Philosophy will be adopted:

- Five years prior to the planned End of Project, a Decommissioning Plan will be developed for agreement with the appropriate authorities.
- All underground equipment (pipeline) will be emptied of oil product, left in a clean state and left in situ unless good practice at the time dictates otherwise;
- All above ground infrastructure (stations) will be evaluated for dismantling, removal and rehabilitation. This will be undertaken in consultation with Affected Communities and County Government to identify any facilities than can be safely handed over for community use; and
- All marine facilities will be emptied of oil product and removed from the site for safe disposal.

The Decommissioning Plan will be submitted to NEMA and other relevant government authorities for review and approval prior to implementation.

9.0 CONCLUSIONS

The ESIA has systematically reviewed and evaluated the potential impacts on existing environmental and social receptors within the Project's Area of Influence (AoI), over the lifetime of the Project. The assessment was undertaken in accordance with Kenyan legislative, regulatory and policy requirements, including the Environmental (Impact Assessment and Audit) Regulations (2003), as well as relevant Good International Industry Practice (GIIP).

The ESIA has evaluated potential impacts on air quality, noise and vibration, water resources, soils, geology and geohazards, terrestrial, aquatic and marine ecology, landscape and visual, cultural heritage, socio-economics and ecosystem services. The ESIA has identified that adverse impacts brought about by the Project are largely manifested during the construction phase and are associated with water abstraction and discharge, groundworks, construction and installation. Impacts during normal operation, once the pipeline, above-ground stations and associated infrastructure are *in-situ* are greatly reduced.

Impacts to a number of important receptors were considered to be moderate and major pre-mitigation during the construction and operation of the Project, however, with the adoption of additional mitigation measures identified in the ESIA, these were all reduced to either **Minor** or **Negligible**. This is with the exception of some residual **Moderate** impacts identified for the construction phase including those associated with:

- The potential for communicable disease transmission;
- The potential for increases in accidents and injuries due to the construction activities and increased traffic during construction;
- Temporary disturbance of tourism activities and wildlife due to construction activities;
- Local price inflation; and
- Visual impacts from Station 7 at Archer's Post (during construction and operation).

For impacts to the socio-economic environment associated with the Project, there are a number of potential positive impacts, including a number of initially negative impacts which can, with the proposed mitigation and benefit enhancement measures in place, result in widespread benefits. The Project intends to target construction employment opportunities to communities within the Project's AoI and provide the necessary pre-employment training to ensure local uptake of jobs. In addition, livelihood restoration and enhancement measures will be developed in consultation with local leadership. The Project also has the potential to contribute positively to community health through health awareness and disease prevention programs associated with its workforce.

There is also the potential for emergency, accidental and non-routine events to occur, with the risk of unplanned events transpiring dependant on the location, circumstances and probability of occurrence. The most significant risk relates to potential oil spills entering marine environment from spills (be they minor or major) from the VLCC moored at Berth 3 in Lamu Port; however, with appropriate mitigation controls in place, impacts in the event of a spill will be minimised.

A number of other major developments have been identified within the Project AoI that have the potential to generate cumulative impacts with the Project. As identified in this ESIA, cumulative impacts associated with the LAPSSET Infrastructure Corridor present the greatest cumulative impacts and these are generally expected to occur during the operation phase.

Lamu County is likely to experience an economic boost due to beneficial cumulative impacts from employment, infrastructure and purchasing associated with the Project and LAPSSET component facilities. Significant adverse cumulative impacts relate to the use and operation of Lamu Port and potential implications on the marine environment associated with marine traffic and the risk of oil spills, as well as additional adverse cumulative impacts anticipated on tourism in the Lamu area. However, appropriate mitigation measures and management procedures should be in place to prevent the occurrence of significant residual cumulative impacts. Ultimately, the Project will endeavour to engage with other developers concerned as well as with the relevant authorities, in order to work concurrently towards the minimisation of the cumulative impacts identified in this ESIA.

In accordance with Kenyan legislation, an outline Environmental and Social Management Plan has been developed for the Project. An ESMP compiles a set of management, mitigation and monitoring measures to be taken pre-construction, during construction (groundworks, construction and installation), operation (including maintenance) and decommissioning to manage key potential environmental and social impacts identified in this ESIA. An ESMS will be developed for the life of the Project, under which each of the ESMPs will be implemented.

This ESIA has development a number of framework management plans as part of the ESMP, which will be further evolved into formal management plans when the PipeCo is established, the EPC Contractors are appointed and prior to commencement of the Project. The management plans which will be ‘living documents’ that will need to be updated as required throughout operations and as part of the ESMS. There will be a continual effort to enhance and further refine an understanding of the environmental and social benefits and concerns associated with the Project throughout construction and operation.

As with the ESMPs, the Stakeholder Engagement Plan (developed as part of this ESIA) for the Project will continue to evolve and will be the framework for stakeholder engagement and communication through construction, operation and eventual decommissioning of the project. The Project will develop a grievance mechanism for all stakeholders and the EPC contractor will similarly develop a grievance mechanism which will be applicable for all contractor and sub-contractor employees engaged by the project.

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DECLARATION

The Environmental and Social Impact Assessment (ESIA) Report for the Lokichar to Lamu Crude Oil Pipeline (LLCOP) Project is submitted by Environnementalistes Sans Frontieres (ESF) Consultants, a firm of Environmental Management Experts, NEMA Registration Number 0204 and Golder Associates (UK). To our knowledge, all the information contained in this report is accurate and a true reflection of the planned activities in the proposed project.

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