

6 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

6.1 Introduction

This section describes the existing environmental and social baseline conditions of the VECs for the Tilenga feeder pipeline.

Each of the VEC subsections includes:

- a description of the AOI
- the existing baseline condition of the VEC, including:
 - trends in condition
 - ecosystem services provided
 - sensitivity rankings
- key considerations.

The subsections summarise the information in the baseline reports for each VEC. For additional information, including methods, see Appendix A.

6.2 VECs

The VECs that have been selected are described below, along with the rationale for their selection. For the process of VEC selection, see Section 5.3.

VEC	Description
Biodiversity	
Habitats of conservation importance (terrestrial and aquatic)	Habitats of conservation importance include habitats within the project AOI that are not common or support species that are not common and include ecological assemblages that are unique, relict, remnant, have high bioquality or support International Union for Conservation of Nature (IUCN) critically endangered, endangered, vulnerable, migratory, congregatory, endemic or range restricted species.
Flora and fauna species of conservation importance (terrestrial and aquatic)	Flora and fauna species of conservation importance within the project AOI include species that are IUCN (or national equivalent) critically endangered, endangered, vulnerable, protected, keystone migratory, congregatory, endemic or range restricted species.
Legally protected, internationally or nationally recognised onshore areas	Areas that are internationally or nationally recognised or legally protected within the pipeline AOI such as national parks; wildlife, forest and game reserves; Ramsar sites, key biodiversity areas; important bird areas; endemic bird areas; wildlife management areas and Alliance for Zero Extinction sites.

VEC	Description
Physical Environment	
Soil	The layers (soil horizons) above the bedrock are composed of weathered mineral materials, organic material, air and water. Soils support plant growth, agriculture and biodiversity by providing important ecosystem services, such as soil formation, nutrient cycling and primary production.
Surface water	Ephemeral and permanent surface watercourses and waterbodies can be used for domestic, agricultural and industrial supplies and for hydropower generation. The term “ephemeral” is considered to cover those watercourses with seasonal flow and those with flow just following rainfall.
Groundwater	Aquifers and vulnerable groundwater used for abstraction or providing important ecosystem services, such as water purification. Groundwater is an important source of irrigation and potable water. Groundwater bodies can also have a connection with, and hence influence on, surface water.
Air quality	The air quality, including dust within the airsheds of: <ul style="list-style-type: none"> • construction facilities (main camp and pipe yard, roads used during construction) • construction work on the pipeline.
Acoustic	The health and wellbeing of humans and fauna is associated with the ambient sound level in the area of their inhabitancy.
Socio-Economic and Health	
Economy	Direct and indirect employment, contracting and procurement, workforce capability and skills, and taxes
Local economy (nonland-based livelihoods)	Formal and informal (nonland based) economic activities and local economic conditions
Land-based livelihoods	Land-based livelihood activities include crop farming, livestock rearing, mining and harvesting of natural resources (wild plants and game).
River, lake -based livelihoods	Fishing and related economic activities including commercial and artisanal fishing. This VEC focuses on negative displacement impacts.
Land and property	Land and property or housing that may be affected by the pipeline through permanent acquisition or change in value
Workers' health, safety and welfare	Workforce health, safety, human rights and welfare
Social infrastructure and services	Physical and social infrastructure such as access to utilities, waste services, roads
Community health	Includes community health status and, access to health services, water and sanitation
Community safety, security and welfare	Includes personal safety affected by the pipeline from traffic and road use, and security affected by presence of workers, new populations, and security arrangements. Welfare includes social cohesion and community stability.

VEC	Description
Tangible and intangible cultural heritage	Tangible cultural heritage sites and intangible cultural heritage valued by local communities including cultures and traditions. This also includes any species of cultural or traditional importance not captured by the assessment of potential effects on ecosystem services, for example, species valued for their part in oral history or traditions, rather than physical (hunting and gathering) value to the community.
Climate	This VEC includes the global climate, including energy use, greenhouse gas emissions, carbon storage and sequestration, and local and global climate regulation

6.3 Area of Influence

To identify, assess and manage potential environmental and social impacts, the potential area of influence (AOI) of the pipeline has been defined.

International Finance Corporation (IFC) Performance Standard (PS) 1, paragraph 8 (IFC 2012), defines the area of influence as encompassing the following components:

- “The area likely to be affected by:
 - (i) the project and the client’s activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project
 - (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location, or
 - (iii) indirect project impacts on biodiversity or on ecosystem services upon which affected communities’ livelihoods are dependent.
- Associated facilities, which are facilities that are not funded as part of the project, would not have been constructed or expanded if the project did not exist and without which the project would not be viable.
- Cumulative impacts that result from the incremental impact, on areas or resources used or directly affected by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.”

The whole pipeline AOI is a combination of the AOIs for each VEC. The criteria for defining the AOI for each VEC takes account of the following, the:

- permanent footprint, associated with the operational right-of-way (RoW) for the pipeline and the other operational facilities such as the above ground installations
- temporary footprint associated with construction and other sites, such as borrow pits and waste management facilities, required to construct the pipeline
- area outside the footprint potentially affected by direct impacts such as noise and dust
- area potentially affected by indirect impacts such as villages and towns affected by in-migration of contractor workers.
- area potentially affected by unplanned events, such as oil spills during construction and operation

- area used for assessing cumulative impacts, which is defined as the areas where AOIs for the Tilenga feeder pipeline and sources of cumulative impact VECs experience overlapping impacts, spatially and temporarily, from past, present and future activities, including from associated facilities and third-party projects

The AOI for each VEC is defined in the following VEC subsections.

The AOI is different for the construction, operation and decommissioning phases of the projects. The AOI is different for each VEC.

The AOI is defined on a precautionary, realistic worst-case basis where there is uncertainty, with any assumptions clearly stated.

The study area for each VEC takes account of the AOI but may be larger than the AOI to understand the context in which the VECs exist, including trends and pressures on the condition of the VECs. A broader region is a study area larger than the AOI to provide regional context for biodiversity, geology and soils, economy and greenhouse gas emissions. The study areas are defined in the baseline reports (see Appendix A).

6.4 Environmental and Social Baseline (Including Ecosystem Services)

6.4.1 Biodiversity

6.4.1.1 Critical Habitat Assessment

A critical habitat assessment has been undertaken for the project in accordance with International Finance Corporation (IFC) Performance Standard 6 (PS6): Biodiversity Conservation and Sustainable Management of Living Natural Resources and the accompanying Guidance Note (IFC 2012). Critical habitats are areas with high biodiversity value that may include one or more of the following values:

- Criterion 1: habitat of significant importance to critically endangered and/or endangered species
- Criterion 2: habitat of significant importance to endemic and/or restricted-range species
- Criterion 3: habitat supporting globally significant concentrations of migratory and/or congregatory species
- Criterion 4: highly threatened and/or unique ecosystems
- Criterion 5: areas associated with key evolutionary processes.

The critical habitat assessment has been developed using information and data provided from baseline reports prepared for the ESIA detailing the presence of species from field surveys (Appendices A1–A4), stakeholder engagement and secondary data, and base layers of spatial data from a variety of sources. Appendix B summarises the results of the critical habitat assessment.

6.4.1.2 Legally Protected, Internationally or Nationally Recognised Areas

Introduction

This section describes the following:

- the AOI for legally protected and internationally or nationally recognised areas
- baseline conditions in terms of:
 - international recognised areas
 - legally protected areas
 - trends in condition and sensitivity to change
 - ecosystem services provided
 - sensitivity rankings
- key considerations.

Legally Protected Areas

The following legislation is relevant to the governing of protected areas within the pipeline area of influence (AOI):

- Constitution of the Republic of Uganda, 1995. Article 237 (2b): The government holds in trust for the people, and is required to protect, natural lakes, rivers, wetlands, forest reserves, game reserves, national parks and any land to be reserved for ecological or tourism purposes for the common good of all citizens
- National Forestry and Tree Planting Act, 2003: The Act provides for the conservation, sustainable management and development of trees and forests for the benefit of the people of Uganda
- National Environment Act, 1995. Ch. 153: The Act provides for sustainable management for the environment
- Wildlife Act, 1996, Ch. 200: The Act provides for the conservation of wildlife throughout Uganda so that the abundance and diversity of their species are maintained at optimum levels commensurate with other forms of land use to allow for sustainable utilisation of wildlife for the benefit of the people of Uganda and the protection of rare, endangered and endemic species of wild plants and animals.

The following policies and plans are applicable to protected areas in Uganda:

- National Forest Plan 2011/12–2021/22, 2013. The plan acknowledges that oil exploitation can have negative effects on forest resources through deforestation and environmental degradation, including indirect effects resulting from induced development. However, it also recognises that revenue from the Albertine Graben developments provides an opportunity to invest in sustainable forest management. The National Forest Plan aims to:
 - enhance the capacity of forestry institutions to enable them to perform their mandates effectively
 - increase the forest resource base by increasing forest cover to 1990 levels
 - increase the economic productivity of forests and employment in the forestry sector
 - raise incomes for households through forest-based initiatives
 - restore and improve ecosystem services derived from sustainably managed forests.

- Uganda Forestry Policy, 2001. This policy outlines guiding principles for the management of forest resources, including conservation and sustainable management. It also outlines strategies for the management of forest resources that include social and environmental impact assessments for commercial forest plantations and forest-product-producing industries.
- Uganda Wildlife Authority Strategic Plan 2013–2018. The plan provides for sustainably managed wildlife areas that are providing enjoyment, supporting community livelihoods and contributing to national development.
- Uganda Wildlife Policy, 2014. This policy guides the conservation and development of wildlife resources in Uganda.
- The Ugandan National Policy for the Conservation and Management of Wetlands protects wetlands. This includes elements that protect the river as a biodiversity area and as a resource for local communities. The policy, designated in 1995 (Ministry of Natural Resources, 1995), aims at protecting and curtailing the rampant loss of wetland to sustain their ecological and socio-economic functions (Glass 2007).
- Murchison Falls Protection Area General Management Plan 2012–2022. The purpose of this management plan is to “Protect and conserve [Murchison Falls Protection Area] MFPA, one of Uganda’s biodiversity hotspots with varied ecosystems including the wetland of international importance, scenic landscapes, spectacular Murchison Falls, rich cultural and historical sites for the benefit of the people of Uganda and the global community”. The plan identifies seven zones within the protected area, each with different management objectives: wilderness, tourism, administrative, critical ecosystems, resource use, active management/recovery and dual management.

Internationally and Nationally Recognised Areas

Key Biodiversity Areas

Key biodiversity areas (KBAs) are sites that contribute to the global persistence of biodiversity, including vital habitat for threatened plant and animal species in terrestrial, freshwater and marine ecosystems. In 2016, the IUCN published a global standard for the identification of KBAs with the following aims:

- harmonise the existing approaches to the identification of important sites for biodiversity
- support the identification of important sites for elements of biodiversity not considered in the existing approaches
- provide a system that can be applied consistently and in a repeatable manner by different users and institutions in different places and over time
- ensure that KBA identification is objective, transparent and rigorous through the application of quantitative thresholds
- provide decision-makers with improved understanding of why particular sites are important for biodiversity.

Sites qualify as global KBAs if they meet one or more of 11 criteria, grouped into five categories:

- threatened biodiversity
- geographically restricted biodiversity
- ecological integrity

- biological processes
- irreplaceability.

Although anyone having the appropriate scientific data may propose a site to qualify as a KBA, consultation with nongovernmental and governmental stakeholders at the national level is required during the proposal process.

No KBAs are crossed by the pipeline but the RoW comes within 10 m of Bugungu Wildlife Reserve (WR) KBA and approximately 650 m from the Lake Albert catchment KBA. This area is described more fully below.

Important Bird Areas

Important Bird Areas (IBAs) form the largest subset of KBAs. These are sites of international importance for conservation, identified using birds as qualifying species. The global network of IBAs has been identified using a set of four internationally agreed criteria:

- A1: globally threatened species. The site is known or thought to hold “significant” numbers of a globally threatened species.
- A2: restricted-range species. The site is known or thought to hold a “significant” component of a group of species whose breeding distributions define an EBA. EBAs are described in more detail below.
- A3: biome-restricted species. The site is known or thought to hold a “significant” component of the group of species whose distributions are largely or wholly confined to one biome.
- A4: congregations. The site is known or thought to hold congregations of $\geq 1\%$ of the global population of one or more species on a regular or predictable basis.

More than 12,000 IBAs in over 200 countries have been identified worldwide. As bird populations have been shown to be effective indicators of wider biodiversity, many IBAs are also likely to be KBAs for other animal and plant species, and ecosystems of concern (BirdLife International 2018).

The pipeline AOI does not cross any IBAs.

Endemic Bird Areas

An EBA is defined as an area that encompasses the overlapping breeding ranges of restricted-range species such that the complete ranges of two or more restricted-range species are entirely included within the boundary of the EBA. This does not necessarily mean that the complete ranges of all of an EBA’s restricted-range species are entirely included within the boundary of that single EBA, as some species may be shared between EBAs.

Restricted-range species are defined as all land birds that historically¹ have a total global breeding range estimated as less than 50,000 km². Species with historical ranges estimated to be above this threshold but that have been reduced to less than 50,000 km² by habitat loss or other pressures are not covered, as EBAs should represent natural areas of endemism for birds.

¹Considered since ornithological records began after 1800

The pipeline AOI does not cross any EBAs.

Area of Influence

The AOI is the area of any legally protected, internationally or nationally recognised areas directly or indirectly affected by the pipeline and its activities arising from, for example, facilitated access, edge effects, the spread of alien invasive species (AIS), and temporary and permanent habitat loss and fragmentation.

Most of the impacts on protected areas will occur during the construction phase and early operation. Indirect impacts such as human influx, including access to previously difficult-to-access land, may extend beyond this duration. As such, the temporal AOI is defined as the construction period and the time required for habitat to re-established to pre-construction condition.

The following areas were identified within 1 km of the pipeline AOI (including access roads and construction facilities); they are illustrated in Figure 6.4-1 and described herein:

- internationally and nationally recognised areas:
 - Bugungu WR and KBA
- legally protected areas:
 - Maseege Central Forest Reserve (CFR²)
 - Bugungu WR
 - Bujawe Forest Reserve (FR).

Except for the Bugungu WR and KBA, there are no adopted management plans for these reserves, so there are no formal management objectives other than those outlined in the National Forest Plan 2011/12–2021/22, 2013. As the Bugungu WR forms part of the MFPA, it is included in the MFPA General Management Plan 2012–2022 (UWA 2013), the objectives of which are summarised above.

Wambabya FR is outside the 1-km AOI but there is the potential for chimpanzees from the FR to move more widely through the landscape, particularly along remnant riparian forest such as that found along the Wambabya River.

² Central Forest Reserves are managed by the National Forestry Authority as per The National Forestry and Tree Planting Act (2003), while Forest Reserves are under the management of District Forest Services.

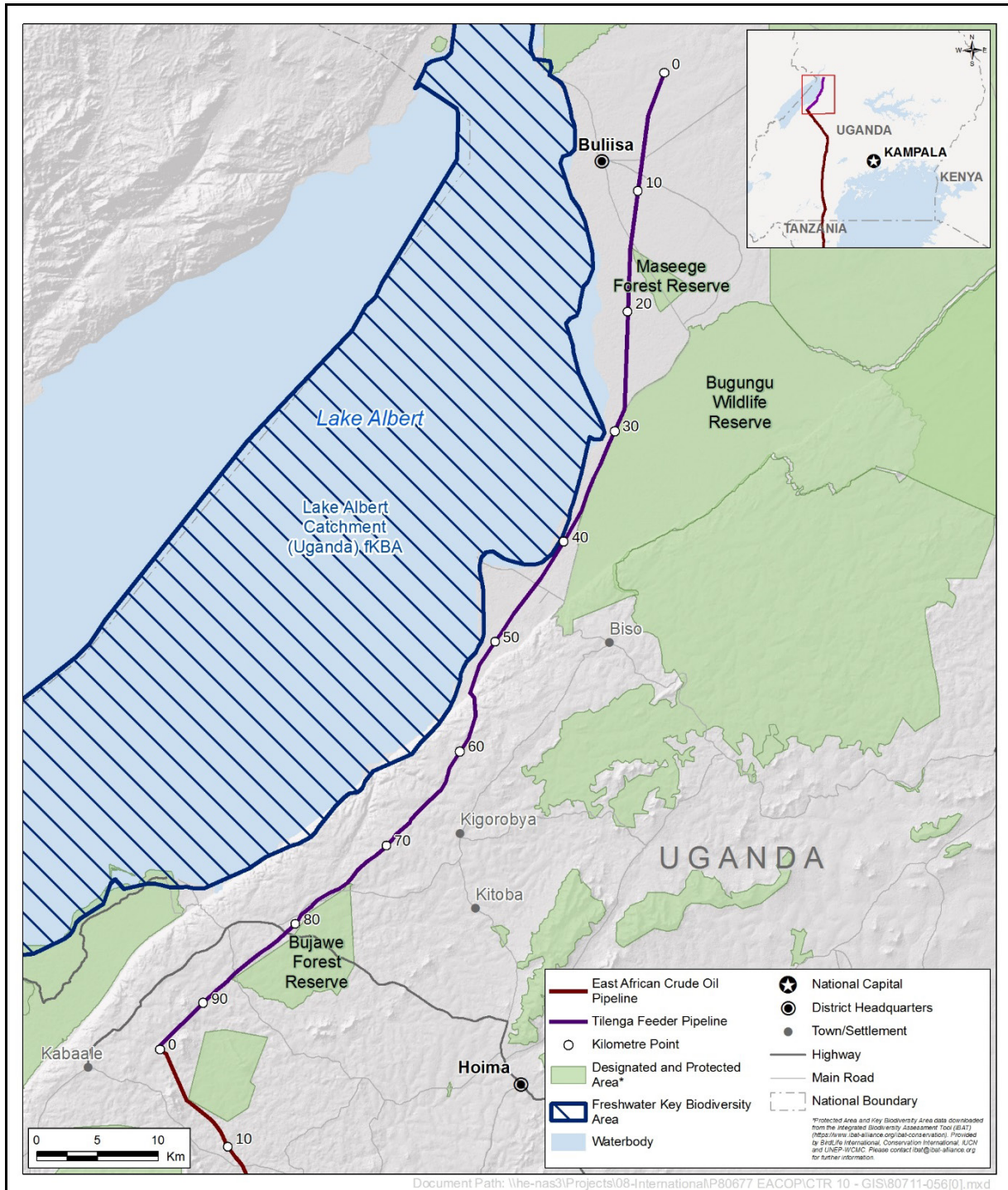


Figure 6.4-1 Protected Areas in the Area of Influence

Baseline Condition

Internationally and Nationally Recognised Areas

Bugungu WR and KBA

The Tilenga feeder pipeline traverses along the western edge of the Bugungu WR (the route is just outside the reserve boundary) to the west of an existing road (the

Hoima–Buliisa road) that is regarded by the Uganda Wildlife Authority (UWA) as the western extent of the reserve (Figure 6.4-2). The road is being widened at the time of writing, as part of the Hoima–Butiaba–Wanseko road project, to facilitate access for oil-field development.

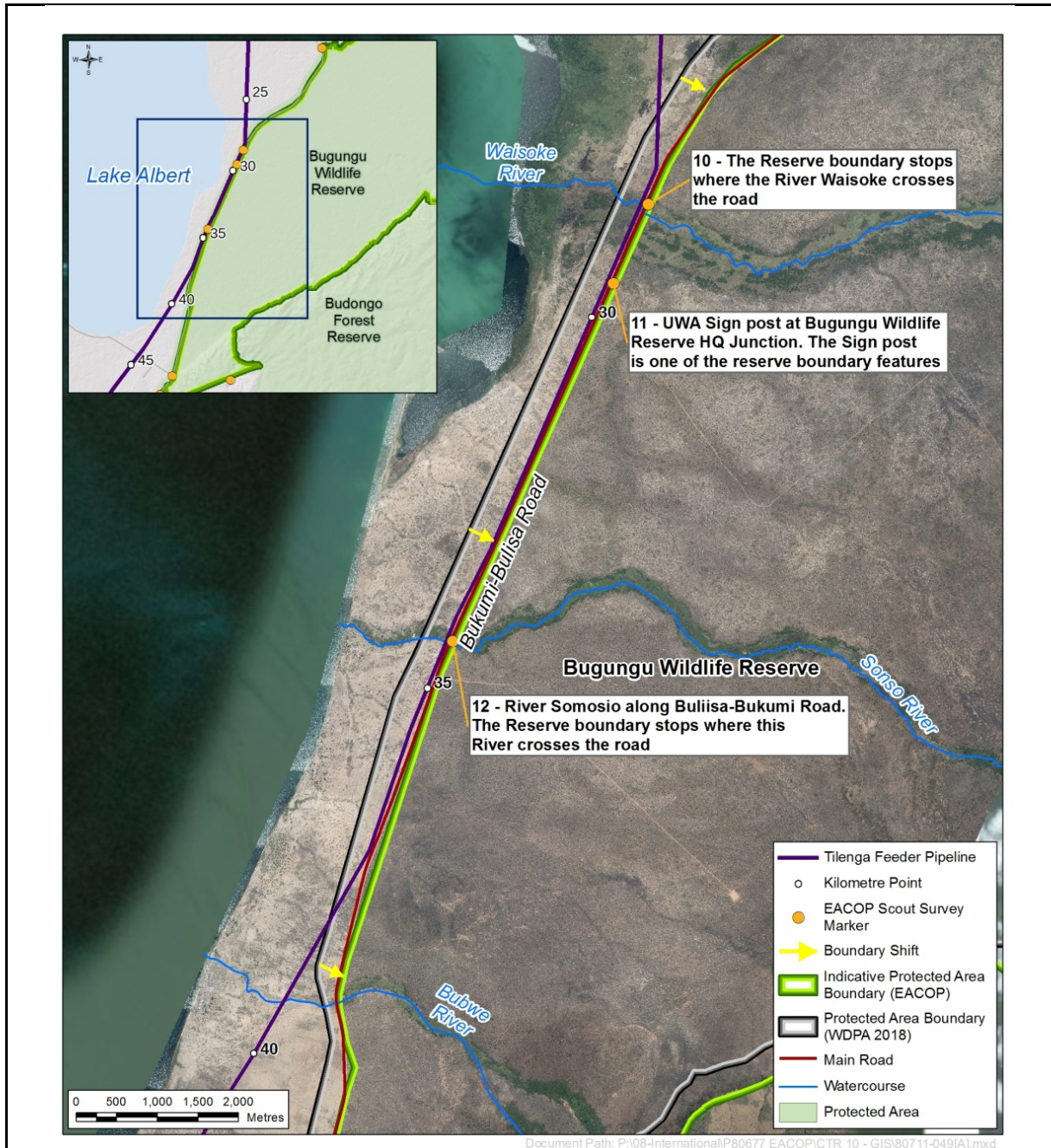


Figure 6.4-2 Bugungu Wildlife Reserve and Key Biodiversity Area Boundary

The Bugungu WR site is designated as a KBA; it also forms part of the wider MFPA along with the Murchison Falls National Park (MFNP) and the Karuma WR, which are outside the pipeline AOI. The Bugungu WR and KBA lies along the southern edge of MFNP and includes a section of land between the Lake Albert escarpment

and the Waiga River. The WR acts as a buffer to the MFNP and gives opportunities for seasonal movements of mammal species within the MFNP.

The Bugungu WR was designated in 1968, is maintained for wildlife and tourism, and is managed by the UWA. It is classified as IUCN category III site (natural monument or feature). The pipeline AOI is adjacent to the two following management zones as outlined in the Murchison Falls Protection Area General Management Plan 2012–2022:

- resource use zone: local communities are permitted to access resources (firewood and grass) within the protected area on a sustainable basis. Collection of poles is not permitted. Communities are encouraged to develop alternatives outside the protected area so that this zone can be abolished in the long-term.
- wilderness zone: representative of the natural area of MFPA comprising dense bushland and thicket with low wildlife numbers. The zone is intended to be subject to minimal disturbance with permitted infrastructure limited to access tracks for patrols. Resource extraction is not permitted in this zone. The boundaries of the wilderness zone are 'soft-edge', reflecting suitability-of-use rather than strict regulation of activities.

Bugungu WR encompasses an area of 474 km². The escarpment of the Albertine Rift crosses in a southwest to northeast direction through the reserve and divides it into two distinct sections that differ in terms of their dominant vegetation. The top of the escarpment supports dense, closed-canopy woodland interspersed with tall grassland, whereas the valley floor supports more open savannah woodland and grassland.

Surveys undertaken as part of the Tilenga Project (WCS and eCountability 2016) noted that the closed woodland on top of the escarpment in the Bugungu WR and KBA was the most species-rich habitat within the reserve.

Bugungu WR habitat is largely intact with a low incidence of degradation; cattle grazing and tree cutting for firewood do occur within the reserve boundaries but at a much lower rate compared with areas outside the reserve. The reserve has only 19 rangers to cover it, so, although human impacts are reduced, they are not completely controlled. Habitats outside the reserve in the area traversed by the pipeline are markedly different to those inside in the reserve. Habitat outside the reserve has been heavily grazed and is degraded and very open in character (UWA 2013), see Figure 6.4-3. It has previously been noted that "There is evidence of agricultural practices along the Buliisa–Biiso³ road that forms the western boundary of Bugungu Wildlife Reserve. These opened up areas for agriculture block the migratory routes for wildlife from the reserve trying to access water from Lake Albert" (UWA 2013). This suggests that the levels of protection provided to the Bugungu WR are proving effective.

The Hoima–Buliisa road is being widened, at the time of writing, to a 6-m-wide two-lane carriageway with 1–2 m shoulders as part of the Hoima–Butiaba–Wanseko road project. The widening to the east is within the reserve.

³ Also referred to as the Hoima to Buliisa road.



Figure 6.4-3 Bugungu Wildlife Reserve and Key Biodiversity Area Land Cover, Habitat and Imagery

Several rivers flow through the Bugungu WR, notably the Bubwe, Sonso, Waisoke and Waiga Rivers. These act as corridors for wildlife to move through the reserve and out to surrounding areas.

Chimpanzee nests have been recorded in the Bugungu WR (WCS and eCountability 2016), in the region where the Bugungu WR abuts the Budongo FR on the eastern edge of the WR. Chimpanzee movement in the area is not well understood, but it is likely that chimpanzees are moving between reserves through remnants of riparian forest.

Species associated with the reserve are described in Section 6.4.1.5 and Appendix A3 Avifauna Baseline Report, and in Section 6.4.1.6 and Appendix A4 Fauna Baseline Report.

Legally Protected Areas

Maseege CFR

The Tilenga feeder pipeline is approximately within 200 m of the Maseege CFR between KP15 and KP16.5. The 951 ha CFR was gazetted as an industrial and commercial forest plantation. It is the only CFR in the Rift Valley near Lake Albert and, as such, provides protection to Lake Albert as noted in the NEMA Sensitivity Atlas⁴ (NEMA 2010). It also contributes to the protection of the River Waiga that drains into Lake Albert. It is a corridor for wildlife between Lake Albert and the MFNP (NEMA 2010).

No fauna species of conservation importance were found by surveys or a review of secondary data in the Maseege CFR. Nevertheless, it is within an area identified as Tier 1 critical habitat for chimpanzee (WCS and eCountability 2016), see Appendix B Critical Habitat Assessment.

Bugungu WR

As the Bugungu WR is also a KBA, it is described earlier in this section.

Bujawe FR

The Tilenga feeder pipeline is within 500 m of the Bujawe FR between KP74 and KP87 approximately. The FR comprises pine and eucalyptus plantations but is also used for subsistence farming and therefore of little conservation value in terms of the flora it supports.

The Bujawe FR is noted in the Sensitivity Atlas (NEMA 2010) for the protection it affords the Hoimo and Rwamutunga rivers, which are sources of water for people and livestock. It is not known how efficient this protection of the rivers is, given the modified condition of the FR. The Sensitivity Atlas indicates that Bujawe FR provides commercial tree planting opportunities that afford employment opportunities to local people.

⁴ The overall aims of the Sensitivity Atlas are to “display, identify and provide the ability to analyse the relative environmental sensitivities (physical, biological and socio-economic) to oil spill and oil development within the exploration areas in the Albertine Graben region of western Uganda” (NEMA 2010)

Further details on the species found in the reserve can be found in Section 6.4.1.6 and Appendix A4 Fauna Baseline Report. In addition, this reserve is within an area identified as Tier 1 critical habitat for chimpanzee (WCS and eCountability 2016), see Appendix B, Critical Habitat Assessment.

Trend in Condition and Sensitivity to Change

Internationally and Nationally Recognised Areas

Bugungu WR and KBA

Over the last five years, cattle grazing has led to marked degradation in some areas of the Bugungu WR and KBA, particularly along the Hoima–Buliisa road, which at the time of writing, is being widened to a 6-m-wide two-lane carriageway with 1–2 m shoulders as part of the Hoima–Butiaba–Wanseko road project. At the time of writing, wildlife from the reserve move through farmland adjacent to the reserve to access Lake Albert, thereby creating human–wildlife conflict (UWA 2013).

Field surveys noted that the vegetation cover inside the reserve was often “semi natural to natural” but became increasingly degraded outside the reserve. Despite protective legislation in place, there is the risk of further degradation.

The Bugungu WR and KBA is internationally recognised for its biodiversity value, so has high sensitivity to change.

Legally Protected Areas

Maseege CFR

The overall trend of habitat decline that typifies Uganda’s forests is seen in the Maseege CFR with further encroachment by agriculture. The main road connecting Hoima and Buliisa passes through the forest reserve and is being upgraded at the time of writing, so there is a high likelihood of increased traffic using the road that could affect fauna within the reserve.

Considering that the CFR is gazetted as industrial and commercial yet is within an area identified as Tier 1 critical habitat for chimpanzee, it has a moderate sensitivity to change.

Bugungu WR

As the Bugungu WR is also designated as a KBA, it is discussed earlier in this section.

Bujawe FR

Large parts of the Bujawe FR have been and continue to be cleared for crop cultivation by local communities (OAG 2010). This trend is anticipated to continue.

The Bujawe FR comprises modified habitat yet is within an area identified as Tier 1 critical habitat for chimpanzee, so has moderate sensitivity to change.

Ecosystem Services

The legally protected, internationally and nationally recognised areas described herein provide a variety of ecosystem services.

Provisioning services include:

- wood and wood fuel, including collection for charcoal manufacture
- food (hunting, gathering and foraging)
- collection of medicinal products
- trapping of wildlife for the live trade market.

Regulating services include:

- climate change amelioration through carbon sequestration
- local climate regulation in terms of providing a cooler micro-climate
- local water and air purification through waste assimilation and water and air filtration
- water regulation and erosion control (i.e., water catchment protection) in terms of maintaining greater river flows and for longer; reducing flood surges; and reducing erosion and sedimentation from vegetation of steep slopes and riverbanks.

Cultural services include:

- ethical and biodiversity 'non-use' values, particularly in terms of maintaining populations of endangered and endemic species
- sense of place or way of life. These locations are likely to provide value to local people living near and utilising them in terms of the way of life and special connection with such areas.
- eco-tourism, particularly in protected areas
- aspects of these locations may provide spiritual, sacred or religious values; inspiration for culture and design; and cognitive development

Habitat and species support includes:

- the abovementioned habitats provide important refuge, feeding, watering, breeding and nursery areas for a host of animals that spend only part of their life in such areas.

Other supporting services include:

- the abovementioned habitats and species within provide a range of supporting services such as photosynthesis and water, carbon and nutrient cycling whose values are typically accounted for in other ecosystem services

Sensitivity Rankings

Based on the results of the studies undertaken, the trend in condition and sensitivity to change, the sensitivity of the VECs has been ranked and is shown in Table 6.4-1.

Table 6.4-1 Protected Area Sensitivity Ranking

Fauna Receptor	Sensitivity Ranking	Rationale for Ranking
Maseege CFR		
Legally protected	Moderate (3)	Nationally protected as a CFR for plantation forestry purposes but mapped as Tier 1 critical habitat for chimpanzee
Bugungu WR and KBA		
Legally protected, internationally or nationally recognised area	High (4)	Internationally recognised for its biodiversity value and nationally protected for biodiversity purposes
Bujawe FR		
Legally protected	Moderate (3)	Nationally protected as an FR but mapped as Tier 1 critical habitat for chimpanzee and retains some biodiversity value

Key Considerations

The following legally protected, internationally and nationally recognised areas are key considerations:

- internationally recognised areas:
 - Bugungu WR and KBA
- legally protected areas:
 - Maseege CFR
 - Bujawe FR.

6.4.1.3 Botany Biodiversity

This section describes the:

- botanical biodiversity area of influence (AOI)
- biodiversity baseline condition in terms of:
 - habitats
 - protected areas
 - vascular plant species
 - trends affecting the condition of habitats, vascular plants and protected areas of conservation importance, and sensitivity to change
 - ecosystem services provided
 - botanical biodiversity sensitivity rankings
- key considerations.

For more information, the botanical biodiversity baseline report is included in Appendix A1.

Area of Influence

The spatial AOI encompasses the pipeline footprint and areas within an ecologically relevant distance of the pipeline to account for potential direct and indirect pipeline-related impacts (i.e., effects of habitat loss, facilitated access, habitat fragmentation, edge effects and spread of invasive species). The definition of an ecologically relevant distance relies on the mobility of a species, habitat connectivity between it and the pipeline, and the potential impact pathways between it and the pipeline.

Where appropriate, the AOI includes downstream wetland and riparian habitats that are potentially at risk from pipeline-related impacts (e.g., from accidental spills or sedimentation). Using a precautionary approach, the spatial AOI for habitats of conservation importance was generally defined by a 2 km-wide corridor centred on the pipeline RoW. The AOI therefore includes habitats associated with Lake Albert.

Most impacts to habitats and species of conservation importance will occur during the construction phase and early operation. Indirect impacts such as human influx, including access to previously difficult-to-access land, may extend beyond this duration. As such, the temporal AOI is defined as the construction period and the time required for habitat to be re-established to preconstruction condition. For new access roads and parts of construction facilities that may be transferred with the land to a third party when no longer needed for pipeline use, the impacts will be considered permanent.

Habitat Mapping

Habitats were identified and mapped using remote sensing, which is an effective approach for characterising the large area traversed by the pipeline. It was then refined using data collected from the botanical field surveys. The advantage of using remote sensing to map vegetation classes is the ability to cover a large area using data from a representative sample of known sites.

Wet and dry season Sentinel-2 satellite imagery was used to map the habitat types along the extent of the pipeline; in addition the following data sets were also used:

- tree height data derived from LiDAR surveys undertaken in 2017
- slope data derived from the LiDAR Digital Elevation Model (DEM) (EACOP)
- very-high-resolution aerial imagery (EACOP)
- existing Africover land cover mapping (FAO).

Each of the satellite images was enhanced using ERDAS Image 2018 to reduce effects such as topographic shading, light and shadows from solar illumination and forest fires. Each Sentinel-2 image was clipped to match the 2 km-wide LIDAR data corridor captured in 2017.

Physiognomic habitat classes were mapped based on the occurrence of habitats throughout the AOI and readily distinguishable differences in height and density. Data provided by the field surveys was used to inform this process. These habitat classes are primarily derived from the physiognomic types defined by White (1983).

Each Sentinel-2 tile was processed using the Random Forests algorithm in the Erdas Imagine geospatial tool; this allocates a physiognomic habitat class, based on the statistical similarity, to each homogeneous area. Following the automated

classification of habitat classes, the habitat map was refined based on the field data and observations.

Physiognomic habitat classes were further categorised into modified and natural habitats in accordance with IFC Performance Standard 6 criteria (IFC 2012) which defines these as follows:

- Natural habitats are areas composed of viable assemblages of plant or animal species of largely native origin, or where human activity has not essentially modified an area's primary ecological functions and species composition.
- Modified habitats are areas of land that support a large proportion of flora and or fauna species that are non-native in origin, or where human activity has substantially modified an area's primary ecological functions and species composition.

Areas composed of shrubland habitat were considered to be transitional habitat. These areas are included as modified habitats.

The habitat map is presented in Attachment A1.1 of Appendix A1.

Table 6.4-2 Physiognomic Habitat Classes in the Area of Influence

Habitat Class	Summary of Description
Natural Habitats	
Forest	Semi-evergreen rainforest, with canopy >10 m high and emergent trees evident. Crowns generally interlocking
Wetland Forest	Tall woody vegetation (>10 m in height) occurring within lower parts of the landscape with evidence of inundation or proximal to other wetland vegetation
Woodland	Open stands of trees of at least 8 m in height – canopy cover of 40% or more. Crowns never interlocking. Usually a layer of grass species dominate ground-level vegetation.
Bushland	Open stands of bushes (usually 3–7 m tall) with a canopy cover of 40% or more
Wooded Grassland	Open woodland habitat dominated by <i>Combretum</i> sp. around native grasslands. Trees >7 m tall, bushes (3–7 m), dwarf trees and shrubs <2 m tall
Wetland	Permanent or seasonally inundated wetland area dominated by closed canopy of papyrus. Habitat periodically harvested in large uninterrupted tracts.
Modified Habitats	
Shrubland	Open or closed stands of shrubs up to 2 m tall
Cultivation/ Pasture	Mosaic of small-scale cropping, fallow, tree-crops (banana or coffee) and human settlements. Also a modified grassland habitat with clear evidence of livestock grazing
Plantation	Monoculture of woody species cultivated for timber production

Most habitat types in the AOI are categorised as modified with only approximately 51% of the study area natural. Three main habitat types supporting different vegetation types were identified during baseline studies, namely:

- wetland and wetland forest comprising:
 - *Cyperus papyrus* dominated swamp
 - swampy grassland (with occasional woody species)
 - riverine and riparian forest
- Acacia woodland, bushland, shrubland, thicket and wooded grassland including:
 - very disturbed *Acacia* woodland, wooded grassland and bushland
 - drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotic plant species
 - drier spectrum of secondary *Acacia* woodland, bushland or thicket with exotics plant species; subgroup: *Combretum* woodland
 - *Acacia polyacantha* woodland in farmland
 - secondary thicket mixed with bushland species
- cultivated land.

A description of each of the habitat types within the AOI and in the RoW and their alignment with the physiognomic habitat classes illustrated by the habitat map (Attachment A1.1 of Appendix A1) is presented in Attachment A1.3 of Appendix A1.

Identification of Habitats of Conservation Importance

The conservation value of each habitat was measured using the Genetic Heat Index (GHI) tool which is an integral component of the Rapid Botanical Survey (RBS) methodology (Hawthorne 1996, Hawthorne and Marshall 2016). The GHI tool estimates the botanical importance of the vegetation or plant communities based on a ranking of species rarity using star rating criteria (see Section A1.1.3.3 of Appendix A1) and identifies the concentration of globally rare species in a habitat. GHI scores are high where the habitat supports a high proportion of globally rare species; this is termed a hotspot (Marshall and Hawthorn 2016).

GHI scores calculated for habitats across the whole of Africa range from 0 to 2700 (Marshall and Hawthorn 2016). The botanical specialists from the University of Oxford supported by Ugandan botany specialists have confirmed that habitats in the study area with a GHI between 150 and 249 are considered to be of moderate conservation importance, while those with a GHI greater than 250 are considered to be of global conservation importance.

Identification of Species of Conservation Importance

In the context of this baseline assessment, the vascular plants of conservation importance are defined as nationally rare species, globally rare species, and endemic and/or restricted range species. The presence of these plants in the study area was identified based on the following criteria:

- IUCN Red List of Threatened Species (2017): The field data were screened against IUCN's defined categories to assess the global rarity of species in the study and their sensitivity to change (Table A1.2-4 of Appendix A1). For this baseline assessment, only species in the study area that are listed as IUCN

vulnerable, endangered or critically endangered are of conservation importance. It is important to acknowledge that most vascular plant species in the AOI are categorised as IUCN not evaluated

- Species listed on the Ugandan Red List prepared by the Wildlife Conservation Society (WCS) in 2016 and which was upheld by the lead agencies of the Government of Uganda, conferring official recognition on the lists. Species are classified into Red List categories but based on information at the national level.
- The RBS star rating: the field data were screened against the RBS star rating criteria to determine the presence of endemic and/or restricted range species in the AOI (Table A1.2-5 of Appendix A1). This rating ranges from Black Star species (the rarest species on a global scale and of high conservation importance) to Green Star species (species that are common, widespread and of no obvious conservation concern). The global range of each species is expressed as degree squares occupied (one degree square is approximately 100 × 100 km). All plant species in the AOI were assigned a star rating (Hawthorne and Marshall 2016). The RBS star rating is described in more detail in the RBS manual (Hawthorne and Marshall 2016) which is presented in Attachment A1.2. The RBS star rating does not rely on Red Listing and takes into consideration records of a species' distribution and abundance. The star rating for each species is derived from a database of global plant rarity. This database was compiled from the same data sources used by IUCN when making evaluations on the statuses of vascular plant species (i.e., herbarium records, monographs global, Genebank Information System etc). However, in comparative terms, the RBS database is comprehensive with up to date information that accounts for historic and recent taxonomic changes.

Baseline Condition of Botany

Habitats of Conservation Importance

Overview

A description of each of the habitat types within the AOI their GHI scores and their alignment with the physiognomic habitat classes illustrated by the habitat map (Attachment A1.1 of Appendix A1) are presented in Attachment A1.3 of Appendix A1.

Anthropogenic activities have severely impacted natural habitats in Uganda. Habitats are highly fragmented with low land cover (National Environment Management Authority 2016; Winterbottom and Eilu 2016). Given the status of natural habitats in Uganda riverine and riparian forests are considered to be of conservation importance in the context of the AOI and the broader region. Appendix A1 presents habitats of conservation importance with respect to the pipeline AOI only; all other habitat types, including those not of conservation importance in the AOI are presented in Attachment A1.3 of Appendix A1.

Riverine Forest

Remote sensing identified the presence of small and highly fragmented patches of wetland forest within the AOI between KP21 to KP94 (Table A1.2-5 of Appendix A1). These areas of wet woodland collectively comprise 166.4 ha, restricted to the margins of watercourses and springs, and are predominantly surrounded by bushland or thicket and cultivated land. The extent of wetland forests (i.e., riverine

and riparian forests) in the AOI is illustrated by Figure 6.4-4 and the habitat map (Attachment A1.1 of Appendix A1). Riverine forest qualifies as critical habitat in accordance with Performance Standard 6, criterion 4: highly threatened and/or unique ecosystems. This is described in the critical habitat assessment (Appendix B).

The botanical survey confirmed the presence of highly degraded riverine forest (which also includes riparian forest) in the study area, which is a type of wet woodland. Several types of riverine forest are present in Uganda. The botanical survey identified riverine forest within the AOI near KP14, KP34.31, KP46.83 and KP94.65. The forest structure was notably variable with either predominantly taller trees or smaller shrubs forming a patchy canopy. The bioquality of these stands of riverine forests is low (GHI range 6–25) and vascular plant species are common and widespread elsewhere in Africa. The abundance of fig trees (i.e., *Ficus mucoso*, *Ficus sycomorus* and *Ficus vallis-choudae*) and the presence of cultivated trees such as *Artocarpus* sp. also indicate habitat disturbance from people and grazing livestock.

Riverine forest within the RoW at KP46.8 was found to support *Tamarindus indica*; this tree is listed as vulnerable on the Ugandan Red List (WCS 216).

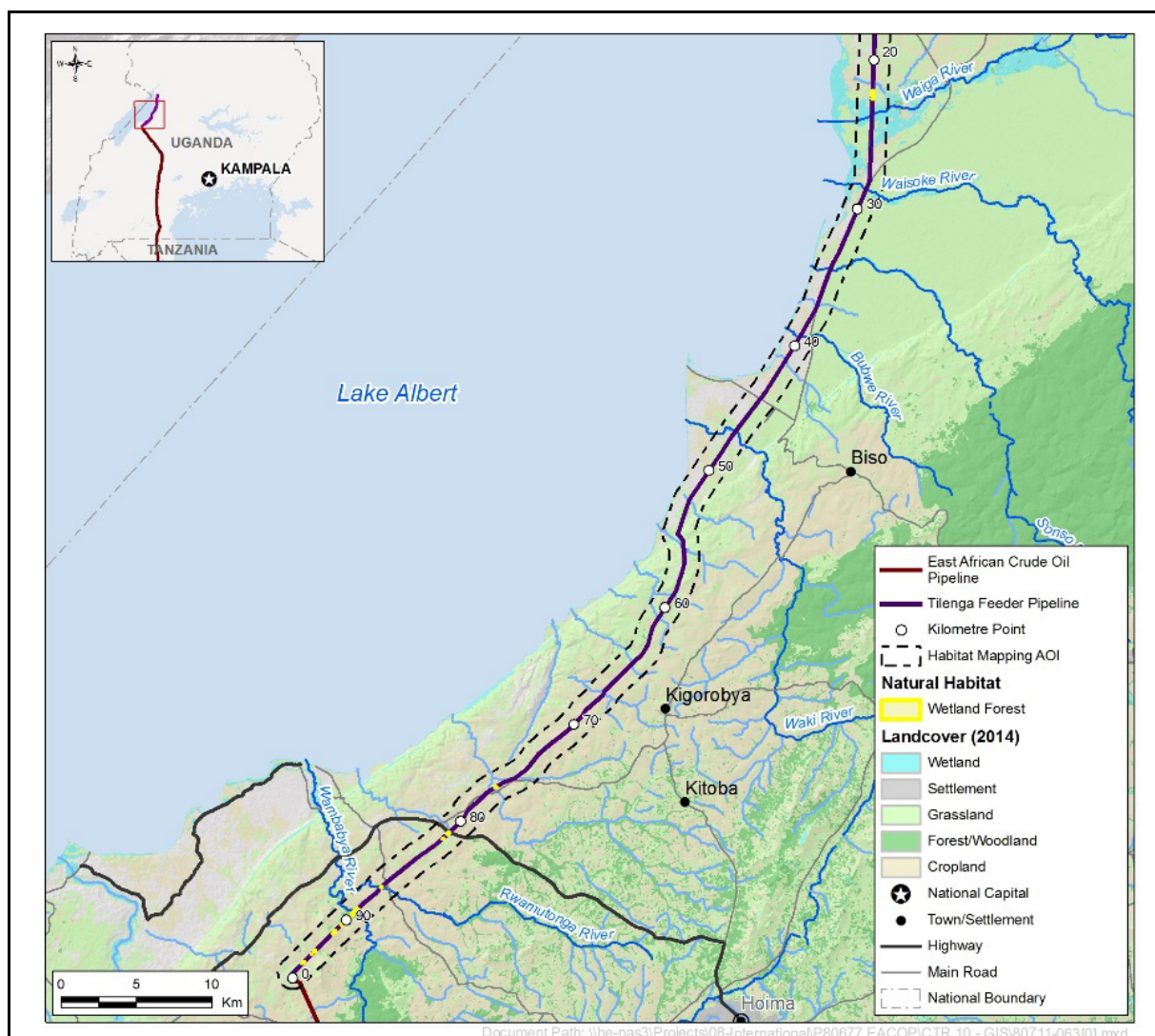


Figure 6.4-4 Location and Extent of Wetland Forest (i.e., Riverine Forest) in the AOI Based on Remote Sensing

Species of Conservation Importance

In total, 351 species of vascular plants were identified within the AOI during the field surveys. Of these, only 34 species (<10% of the total sample) have been assessed by the IUCN Red List of Threatened Species (IUCN 2017). Within this sample, one tree species, *Milicia excelsa*, is categorised as IUCN lower risk/near threatened and the remaining species are listed as IUCN least concern.

The following four plant species recorded during the baseline surveys are listed on the National Red List for Uganda (WCS 2016):

- *Aeschynomene indica*, data deficient
- *Nymphaea nouchali*, critically endangered
- *Milicia excelsa*, endangered
- *Tamarindus indica*, vulnerable.

Biodiversity baseline data from studies by WCS (Attachment A1.6 of Appendix A1) were screened against the RBS star rating criteria to identify the presence of any

globally rare or restricted-range/endemic (Black Star) vascular plant species within the AOI. This identified the presence of one endemic/restricted-range (Black Star) species, *Tinospora orophila* (IUCN endangered) (Attachment A1.4 and A1.6 of Appendix A1). *Tinospora orophila* is known from a few locations in Burundi and Rwanda (IUCN 2017). Further surveys and validation of this species' record would be required to explicitly verify the presence of *Tinospora orophila* in the RoW.

Protected Areas

Three protected areas are immediately adjacent to the RoW. These sites are described and mapped in Section 6.4.1.1. Forest reserves addressed in this section are identified as protected areas supporting areas of high habitat quality in Uganda and / or vascular plants of conservation importance. Other protected areas that do not meet these criteria are described in Section 6.4.1.1.

Only one protected area, Bugungu Wildlife Reserve was identified as being of botanical or floristic value. The pipeline traverses adjacent to the western edge of the Bugungu Wildlife Reserve (WR) between KP27.3 and KP38.1. While natural habitats along the western boundary of the Bugungu Wildlife Reserve were degraded and typically included the encroachment of cultivated trees (i.e., *Mangifera* sp., *Elaeis* sp. and *Anacardium* sp.) and areas of agricultural land (UWA 2013), habitat quality is considered to substantially improve further into the reserve.

Screening of the WSC biodiversity baseline data identified the presence of nine endemic/restricted range (Black Star) species within the reserve, namely:

- *Alafia microstylis*
- *Digitaria melanotrichia*
- *Ecbolium hastatum*
- *Entada phaneroneura*
- *Isoglossa laxiflora*
- *Keetia purseglovei*
- *Leptonychia mildbraedii*
- *Pentarrhinum gonoloboides*
- *Snowdenia microcarpha*.

Trend in Condition and Sensitivity to Change

Habitats of Conservation Importance

Riverine Forest

Forest habitats are under major threat in Uganda with rapid losses occurring within, and outside, protected areas. Between 1990 and 2015, Uganda's forest cover was reduced from 4.9 to 1.8 million ha. An average of 86,400 ha (2.1%) of forest cover per year was cleared between 2000 and 2015 (Ministry of Water and Environment 2016).

The primary causes of forest degradation and deforestation are land conversion for agro-pastoral activities and urbanisation; unsustainable exploitation of timber for fuel (firewood and charcoal); illegal and unregulated trade in forest products and unsecure forest tenure rights (Ministry of Water and Environment 2016).

In addition to the increased pressure on forest resources for natural resource collection, remnant forest fragments are vulnerable to edge effects that can have serious impacts on species diversity, composition, community dynamics and ecosystem functioning (Laurance et al. 2010).

In Uganda, riverine and riparian forests are fragmented, in a state of decline and highly threatened by anthropogenic activities, which continue to cause losses, fragmentation and degradation (International Resources Group 2016; Ministry of Water and Environment 2016); this is supported by information yielded by the RBS survey.

Riverine and riparian forests are unlikely to naturally regenerate if upstream seed stock is depleted and edaphic conditions and hydrology is altered; hence wetland forest is unlikely to be resilient to substantial disturbance over large areas. Riverine and riparian forests are considered to have a high sensitivity to change.

Species of Conservation Importance

As *Tinospora orophila* and *Ecbolium hastatum* are endemic / restricted range (Black Star) species, *Nymphaea nouchali* is listed critically endangered on the Ugandan Red List (WCS 2016) and *Milicia excelsa* is listed endangered on the Ugandan Red List, these species have a high sensitivity to change. As *Tamarindus indica* - is listed vulnerable on the Ugandan Red List, this species has a moderate sensitivity to change.

Forest Reserves and Other Protected Areas

The Bugungu Wildlife Reserve is an IUCN category III protected area, it has a high sensitivity to change as described in Appendix D.

Ecosystem Services Provided

The habitats described in the preceding sections with the species they comprise, generate the range of ecosystem services. Further details on the general nature and extent of the provisioning ecosystem services listed can be found in the land-based livelihoods section of Appendix A9 Socio-economic and Health Baseline Report.

Provisioning services include:

- wood and wood fuel (including collection for charcoal manufacture). These activities are legal in some areas but not in others
- food (gathering and foraging). These activities are legal in some areas but not in others
- collection of medicinal products.

Regulating services include:

- climate change amelioration – in terms of carbon sequestration and carbon sinks, and attenuating directional or hemispherical surface albedo
- microclimate – climate regulation by vegetation and soils – in terms of regulating ambient temperatures and water vapour levels
- local water and air pollution control – through waste assimilation, water and air filtration

- water regulation, erosion control and water catchment protection – in terms of maintaining higher flows in rivers and for longer duration; reducing flood surges; and reducing sedimentation of receiving waters through the stabilisation of riverbanks and steep slopes by vegetation, including riparian and emergent habitats
- erosion control of terrestrial habitats (i.e., arising from wind erosion) – in terms of controlling ambient fugitive dust emissions through the stabilisation of soil by terrestrial habitats and maintaining edaphic conditions, including soil moisture levels
- regulation of ambient noise levels – habitats and vegetation act as a natural sound barrier buffering noise emissions, including those arising from anthropogenic sources (e.g., vehicle movement, people and machinery).

Cultural services include:

- ethical and biodiversity values – in particular maintaining populations of endangered and endemic species. These values are difficult to ascertain and are more likely to be held by wealthier native and non-native populations.
- sense of place/way of life – these locations are likely to provide value to local people who use these areas as part of their way of life and who have a special connection with them.
- eco-tourism, particularly in protected areas.
- aspects of these locations may provide spiritual, sacred or religious values, inspiration for culture and design, and cognitive development.

Habitat and species support include:

- the abovementioned habitats provide important refuge, feeding, watering, breeding and nursery areas for many animals that spend only part of their life in such areas.

Other supporting services include:

- the abovementioned habitats and the species they contain provide a range of supporting services such as photosynthesis and water, and carbon and nutrient cycling, and whose benefits are typically accounted for in other ecosystem services.

Sensitivity Rankings

Based on the survey data, the trend in condition, and sensitivity to change, the sensitivity of the VECs have been ranked and are shown in Table 6.4-3.

Table 6.4-3 Botany Sensitivity Ranking

Ecology VEC	Sensitivity Ranking	Rationale for Ranking
Riverine Forest (degraded)		
Habitat of conservation importance	Very High (5)	Riverine forest is considered to have a high sensitivity to change.
Flora and fauna species of conservation importance	Moderate (3)	Supports Ugandan Red Listed vulnerable species: <ul style="list-style-type: none"> • <i>Aeschynomene indica</i>

Table 6.4-3 Botany Sensitivity Ranking

Ecology VEC	Sensitivity Ranking	Rationale for Ranking
		<ul style="list-style-type: none"> • <i>Nymphaea nouchali</i> • <i>Milicia excelsa</i> • <i>Tamarindus indica</i>
Bugungu Wildlife Reserve and Key Biodiversity Area (KBA)		
Legally protected, internationally or nationally recognised areas	High (4)	Designated as a wildlife reserve and KBA
Flora and fauna of conservation importance	High (4)	Endemic or range-restricted (Black Star) species triggering Tier 2 Critical Habitat as per IFC PS6: <ul style="list-style-type: none"> • <i>Alafia microstylis</i> • <i>Digitaria melanotrichia</i> • <i>Ecbolium hastatum</i> • <i>Entada phaneroneura</i> • <i>Isoglossa laxiflora</i> • <i>Keetia purseglovei</i> • <i>Leptonychia mildbraedii</i> • <i>Pentarrhinum gonoloboides</i> • <i>Snowdenia microcarpha</i>.

Key Considerations

Habitats

Based on the outcomes of the botanical assessment, the following habitats are considered sensitive VECs:

- riverine forest.

Flora

The botanical survey confirmed the presence of six species of vascular plants of conservation importance in the study area. Of these further surveys would be required to verify the presence of *Tinospora orophila* and *Ecbolium hastatum* in the RoW. Table 6.4-4 summarises confirmed species of conservation importance.

Protected Areas

Based on the baseline assessment, and particularly the known or likely presence of species and habitats of conservation importance, the Bugungu Wildlife Reserve and KBA (KP27.3 and KP38.1) is considered a sensitive VEC.

Table 6.4-4 Key Flora Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
<i>Ecbolium hastatum</i>	WCS records from within Bugungu Wildlife Reserve and the Murchison Falls National Park. Further surveys are required to explicitly verify the presence of this species	Endemic/ restricted-range (Black Star)	<p>Restricted-range/endemic (Black Star) species have a Highly localised distribution, niche and physical or environmental requirements. These species are particularly vulnerable to the impacts of habitat loss, degradation and fragmentation.</p> <p>Further verification is required to confirm if the <i>Ecbolium hastatum</i> record is a misidentification or not.</p> <p>The majority of national rare species in the study area were recorded in degraded habitat types of low bioqualities.</p> <p>Clearance of these habitats supporting Ugandan Red List critically endangered and endangered species may potentially impact these populations in Uganda (depending on the number of individuals cleared) but will not impact populations at the global scale.</p>
<i>Tinospora orophila</i>	WCS records from modified vegetation near Buliisa approx. 500 m from the pipe centre-line	Endemic or restricted range (Black Star) IUCN listed endangered	
<i>Aeschynomene indica</i>	Swampy grassland, occasional woody species	Ugandan Red List data deficient IUCN listed least concern	
<i>Nymphaea nouchali</i>	Papyrus swamp (Cyperus papyrus)	Ugandan Red List critically endangered IUCN listed least concern	
<i>Milicia excelsa</i>	Dry spectrum of secondary Acacia woodland, bushland or secondary thicket mixed with bushland species Riparian or riverine forest	Ugandan Red List endangered	
<i>Tamarindus indica</i>	Acacia polyacantha woodland in farmland; Secondary thicket mixed with bushland species; and riverine or riparian forest	Ugandan Red List vulnerable	

6.4.1.4 Aquatic Biodiversity

This section describes the:

- aquatic biodiversity AOI
- baseline condition of aquatic biodiversity in terms of:
 - aquatic habitats
 - aquatic fauna species (fish and macroinvertebrates)

- trends affecting the condition of aquatic habitats and fauna species of conservation importance and sensitivity to change
- ecosystem services provided
- aquatic biodiversity sensitivity rankings
- key considerations.

For more information, the aquatic biodiversity baseline report is included in Appendix A2.

Area of Influence

The spatial AOI for aquatic biodiversity encompasses 250 m upstream and 750 m downstream of the proposed pipeline crossing location at the following rivers:

- Sambiye River
- Waiga River
- Waisoke River
- Waki River
- Wambabya River
- Sonso River.

In some locations, Lake Albert falls just within the AOI, but the distance between the pipeline and the lake varies between 1 and 12 km and the pipeline does not cross the lake at any point. The focus of this ESIA is on the major rivers crossed by the RoW, all of which drain into Lake Albert. Sampling was undertaken for these rivers thus removing the need for sampling points in the lake itself. The Bubwe, Hoimo and Rwamutonga rivers are also within the AOI but, based on discussions with the national experts, who identified a high degree of similarity with the rivers listed above, these were not surveyed.

The 1-km length of AOI was chosen to encompass the immediate area surrounding the potential crossing locations that could be impacted by construction activities.

Lake Albert is not crossed by the pipeline but all of the rivers drain into the lake. The nearest pipeline crossing is of the Bubwe River, 1.3 km upstream of its discharge into Lake Albert, placing Lake Albert outside the AOI. However, the rivers support the aquatic biodiversity of Lake Albert and there are potential impacts on Lake Albert fisheries so Lake Albert is included in the study area.

Impacts on these rivers occur only during the construction phase. The temporal AOI will be the duration of pipeline crossing construction extended by the time required for the river to recover to preconstruction condition.

Baseline Condition of Aquatic Biodiversity

Aquatic Habitats of Conservation Importance

As well as providing some cover and protection for animal movements, the rivers are valuable habitats in their own rights. They drain water from the escarpment into Lake Albert thus helping maintain the water level in the lake and consequently supporting the fish and aquatic life within. The quality of the water entering the lake is, therefore, important and the riparian fringes help to maintain a buffer and filter out some substrates before they enter the water.

Sambiye River

At the time of ESIA baseline survey, this river channel at KP7 was dry and local inhabitants claimed that this was always the case, except during infrequent periods of extended heavy rainfall. This is supported by evidence presented in Section 6.4.2.2 and Appendix A6 Surface Water Baseline Report.

This river channel has low value from an aquatic ecology perspective. Some species of fish depend on the seasonal drying out of waterbodies they inhabit to complete their lifecycles. Similarly, some macroinvertebrates have also adapted to live in ephemeral waterbodies. However, owing to the infrequency with which this channel is thought to flow, it is considered unlikely that such fish or macroinvertebrates occur at this location.

Waiga River

The survey location is at KP23 in a floodplain that includes large wetland components, intersected by numerous small tributaries of the Waiga River. Owing to the need to cross multiple turbid tributaries of unknown depth in the marshy wetland area, it was not possible to access or survey the main river channel. An alternative survey location, approximately 2 km from KP23, was identified at a large tributary of the Waiga River. Local inhabitants reported that this tributary contained the same fish species as the Waiga River and it is likely that the macroinvertebrate community is also similar.

The surveyed river section was a relatively small channel with an average width of 4 m and depths ranging from 0.2 m to 1.5 m, with an average depth estimated at 0.8 m.

The river had high turbidity levels because of livestock using the river to drink, damaging the riverbank and disturbing the riverbed and causing an increase of suspended sediment levels. This restricts light penetration through the water column, inhibiting the growth of aquatic plants except for emergent species.

The surrounding habitat was predominantly intermittent wetland that is inundated during heavy rainfall creating connectivity between the flowing river channels and the surrounding wetlands and associated pools.

At this location, most fish were caught or observed in the marginal areas of the channel or an online pond close to the emergent macrophytes.

Upstream of the pipeline, approximately 85% of the Waiga River catchment is within the Murchison Falls National Park.

Waisoke River

This survey location is close to KP28.5, where the river passes under the road between Hoima and Buliisa. Upstream of the road, the river channel passes through a wetland dominated by a dense cover of emergent macrophytes and grasses, obscuring most of the river channel.

The Waisoke River is small (approximately 2 m wide) with heterogeneous flow characteristics. The riverbed appeared to be sand and silt with some patches of cobble and boulders. Depths are variable, with deeper pools estimated to be more than 1 m and shallow marginal and riffle areas of less than 0.1 m. Further

downstream, the wetland vegetation is less dense in places. However, several sections of the river remain obscured by the non-native and highly invasive common water hyacinth (*Eichhornia crassipes*).

One large area of open water was observed with a wider channel and sparse riparian vegetation. Trampled and damaged areas of the banks indicate frequent use by livestock.

Sonso River

The land surrounding the Sonso River close to KP34 was predominantly a mixture of seasonal wetland and dense scrub. Much of the river channel and the banks were inaccessible because of the dense vegetation, comprised predominantly by emergent macrophyte species such as different types of reeds and rushes.

A narrow river channel (1 m average width) and shallow (0.3 m average depth) had a sand and silt substrate. Downstream, a pool of deeper open water was surveyed – mainly still with a silt substrate. Downstream of the pool, much of the river channel was inaccessible, but there were some small open areas that could provide refuge for fish and macroinvertebrate species. Typically, long sections of the river channel were choked with emergent macrophyte vegetation.

Upstream of the pipeline, approximately 90% of the upper Sonso catchment is within National Forest Reserves.

Waki River

The Waki River at KP47 flowed through a channel with steep banks, almost vertical in many places. The channel was surrounded on both sides by a mixture of scrub, maize crop and bare ground, which local community members advised had been cleared for farming. Flow types throughout the surveyed reach were predominantly a mixture of run and glide with occasional slack water in marginal areas of the channel. The substrate throughout the reach was relatively firm clay-like substrate with occasional boulders and silt in slack water marginal areas. Despite much of the riparian zone having been cleared for agriculture or to allow cattle to drink from the river, there were several stretches where the riparian vegetation was overhanging the river channel creating potential refuge areas for fishes. Accumulations of woody debris were observed, providing good refuge for fish and macroinvertebrates.

The Waki River is heavily affected by high sediment loads likely to be originating from agricultural activities throughout its catchment.

A proposed hydropower scheme has yet to be constructed, but, without mitigation, it would have impacts on aquatic ecology by altering flow patterns and creating a barrier to migration for aquatic animals, particularly fish.

Wambabya River

The northern area of land beyond the Wambabya River is an extensive floodplain, almost entirely flooded at the time of survey in June 2018. Rice paddies border most of the forest where large-scale reclamation was underway. The habitat surrounding the river is largely pristine, with the floodplain submerged up to 0.5 m in places. The river channel depth was recorded at a maximum of 2.9 m, and the open river channel is bordered by dense vegetation.

The Wambabya River habitat is currently pristine in places but is under threat from encroachment due to agriculture, primarily for rice. Within the protected area of Wambabya Forest Reserve, the river habitat is afforded more protection than it has when it is outside the protected area. Impacts on the river are considered likely to increase with increasing land use pressures and the overall condition of the site, from an ecological perspective, is likely to decline.

Ephemeral Rivers

The AOI crosses 20–50 ephemeral watercourses. Local experts advised that these would not be flowing at the time of the ESIA baseline surveys and they were therefore not surveyed. It is possible that small isolated pools may have remained, with aquatic life seeking refuge in such pools. However, locating these pools would have required a substantial amount of survey effort and may not have proven to be representative. Furthermore, such pools are likely to be heavily impacted by people, wildlife and livestock.

Aquatic Fauna Species of Conservation Importance

Overview

The FishBase (2018) and IUCN (2018) websites identified 72 species of fish occurring in Ugandan freshwater habitats listed by the IUCN as vulnerable, endangered or critically endangered. Many of these species were also considered to be endemic or at least range-restricted (i.e., only found in the Lake Albert basin). Regarding Lake Albert and its associated rivers the total number of fish species reported varies but generally does not exceed 53 (NEMA 2009).

Freshwater macroinvertebrates have been poorly studied in the AOI. Notwithstanding this, 44 threatened dragonfly species are listed in the National Red List for Uganda (WCS 2016). Of these species, only *Pseudagrion bicoerulans* is listed as vulnerable on the IUCN Red List and this species has only been recorded from montane streams greater than 2000 m above sea level and therefore would not be expected to be found in the AOI. All other species listed as threatened at a national level are listed globally as not evaluated, data deficient, least concern or near threatened.

Secondary literature indicates that the actual number of fish and macroinvertebrate species within the AOI for the aquatic habitats studied is likely to be larger than the sampling results of the surveys. Field survey data only provide a snapshot in time, so are unlikely to represent the full diversity of species at a site. Therefore, baseline assessments include secondary data as well as data gathered during field surveys.

Eight species of molluscs are endemic to or severely range restricted within Lake Albert.

Sambiye River

Fish and macroinvertebrate surveys were not undertaken at the Sambiye River, as it was dry during both ESIA baseline surveys.

Waiga River

Nine fish species were recorded at the Waiga River during the surveys. Most of the catch were *Barbus altianalis* and *Barbus jacksoni*, followed by *Schilbe intermedius*. These species are common and widespread across their global range and as such are listed by IUCN (2017) as least concern. All species, as well as *Protopterus aethiopicus* noted by local people, are hardy and can be found in slow flowing, turbid watercourses with relatively poor water quality.

Only three species of macroinvertebrate were recorded for the Waiga tributary, the majority of which was chironomid larvae. The only other species caught were a mollusc (freshwater snail) and a mayfly species. All three species can be found in relatively poor quality and slow flowing water. The macroinvertebrate survey results indicated that the survey site comprised a slow flowing watercourse with relatively poor water quality. Despite the relatively poor macroinvertebrate community, which provide a food source for fish, the fish community was relatively diverse.

Waisoke River

Six different fish species were caught during the surveys. The interface between the open water area and section covered by vegetation appeared to be favourable habitat for a catfish, *Clarias gariepinus* (IUCN least concern), with several individuals caught during surveys. Local inhabitants also reported that they often catch *Protopterus aethiopicus* (not assessed by IUCN 2017), *Schilbe intermedius* (IUCN least concern), a small mormyrid species and small *Labeo* species. The fish community was considered to be relatively poor with low overall abundance and diversity.

Six species of macroinvertebrate were recorded in samples from the Waisoke River. *Euthraulius* sp. (a mayfly) comprised most of the macroinvertebrates caught in the Waisoke River followed by *Orectogyrus* sp. (a water beetle). The macroinvertebrate community was poor in terms of the number, diversity and overall abundance of species observed. This is probably a reflection of poor water quality and an absence of habitat important for supporting diverse and abundant macroinvertebrates.

Sonso River

Only four species of fish were captured during surveys at the Sonso River, namely: *Aplocheilichthys bukobanus*, *Clarias gariepinus*, *Ctenopoma muriei* (synonym *Ctenopoma murie*) and *Polypterus senegalus*. All these species are categorised as IUCN least concern, except *Polypterus senegalus* which has not been assessed to date. Local inhabitants said that they often catch *Protopterus aethiopicus* (IUCN not assessed), *Schilbe intermedius* (IUCN least concern), small mormyrid species and small *Labeo* species.

Six types of macroinvertebrate were recorded in samples from the Sonso River, chironomid larvae comprising the majority. Although the habitat immediately surrounding the river did not appear to be heavily impacted by land use, there were very few fish or macroinvertebrate species caught during surveys.

The surveys showed a relatively uniform habitat throughout the river with few variations in flow types, substrate composition, and channel width or channel depth.

Such homogeneity is likely to be one of the factors contributing to the low diversity of fish and aquatic macroinvertebrates. Other factors could include fishing pressure and water quality.

Waki River

Seven different fish species were recorded during surveys in the Waki River, namely *Auchenoglanis occidentalis*, *Bagrus bajad*, *Raiamas senegalensis*, *Labeo horie*, *Schilbe intermedius*, *Synodontis frontosus* and *Synodontis nigrita*. All these species are IUCN listed least concern, except *Labeo horie*, which has not been assessed.

Just three types of macroinvertebrate were recorded in samples from the Waki River. Freshwater crabs (Potamonautidae) comprised the majority.

The Waki River habitat is considered degraded. However, eight species of fish were caught during the field survey indicating that the river has ecological potential if existing land-use pressures are managed.

Wambabya River

Only three fish species were recorded in the Wambabya River; a species of *Astatotilapia* which could not be identified, *Clarias liocephalus* and *Amphilius jacksonii*.

All species found during the field surveys are classified by the IUCN as least concern and are not of conservation importance. However, it is likely that other fish species inhabit the river and surrounding wetlands that were not found by the survey. Local fishermen suggest the area is a seasonal breeding and feeding ground for fish, most notably *Haplochromine* species, many of which are critically endangered or endangered.

Seventeen macroinvertebrate species were recorded in samples from the Wambabya River. All but one species are listed as IUCN least concern or have not been assessed.

Gastropods, such as *Gabiella humerosa*, were the most frequently recorded species. This species has a disjunct distribution⁵ in the Great Lakes of central Africa, but is subdivided into six subspecies according to which lake they are found in (Van Damme and Lange 2017). The Lake Albert subspecies *Gabiella humerosa* ssp. *Alberti* is classed as endangered by the IUCN on the basis of being an endemic species to Lake Albert and being found in only five known locations (Kyambadde 2010).

Trend in Condition and Sensitivity to Change

Except for the Sonso and Wambabya Rivers, all the surveyed rivers have been modified by human activity within the AOI, primarily due to livestock and people using the watercourses to drink and bathe. This damages the banks and leads to disturbance of the river bed and affects water quality. These rivers are showing

⁵ A disjunct distribution is one where two or more groups of a species are related but considerably separated from each other geographically.

transition between natural and modified habitat types, so have moderate sensitivity to change.

The Sonso and Wambabya Rivers comprise natural habitat in a relatively stable condition with only minor levels of human impacts. Despite this, the fish and macroinvertebrate communities are considered poor in diversity and abundance. Given the natural habitat and likely increase in land use pressures, these rivers have a high sensitivity to change.

The road upgrade being undertaken at the time of writing between Hoima, Butiaba and Wanseko crosses the rivers but should have a short-term impact only.

Table 6.4-5 Site-Specific Trends in Condition and Sensitivity to Change

Site	Trend in Condition	Sensitivity to Change
Sambiye River	The terrestrial vegetation in the river channel indicates it has been dry for a considerable time and probably has not flowed for months or possibly years. This trend is anticipated to continue.	Low
Waiga River	Declining due to livestock damage to the banks, disturbing the river bed and defecating in the water. This causes an increase in suspended sediment levels (inhibiting aquatic plant growth) and elevated nutrient levels.	Moderate
Waisoke River	Stable – affected by livestock and alien invasive species. Perennial watercourse that comprises semi-natural habitat	Moderate
Sonso River	Declining – although subject to low anthropogenic activity, this is likely to increase with increasing land use pressures which will cause the ecological value of the site to decline. Comprises natural habitat although the fish and macroinvertebrate communities within the river channel are considered poor in terms of their diversity and overall abundance	High
Waki River	Already degraded with visually high suspended sediment loads and cleared riparian vegetation. Anticipated to remain the same or worsen given the proposed hydropower scheme	Moderate
Wambabya River	Comprises natural habitat, although the fish and macroinvertebrate communities within the river channel are considered poor in terms of their diversity and overall abundance	High

Ecosystem Services Provided

The Sambiye, Waiga, Waki, Waisoke, Sonso and Wambabya Rivers and associated papyrus wetlands provide the following ecosystem services:

Provisioning services include:

- fisheries and a source of other wild food. These provisioning ecosystem services are covered in the freshwater livelihoods section of Appendix A9.

Regulating services include:

- water regulation, whereby the river helps retain and control the flow of water in times of heavy rainfall and during the wet season. The vegetation and shape of the river are important factors in this role.

Habitat and species support services include:

- the river supports various fauna that either use the water for drinking or cooling off in the heat, or as a food source (e.g., birds eating the insects that frequent the rivers). They also provide important connectivity between habitats, particularly during the wet season.

Sensitivity Rankings

Based on the survey, the trend in condition and sensitivity to change, the sensitivity of the VECs has been ranked and is shown in Table 6.4-6.

Table 6.4-6 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Biodiversity VEC	Sensitivity Ranking	Rationale for Ranking
Sambiye River		
Legally protected areas	High (4)	The Ugandan National Policy for the Conservation and Management of Wetlands protects the Sambiye River wetlands. This includes elements that protect the river as a biodiversity area and as a resource for local communities. Although outside the AOI, approximately 55% of the Sambiye catchment is within the Murchison Falls National Park.
Aquatic habitat of conservation importance	Low (2)	This is an ephemeral watercourse that was not in flow at the time of survey; local inhabitants claimed that this is always the case, except during infrequent periods of extended heavy rainfall. The site is therefore terrestrial for most of the time and thus has negligible value as an aquatic habitat.
Flora and fauna species of conservation importance	Very low (1)	No threatened aquatic species were identified during surveys as the watercourse was dry. Established terrestrial vegetation indicated that the river had not flowed at this location for some time and it is therefore considered unlikely to be a sensitive habitat or critical habitat for aquatic species.

Table 6.4-6 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Biodiversity VEC	Sensitivity Ranking	Rationale for Ranking
Waiga River		
Legally protected areas	High (4)	The Ugandan National Policy for the Conservation and Management of Wetlands protects the Waiga River wetlands. This includes elements that protect the river as a biodiversity area and as a resource for local communities. Although outside the AOI upstream of the pipeline, approximately 85% of the Waiga River catchment is within the Murchison Falls National Park.
Aquatic habitat of conservation importance	Moderate (3)	The surveyed area lies within a largely natural wetland area and is predominantly natural habitat. The Waiga is a permanent watercourse but does not link the Albertine Rift Lakes. Some disturbance from cattle was evident.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, and migratory (potamodromous) species are known to be present and others are considered to potentially be present based on secondary data (including the Critical Habitat Assessment undertaken by WCS and eCountability in 2016). The following species were recorded during field surveys and trigger critical habitat status under Criterion 3 (migratory and/or congregatory species), see Appendix B Critical Habitat Assessment: Barbus jacksoni Schilbe intermedius. AECOM 2017 also recorded another critical habitat trigger species, <i>Marcusenius victoriae</i> .
Waisoke River		
Legally protected areas	High (4)	The Ugandan National Policy for the Conservation and Management of Wetlands protects the Waisoke River wetlands. This includes elements that protect the river as a biodiversity area and as a resource for local communities. Although outside the AOI, approximately 70% of the upper Waisoke River catchment (upstream of the pipeline) is within National Forest Reserves.
Aquatic habitat of conservation importance	Moderate (3)	The surveyed area lies within a large wetland area and is predominantly semi-natural habitat. The Waisoke is a permanent watercourse but does not link the Albertine Rift lakes. Some disturbance from cattle was evident.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, and migratory (potamodromous) species are known to be present and others are considered to potentially be present based on secondary data (WCS and eCountability in 2016).

Table 6.4-6 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Biodiversity VEC	Sensitivity Ranking	Rationale for Ranking
Sonso River		
Legally protected areas	High (4)	The Ugandan National Policy for the Conservation and Management of Wetlands protects the Waiga River wetlands. This includes elements that protect the river as a biodiversity area and as a resource for local communities. Although outside the AOI upstream of the pipeline, approximately 90% of the upper Sonso catchment is within National Forest Reserves.
Aquatic habitat of conservation importance	High (4)	The surveyed area lies within a largely natural wetland area and is predominantly natural habitat. The Sonso is a permanent watercourse but does not link the Albertine Rift lakes. Some fishing activity was evident.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, and migratory (potamodromous) species are known to be present and others are considered to potentially be present based on secondary data (including the Critical Habitat Assessment undertaken by WCS and eCountability in 2016). <i>Clarias gariepinus</i> was recorded and <i>Schilbe intermedius</i> was reported by local fishers during field surveys and these species trigger critical habitat status under Criterion 3 (migratory and/or congregatory species), see Appendix B Critical Habitat Assessment.
Waki River		
Legally protected areas	Moderate (3)	The Waki River discharges into Lake Albert, which is part of a Ramsar site. However, the Waki is not considered to be a notable component of this site due to its distance from the Nile–Lake Albert Delta.
Aquatic habitat of conservation importance	Moderate (3)	This watercourse comprises semi-natural habitat.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, and migratory (potamodromous) species are known to be present and others are considered to potentially be present based on secondary data (including the Critical Habitat Assessment undertaken by WCS and eCountability in 2016). <i>Schilbe intermedius</i> was recorded during field surveys and triggers critical habitat status under Criterion 3 (migratory and/or congregatory species), see Appendix B Critical Habitat Assessment.

Table 6.4-6 Aquatic Biodiversity VECs and Sensitivity Ranking

Aquatic Biodiversity VEC	Sensitivity Ranking	Rationale for Ranking
Wambabya River		
Legally protected areas	High (4)	The Wambabya River discharges into Lake Albert, which is part of a Ramsar site. However, the Wambabya is not considered to be a notable component of this site due to its distance from the Nile–Lake Albert Delta. Upstream of the pipeline, the river’s catchment lies within a National Forest Reserve.
Aquatic habitat of conservation importance	High (4)	The surveyed area lies within a large wetland and is predominantly semi-natural habitat. The Wambabya is also a permanent watercourse but does not link the Albertine Rift lakes. Some disturbance of encroachment from agriculture was evident.
Flora and fauna species of conservation importance	High (4)	Endemic and range-restricted species, <i>Gabiella humerosa</i> ssp. <i>Alberti</i> (IUCN endangered) is known to be present

Key Considerations

Based on the outcomes of the aquatic ecology study, and particularly the known or likely presence of fauna species of conservation importance, the following watercourses are identified as sensitive VECs:

- Waiga River
- Waisoke River
- Sonso River
- Waki River
- Wambabya River.

All fish species recorded during the field surveys are on the IUCN Red List as either least concern or not assessed. Several endemic and or range-restricted (Lake Albert catchment) species were noted in the assessment and many of these are considered to trigger Tier 2 Critical Habitat status under Criterion 2 (endemic and or range-restricted species), see Appendix B Critical Habitat Assessment.

No anadromous (migrating between the sea and freshwater) species were encountered during surveys. However, several fish species were identified that undertake in-river migrations (potamodromous) for spawning. Such species have the potential to be affected by temporary or permanent in-river obstacles (e.g., dams installed during the installation of the proposed pipeline).

In addition, Appendix B Critical Habitat Assessment (WCS and eCountability 2016) identifies the following fish species as triggering critical habitat in Lake Albert and associated watercourses and wetland areas. In the absence of known barriers to movement along the watercourses within the project AOI, any or all these species could be present in any of or all the watercourses crossed by the pipeline.

- Criterion 1: threatened species
 - *Citharinus citharus*
 - *Citharinus latus*
 - *Lates macrophthalmus*
 - *Mesobola bredoi*
 - *Marcusenius victoriae* (IUCN endangered, Uganda not assessed)
 - *Synodontis victoriae* (IUCN near threatened, Uganda endangered)
- Criterion 2: endemic and/or range-restricted species
 - *Mesobola bredoi*
 - *Marcusenius victoriae*
 - *Haplochromis alberianus*
 - *Haplochromis loati*
 - *Haplochromis mahagiensis*
 - *Haplochromis avium*
 - *Haplochromis wingatii* (IUCN data deficient, Uganda endangered)
 - *Lates macrophthalmus*
 - *Oreochromis leucostictus* (IUCN least concern, Uganda not assessed)
 - *Synodontis afrofisheri* (IUCN least concern, Uganda not assessed)
 - *Synodontis victoriae*.

The presence of large intact mats of aquatic or wetland vegetation, in addition to several macroinvertebrate species from the order Ephemeroptera, indicates that these rivers are largely undisturbed.

The presence of freshwater crabs (family Potamonautidae) in the Waisoke and Waki Rivers probably indicates good quality water, as these invertebrates have been reported to dwell mainly in relatively pristine water conditions (Darwall and Smith 2011). The genus *Potamnautes*, found in the Waisoke River, has been reported to be either IUCN endangered or vulnerable (Cumberlidge 2011)⁶.

6.4.1.5 Avifauna Biodiversity

This section describes the:

- avifauna biodiversity AOI
- baseline condition of avifauna biodiversity in terms of:
 - habitats of importance for avifauna
 - avifauna species of conservation importance
 - trends affecting the condition of avifauna habitats and species of conservation importance and sensitivity to change
 - ecosystem services provided
 - avifauna biodiversity sensitivity rankings
- key considerations.

⁶ Individuals caught during the field surveys could only be identified to genus and hence the threat listing is uncertain

For more information, the avifauna biodiversity baseline report is included in Appendix A3.

Area of Influence

The AOI for the avifauna study is a 2-km corridor centred on the pipeline RoW, as this encompasses the area that has the potential for direct impacts during construction and operation. This is extended at certain locations where possible pathways exist to sites designated specifically for avifauna (e.g., a watercourse crossing upstream of an IBA).

The temporal AOI for avifauna is defined as the duration of the pipeline construction phase extended by the time required for the habitat to recover to its pre-pipeline potential (i.e., the habitat can support the species diversity and abundance, and ecological processes of the habitat in its pre-pipeline condition). The temporal AOI for avifauna species of conservation importance is the duration of operation of the AGIs where these have the potential to cause noise or visual disturbance.

Baseline Condition of Avifauna Biodiversity

Avifauna Habitats of Conservation Importance

Albert Flats

Eight locations within the Albert Flats area were surveyed during the wet season, and 22 locations were surveyed during the dry season (including repeat visits to the same location).

The Albert Flats are alongside Lake Albert's south-eastern shore and comprise natural and semi-natural grassland habitat with low, variable incidence and concentration of shrubs and trees. There are also extensive areas of bushland, thicket and wetlands.

Evidence of degradation was recorded, although the area is still rich in bird species. In some places, bare ground has been exposed, typically indicating overuse. Tree clearing, and a high level of overgrazing was recorded in most places.

The Albert Flats has high avifauna species diversity, with 60 species being recorded at a single site during the field surveys. Grey-crowned cranes, *Balaerica regulorum* (IUCN endangered, Uganda endangered) were recorded during both the wet and dry season surveys. The African woollyneck, *Ciconia microscelis* (IUCN least concern, Uganda vulnerable) was also recorded in this area.

Bugungu Wildlife Reserve (WR)

Eight locations within and adjacent to Bugungu WR were surveyed during the wet season, and 24 locations were surveyed during the dry season (including repeat visits to the same locations).

Bugungu WR is species-rich for avifauna, with several survey locations having sightings of more than 50 different species within the one-hour timed species count (TSC). Desk-based information highlighted that up to 240 species have been recorded in Bugungu WR including shoebill, *Balaeniceps rex* (IUCN vulnerable, Uganda endangered) in the seasonal wetlands.

Important species recorded during the field visits include:

- pallid harrier, *Circus macrouris* (IUCN near threatened, Uganda critically endangered)
- ovambo sparrowhawk, *Accipiter ovampensis* (IUCN least concern, Uganda vulnerable)
- grey-crowned cranes, *Balearica regulorum* (IUCN endangered, Uganda endangered)
- African woollyneck, *Ciconia microscelis* (IUCN least concern, Uganda vulnerable).

Above Escarpment

Twelve locations above the escarpment were surveyed during the wet season, and eleven were surveyed during the dry season.

As detailed above, most sites outside protected areas are undergoing degradation. Land is being cleared and trees cut for a variety of reasons (including firewood and charcoal), and thickets cleared for grazing and cultivation. Evidence of burning was noted at several locations.

The habitat above the escarpment is mainly characterised by modified habitat, such as shrubland and agriculture. Agricultural areas support small patches of native vegetation and few trees. Species richness based on the TSCs across the AOI ranged from 28 to 46 during the dry season surveys, reflecting the range of habitats, including agricultural habitats.

The habitat around KP84 is semi-natural and is characterised by scattered native trees and bushes with a low incidence of agricultural activity; KP65 is similar but supports degraded woodland and a wider variety of habitats than the agricultural areas.

The avian species composition of this area largely reflects the predominantly agricultural habitat with the mocking cliff chat, *Thamnolaea cinnamomeiventris* (IUCN least concern, Uganda not listed but with a local distribution) being a notable species.

One species of conservation importance, the ovambo sparrowhawk, *Accipiter ovampensis* (IUCN least concern, Uganda vulnerable), was recorded in this area.

Avifauna Fauna Species of Conservation Importance

Uganda is a bird-rich country, with about 1040 species recorded, of which about 800 are resident species (Carswell et al. 2005). The AOI avoids protected areas, but the Lake Albert flats, which are pastoral areas, are known to be species-rich (D Pomeroy, unpublished data for Total). Uganda's predominantly small-scale farmlands are also species-rich. However, other than species that require native trees for breeding, the species found there are typically not of conservation importance (Douglas et al. 2013).

Bird species richness was high in almost all sites, with several sites recording 40 or more species during a 1-hour TSC. Several sites recorded more than 50 species, indicating the importance of birds everywhere as contributors to ecosystem

services; notably pollination, seed dispersal and pest control. Several species were also identified as being of conservation importance, as detailed in Table 6.4-7.

Table 6.4-7 Key Avifauna Species of Conservation Importance Recorded During Field Surveys

COMMON NAME <i>Scientific Name</i> (Alternative Name)	Global					East Africa						Uganda					
	CR	EN	VU	NT	DD	CR	EN	VU	NT	RR	DD	CR	EN	VU	NT	RR	DD
Great white egret <i>Ardea alba</i>								✓									
Grey heron <i>Ardea cinerea</i>									✓								
Purple heron <i>Ardea purpurea</i>									✓								
African woollyneck <i>Ciconia microscelis</i>									✓					✓			
Short-toed snake eagle <i>Circaetus gallicus</i> (includes Beaudouin's Snake Eagle <i>C.beaudouini</i>)															✓		
Brown snake eagle <i>Circaetus cinereus</i>									✓								
Bateleur <i>Terathopius ecaudatus</i>									✓								
Pallid harrier <i>Circus macrourus</i>				✓					✓			✓					
Montagu's harrier <i>Circus pygargus</i>									✓						✓		
Ovambo sparrowhawk <i>Accipiter ovampensis</i>									✓					✓			
Grey-crowned crane <i>Balearica regulorum</i>		✓							✓			✓					
Western Banded snake eagle <i>Circaetus cinerascens</i>								✓									
African marsh harrier <i>Circus ranivorus</i>									✓								
Swallow-tailed bee eater <i>Merops hirundineus</i>									✓								

Table 6.4-7 Key Avifauna Species of Conservation Importance Recorded During Field Surveys

COMMON NAME Scientific Name (Alternative Name)	Global					East Africa						Uganda					
	CR	EN	VU	NT	DD	CR	EN	VU	NT	RR	DD	CR	EN	VU	NT	RR	DD
Spot-flanked barbet <i>Tricholaema lachrymosa</i>										✓							
Red-necked falcon <i>Falco chicquera</i>									✓								
Grey parrot <i>Psittacus erithacus</i>				✓					✓					✓			
Emin's shrike <i>Lanius gubernator</i>									✓								
Red-chested sunbird <i>Cinnyris erythrocerus</i>										✓							
Golden backed weaver <i>Ploceus jacksoni</i> (Jackson's Golden-backed Weaver)										✓							
Red-winged grey warbler <i>Drymocichla incana</i>									✓								
Grey-capped warbler <i>Eminia lepida</i>										✓							
Rufous sparrow <i>Passer cordofanicus</i> (include Shelley's Rufous Sparrow <i>P. shelleyi</i>)										✓							
Spotted greenbul <i>Ixonotus guttatus</i>									✓								
Toro olive greenbul <i>Phyllastrephus hypochloris</i>								✓							✓		
Yellow-billed oxpecker <i>Buphagus africanus</i>								✓									
Black-faced firefinch <i>Lagonostictats larvata</i>									✓								
Number of species	0	1	0	2	0	0	0	4	17	5	0	1	1	3	3	0	0

NOTES: CR = critically endangered, EN = endangered, VU = vulnerable, NT = near threatened, RR = regionally restricted, DD = data deficient

In addition to the species recorded during field surveys, see Appendix A3, the following species of conservation importance are potentially present in the AOI based on secondary data:

- lappet faced vulture, *Torgos tracheliotos* – IUCN endangered, Uganda critically endangered
- white-headed vulture, *Trigonoceps occipitalis* – IUCN critically endangered, Uganda endangered
- Denham’s bustard, *Neotis denhami* – IUCN near threatened, Uganda critically endangered)
- black stork, *Ciconia nigra* – IUCN least concern, Uganda endangered
- shoebill, *Balaeniceps rex* – IUCN vulnerable, Uganda endangered
- hooded vulture, *Necrosyrtes monachus* – IUCN critically endangered, Uganda endangered
- African white-backed vulture, *Gyps africanus* – IUCN critically endangered, Uganda endangered
- Rüppell’s griffon vulture, *Gyps rueppelli* – IUCN critically endangered, Uganda endangered
- African crowned eagle, *Stephanoaetus coronatus* – IUCN near threatened, Uganda endangered
- black-rumped buttonquail, *Turnix nanus* – IUCN least concern, Uganda endangered
- Pel’s fishing owl, *Scotopelia peli* – IUCN least concern, Uganda endangered.

Trend in Condition and Sensitivity to Change

Albert Flats

The trend of overgrazing and tree clearance is likely to continue without protection; in the long term, this is likely to reduce avifauna species diversity.

The Albert Flats comprise natural and semi-natural habitat that supports high avifauna diversity, and thus is considered to have high sensitivity to change.

Bugungu Wildlife Reserve (WR)

It is reasonable to expect that the condition of habitats well inside the reserve will remain unchanged in the future, as Bugungu WR forms part of the MFPA and is classed as an IUCN Category III site. However, continued land-use pressure such as cattle grazing has led to marked degradation in some areas of the Bugungu WR and KBA, particularly along the Hoima to Buliisa road which is also being widened at the time of writing as part of the Hoima–Butiaba–Wanseko road project. Despite protective legislation in place, there is the risk of further degradation. The condition of habitats immediately outside the reserve is likely to decline and this could result in increased edge effects on the reserve.

As Bugungu WR and the area immediately adjacent comprises natural and semi-natural habitat that supports high avifauna diversity, this area has high sensitivity to change.

Above Escarpment

Within existing agricultural areas there will be no change in condition; however, in remaining semi-modified habitats, the trend of habitat conversion is likely to continue, without protection, and is likely in the long term to reduce avifauna species diversity.

As this area is largely modified habitat, it is considered to have moderate sensitivity to change.

Ecosystem Services Provided

The habitats described in this report, with the avifauna species they support, generate a range of ecosystem services as set out below.

Provisioning services include:

- food (bushmeat hunting and egg gathering).

Regulating services include:

- many of the bird species (raptors, vultures and owls) being keystone species that provide pest control services.

Cultural services include:

- eco-tourism, particularly in protected areas
- use of feathers, bones and other body parts in ceremonial rituals.

Habitat and species support includes:

- refuge, feeding, watering, breeding and nursery areas for a range of bird species.

Supporting services include:

- pollination and seed dispersal.

Sensitivity Rankings

Based on the survey, the trend in condition and sensitivity to change, the sensitivity of the VECs has been ranked and is shown in Table 6.4-8.

Table 6.4-8 Avifauna VECs and Sensitivity Ranking

Avifauna VECs	Sensitivity Ranking	Rationale for Ranking
Lake Albert IBA		
Legally protected, internationally or nationally recognised areas	High (4)	Internationally recognised as an IBA
Flora and fauna species of conservation importance	High (4)	Supports migratory and/or congregatory species triggering Tier 2 Critical Habitat as per IFC PS6

Table 6.4-8 Avifauna VECs and Sensitivity Ranking

Avifauna VECs	Sensitivity Ranking	Rationale for Ranking
Albert Flats		
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Natural and semi-natural habitats supporting high avifauna diversity
Avifauna species of conservation importance	Very high (5)	Supports a species listed as endangered on the IUCN Red List: <ul style="list-style-type: none"> grey-crowned crane
Bugungu WR		
Legally protected, internationally or nationally recognised areas	High (4)	Nationally designated site (WR) and internationally recognised area (KBA)
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Natural and semi-natural habitats supporting high avifauna diversity
Avifauna species of conservation importance	Very high (5)	Supports critically endangered, endangered and vulnerable species: <ul style="list-style-type: none"> grey-crowned crane (IUCN endangered, Uganda endangered) pallid harrier (IUCN near threatened, Uganda critically endangered) African woollyneck (IUCN least concern, Uganda vulnerable)
Above Escarpment		
Avifauna species of conservation importance	Moderate (3)	Supports a species listed as vulnerable on the Uganda Red List <ul style="list-style-type: none"> ovambo sparrowhawk, <i>Accipiter ovampensis</i> (IUCN least concern, Uganda vulnerable)
Habitats of conservation importance (terrestrial and aquatic)	High (4)	Habitats providing important feeding and breeding grounds
Avifauna Species		
Avifauna species of conservation importance	Very high (5)	Species listed as critically endangered or endangered on the IUCN Red List: <ul style="list-style-type: none"> grey-crowned crane (IUCN endangered, Uganda endangered) lappet-faced vulture (IUCN endangered, Uganda critically endangered) white-headed vulture (IUCN critically endangered)

Table 6.4-8 Avifauna VECs and Sensitivity Ranking

Avifauna VECs	Sensitivity Ranking	Rationale for Ranking
		<ul style="list-style-type: none"> hooded vulture (IUCN critically endangered, Uganda endangered) African white-backed vulture (IUCN critically endangered, Uganda endangered) Rüppell's griffon vulture (IUCN critically endangered, Uganda endangered)
Avifauna species of conservation importance	High (4)	<p>Species listed as vulnerable on the IUCN Red List, or listed as critically endangered or endangered on the Uganda Red List:</p> <ul style="list-style-type: none"> shoebill (IUCN vulnerable, Uganda endangered) African crowned eagle (IUCN near threatened, Uganda endangered) Denham's bustard (IUCN near threatened, Uganda critically endangered) black stork (IUCN least concern, Uganda endangered) black-rumped buttonquail (IUCN least concern, Uganda endangered) Pel's fishing owl (least concern, Uganda endangered)
Avifauna species of conservation importance	Moderate (3)	<p>Species listed as vulnerable on the Uganda Red List:</p> <ul style="list-style-type: none"> African woollyneck (IUCN least concern, Uganda vulnerable) ovambo sparrowhawk (IUCN least concern, Uganda vulnerable)

Key Considerations

Based on the outcomes of the avifauna biodiversity study, and particularly the known or likely presence of species of conservation importance, the following areas are identified as sensitive VECs:

- Albert Flats, KP0–54 (excluding section within Bugungu WR; see next bullet)
- Bugungu WR, KP27–38
- above the escarpment, KP54–94.

The Bugungu WR and Albert Flats areas supported the greatest diversity of species and numbers of species of conservation importance. However, even in areas of

lower diversity, species of conservation importance were recorded, especially in semi-natural habitats that have not been degraded through grazing and agriculture.

Several avifauna species of conservation importance have been identified that are key considerations for the impact assessment. These species are important because they are listed as IUCN critically endangered, endangered or vulnerable; some are migratory and congregatory; and some are endemic to Uganda or range-restricted.

Table 6.4-9 Avifauna Key Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
African woollyneck	Bugungu WR and Albert Flats	Uganda vulnerable	Uganda vulnerable owing to a declining population and subpopulations being less than 1000 mature individuals
Pallid harrier	Bugungu WR	Uganda critically endangered	The main threats to this species include loss of grassland due to burning, cutting and overgrazing, and the use of pesticides, rodenticides and other chemicals.
Ovambo sparrowhawk	Bugungu WR, Albert Flats and above escarpment	Uganda vulnerable	Loss of woodland habitat due to cutting is a threat (Kemp and Kirwan 2013).
Grey-crowned crane	Bugungu WR and Albert Flats	IUCN endangered, Uganda endangered	The main threats to this species are loss and degradation of wetland breeding areas, illegal captive trade, hunting and egg capture, and human disturbance.
Lappet-faced vulture	Not observed during the field surveys, but is known in several protected areas in Uganda, including MFNP	IUCN endangered, Uganda critically endangered	The main threats to this species include poisoning, either intentionally or unintentionally, and hunting for bushmeat or body parts for use in traditional medicine.
White-headed vulture	Not observed during the field surveys, but is known in several protected areas in Uganda, including MFNP	IUCN critically endangered, Uganda critically endangered	The main threats include a reduction in medium-sized mammals and ungulates, as well as habitat conversion. Additional threats include indirect and deliberate poisoning.
Denham's bustard	Not observed during the field surveys, but is known to occur close to the pipeline AOI, within MFNP	IUCN near threatened, Uganda critically endangered	The main threats to this species are hunting, conversion of grassland and light woodland to agriculture and accidental collision with powerlines.
Black stork	Not observed during the field surveys but is known from several areas close to the pipeline AOI in	IUCN near threatened and Uganda endangered	The main threats to this species include habitat degradation, conversion of wetland wintering habitats, desertification and

Table 6.4-9 Avifauna Key Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
	Uganda, including Budongo and Bugoma FRs and Lake Victoria		pesticide pollution and accidental collision with powerlines.
Shoebill	Not observed during the field surveys but is known from several areas close to the pipeline AOI in Uganda including Bugungu WR and MFNP	IUCN vulnerable, Uganda endangered	Over most of its range, it is threatened by habitat destruction and degradation, disturbance, hunting, and capture for the bird trade.
Hooded vulture	Not observed during the field surveys but is known to occur throughout Uganda and from several areas close to the pipeline AOI	IUCN critically endangered, Uganda EN	Main threats to this species include habitat loss, intentional or unintentional poisoning, bushmeat hunting and small clutch size meaning the loss of one parent will lead to loss of offspring.
African white-backed vulture	Not observed during the field surveys but known to occur in several protected areas in Uganda and some areas close to the pipeline AOI including MFNP	IUCN critically endangered, Uganda endangered	The main threats include a reduction in medium-sized mammals and ungulates, as well as habitat conversion. Additional threats include indirect and deliberate poisoning.
Rüppell's griffon vulture	Not observed during the field surveys but is known from several areas close to the pipeline AOI including MFNP	IUCN critically endangered, Uganda endangered	The main threats to this species are habitat conversion, loss of wild ungulates, hunting for trade, persecution and poisoning.
African crowned eagle	Not observed during the field surveys but is known from several areas close to the pipeline AOI including Budongo and Bugoma FRs and Lake Victoria	IUCN near threatened, Uganda endangered	The main threats to this species are deforestation, collisions with anthropogenic structures and electrocution on utility networks, competition from humans for prey species, persecution in 90% of its range and human disturbance.
Black-rumped buttonquail	Not observed during the field surveys but is known from several areas close to the pipeline AOI in Uganda, including MFNP, Lake Victoria and Lake Albert	IUCN least concern, Uganda endangered	The main threats to this species are habitat loss and exploitation by humans.

Table 6.4-9 Avifauna Key Considerations

Species	Location(s)	Conservation Status	Considerations for Impact Assessment
Pel's fishing owl	Not observed during the field surveys but is known from several areas close to the pipeline AOI in Uganda, including MFNP	IUCN least concern, Uganda endangered	The main threats to this species construction of dams, water extraction, overfishing and water quality degradation reducing stocks of prey species.

Key considerations are:

- loss of habitat
- disturbance to nesting and foraging, both of which occur throughout the year.

6.4.1.6 Fauna Biodiversity

This section describes the:

- fauna biodiversity AOI
- baseline condition of fauna biodiversity in terms of:
 - habitats
 - fauna species (large mammals, small mammals, reptiles, amphibians and invertebrates)
 - trends affecting the condition of fauna habitats and species of conservation importance, and sensitivity to change
 - ecosystem services provided
 - fauna biodiversity sensitivity rankings
- key considerations.

For more information, the fauna biodiversity baseline report is included in Appendix A4.

AOI

For fauna species of conservation importance, the spatial AOI encompasses the direct pipeline footprint and areas within an ecologically relevant distance of the pipeline to account for potential indirect impacts arising from, for example, facilitated access, edge effects, the spread of invasive species and permanent habitat loss and fragmentation. The definition of an ecologically relevant distance relies on the mobility of a species, habitat connectivity between it and the pipeline, and the potential impact pathways between it and the pipeline. On a precautionary basis, the spatial AOI was generally defined by a 10-km-wide corridor centred on the pipeline route to account for the mobility of some fauna species.

In accordance with International Finance Corporation Performance Standard 6 (IFC PS6), the AOI may need to be extended to incorporate the entirety of any discrete management units (DMU) identified for endangered or critically endangered species, endemic or range-restricted species, migratory or congregatory species, or keystone species.

The temporal AOI is defined as the duration of the pipeline construction phase extended by the time required for the relevant habitat to recover to its pre-pipeline potential (i.e., the habitat is able to support the species diversity and abundance, and ecological processes of the habitat in its pre-pipeline condition).

Baseline Condition of Fauna Biodiversity

Habitats of Conservation Importance

Bugungu Wildlife Reserve

The Tilenga feeder pipeline route traverses adjacent to the western edge of Bugungu WR; as described in Section 6.4.1.1. Habitats within Bugungu WR are a mosaic of open grassland with scattered trees and scrub, with the most species rich habitat being closed woodland. The Tilenga feeder pipeline does not cross any such habitat. However, the Bugungu WR is part of the wider Murchison Falls Protected Area (MFPA); it acts as a buffer to the MFNP and provides opportunities for seasonal movements for mammal species within MFNP.

Bugungu WR supports several mammals of conservation importance (evidenced through interviews with locals and observations, see Appendix A4 for details); the Uganda Kob (*Kobus kob*), a congregatory lekking species found in great numbers within MFPA and Bugungu WR, lion (*Panthera leo*) and African elephant (*Loxodonta africana*), both of which the International Union for Conservation of Nature (IUCN) lists as vulnerable and the National Redlist of Uganda lists as critically endangered. Bugungu WR also supports the smooth chameleon, a Uganda endangered species.

Chimpanzee nests have previously been recorded in Bugungu WR (WCS and eCountability 2016). The data on these nests have been requested from the authors of the 2016 report. At present, it is assumed that nests were recorded in the region where Bugungu WR abuts the Budongo FR on the eastern edge of the WR.

Maseege Forest Reserve

The pipeline RoW is within 200 m of the Maseege Central Forest Reserve (CFR) between approximately KP15 and KP16.5 as described in Section 6.4.1.1.

No fauna species of conservation importance were found in the Maseege CFR. Nevertheless, the Maseege CFR is within an area identified as Tier 1 critical habitat for chimpanzee (WCS and eCountability 2016), see Appendix B Critical Habitat Assessment.

Bujawe Forest Reserve

The pipeline RoW passes close to (within 1km) but not through the boundary of Bujawe FR. At the time of survey, it was noted that large portions of Bujawe FR had been converted to agriculture and pine plantation, thereby reducing its conservation value. However, it does support common primate species and it is noted in the Sensitivity Atlas for the protection it affords the Hoimo and Rwamutunga Rivers, which are sources of water for people and livestock. Whilst no direct observations of mammals of conservation importance were recorded during the field surveys, interviews with community members noted that chimpanzee (*Pan troglodytes*

schweinfurthii), listed by both the IUCN and national red list as endangered, and Temminck's ground pangolin (*Smutsia temminckii*), listed by both the IUCN and national red list as vulnerable, use the FR.

Wetland and Aquatic Habitats

Aquatic habitats throughout the AOI, including wetlands, ponds and riparian habitats, support species of interest and act as movement corridors for several species. The Ugandan lowland shrew, *Crocidura selina* (IUCN data deficient, Uganda endangered and endemic) was recorded on two of the watercourses (Waisoke and Sonso Rivers). In addition, hippopotamus, (*Hippopotamus amphibius*, IUCN and national red list vulnerable) movement corridors between Lake Albert (refuge) and Bugungu WR were confirmed on the Waiga, Waisoke, Sonso and Waluka Rivers.

Wildlife Corridors

Previous studies within the AOI have identified the potential for wildlife movement corridors across the region. These include:

- daily movements by animals between Lake Albert and Bugungu WR
- seasonal movements of animals from the lowland areas north to the Nile River
- the potential for elephant movements south from the MFPA to the escarpment and beyond
- a corridor linking the MFNP, Budongo and Bugoma. This will not be affected by the Tilenga feeder pipeline.

By providing connectivity, corridors are noted as key ecological targets in the Strategic Plan for the Northern Albertine Rift of Uganda. Their importance is also specifically recognised in the Operational Guidelines for Oil and Gas Exploration and Production in Wildlife Protected Areas (UWA 2014).

Hippopotamus corridors have been confirmed between Lake Albert and Bugungu WR on the Waiga, Waisoke, Sonso and Walika Rivers. It is likely that other species make similar journeys under the cover of the rivers and the associated riparian vegetation. Given the level of habitat modification outside the reserve, it is also likely that most of these movements are also undertaken along watercourses connected to the lake.

Elephants within the MFNP have previously been recorded moving northwards during the wet season (UWA 2013). Elephants have been recorded south of the Nile River (Plumptre et al. 2015), specifically, in the Bugungu WR (WCS and eCountability 2016). However, information on elephants outside the MFNP, especially to the south, is not well documented and their use of Bugungu WR is not well-studied. Therefore, the use of the pipeline AOI by elephants needs to be considered carefully using the available data.

Species of Conservation Importance

Bats

Uganda has 95 documented species of bats. Of these species, twelve were observed during the baseline surveys. No species of conservation importance were found during the fauna baseline surveys.

Large Mammals

Of the 37 large mammal species recorded during the surveys, most were recorded in the Bujawe FR. Most species were common and widespread with the exception of the following, which are considered of conservation importance:

- chimpanzee (*Pan troglodytes Schweinfurthii*), IUCN endangered and Uganda endangered (identified through interviews and literature review)
- sitatunga (*Tragelaphus speki*), IUCN least concern, Uganda vulnerable: IUCN least concern and Uganda vulnerable (identified in the field survey at Hoimo River near KP77)
- Bohor reedbuck (*Redunca redunca*), IUCN least concern and Uganda endangered (evidence recorded at Hoimo River near KP77, Bubwe River at KP37 and Waiga River near KP21)
- Temminck's ground pangolin (*Smutsia temminckii*), IUCN and Uganda vulnerable (evidence recorded in Bujawe FR)
- tree pangolin (*Phataginus tricuspis*), IUCN and Uganda vulnerable (evidence of this species was found near KP58)
- leopard (*Panthera pardus*), IUCN and Uganda vulnerable (recorded by camera trap at the Waisoke River)
- Uganda kob (*Kobus kob*), IUCN least concern, Uganda not assessed and congregatory (lekking species) (reported in Bugungu WR and at the Waiga (KP21), Waisoke, Sonso, Bubwe (KP37) and Waluka Rivers, and KP41))
- Hippopotamus (*Hippopotamus amphibius*), IUCN and Uganda vulnerable (reported at the Waiga (KP21), Waisoke, Sonso, Waluka and Waki Rivers))
- lion (*Panthera leo*) IUCN vulnerable and Uganda critically endangered (identified through secondary data)
- African elephant (*Loxodonta africanus*), IUCN vulnerable and Uganda critically endangered (identified through secondary data)
- spot-necked otter (*Hydrictis maculicollis*), IUCN near threatened and Uganda endangered. (evidence recorded at the Hoimo (KP77) and Wambabya Rivers (KP89)).

Small Mammals

Only one small mammal species is of conservation importance was recorded during the baseline surveys:

- Ugandan lowland shrew (*Crocidura selina*), IUCN data deficient and Uganda endangered.

Reptiles

The baseline surveys in the AOI observed 26 species of reptiles. The most species-rich site was the Wambabya River and its immediate surroundings. Two-thirds of

the survey sites along the route could be considered species-poor, with four or fewer species recorded.

Two species of conservation importance were recorded during the field surveys:

- rainbow skink (*Lampropholis delicata*), IUCN not evaluated and Uganda vulnerable
- smooth chameleon (*Chamaeleo laevigatus*),

Amphibians

A total of 16 amphibian species, all of order Anura, was recorded along the pipeline AOI during the field surveys. The Wambabya River (KP89) and immediate surroundings had the highest diversity with 13 species, followed by the Waiga River (KP21) with 9 species. One species of conservation importance was recorded during the field surveys:

- Albertine Rift tree frog (*Leptopelis kivuensis*), IUCN least concern and Uganda vulnerable, endemic to the Albertine Rift.

There is little information available regarding reptile and amphibian populations in the region traversed by the pipeline AOI. However, information does exist for the Albertine Graben and the MFPA, which has mainly been collected through other studies associated with oil exploration in the region. From a review of the available information, based on the known distribution and habitat preferences, the following species of conservation importance could use habitats traversed by the route, though they were not recorded during the baseline surveys:

- *Pelusios chapini* (Zaire hinged terrapin): Uganda critically endangered; found in wetlands along the shore of Lake Albert
- *Trionyx triunguis* (African soft-shelled turtle): Uganda critically endangered; found in the Murchison Falls–Albert Delta wetland system
- *Phrynobatrachus auritus* (golden puddle frog): Uganda endangered; found in the Budongo, Bugoma and Wambabya FRs
- *Aparallactus lunulatus* (reticulated centipede-eater): Uganda vulnerable; found in Semliki National Park and Kabwoya WR.

Invertebrates

The invertebrate surveys identified several widespread species throughout the AOI. Some of these species require undisturbed habitat, and their presence shows that the habitats encountered still retain some of their original functions, despite varying degrees of modification.

Many of the species encountered during the survey have not been assessed at the global level and their conservation importance has been assigned using the Uganda Red List.

During the wet and dry season surveys, 202 species of butterflies and 61 species of dragonflies were recorded. No species were listed by the IUCN, but all were listed on the Uganda Red List. No records were available for the AOI from literature or consultations.

The following butterfly species are of conservation importance:

- *Anthene indefinita*, vulnerable
- *Anthene liodes*, vulnerable
- *Colotis chrysonome*, vulnerable
- *Platylesches moritili*, vulnerable
- *Prosopalpus styla*, vulnerable
- *Pentila tachyroides*, critically endangered (due to be revised to endangered owing to additional records)
- *Semalea arela*, data deficient – first known record in Uganda.

The following dragonfly species of conservation importance:

- *Acisoma inflatum*, vulnerable
- *Acisoma variegatum*, vulnerable
- *Agriocnemis palaeforma*, endangered
- *Azuragrion vansomereni*, data deficient – few known records in Uganda
- *Chlorocypha victoriae*, vulnerable
- *Hadrothemis camarensis*, vulnerable
- *Pseudagrion torridum*, vulnerable
- *Pseudagrion glaucoideum*, critically endangered.

Trend in Condition and Sensitivity to Change

Bugungu Wildlife Reserve

It is reasonable to expect that the conditions of habitat within the reserve will remain unchanged in the future, as Bugungu WR forms part of the Murchison Falls Protected Area. However, with continuing land-use pressure outside the protected areas network, the condition of the habitat immediately outside the reserve is likely to decline, which could cause increased edge effects on the reserve.

The Bugungu WR and its immediate surroundings support natural and semi-natural habitat that supports IUCN vulnerable species and has high sensitivity to change.

Maseege Central Forest Reserve

It is likely that the overall trend of habitat decline that typifies Uganda's forests applies even more in the Maseege CFR as a result of agricultural encroachment. The main road connecting Hoima and Buliisa, which is being widened at the time of writing, passes through the forest reserve, so there is high likelihood of increased traffic, which could affect fauna within the reserve.

Considering that the CFR is gazetted as industrial and commercial the forest reserve has a moderate sensitivity to change.

Bujawe Forest Reserve

Large parts of the FR have been and continue to be cleared for crop cultivation by local communities (OAG 2010). This trend is anticipated to continue.

Bujawe FR comprises modified habitat yet is within an area identified as Tier 1 critical habitat for chimpanzee, so has moderate sensitivity to change.

Wetland and Aquatic Habitats

The condition of these habitats outside protected areas is substantially degraded compared with the same rivers inside the protected areas. Livestock movements and agricultural activities have reduced cover and resulted in more open areas. This is anticipated to continue in response to land-use pressures.

The wetlands and other aquatic habitats providing connectivity across the landscape and therefore have high sensitivity to change.

Wildlife Corridors

There is insufficient information available to comment on the trend in condition of wildlife corridors.

Wildlife corridors provide important ecological function and therefore have high sensitivity to change.

Ecosystem Services Provided

Fauna generates a range of ecosystem services as set out below. Further details on the general nature and extent of the ecosystem services listed can be found in the land-based livelihoods Section 9.4.6 of Appendix A9 Socio-economic and Health Baseline Report.

Provisioning services include:

- food (hunting, gathering and foraging). In some areas, these activities are legal whereas in others they are not.
- trapping of wildlife for the live trade market
- other products, e.g., skins
- collection of medicinal products.

Cultural services include:

- ethical and biodiversity 'non-use' values, in particular in terms of maintaining populations of endangered and endemic species. These values are difficult to determine.
- eco-tourism, particularly in protected areas
- aspects of these species may provide spiritual, sacred or religious values; inspiration for culture and design; and cognitive development.

Fauna Sensitivity Rankings

The sensitivity of the VECs has been ranked and is shown in Table 6.4-10.

Table 6.4-10 Fauna Sensitivity Ranking

Fauna VEC	Sensitivity Ranking	Rationale for Ranking
Bugungu WR		
Legally protected area	High (4)	Nationally designated for biodiversity purposes
Fauna habitats of conservation importance	High (4)	Comprises natural habitat ¹
Flora and fauna species of conservation importance	High (4)	This area supports a range of species of conservation importance, including lion and smooth chameleon and chimpanzee (WCS and eCountability 2016)
Maseege CFR		
Legally protected area	Very low (1)	Designated as a FR for plantation forestry purposes
Fauna habitats of conservation importance	Moderate (3)	Comprises habitat in the process of transitioning from natural to modified habitat
Flora and fauna species of conservation importance	High (4)	This reserve is within an area identified as habitat for chimpanzee (WCS and eCountability 2016)
Bujawe FR		
Legally protected area	Moderate (3)	Designated as a FR and retains some biodiversity value
Fauna habitats of conservation importance	Moderate (3)	Comprises modified habitat with some biodiversity value
Flora and fauna species of conservation importance	High (4)	This reserve is within an area identified habitat for chimpanzee (WCS and eCountability 2016)
Wetland and aquatic habitats		
Fauna habitats of conservation importance	High (4)	Habitats providing connectivity, such as (but not limited to) riparian corridors and wetlands providing ecological linkages
Flora and fauna species of conservation importance	High (4)	Supports IUCN vulnerable and Uganda vulnerable species: <ul style="list-style-type: none"> • hippopotamus • Ugandan lowland shrew

Table 6.4-10 Fauna Sensitivity Ranking

Fauna VEC	Sensitivity Ranking	Rationale for Ranking
Wildlife corridors		
Fauna habitats of conservation importance	High (4)	Habitats providing connectivity, such as (but not limited to) riparian corridors and wetlands providing ecological linkages
Flora and fauna species of conservation importance	Very high (5)	Supports Uganda critically endangered species: <ul style="list-style-type: none"> • African elephant

Key Considerations

Based on the outcomes of the fauna biodiversity study, and particularly the known or likely presence of species of conservation importance, the following areas are identified as sensitive receptors:

- Bugungu WR is within an area identified as habitat for chimpanzee and a range of other fauna species, including lion, African elephant and smooth chameleon
- Maseege CFR owing to its location within an area identified habitat for chimpanzee
- Bujawe FR comprises modified habitat yet is within an area identified as habitat for chimpanzee, and supports IUCN and Uganda vulnerable species such as the Temminck's ground pangolin
- wetland and aquatic habitats such as Waiga, Waisoke, Sonso and Waluka rivers on the basis of the recorded presence of Ugandan lowland shrew (IUCN data deficient, Uganda endangered and endemic) and hippopotamus (IUCN and Uganda vulnerable)
- wildlife corridors providing connectivity such as (but not limited to) riparian corridors and wetlands.

Some species identified during the study (either recorded during field surveys or reported in secondary data) are considered to be of conservation importance and are key considerations. These species are important because:

- they are listed as IUCN endangered or vulnerable
- some are endemic to Uganda
- some are included in species action plans or the Uganda Red List, or are listed in the Convention on Migratory Species.

Table 6.4-11 summarises species of conservation importance.

Table 6.4-11 Key Fauna Considerations

Species	Location(s)	Conservation Status
Large mammals		
Chimpanzee	Wambabya River, Bugungu WR, Maseege CFR, Bujawe FR	IUCN endangered, Uganda endangered
Sitatunga	Hoimo River	IUCN least concern, Uganda vulnerable
Bohor reedbuck	Hoimo River, Bubwe River, Waiga River	IUCN least concern, Uganda endangered
Leopard	Waisoke River, Waiga River	IUCN vulnerable, Uganda vulnerable
Spot-neck otter	Hoimo River, Wambabya River	IUCN near threatened, Uganda endangered
Temminck's ground pangolin	Bujawe FR	IUCN vulnerable, Uganda vulnerable
Tree pangolin	KP58	IUCN vulnerable, Uganda vulnerable
Uganda kob	Waiga River, Waisoke River, Sonso River, Bubwe River, Walubkuba River	IUCN least concern, Uganda not listed, congregatory, key prey species for lion
Hippopotamus	Waiga River, Waisoke River, Sonso River, Walubkuba River, Waki River	IUCN vulnerable, Uganda vulnerable
Lion	Bugungu WR	IUCN vulnerable, Uganda critically endangered
African elephant	Bugungu WR	IUCN vulnerable, Uganda critically endangered, migratory
Small mammals		
Uganda lowland shrew	Sonso River, Waisoke River	IUCN data deficient, Uganda endangered, endemic
Reptiles		
Rainbow skink	KP55, KP56, KP59, KP64 and KP67	IUCN least concern, Uganda vulnerable
Smooth chameleon	Bugungu WR	IUCN least concern, Uganda endangered
Amphibians		
Golden puddle frog	Budongo, Bugoma and Wambabya FRs	IUCN least concern, Uganda endangered
Albertine Rift Tree Frog	Recorded during ESIA baseline survey – location not noted in field report	IUCN least concern, Uganda vulnerable and endemic to the Albertine Rift

Table 6.4-11 Key Fauna Considerations

Species	Location(s)	Conservation Status
Butterflies		
<i>Anthene indefinite</i>	Waisoke River (KP28), Bulwo River (KP36 and 37), KP56–59, KP61	IUCN not evaluated, Uganda vulnerable
<i>Anthene liodes</i>	KP15, KP16 (Maseege CFR), KP20, KP22–23, KP61 and Bulwo River (KP36, KP37) and Wambabya River (KP89)	IUCN not evaluated, Uganda vulnerable
<i>Colotis chrysonome</i>	KP15, KP16 (Maseege CFR), KP36, 37 and KP39	IUCN not evaluated, Uganda vulnerable
<i>Platylesches moritili</i>	KP84	IUCN not evaluated, Uganda vulnerable
<i>Prosopalpus styla</i>	KP13, KP15, KP16, KP36–37 (Bubwe River), KP64 and KP93	IUCN not evaluated, Uganda vulnerable
<i>Pentila tachyroides</i>	Wambabya River	IUCN not evaluated, Uganda critically endangered
<i>Semalea arela</i>	Maseege CFR	IUCN not evaluated, Uganda data deficient
Dragonflies		
<i>Acisoma inflatum</i>	KP36–39, KP21–23 (Waiga River), KP79	IUCN least concern, Uganda vulnerable
<i>Acisoma variegatum</i>	Kafu River	IUCN least concern, Uganda vulnerable
<i>Agriocnemis palaeforma</i>	KP16	IUCN vulnerable, Uganda endangered
<i>Azuragrion vansomereni</i>	KP0	IUCN least concern, Uganda data deficient
<i>Chlorocypha victoriae</i>	KP07, KP08, KP11, KP13, KP16, KP25–27	IUCN least concern, Uganda vulnerable
<i>Hadrothemis camarensis</i>	Wambabya River	IUCN least concern, Uganda vulnerable
<i>Pseudagrion (B) torridum</i>	Maseege CFR (KP15 and KP16), KP28 (R. Waisoke), KP39, stream at KP23–24, Bujawe forest (KP86–87)	IUCN least concern, Uganda vulnerable
<i>Pseudagrion (B) glaucoideum</i>	KP21, river at KP22–23	IUCN least concern, Uganda critically endangered

6.4.2 Physical Environment

6.4.2.1 Geology and Soil

This section describes the:

- soil AOI
- baseline condition of soil and geology along the route:
 - ecosystem services provided
 - soil sensitivity rankings
- key considerations.

For more information, please see Appendix A5: Geology and Soil Baseline Report.

Area of Influence

The geology and soil AOIs are based on the pipeline footprint and construction and operation of:

- the 30-m pipeline RoW
- construction camp and facilities
- access roads.

Aggregates are considered in the project description (see Section 2.4.2).

Baseline Condition of the Geology and Soil

Geology

In Uganda, precambrian crystalline rock, including gneiss and granite, constitutes approximately 90% of the land area. The remaining area is mostly underlain by younger volcanic and sedimentary rocks. The regolith covering the crystalline rock is weathered material that varies from rock fragments near the bedrock interface to well-weathered soil and hardened laterite at the surface. This regolith layer varies in thickness, but averages approximately 30 m (British Geological Survey 2001).

The Tilenga feeder pipeline traverses Cenozoic alluvial and rift sediments (approximately KP0–KP55) and Precambrian gneiss and granite complexes (approximately KP55–KP95) (Geological Survey of Uganda 1961; Schlüter 2006).

Seismicity and Earthquakes

Earthquakes in Uganda are associated with the East African Rift system, Rwenzori Mountains, Katonga fault and Aswa shear zone. Uganda lies between two parts of the Rift system: an eastern branch and a more seismically active western branch, neither of which is traversed by the pipeline RoW in Uganda. The western branch mostly overlaps the eastern border of the Democratic Republic of the Congo; the eastern branch traverses from southern Tanzania to northern Kenya.

Landslides and Sinkholes

A review of secondary data did not find landslides or sinkholes within the AOI and broader region at the time of writing. However, the Tilenga feeder pipeline traverses a scarp at approximately KP55, which is more likely to be prone to erosion and landslides.

Mining and Quarrying

A review of secondary data indicates that there may be existing mining and quarrying operations inside the AOI and broader region, further information is not available at the time of writing.

Artisanal and small-scale mining, including unlicensed mining, is described in the Socio-economic and Health Baseline Report (see Section 6.4.3.8).

Soil

Soil types within the AOI and broader region are shown on the soil type map in Figure A5.4 2 of Appendix A5. Table A5.4-1 of Appendix A5 presents the baseline survey soil classifications. In addition to the field survey, data from Isabirye et al. (2004) and Kaizzi (2017) has also been used to map soil resources within the AOI. The soil type classifications resulting from the baseline soil survey did not always correspond with the mapped soil type reported in Isabirye et al. (2004) and Kaizzi (2017). Isabirye et al. (2004) and Kaizzi (2017) provides consistent and comparable soil data and information in the AOI and broader region, whereas the field survey provides point data, relevant to the sampling location only. Soil profile data in Isabirye et al. (2004) and Kaizzi (2017) can sometimes be incomplete, which explains why there may be inconsistencies with the field survey classifications. Where inconsistencies exist at individual sample sites, the field survey data has been given preference.

Soil Structure

Soil texture varies along the length of the AOI (see Table A5.4-1 of Appendix A5). However, soil types with a high sand content, i.e., sandy clay loam and sandy loam, were found to be present along most of the route and were identified at 50% of the sample locations.

Soil containing high proportions of sand have been shown to be less vulnerable to dust and silt generation. However, soil with a low sand content was also identified at two of the sample locations (KP80 and KP95). Further, the potential for dust generation is also greatly influenced by the moisture content of the soil, and it is likely that many sections of the route will be prone to dust generation during the dry season, when moisture content will typically be low.

Sandy soil tends to have a relatively low bulk density owing to its larger particle size, so will be less sensitive to compaction. Soil comprising primarily silt and clay, for example, KP60 and KP95, has a higher bulk density, so will be more sensitive to compaction. Silty clay soil also has poor trafficability when wet.

Topsoil depth within the study area was found to range from 15 to 30 cm, although for most of the route the depth was 20–30 cm (Table A5.4-1 of Appendix A5). Thin topsoils (<5 cm) were not encountered during the field survey, although it is likely that such soil may be present along the route, particularly in areas of steep slopes or where shallow soils are developed on exposed bedrock.

Soil Productivity and Nutrient Content

The soil between KP0 and KP53.9 is characterised as low in productivity, with some areas not used for agriculture. The soil between KP53.9 and KP94.4 is more

productive (low–medium) and is predominantly used for growing crops, specifically maize and coffee (Kaizzi 2017). Soil types and characteristics along the Tilenga feeder pipeline have been outlined in Table A5.4-2 of Appendix A5.

The electrical conductivity of the samples ranged from 3.8 to 17.5 $\mu\text{S}/\text{m}$ and averaged 8.3 $\mu\text{S}/\text{m}$; this would be considered low to moderate. Sample SU005 (KP80) had the highest electrical conductivity at 17.5 $\mu\text{S}/\text{m}$. The cation exchange capacity (CEC) of this sample was 26.2 meq/100 g soil and it had a moderate amount of organic matter (4.6%). However, it was nutrient poor, with low levels of phosphorous, magnesium and potassium. This dark soil was described by the surveyors as in a transitional phase owing to material having been deposited from the nearby slopes.

All the other samples contained very low levels of extractable nutrients and had a low organic matter content.

Phosphorus, potassium, and magnesium are macronutrients required by plants that are necessary for the basic biological functions such as growth, photosynthesis and respiration (Singh and Schulze 2015). Deficiencies can negatively affect vegetative growth and yield and result in increased mortality rates.

Soil erosion risk is categorised in the erosion risk assessment (Appendix G1) and soil sensitivity is categorised in the sensitivity tables.

The soil types identified along the pipeline route were Lixic Ferralsols, Acric Ferralsols and Calcisols (Table A5.4-2 and glossary of Appendix A5). Soil pH ranged from 6.4 to 7.2, which indicates that most of the profiles were within the slightly acidic to moderately alkaline range, so have good agricultural production potential. Most of the topsoil had low to medium organic matter content and high base status, which indicates that soil could be productive if well managed. Most of the soil had low to very low extractable phosphorus levels.

The results of the soil laboratory tests for parameters potentially indicative of fertility are presented in Table A5.4-3 of Appendix A5.

Potential Sodic B Horizons

Attachment A5.1 of Appendix A5 presents the results of the soil laboratory tests for parameters potentially indicative of possible sodic B horizons.

A sodic B horizon is a subsoil layer in which sodium occupies greater than 15% of the exchange complex (i.e., the exchangeable sodium content is greater than 15% of the cation exchange capacity; by definition, therefore, the combined exchangeable calcium and magnesium content would be less than 85% of the cation exchange capacity). Soil with a high exchangeable sodium content is associated with adverse physical conditions such as slumping or compaction and deflocculation of clay particles, which makes them more susceptible to erosion. Potential sodic B horizons were not observed during the field survey.

Soil Contamination

At the time of writing, potential sources of contamination such as industry, commerce or heavily populated areas do not occur within the AOI and there was no evidence of existing sources of potentially substantial contamination.

Table A5.4-4 of Appendix A5 presents the results of the soil laboratory tests for parameters potentially indicative of contamination.

Laboratory analysis was undertaken on the six samples (SU001–SU006) collected during the field survey:

- Copper was detected in two samples at a maximum of 0.12 mg/kg.
- Manganese was detected in six samples at a minimum of 0.06 mg/kg and a maximum of 0.40 mg/kg.
- Zinc was detected in three samples at a maximum of 0.30 mg/kg.

The results indicate that there is no soil contamination at the locations sampled and that the levels detected are typical of natural soil concentrations in Uganda. No arsenic, cadmium, hexavalent chromium, lead, mercury, molybdenum, nickel, selenium or total petroleum hydrocarbons were detected in the samples, which indicates no contamination at sampling locations.

Oil seeps, where hydrocarbons naturally travel to the Earth's surface, have been identified in several locations in the Albertine graben (Patton et al. 1995; Cassie et al. 2006; Lirong et al. 2006). Although the extent of the seeps is uncertain, at least eight "low-confidence" seeps are known to occur in Lake Albert (Cassie et al. 2006). The nearest recorded oil seep (Runga-1) is approximately 300 m outside the AOI (Petroleum Authority of Uganda 2017). Although oil seeps have not been observed within the AOI, it is possible they may exist or that hydrocarbons from seeps outside the AOI have migrated laterally to within the AOI.

Trend in Condition and Sensitivity to Change

The soil types within the AOI are of reasonable agricultural quality but are vulnerable to differing pressures.

External physical (e.g., vehicle movement) or chemical (e.g., fertiliser use) pressures may reduce soil quality as a result of nutrient loss, compaction, erosion and or contamination. Within this area of Uganda there has been long-term drought, and flooding and heavy rainfall at different times, with some areas experiencing both drought and flooding during the same year (see climate baseline, Appendix A14). Drought and flooding may exacerbate weathering, make soil more prone to erosion and cause the loss of nutrients and organic matter.

Current and future agricultural activities and practices are also likely to affect the soil within the study area. Animals and machinery can diminish protective plant cover and cause structural damage and erosion of soil. Fertiliser is now required to improve soil fertility in many areas. If used incorrectly, fertiliser can cause diffuse and point-source agricultural pollution to surface and groundwater. In addition, there is increasing evidence of severe soil degradation caused by erosion (mining and deforestation) in Uganda (Lufafa et al. 2003). Stakeholders engaged as part of the baseline surveys have commented that much of their land is less fertile and productive than it has been in the past. Continued use of the land within the study area for agriculture and grazing is likely to result in continuing deterioration in soil quality.

Ecosystem Services Provided

The soil in the AOI and their associated micro-organisms provide a range of ecosystem services as set out below.

Provisioning services include:

- quarrying operations for rock and construction aggregate materials.

Regulating services include:

- soil quality regulation, nutrient cycling, carbon storage and water storage and flow control.

Soil Sensitivity Rankings*Fertility*

Table 6.4-12 summarises the sensitivity ranking for soil fertility based on the sensitivity table in Appendix D. The fertility sensitivity scores are based on soil descriptions in the World Reference Base for Soil Resources (WRB) (FAO 2014) and the data from Isabirye et al. (2004) and Kaizzi (2017). Location-specific ranking based on the soil classification information collected during the field survey is also provided. This was supported by data gathered by the soil field surveys.

Table 6.4-12 Soil Fertility Sensitivity Ranking

Fertility	Sensitivity Ranking	Rationale for Ranking
6 locations	Very low (1)	No ecosystem or agricultural value
1 location	Low (2)	Soil with low agricultural productivity
2 locations	Moderate (3)	Soil with moderate agricultural value. May take up to three years to fully recover
1 location	High (4)	Soil with high agricultural productivity. May take three to six years to fully recover
None recorded but may be found to occur locally	Very high (5)	Soil with very high agricultural productivity or ecosystem value

NOTE: KP ranges can be found in Appendix A5.

Compaction

Table 6.4-13 summarises the sensitivity ranking for soil compaction based on the sensitivity table in Appendix D. The compaction sensitivity scores are based on soil descriptions in the World Reference Base for Soil Resources (WRB) (FAO 2014) and the data from Isabirye et al. (2004) and Kaizzi (2017).

Table 6.4-13 Soil Compaction Sensitivity Ranking

Compaction (KP Ranges)	Sensitivity Ranking	Rationale for Ranking
None recorded but may be found to occur locally	Very low (1)	Not susceptible to erosion or compaction
1 location	Low (2)	Soil will respond well to restoration techniques to mitigate compaction
1 location	Moderate (3)	Soil will usually respond moderately well to restoration techniques to mitigate compaction. May take up to three years to fully recover
None recorded but may be found to occur locally	High (4)	Soil that may need more intensive restoration techniques to mitigate compaction. May take three to six years to fully recover
None recorded but may be found to occur locally	Very high (5)	Soil that may be difficult to restore to its former condition

NOTE: KP ranges can be found in Appendix A5.

Erosion

Table 6.4-14 summarises KP ranges for soil with sensitivity rankings of very high risk for erosion. The erosion risk assessment focuses on areas of very high sensitivity rankings only due to high potential for erosion to occur in these locations. The erosion sensitivity scores are in the erosion risk assessment (Appendix G1).

Table 6.4-14 Soil Erosion Sensitivity Ranking

KP Ranges	VEC	Sensitivity Ranking	Rationale for Ranking
2 locations	Soil	Very high (5)	Soil at very high risk of erosion, according to soil type and slope

NOTE: KP ranges can be found in Appendix A5.

Soil Contamination

Throughout the length of the study area, the value of the soil varies. However, contamination was not identified at any of the locations in the AOI and owing to the predominantly rural nature of the AOI, contamination is unlikely to exist. Therefore, soil is considered to have a moderate sensitivity to contamination.

Key Considerations

Soil sensitivity rankings range from very low to very high, depending on the soil type; there is considerable variation along the entire length of the AOI.

Soil is recognised as providing both regulating ecosystem services (e.g., erosion regulation and soil quality regulation) and provisioning ecosystems services (e.g., provision of aggregate).

6.4.2.2 Surface Water

This section describes the surface water:

- area of influence (AOI) and study area boundaries
- baseline conditions:
 - trend in condition and sensitivity to change
 - ecosystem services provided
 - sensitivity rankings
- key considerations.

A water source study is being conducted concurrently with the preparation of this ESIA. Information obtained by the water source study has been used to inform the surface water baseline. The water source study objective is to investigate and develop:

- water resources to supply construction facilities, pipeline construction and hydrostatic pressure testing (hydrotesting) of the constructed pipeline
- a strategy for using surface water as a potential source of supply for hydrotesting.

Lake Albert has been identified as a potential source of hydrotest water but has not been included in surface water surveys or investigations at the time of writing.

Baseline surface water investigations for hydrotest water, including Lake Albert if it is confirmed that lake water will be used for the hydrostatic test, will be included in the water use permit application to the Department for Water Resources Management (DWRM) with jurisdiction for water abstractions.

Surface water may occur as permanent or ephemeral watercourses (channels and floodplains), wetlands and waterbodies. The term “ephemeral” is used to include those watercourses with seasonal flow and those with flow just following rainfall.

For more information, see the surface water baseline report (Appendix A6).

Area of Influence

The AOI for the construction phase includes:

- the footprint at the location where the pipeline or access road crosses a watercourse or waterbody
- waterbodies downstream of the crossing point, including Lake Albert.

The spatial AOI for construction varies from 2–5 km downstream of the pipeline crossing point or construction facility, depending on the extant quantity of water and

its quality, including sediment concentrations and turbidity, in the watercourse and the quantity and quality of any water discharged.

The AOI also includes surface waterbodies that will be used to supply water to the project. At the time of writing, surface water is considered a potential water resource for hydrotesting.

The temporal AOI for construction is the period that includes abstraction and discharge and a short recovery period of less than one year.

The spatial AOI for operation is 2–5 km downstream of watercourses and waterbodies and the temporal AOI for the operations stage is the life of the project, approximately 25 years.

The study area is larger than the AOI as it comprises the upstream catchment areas of the watercourses crossed by the pipeline, access roads or discharge points and downstream to key VECs. This is because land use in catchments upstream of the pipeline influences the flow and water quality regimes at the crossing points and downstream VECs. The pipeline route crosses many minor tributaries. These are characterised by indistinct channels when viewed on satellite imagery and small catchment areas. The route crosses nine major watercourses: the Sambiye, Waiga, Waisoke, Sonso, Bubwe, Waki, Hoimo, Rwamutonga and Wambabya Rivers. These rivers are the focus of this report (Figure 6.4-5). The rivers all drain into Lake Albert which is within the AOI for the Waiga, Waisoke, Sonso, Bubwe and Waki Rivers.

Water scarcity for communities was assessed within a 2-km corridor along the pipeline, along pipeline roads and near construction facilities.

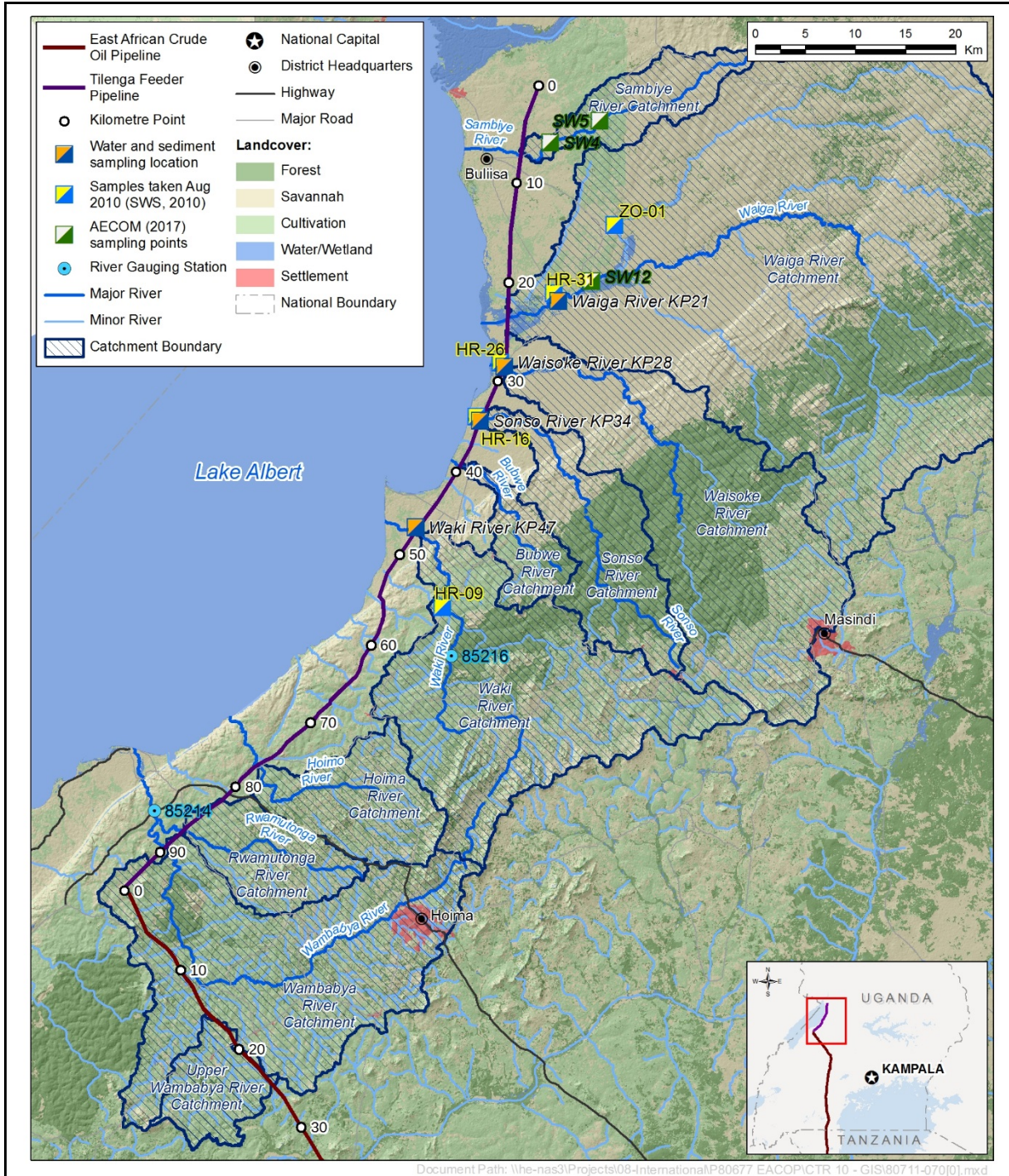


Figure 6.4-5 Lake Albert, Main Watercourse Crossings and Catchments

Baseline Condition of Surface Water

Flow and Flood Regimes

Pipeline Crossings

There are nine pipeline crossings of major watercourses as listed in Table 6.4-14. There are no other important surface waterbody pipeline crossings within the AOI other than those listed in this table.

With the exception of the Sambiye River, which is ephemeral, all rivers studied have a permanent flow regime. A bimodal flow distribution is evident in most rivers, with higher flows in April–May and October–November reflecting rainfall maxima in these periods and dry seasons from December to March and from June to July (Table 6.4-15 and Figure 6.4-6).

The flood study (see Appendix A6) suggests the bankfull capacities of the Waiga, Waisoke, Sonso, Bubwe and Wambabya Rivers are considerably less than their mean annual floods. Consequently, these rivers may be expected to flow over their banks and across their floodplains several times a year during floods smaller and more frequent than the mean annual flood. The Hoimo and Rwamutonga Rivers may flow over their banks on average once a year for floods equal to and greater than the mean annual flood. The Waki River may flow over its banks once on average every five years. The Sambiye River lacks a defined channel and ephemeral flow always occurs in the floodplain.

Road Crossings and Construction Facilities

There are two access roads, ERU-BCPF⁷ and ERU-MCPY⁸, in the study area (Figure 6.4-7), but they cross no waterbodies. Consequently, no road–watercourse crossings are assessed in this chapter.

Table 6.4-17 presents a list of construction facilities. The only construction facility associated with the Tilenga feeder pipeline is the MCPY at KP45. There are no nearby watercourses. Lake Albert is approximately 800 m north of the MCPY. Flow in the immediate vicinity of the MCPY may be characterised as sheet surface runoff occurring for short periods during and after storm rainfall.

⁷ ERU-BCF = existing road upgrade-Buliisa central production facility

⁸ ERU-MCPY = existing road upgrade-main camp and pipe yard

Table 6.4-15 Estimated Median Monthly Flows at Main Watercourse Crossings, m³/s

KP	River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
7	Sambiye	ND												
21–25 ¹	Waiga	8.05	7.58	8.05	12.53	14.08	9.75	10.99	12.07	13.07	14.08	14.62	9.75	11.53
28–29 ¹	Waisoke	2.46	2.32	2.46	3.84	4.31	2.98	3.36	3.69	4.00	4.31	4.48	2.98	3.53
34.3	Sonso	0.93	0.88	0.93	1.45	1.63	1.13	1.27	1.40	1.51	1.63	1.69	1.13	1.34
39	Bubwe	0.30	0.29	0.30	0.47	0.53	0.37	0.42	0.46	0.49	0.53	0.55	0.37	0.44
46.9	Waki	2.32	2.19	2.32	3.61	4.06	2.81	3.17	3.48	3.77	4.06	4.21	2.81	3.33
77	Hoimo	0.69	0.65	0.69	1.08	1.21	0.84	0.94	1.04	1.12	1.21	1.26	0.84	0.99
87	Rwamutonga	0.32	0.20	0.26	0.58	0.82	0.43	0.48	0.64	0.82	1.08	1.18	0.55	0.56
89.5	Wambabya	1.64	1.04	1.30	2.97	4.25	2.21	2.48	3.30	4.22	5.59	6.10	2.81	2.89

NOTES: ND = no data

¹ The range in KP indicates the width of the floodplain.

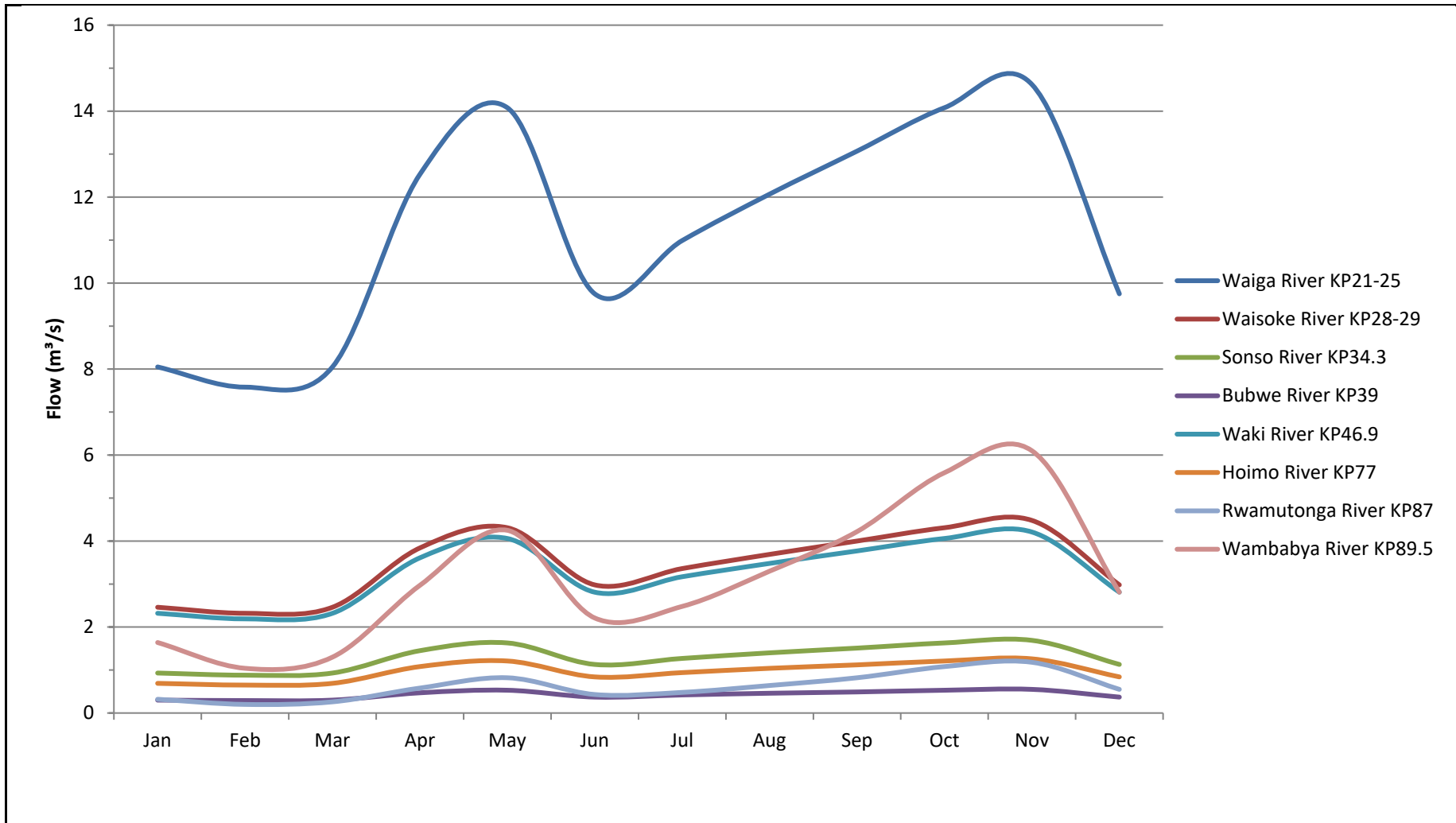


Figure 6.4-6 Streamflow Regime at Watercourse Crossings

Lake Albert

Lake Albert is the largest surface waterbody within the AOI. The largest rivers flowing into the lake are the Semliki River from Lake Edward and the Victoria Nile from Lake Victoria through Lake Kyoga. The Albert Nile flows out of the lake. Outflows from both Lake Victoria and Lake Albert have been shown to fluctuate between 1000 and 2000 m³/s with an average outflow of about 1250 m³/s (107 million cubic metres per day (m³/d)). Data indicate (Nsubuga et al. 2014) that there is a strong correlation between inflows, in this case from Lake Victoria to Lake Albert and outflows from Lake Albert, and this has been relatively constant over time, with a constant mass balance between inflows and outflows.

Local studies (MWE 2013) show that inflows from the Victoria Nile River help to maintain the level of water in Lake Albert and its rate of flow is considerably higher than that of the Semliki River, which has annual flows between five and thirty times less than the corresponding annual flows in the Victoria Nile River. Studies also revealed that the rivers (e.g., Waisoke and Waiga River) in the Lake Albert basin catchment area (i.e., south of the Victoria Nile River) have relatively stable dry season flows compared to rivers (e.g., Tangi River) in the Albert Nile sub-basin catchment area (i.e., north of the Victoria Nile) which exhibit seasonal variation.

Although Lake Albert is not entered, all the rivers crossed by the pipeline drain into the lake. The Bubwe River crossing is nearest to Lake Albert at 1.3 km.

River Channel Morphology and Stability

Pipeline Crossings

Table 6.4-16 presents estimates of stream power (a measure of the energy available to cause erosion and sediment transport) and an assessment of stream channel stability based on stream power, channel planform, bed and bank materials and riparian vegetation.

With the exception of the Bubwe River (KP39), most channels are assessed as being stable. The Bubwe River is considered unstable, as papyrus swamp vegetation is absent and bank protection is reliant on degraded grasses and shrubs. Erosion and deposition processes are likely to be more active along this river.

Construction Facilities

Table 6.4-17 presents an estimate of watercourse stability at the MCPY at KP45. The area near the MCPY that will receive site drainage is assessed as stable.

Table 6.4-16 Main Pipeline Crossings: River Channel Morphology and Stability

Watercourse	KP	Stream Power (W/m) ¹	Estimated Floodplain Width (m)	Channel Bankfull Width (m)	Channel Planform	Channel Bed Materials	Channel Bed Materials	Riparian Vegetation	Stable or Unstable Channel
Sambiye River	7	290	59	Channel absent	Sinuuous ²	Sand, silt	Sand, silt	Degraded savannah	Stable ¹
Waiga River	21–25	451	5200	6	Meandering	Sand, silt	Sand, silt	Swamp vegetation, grass	Stable
Waisoke River	28–29	410	600	6	Meandering	Sand, silt	Sand, silt	Swamp vegetation	Stable
Sonso River	34.3	255	50–60	9	Meandering	Sand, silt	Sand, silt	Swamp vegetation	Stable
Bubwe River	39	455	20–30	3	Meandering	Sand, silt	Sand, silt	Grass, shrubs	Potentially unstable
Waki River	46.9	944	60	9	Meandering	Sand, silt	Sand, silt	Discontinuous woodland, swamp vegetation	Stable
Hoimo River	77	638	10	7	Sinuuous	Basement rock, coarse gravel	Silt, clay	Thick woodland and swamp vegetation	Stable
Rwamutonga River	87	78	30	8	Sinuuous	Basement rock, coarse gravel	Silt, clay	Thick woodland	Stable
Wambabya River	89.5	309	20	10	Meandering	Basement rock, coarse gravel	Silt, clay	Thick woodland	Stable

NOTES: ¹Stream power is calculated at the MAF (see Attachment A6.4 in Appendix A6). ² This applies to the floodplain.

Table 6.4-17 Pipeline Facilities – Stability of Watercourses Nearby

KP	Pipeline Facility	Watercourse Type	Distance to Watercourse/VEC from Facility (m)	Land Cover	Likely Nature of VEC Soil	Evidence of Existing Erosion	Stable or Unstable Receptor
45	MCPY	Ephemeral wetland	150 m (north)	Grassland	Sandy-silt	None	Stable

Water and Sediment Quality and Sensitivity to Contamination

Water Quality – River Crossings

Water quality was assessed in relation to the national potable water specification (UNBS 2014). The national potable water specification is incorporated into EACOP project standards which will be used for Tilenga feeder pipeline. Onsite and laboratory analytical results showed good water quality in the rivers at the times of sampling with low levels of anthropogenic contamination. Exceedances of national potable water quality standards were observed for:

- turbidity: exceedances were measured in the Waiga, Waisoke and Waki Rivers during the dry season water quality survey. Exceedances were also measured in August 2010 and June 2017 (SWS 2010; AECOM 2017). The exceedances are likely to be due to rainfall and flow variation in the days preceding the sampling and are likely to be temporary.
- aluminium: two exceedances of the limit for natural and treated water in the Waiga River (AECOM 2017), likely to be due to natural geological causes
- iron: exceedances of the limit for natural and treated water in all rivers sampled in the present study, by SWS (2010) and by AECOM (2017), likely to be due to natural geological causes
- manganese: two exceedances of the limit for natural and treated water in the Waiga River (AECOM 2017), likely to be due to natural geological causes
- total coliforms and E. coli: exceedances in all samples in the present study, likely to be due to use of the rivers by wild animals, livestock and by people for domestic purposes.

All hydrocarbon analyses in the rivers sampled were below the detection limits at the times of sampling.

Overall, the water quality results are consistent with rivers in catchments with dispersed rural settlement, frequent use by livestock and people and for domestic purposes, and in which there are high rates of biological activity.

Water Quality – Lake Albert

Baseline water quality studies were undertaken at Lake Albert between 2014 and 2017 (AECOM 2018) and the following observations were made:

- The water of Lake Albert is more saline than that of other surface water bodies within the area.
- Physio-chemical water quality analysis results show that most of the parameters analysed comply with national potable water quality standards except for aluminium and iron which exceeded the corresponding limits.
- Elevated iron and aluminium exceedances were detected only in near-shore samples and this can be linked to the water quality of inflows from the Victoria Nile River. Other watercourses draining the area and groundwater, as elevated iron and aluminium were also detected in samples taken from these waterbodies and groundwater boreholes.
- No petroleum hydrocarbons were detected in any samples above the laboratory detection limits. There are no water quality standards for this parameter.

- Trace concentrations of toluene and ethylbenzene were noted but at levels ranging from three to four levels of magnitude lower than national potable water quality standards.

Sediment Quality

The concentrations of hydrocarbons and PAHs were below the detection limit at all the sites sampled. However, some metals were above the detection limit in several samples taken downstream of road bridges, which suggests that road runoff affects sediment quality at these locations.

Sensitivity of Watercourses to Potential Contamination

The sensitivity to potential contamination depends on the degree of existing contamination and was ranked according to the table for water quality sensitivity in Appendix D. Attachment A6.18 of Appendix A6 presents the assessment of the sensitivity of watercourses near pipeline construction facilities to potential contamination.

Pipeline Crossings

The Waiga, Waisoke and Sonso Rivers were assessed as having a very high sensitivity to potential change in water quality. Their catchments are covered with natural vegetation in good condition, legally protected by the Murchison Falls National Park, Bugungu Wildlife Reserve and Budongo Forest Reserve.

The Sambiye, Bubwe, and Waki Rivers were assessed as having a high sensitivity to potential change in water quality. Their catchments are partially within legally protected areas (the Murchison Falls National Park, Bugungu Wildlife Reserve and Budongo Forest Reserve) and partially settled with subsistence agriculture and livestock rearing.

The Hoimo, Rwamutonga and Wambabya Rivers were assessed as having a moderate sensitivity to potential change in water quality. Their catchments are relatively densely settled with subsistence agriculture, some plantation agriculture and livestock rearing.

Construction Facilities

The ephemeral wetland near the MCPY was assessed as having a high sensitivity to potential change in water quality because its catchment is sparsely settled, and livestock grazing is the main activity.

Water Scarcity for Community Use

An assessment of relative water scarcity for communities along the pipeline route, along project roads and near construction facilities is included in the surface water baseline study (see Appendix A6). The assessment of relative water scarcity includes groundwater as a source of water supply (please refer to the “Water Scarcity for Community Use” section in Appendix A6 which explains the methodology). A summary is shown in Table A7.4-3 in Appendix A7.

Project Districts

The percentage of the population in districts and subcounties without access to safe water supplies and the percentage of nonfunctioning water sources have been estimated from the Uganda Water Supply Atlas 2017 (MWE 2017c). Official statistics suggest slightly lower non-access rates in Buliisa district at the northern end than in Hoima district at the southern end of the pipeline (Figure 6.4-7). In both Buliisa and Hoima districts, nonfunctionality due to technical breakdown 50–60%. In Buliisa district, water quality accounts for 33% and low yield 8.3% of nonfunctionality. In Hoima district, water quality and low yield both account for 20% of source nonfunctionality (MWE 2017c).

Pipeline

Within a 2-km corridor along the pipeline, water is scarcest at the northern end of the pipeline route and scarcity reduces in a southerly direction. Water scarcity was assessed as high between KP0 and KP20, mainly due to the semi-arid climate in the Rift Valley, the unreliability of surface water sources and the distance to water that livestock must walk. There are relatively few wells and boreholes in this zone and a substantial number were found to be not functioning. From KP20 to approximately KP54, water scarcity is assessed to be moderate. This is largely due to the proximity of Lake Albert and the rivers, with headwaters in the uplands. Both are important sources of water for people and livestock.

From KP54 to KP56.5, the pipeline route climbs the Rift Valley escarpment to a plateau at an average elevation of approximately 1100 masl. There is greater rainfall and improved water availability, which is manifested in the form of streamflow and springs.

From KP51 to KP56, the AOI is largely uninhabited as the route climbs the Rift Valley escarpment. From KP56 to the end of the pipeline at KP95, the pipeline route is situated on the relatively well-watered and more densely populated Rift Valley plateau. Water scarcity here is assessed to be low. This is due to the likelihood that the numerous watercourses, though small, are mostly permanent and therefore reliable sources of water. Shallow wells and boreholes are more numerous and were found to be functioning.

Road Crossings and Construction Facilities

Relative water scarcity along the existing road to be upgraded by the pipeline (ERU-BCPF) was assessed as low at both Kasinyi village at the eastern end of the road and at Katanga at the western end of the road (Figure 6.4-7). Both villages have boreholes with hand pumps and shallow wells and access to the Nile River and Lake Albert.

The second pipeline road, ERU-MCPY, approximately 3.8 km long, links the main Buliisa–Hoima road with the MCPY. Water scarcity near ERU–MCPY is assessed at Booma, some 1.8 km west of the road, as low. This is because Booma receives water from a gravity flow scheme and the communities there also have access to water from Lake Albert and the ephemeral wetland near the MCPY.

As Booma is 0.8 km northwest of the MCPY, the comments above in relation to ERU-MCPY also apply to water scarcity near the MCPY. Water scarcity near the MCPY is considered low (Attachment A6.23 of Appendix A6).

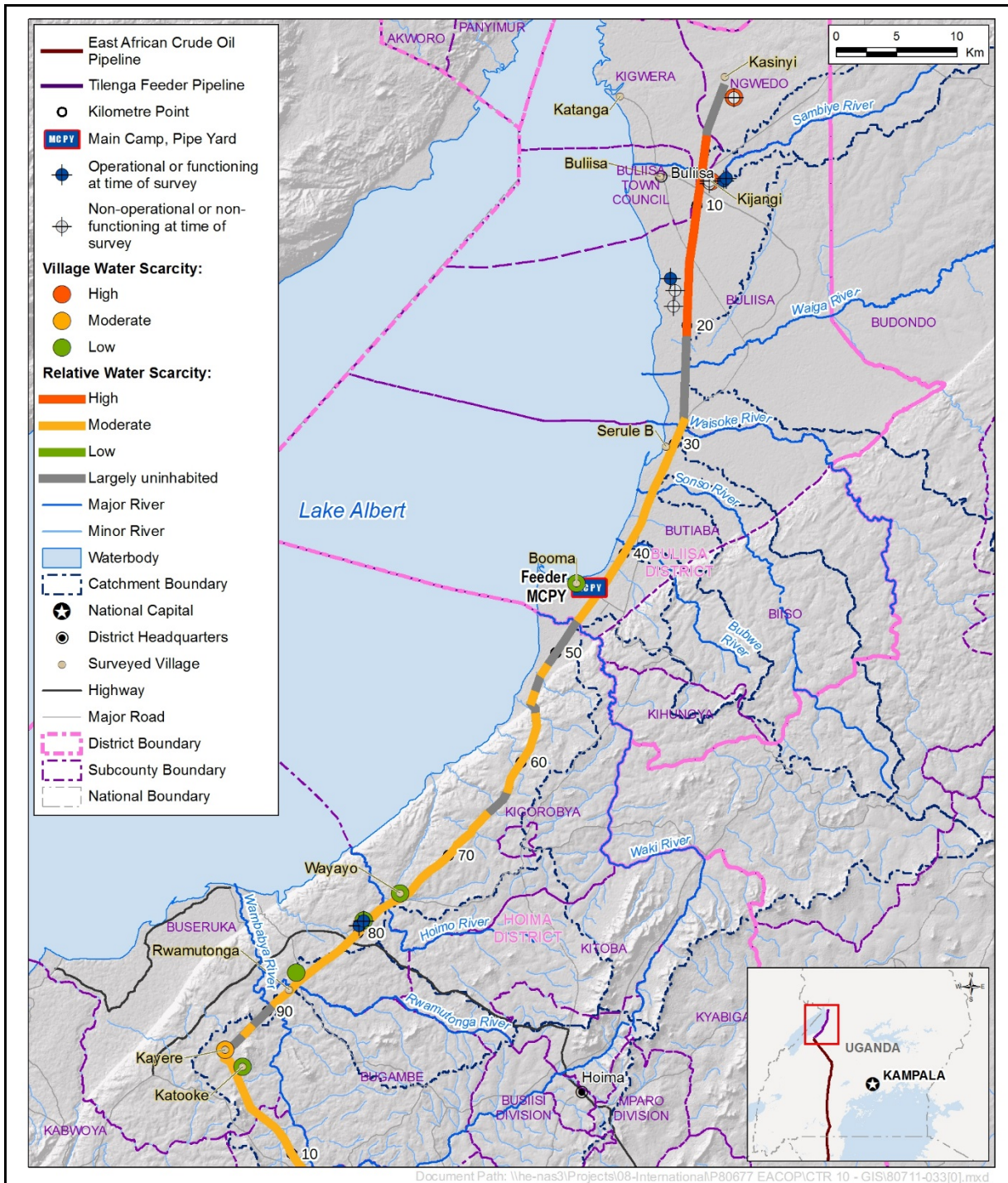


Figure 6.4-7 Water Scarcity

Trend in Condition and Sensitivity to Change

Flow and Flood Regimes

Several environmental changes have taken place in Uganda. Land cover has undergone rapid change because of increasing population pressures. Human activities such as timber cutting, clearing of land for agriculture, settlement and overgrazing have affected the natural vegetation cover, which has resulted in deforestation, encroachment on wetlands (Government of Uganda 2016) and land degradation (MEMD 2013). Soil productivity has declined, and soil erosion is a major cause of river siltation (NEMA 2009). Increased pressure is also evident in the rangelands of the cattle corridor. Increasing livestock numbers have led to overgrazing of the savannah, reduced groundcover and increased soil erosion. Consultation and literature indicate that these processes are likely to intensify. Water resources along the watercourses traversed by the AOI are relatively undeveloped and used mainly for livestock watering and domestic purposes. Water collection from the rivers is relatively small scale, but as populations grow and agriculture intensifies, the pressure to pump water from the rivers for public water supply and agricultural and commercial uses will increase. This is likely to lead to reduced flows downstream. Sensitivity to change therefore depends on current levels of use and likely future development.

As agriculture intensifies and soil degrades, flood volumes and peak flows may increase. Wetlands and swamps in floodplains tend to attenuate floods by slowing water velocities, thus delaying and reducing peak flows. Where there is wetland encroachment and conversion to farmland, increased flooding and flood risk may be expected. At the time of writing, it is unclear whether this is occurring in the rivers traversed by the AOI.

River Channel Morphology and Stability

Floods deliver water and sediment from the land to river channels. The rate of wetland siltation and floodplain swamp formation is likely to increase as soil erosion intensifies. As the floodplains are incised, continuing siltation maintains the stability of the river channels, providing the swamp vegetation cover remains. Over time, continuing siltation may cause water levels during floods to rise, thereby possibly causing increasing inundation of public infrastructure or informal settlements on floodplains.

Water and Sediment Quality and Sensitivity to Contamination

Water and sediment quality are coming under increasing pressure from growing populations and human activities. Increased pesticide and fertiliser use, and urbanisation in the agricultural catchments traversed by the AOI threatens water supplies and ecosystems in the long term. It is assumed that the same trends are occurring in the pipeline catchments, particularly in the Waki, Hoimo, Rwamutonga and Wambabya catchments, which are not legally protected, threatening water supplies and associated ecosystems in the long term. As water quality deteriorates, sensitivity to potential contamination is likely to reduce.

Ecosystem Services Provided

The watercourses and waterbodies in the AOI, including Lake Albert, described herein provide the following ecosystem services.

Provisioning services include:

- water for local people in rural communities, their livestock and agricultural activities. Water is also collected from rivers by entrepreneurs using vehicles and pumps to sell to people in urban areas
- water for hydroelectricity generation at the Kabalega hydroelectric power station on the Wambabya River in Hoima district about 7 km downstream of the pipeline crossing.
- sources of water and food for visiting wild animals and birds.

Regulating services include:

- floodplains regulate floods by slowing water velocities; storing water on their surfaces and transmitting water relatively slowly downstream and reducing peak flows.
- wetlands along watercourses regulate water quality by acting as filters causing reduction of suspended sediment and associated metals, and local water purification through microbial breakdown of organic matter.

Habitat and species support includes:

- waterbodies provide habitat and support for aquatic and terrestrial species.

Cultural services include:

- benefits to people from the watercourses, such as for recreation or being of spiritual value, were not identified during the study.

Sensitivity Rankings

Flow Regime

Pipeline Crossings and Lake Albert

Based on the trend in condition and the sensitivity to change, the sensitivity of Lake Albert and the nine watercourses (VECs) at pipeline crossings with respect to their flow regimes and uses is shown in Table 6.4-18. Sensitivity has been ranked according to the table for surface water sensitivity in Appendix D.

Table 6.4-18 Surface Water Flow Sensitivity Rankings – Pipeline Crossings and Lake Albert

Watercourse or VEC	KP	Sensitivity Ranking	Rationale for Ranking ¹
Sambiye River	7	Low (2)	Provides water directly for rural communities and livestock. Water demand will rise.
Waiga River	21–25		
Waisoke River	28–29		
Sonso River	34.3		
Bubwe River	39		

Table 6.4-18 Surface Water Flow Sensitivity Rankings – Pipeline Crossings and Lake Albert

Watercourse or VEC	KP	Sensitivity Ranking	Rationale for Ranking ¹
Waki River	46.9		
Hoimo River	77		
Rwamutonga River (tributary of Wambabya River)	87	Moderate (3)	Provides water directly for rural communities and hydropower generation downstream. Water demand will rise.
Wambabya River	89.5	Moderate (3)	
Lake Albert	N/A	Low (2)	Provides water directly for rural communities and livestock. Water demand will rise.

NOTE: ¹Rationale relates to the situation at the time of writing. Species and habitats of conservation concern have been considered within the biodiversity VEC in Section 8.2

Construction Facilities

Table 6.4-19 presents the sensitivity ranking of the flow regime to changes in watercourses near the construction facility.

Table 6.4-19 Surface Water Flow Sensitivity Rankings – Project Facilities

KP	Pipeline Facility	Watercourse or VEC	Sensitivity Ranking	Rationale for Ranking
45	MCPY	Ephemeral wetland (150 m north)	Low (2)	Waterbody provides water for rural communities and livestock

River Channel Morphology and Stability – Pipeline Crossings

Based on the trend in condition and the sensitivity to change, the sensitivity of the nine watercourses (VECs) with respect to the stability of their channels within the AOI is shown in Table 6.4-20. Sensitivity has been ranked according to the table for surface water flow sensitivity in Appendix D.

Table 6.4-20 River Channel Morphology and Stability Sensitivity Rankings – Pipeline Crossings

Watercourse or VEC	KP	Sensitivity Ranking	Rationale for Ranking
Sambiye River	7	Low (2)	Channel absent. Natural floodplain in uncohesive materials with grass and tree cover. Considered to be stable.
Waiga River	21–25	Low (2)	Natural channel in uncohesive materials. Continuous swamp vegetation along the river channel. Floodplain is grass covered.

Table 6.4-20 River Channel Morphology and Stability Sensitivity Rankings – Pipeline Crossings

Watercourse or VEC	KP	Sensitivity Ranking	Rationale for Ranking
Waisoke River	28–29	Low (2)	Natural channel in uncohesive materials. Continuous swamp vegetation along the river channel. Floodplain is grass covered.
Sonso River	34.3	Low (2)	Natural channel in uncohesive materials. Continuous swamp vegetation along the river channel. Floodplain is grass covered.
Bubwe River	39	High (4)	Natural channel in uncohesive materials. Riparian vegetation along river channel is a discontinuous cover of grass and scrub. Floodplain is grass and scrub covered.
Waki River	46.9	Low (2)	Natural channel in uncohesive materials. Discontinuous woodland and swamp vegetation along river channel and floodplain.
Hoimo River	77	Low (2)	Natural channel with bedrock or gravel bed and cohesive silt-clay banks. Riparian vegetation is thick woodland and swamp vegetation.
Rwamutonga River	87	Low (2)	Natural channel with bedrock or gravel bed and cohesive silt-clay banks. Riparian vegetation is thick woodland.
Wambabya River	89.5	Low (2)	Natural channel with bedrock or gravel bed and cohesive silt-clay banks. Riparian vegetation is thick woodland.

River Channel Morphology and Stability - Construction Facilities

Table 6.4-21 presents the sensitivity ranking of watercourses (VECs) that will receive drainage from pipeline facilities for morphology and stability.

Table 6.4-21 River Channel Morphology and Stability Sensitivity Rankings – Project Facilities

KP	Pipeline Facility	Watercourse/ Distance from Facility	Sensitivity Ranking	Rationale for Ranking
45	MCPY	Ephemeral wetland (150 m north)	Low (2)	Floodplain with uncohesive materials and vegetation cover of grassland.

Water and Sediment Quality and Sensitivity to Contamination – Pipeline Crossings

Based on the trend in condition and the sensitivity to change, the assessment of the sensitivity of the main watercourses and Lake Albert to potential contamination is shown in Attachment A6.19. The results are summarised in Table 6.4-22.

Sensitivity has been ranked according to the table for surface water flow sensitivity in Appendix D.

Table 6.4-22 Water and Sediment Quality and Sensitivity to Contamination Sensitivity Rankings – Pipeline Crossings and Lake Albert

Watercourse or VEC	KP	Sensitivity Ranking	Rationale for Ranking
Sambiye River	7	Moderate (3)	The mid catchment is densely settled with subsistence agriculture and livestock rearing. Water quality at times of flow is likely to be good.
Waiga River	21–25	Very high (5)	Catchment is in a legally protected area (Murchison Falls National Park – MFNP) with no settlement. Water quality is likely to be natural.
Waisoke River	28–29	Very high (5)	Catchment is in a legally protected area (Bugungu and Budongo Forest Reserves) with no settlement. Water quality is likely to be natural.
Sonso River	34.3	Very high (5)	Catchment is partly in a legally protected area (Budongo Forest Reserve) with no settlement. Water quality is likely to be natural.
Bubwe River	39	High (4)	Catchment is sparsely settled with subsistence agriculture and livestock rearing. Water quality is likely to be very good.
Waki River	46.9	Moderate (3)	Headwaters are densely settled with rainfed and plantation agriculture. Natural forest cover in mid catchment. Sparsely settled with subsistence agriculture and livestock rearing in the lower catchment. Water quality is likely to be good.
Hoimo River	77	Moderate (3)	Catchment is densely settled with subsistence agriculture and livestock rearing. Water quality is likely to be good.
Rwamutonga River	87	Moderate (3)	Catchment is densely settled with subsistence agriculture and livestock rearing. Water quality is likely to be good.
Wambabya River	89.5	Moderate (3)	Catchment is densely settled with subsistence and plantation agriculture and livestock rearing. Water quality is likely to be good.
Lake Albert	N/A	Moderate (3)	Catchment is densely settled with subsistence and plantation agriculture and livestock rearing. Water quality is likely to be good.

Water and Sediment Quality and Sensitivity to Contamination – Construction Facilities

Table 6.4-23 presents the sensitivity of watercourses (VECs) near pipeline facilities to potential contamination.

Table 6.4-23 Sensitivity to Contamination Sensitivity Rankings – Pipeline Facilities

KP	Pipeline Facility	Watercourse/Distance from Facility	Sensitivity Ranking	Rationale for Ranking
44	MCPY	Ephemeral wetland (150 m north)	High (4)	Rural catchment sparsely settled with land used for livestock rearing. Water quality likely to be very good during periods of surface water occurrence.

Key Considerations

Key considerations for surface water VECs are summarised below for:

- flow in watercourses
- river channel morphology and stability
- water and sediment quality and sensitivity to contamination.

Flow in Watercourses

Flow in most watercourses crossed by the pipeline is considered to have a low sensitivity to change. This is because there are relatively few uses of the watercourses other than providing water for a dispersed rural population and livestock. Present and likely future demands, based on available information, are relatively low. The exceptions are the Wambabya River (KP89.5) and its tributary, the Rwamutonga River (KP87). The Wambabya River is used for hydroelectricity generation at the Kabalega hydroelectric power station in Hoima district approximately 7 km downstream of the pipeline crossing at KP89.5. The Wambabya River is considered to have a moderate sensitivity to change in flow.

Surface water occurrence in the ephemeral wetland north of the MCPY at KP44 is considered to have a low sensitivity to change. This is because the wetland provides an ephemeral source of water only for rural communities and livestock.

River Channel Morphology and Stability

The morphology and stability of the watercourses traversed by the AOI are considered to have a low sensitivity to change. This is because the floodplains contain aquatic vegetation that limits flow velocities, inhibits erosion and makes these watercourses very stable. The exception is the Bubwe River (KP39), which is considered to have a high sensitivity to change. The Bubwe river has riparian vegetation comprising a discontinuous cover of grass and scrub. The floodplain is grass and scrub covered.

The stability of the ephemeral wetland north of the MCPY at KP44 is considered to have a low sensitivity to change, principally due to the grass cover.

Water and Sediment Quality and Sensitivity to Contamination

The following watercourses crossed by the pipeline were considered to have a high or very high sensitivity to contamination:

- Waiga River (KP21–25)
- Waisoke River (KP28–29)
- Sonso River (KP34.3)
- Bubwe River (KP39).

The catchments of the Waiga, Waisoke and Sonso Rivers are mostly situated within the Murchison Falls National Park, Bugungu Wildlife Reserve and Budongo Forest Reserve with no settlement and are predominantly natural. Water quality in these rivers is likely to be natural. The catchment of the Bubwe River is sparsely settled with subsistence agriculture and livestock rearing; water quality is likely to be very good.

Water quality in the ephemeral wetland north of the MCPY at KP44 is considered to have a high sensitivity to change, as the land is sparsely populated, causing water quality to be relatively good in times of surface water occurrence.

6.4.2.3 Groundwater

This section describes:

- groundwater area of influence (AOI) and broader region
- the baseline condition of groundwater:
 - trends affecting groundwater
 - sensitivity of groundwater to change
 - ecosystem services provided
 - groundwater sensitivity rankings
- key considerations.

Area of Influence

The groundwater AOI during the pipeline construction and operational phase will encompass aquifers:

- that will be used for pipeline groundwater abstraction
- that may be affected by planned discharges of treated water, and accidental spills, leaks of fuels and chemicals.

During construction, the AOI will include aquifers crossed by the RoW and used by the MCPY. During the approximate 25-year operational phase, the AOI will include aquifers crossed by the RoW.

Baseline Condition of Groundwater

Aquifer Characteristics

The AOI traverses areas that are characterised by unconsolidated fluvial, sedimentary and basement aquifers. In all the districts that are traversed, groundwater is an important source of public water supply. A review of Ministry of Water and Environment (MWE) published data (2008a, 2008b, 2012a, 2012b and 2012c) indicates that groundwater quality is generally good in all districts.

A summary of aquifer characteristics is presented in Table 6.4-24.

Sampling was undertaken at 5 locations during the field survey. The laboratory testing results indicate one exceedance of the zinc national drinking water quality (The Uganda Standard, US EAS 12: 2014) and project standard at the well in Kibukwa-Barwogeza (DWD53493). No exceedances of the national water quality standards were recorded for the other wells.

Table 6.4-24 Summary of Aquifer Geology and Characteristics

District, Approximate KPs and Project Facilities	Geological Formations Aquifer Lithology	Soil Description ¹	Main Water Strike (mbgl) (Average) ²	Static Water Level (mbgl) (Mean Value) ³	Yield (m ³ /h) and Recharge ⁴
Buliisa (KP0–48) MCPY near KP44	Tertiary–Quaternary sediments within the Rift Valley system, predominantly sandstones, siltstones, claystones and shales	Loamy sand; sandy clay (Arenosols and Ferralsols or Calcisols)	42	29	Yield: 7.1 Recharged by rainfall
	Precambrian basement: undifferentiated gneisses and granulite facies rocks		57	23	Yield: 7.3 Recharged by rainfall
Hoima (KP48–90)	Regolith and fluvial sediments (palaeochannels); Tertiary–Quaternary sediments within the Rift Valley system, predominantly sandstones, siltstones, claystones and shales	Sandy clay loam	52	17	Yield: 6.3 Recharged by rainfall
	Precambrian basement (weathered and fractured crystalline bedrock): shales, arkoses and quartzites; undifferentiated gneisses and granulite facies rocks		43	19	Yield: 4.1 Recharged by rainfall

SOURCE: From district groundwater reports provided by DWRM (2012a, 2012b)

NOTES: ¹Based on field observations during the baseline survey for the pipeline in November 2017. ²Main water strike is the level at which groundwater is first encountered during drilling. ³Main water strike is the level at which groundwater is first encountered during drilling ⁴Recharge information is from BGS (2017) data; average airlift yields from district groundwater reports provided DWRM (2012a, 2012b).

Trend in Condition and Sensitivity to Change

Groundwater will continue to be a primary source of water for the population in all districts, with shallow wells and boreholes providing water for over 60% of the population in all districts (MWE 2017).

Population growth is likely to increase the reliance of local communities on groundwater for domestic use. Data on past groundwater quality and water levels was not available to undertake an accurate assessment of trends of these aspects.

However, the information available was considered sufficient to support this assessment. Groundwater in both the sedimentary and basement aquifers is considered highly sensitive to change.

Ecosystem Services Provided

Groundwater within the AOI provides the range of ecosystem services set out below.

Provisioning services include:

- groundwater supplying freshwater for community use.

Regulating services include:

- groundwater supporting aquatic and riparian habitats and wildlife, both directly (where groundwater feeds wetlands) and indirectly (where groundwater maintains surface water flows).

Sensitivity Rankings

Table 6.4-25 summarises the sensitivity ranking for groundwater.

Table 6.4-25 Groundwater VEC Sensitivity Ranking

District	Groundwater VEC	Sensitivity Ranking	Rationale for Ranking
Buliisa (KP0–48)	Aquifers – Rift Valley sediments	High (4)	Good quality groundwater used for drinking and other domestic uses
Hoima (KP48–90)	Aquifers – basement	High (4)	Good quality groundwater used for drinking and other domestic uses

Key Considerations

Key considerations are summarised below:

- the sensitivity rankings of groundwater VECs are very high
- groundwater is an important ecosystem service.

6.4.2.4 Landscape

This landscape section describes the:

- landscape AOI
- baseline condition of the landscape:
 - introduction to the general landscape of the AOI
 - the landscape character of the AOI from KP27.3 to KP38.1, and KP55
 - trends affecting the condition of the landscape and views, and sensitivity to change
 - ecosystem services provided
 - landscape sensitivity rankings
- key considerations.

Area of Influence

The landscape AOI was set provisionally, based on engineering information and satellite images, to identify the location of potential receptors at a 1-km corridor for the RoW.

The project components included in the AOI are:

- the RoW from KP27.3 to KP38.1 due to the presence of a protected area adjacent to, but not within, the RoW
- the escarpment at KP55 due to the extensive views from the ridge.

Other sections of the pipeline RoW, the MCPY and the small AGIs (block valves and electric substations) were screened out during scoping as they are considered unlikely to have a major impact on visual receptors but a general description is included for completeness.

The RoW is permanent and will remain operational over the project lifetime, so the temporal AOI will be a minimum of 25 years.

Baseline Condition of Landscape

Introduction – General Landscape of the AOI

The Lake Albert basin influences the landscape character of the AOI. From KP0 – KP55 the pipeline primarily traverses the Lake Albert coastal fringe, which is characterised by settled coastal lowlands adjacent to the eastern banks of Lake Albert, with an elevation of approximately 600 metres (m) Above Sea Level (ASL). This section of the pipeline also traverses along the western edge of the Bugungu Wildlife Reserve (WR) (the route is just outside the reserve boundary) between KP27.3 and KP38.1.

At KP55, the pipeline traverses the steep slopes of the rift escarpment, where the elevation increases to 850–1000 m ASL in areas further away from the lake. From KP55–KP95, the pipeline traverses a mixed landscape of gently undulating grasslands and farmland, hills with open plateaus and bare rocky outcrops, forested areas and wetlands.

Most of the AOI comprises modified habitat, except for a few sections that are adjacent to forest reserves and the Bugungu WR that are less modified. Areas of high biodiversity value are often linked to sensitive landscapes, as they can possess valued or rare natural scenic features, such as forests. However, most of the areas crossed by RoW have been affected by human activity for farming and grazing. The area as whole, however, attracts international tourists, drawn by the Murchison Falls National Park and other wildlife attractions.

The settlement pattern comprises a few sporadic settlements with a complex minor road network extending from the major routes between the larger settlements of Buliisa and Hoima.

Landscape Character

Right-of-Way from KP27.3 to KP38.1

The AOI of the RoW from KP27.3 to KP38.1 consists of lowland coastal landscape, fairly flat with some gentle undulation. The pipeline route runs parallel to, and at its nearest point 36 m from the western boundary of the Bugungu WR. Bugungu WR is an example of rich wooded landscape. The landscape of the WR is characterised by riverine or riparian forest and swampy grassland occasionally interspersed with woody species. The reserve retains much of its natural bush and tree cover and old growth woodland and therefore has natural scenic value. However, outside the western boundary of the Bugungu WR, along the pipeline route, the landscape is degraded compared to the reserve due to grazing and the Hoima to Buliisa road which traverses the AOI between the pipeline route and the WR.

The Hoima to Buliisa road is used by tourists exploring the Murchison Falls area. The area is remote, with a widely dispersed population. There are no large settlements in the AOI and habitation is limited to small, quiet agricultural settlements and isolated farms surrounded by grazing land.

Right-of-Way at KP55

The AOI of the RoW at KP55 consists of the steep slopes of the rift escarpment, where the elevation increases from approximately 600 m ASL to 1000 m ASL over a relatively short distance.

The area is remote, with a widely dispersed population. There are no large settlements in the AOI and habitation is limited to small, quiet agricultural settlements and isolated farms surrounded by grazing land. There is a network of unpaved roads and pedestrian tracks used by the local population which offers typically long distant views of the lowland areas at the bottom of the escarpment. Due to their increased elevation receptors within this area would have a clear view of the proposed pipeline.

Most of the landscape within the AOI has been modified by human activity. Although rural in nature, the landscape has lost most of its natural vegetation but the scenic value is increased by the topography which allows long distance views from the top of the escarpment.

Trend in Condition and Sensitivity to Change

Right-of-Way from KP27.3 to KP38.1

The Bugungu WR has been subject to some human activities especially along its boundary. This includes the widening of the Hoima to Buliisa road at the time of writing, as part of the Hoima–Butiaba–Wanseko road project. The reserve is protected, however, which appears to have been successful in limiting change further into the WR, which remains largely intact. These intact areas would have a high sensitivity to change.

Overall, the Bugungu WR has a moderate to high sensitivity to change.

Right-of-Way at KP55

KP55 is in an area that has seen gradual conversion from grassland and scrub to predominantly agricultural land, which is sparsely settled. This trend appears to be continuing. The landscape is expected to be able to tolerate further similar change or modification without change to its present character, so is not regarded as sensitive to change.

There is also potential for the landscape to change if oil wells and associated infrastructure are installed. This is dependent on the outcome of further exploration and appraisal drilling.

Ecosystem Services Provided

Landscape provides the following ecosystem services:

Cultural services include:

- nonmaterial benefits from the sense of wellbeing and value provided to people by living in an attractive environment.

Local residents did not perceive proposed project infrastructure as negative visual intrusions in the landscape (see Appendix C Stakeholder Engagement and Appendix A11 Socio-economic and Health Baseline Report).

The area as whole, however, attracts international tourists, drawn by the Murchison Falls National Park and other wildlife attractions and the landscape is an integral part of the attraction of these areas.

Sensitivity Rankings

Based on the landscape assessment, trend in condition and sensitivity to change, the sensitivity of the landscape character and visual receptors of the RoW from KP27.3 to KP38.1 have been ranked and are shown below in Table 6.4-26.

Table 6.4-26 Pipeline Right-of-Way from KP27.3 to KP38.1: Landscape Receptor Sensitivity Ranking

Landscape Receptor	Sensitivity Ranking	Rationale
Bugungu WR	Moderate (3) to High (4)	Moderate sensitivity where some agricultural conversion has occurred and near the Hoima–Buliisa road. High sensitivity where landscape retains much of its natural scrub and tree cover, and old growth woodland that has some natural scenic value.
Small settlements, farms and users of roads and paths	Low (2) to Moderate (3) to	The Hoima to Buliisa road is used by tourist traffic.

Based on the landscape assessment, trend in condition and sensitivity to change, the sensitivity of the landscape character and visual receptors at KP55 have been ranked and are shown below in Table 6.4-27.

Table 6.4-27 Pipeline Right-of-Way at KP55: Landscape Receptor Sensitivity Ranking

Landscape Receptor	Sensitivity Ranking	Rationale
Grazing land, grassland and scrub	Moderate (3)	Landscape modified by farming activity with few intact or distinctive natural or historic features, but the scenic value is increased by the topography which allows long distance views from the top of the escarpment.
Small settlements, farms and users of roads and paths	Low (2)	Desk top study did not reveal any elements of high aesthetic, cultural or religious or tourist importance.

Key Considerations

Most of the pipeline route is in an area of low biodiversity significance with the exception of a few sections that are adjacent to forest reserves and the Bugungu WR. Areas of high biodiversity value are often linked to sensitive landscapes, as they can possess valued or rare natural scenic features. However, most of the areas traversed by EACOP have been affected by farming and grazing. The overall area is, however, important for tourism, with key attractions including the Murchison Falls National Park.

The Bugungu WR has been subject to some human activities especially along its edges, although remains largely intact further away from the reserve boundary and the RoW. The natural scenic value varies accordingly, from moderate to high. The protection afforded to the WR, as a nationally designated reserve will continue, which is likely to protect the area from change. However, the intact areas of the reserve would have a high sensitivity to any change.

Most of the landscape at KP55 has been modified by human activity but the scenic value is increased by the topography which allows long distance views from the top of the escarpment. The landscape is therefore assessed as moderate sensitivity.

Most visual receptors are of low sensitivity comprising local users of roads, farm workers and people living in small settlements. International tourists visiting the area are, however, of very high sensitivity.

6.4.2.5 Air Quality

This section describes:

- air quality AOI
- baseline condition of air quality
 - baseline characteristics
 - trends in condition and sensitivity to change
 - ecosystem services
 - sensitivity rankings
- key considerations.

Area of Influence

The AOI for air quality depends on the nature and scale of each source of project emissions. The AOI is the distance to the furthest receptor where the air quality standards are met. Changes in substance concentrations are likely to be measurable within a few kilometres of these facilities. The AOI for emissions from construction activities and project vehicles will be no more than a few hundred metres from each source.

Methods

Primary data was collected at four locations around the southern end of the Tilenga feeder pipeline, near pump station (PS)1 at the start of the EACOP pipeline, as this is a permanent component of the EACOP project. This has been used along with secondary data collected at three locations along the Tilenga feeder pipeline to describe the condition of the air quality VEC (see Figure 6.4-8 and Figure 6.4-9).

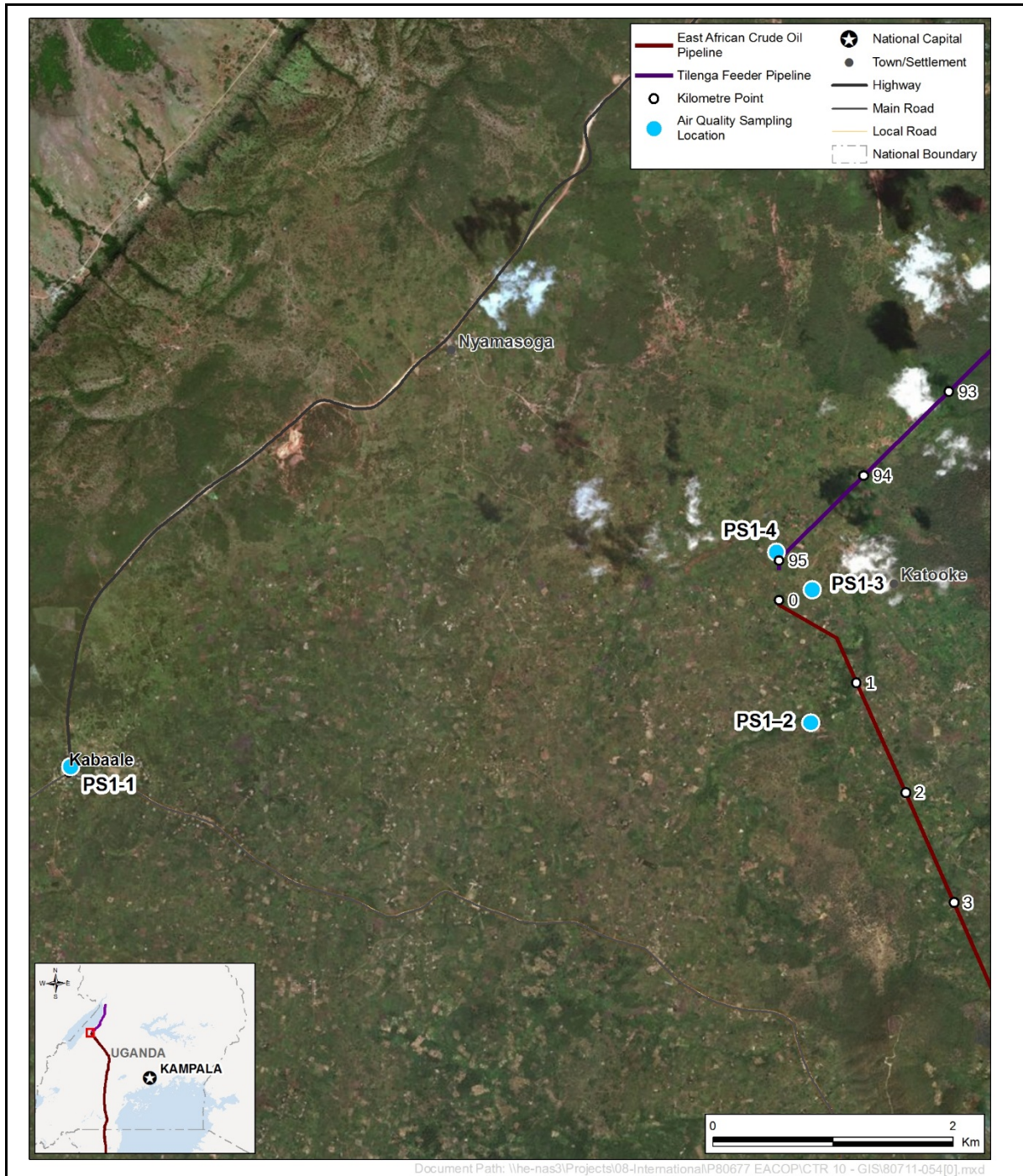


Figure 6.4-8 Monitoring Locations around the Southern End of the Tilenga Feeder Pipeline

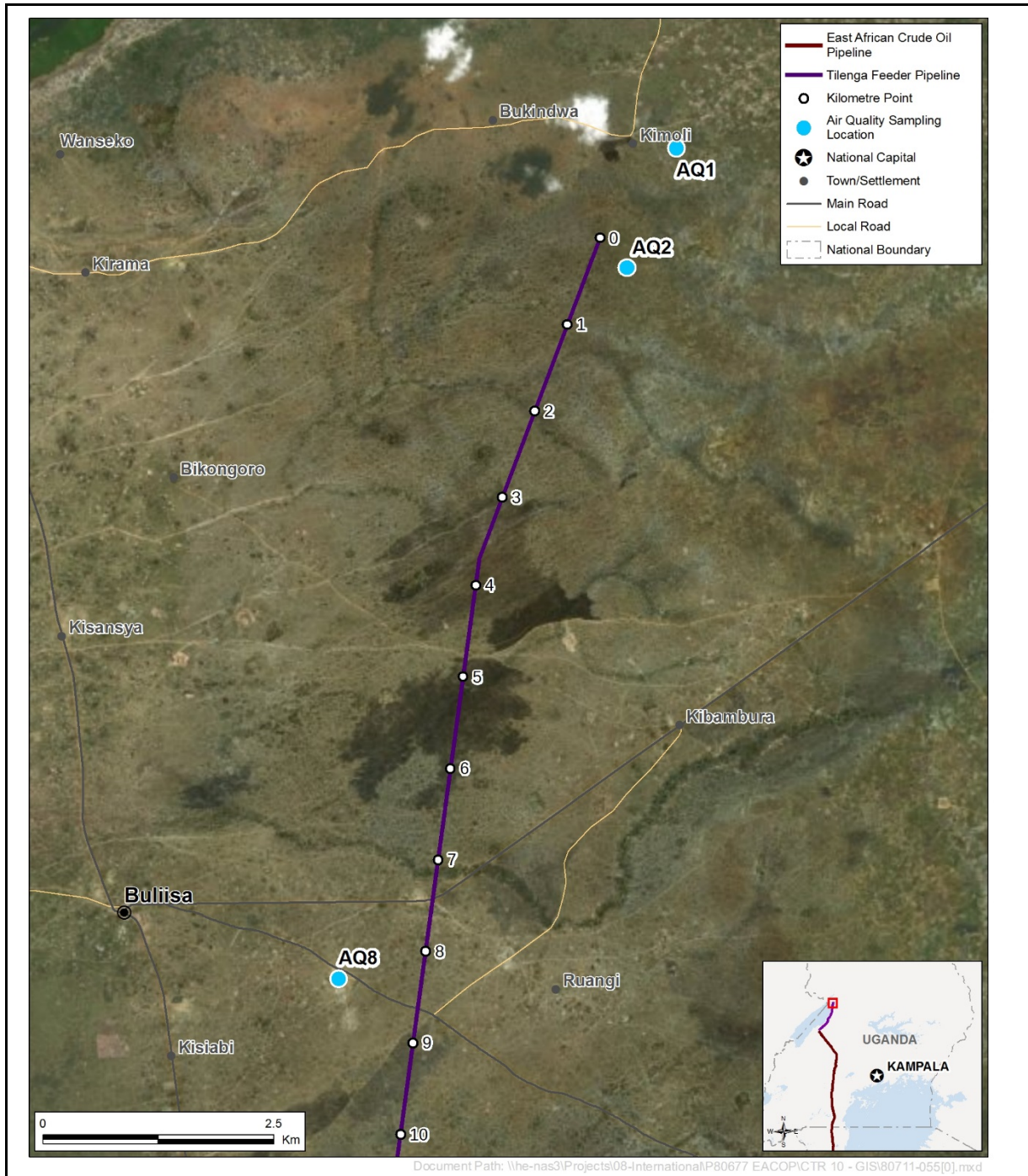


Figure 6.4-9 Monitoring Locations, Feeder Pipeline

Baseline Condition of Ambient Air Quality

Table 6.4-28 summarises the survey results. Comparisons of sampled concentrations with the project environmental standards are indicative as the sampling periods differ from the averaging periods of the standards.

Table 6.4-28 Summary of Average Measured Baseline Substance Concentrations

Substance	Concentration ($\mu\text{g}/\text{m}^3$)				Project Environmental Standard (PES)
	Mean, All Samples				
	AQ1*	AQ2*	AQ8*	Primary Data +	
NO ₂	5.4	4.8	8.0	5	40 (annual average) 150 (24-hour average) 120 (8-hour average) 200 (1-hour average)
NO _x	8.2	7.4	8.9	6	No PES
O ₃	67.3	72.8	76.5	81	100 (8-hour average, daily maximum)
SO ₂	1.1	1.2	2.1	<1	50 (annual average) 20 (24-hour average) 500 (10-minute average)
Benzene	-	-	-	2.5	No PES
Total VOC	2.0	8.4	3.0	132	6000 (24-hour average)
PM ₁₀	91.9	67.7	36.5	56	20 (annual average) 50 (24-hour average) 200 (1-hour average)
PM _{2.5}	19.6	13.4	8.6	52	10 (annual average) 25 (24-hour average)

NOTES: *Data from AECOM 2017 baseline survey. + Average of 4 monitoring locations

The following observations and conclusions can be made from the ambient air quality monitoring results, noting that comparisons with the PES are indicative only as the sampling and PES averaging periods do not match:

- concentrations of NO₂ and NO_x are low at all locations and show a high degree of uniformity between all monitoring sites. No sample measured greater than 12 $\mu\text{g}/\text{m}^3$.
- SO₂ measurements are low at all locations and show a high degree of uniformity between all monitoring sites. No sample measured greater than 7 $\mu\text{g}/\text{m}^3$.
- ground-level O₃ concentrations are moderate and consistent across the locations. This uniformity is expected, as ozone is not a directly emitted substance but is formed by reactions in the atmosphere and therefore, changes are normally seen at a regional scale and are not sensitive to local emission sources.

- particulate concentrations are high and, in some cases, exceed the PES included in Appendix F. This is to be expected given the dusty nature of the environment.
- NO_x, VOC and PM concentrations at the measuring location in the small settlement of Kyabalendere near the southern end of the Tilenga feeder pipeline are higher than those measured at the more isolated stations in this area. This is likely to be a result of the greater traffic and general activity close to the sampling location.

The data used in this study focused on areas close to the proposed pipeline. However, it is reasonable to assume that the levels of substances found in these areas will be representative of the air quality for the majority of the pipeline's AOI throughout Uganda.

Trend in Condition and Sensitivity to Change

Air quality is sensitive to change, reacting to emission sources which are almost always associated with human activity. These activities can include vehicles; nonroad machinery for construction, industry or agriculture; and burning for agriculture, waste disposal, cooking or heating.

The substances covered in this baseline have the potential to be emitted or created as a result of construction or operational activities, affecting air quality within a limited distance of the source, and will return to background levels a short time after the activity has ceased.

Sensitivity to change is related to how close the baseline levels are to the standards. The baseline survey has shown the VEC to have a low level of sensitivity to NO_x, VOC, CO or SO₂ emissions, and that sensitivity to changes in PM is greater as the baseline levels are moderate to high. NO_x and VOC are the primary precursors of low-level ozone, which had moderate baseline levels. As such, emissions of NO_x and VOC are important in the control of ozone formation at a regional scale.

No historical air quality data for identifying trends in development and activity in the AOI have been identified, so air quality trends were not established.

Based on the air quality surveys, engagement with stakeholders, trend in condition and sensitivity to change, the sensitivity of the air quality related receptors within the AOI has been ranked and is shown in Table 6.4-29. The sensitivity is determined by two primary factors:

- the quantity and nature (including likely exposure patterns) of receptors (predominantly people) that are sensitive to air quality
- the baseline levels of substances present, relative to project environmental standards, which determines the environment's capacity to contain new emission sources without substance levels becoming potentially harmful.

The sensitivity rankings are shown in Table 6.4-29.

Table 6.4-29 Air Quality Receptor Sensitivity Ranking

Receptor and Specific Sensitivity	Sensitivity Ranking ¹	Rationale
Sensitivity to dust	Very low (1) to moderate (3)	Dust sensitivities are highly transient and geographically variable, and therefore it is inappropriate to apply rankings at a large scale and impracticable to identify small-scale variations in advance. Most of the AOI for dust will be sparsely occupied by people. Where the AGIs will be constructed the areas are of low ecological value. The AOI will occasionally include buildings, crops and animals of moderate sensitivity.
Sensitivity to gaseous emissions	Moderate (3)	Long term exposure to O ₃ must be assumed as the AOI is regional.
Sensitivity to airborne fine PM	Low (2) to very high (5)	Baseline concentrations are moderate to high, with exceedances of standards ² . The range reflects the variability of public presence.
Sensitivity to hydrocarbon vapour – refuelling sites' AOIs	Very low (1)	Impacts of this activity will be highly localised and members of the public are highly unlikely to be present within the area of impact.

NOTES: ¹The definitions of sensitivity are described in the VEC sensitivity tables included in Appendix D. ² All comparisons of baseline concentrations are indicative owing to differences in sampling periods and averaging periods of standards.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Key Considerations

High levels of airborne fine PM, above project environmental standards, were consistently detected by the baseline survey.

Much of the pipeline's AOI is sparsely populated and infrequently occupied.

There is capacity in the environment for gaseous emissions without harmful levels being reached. However, ground-level ozone concentrations were found to be moderately high. As such, control of NO_x and VOC, the primary precursors of ground-level ozone, will be important in limiting regional-scale O₃ levels.

6.4.2.6 Acoustic Environment

This baseline report describes the:

- acoustic AOI
- baseline conditions
 - acoustic character
 - trends in condition and sensitivity to change
 - ecosystem services
 - sensitivity rankings
- key considerations

Baseline acoustic conditions were measured in the AOI.

For more information, the acoustic baseline report is included in Appendix A8.

Area of Influence

AOIs apply to existing, planned new and upgraded construction access roads, the MCPY and the RoW.

The AOI was set at a 500-m radius around the MCPY and RoW, based on a review of engineering information and satellite images taking into consideration likely noise emission levels and to identify the location of potential receptors.

The temporal AOI for operations will be approximately 25 years. For the temporary construction access roads and MCPY, the temporal AOI is the period of construction, approximately three years.

Baseline Condition of the Acoustic Environment

Acoustic Character

Main Camp and Pipe Yard

The noise environment in the AOI surrounding the MCPY is a rural environment with interspersed farming, localised traffic on unsealed roads and small-scale human settlements. The noise environment was observed to consist of human activities including motor vehicles (particularly motorbikes), localised farming activities (predominantly restricted to hand tool use) as well as bird song and wind through vegetation.

Watercourse and existing industrial (plant) noise was not observed in the MCPY AOI, although distant noise from Lake Albert was occasionally audible.

Quantified noise levels during the day around the MCPY are measured to be 25 dB(A) $L_{90,1hr}$ and 43 dB(A) $L_{eq,1hr}$.

Right-of-Way and Construction Access Roads

The landscape and environmental components of the RoW and construction access roads AOI vary. However, the noise character is very similar. This is due to the absence of large-scale road networks, industrial and commercial facilities, and other intense noise sources. The main noise sources contributing to baseline conditions throughout the RoW include wind through vegetation, localised and

larger scale farming, people interactions (with land, livestock and each other), motorised vehicle movements (dominated by motorbikes) and occasional construction activities.

In the most remote areas of the RoW, there is an absence of human-induced noise, but there is also an absence of human receptors.

The noise associated with terrestrial fauna was not considered to be dominant through any of the monitoring surveys, although the noise environment across the RoW did include some bird, insect and occasional amphibian noise (frogs at night).

Given the similarity of noise sources along the RoW, and the varying contribution of such sources throughout a given time period, the levels measured across the RoW can be considered to be a good representation of the range of levels to which the baseline noise environment is exposed. This is particularly the case given the short-term nature of noise measurements (i.e., 1-hour measurements).

Quantified noise levels during the day through the RoW are 24 to 47 dB(A) $L_{90,1hr}$ and 38 to 55 dB(A) $L_{eq,1hr}$.

Trend in Condition and Sensitivity to Change

Right-of-Way, Main Camp and Pipe Yard and Construction Access Roads

The impacts, and tolerance to change, across the AOI for the RoW, MCPY and construction access roads will be from temporary activities such as construction and operation of camps.

The noise environment throughout the AOI, particularly around human habitations and settlements, has been exposed to road construction using heavy machinery and although vehicle movements have the potential to increase, the character of the noise source is not new to most of the areas. Sensitivity will be greater where new access roads are created than where existing roads will be used to facilitate project access.

Therefore, given the temporary nature of the noise emissions associated with the wider acoustic AOI, and the experience of similar noise emissions, the tolerance to change is considered relatively high. This will depend on actual magnitude of emissions.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Rankings

Based on the survey, engagement with stakeholders and trend in condition and sensitivity to change, the sensitivity of the acoustic environment for the RoW and access roads across the AOI has been ranked (Table 6.4-30). The sensitivity ranking is reasonably generic across the AOI.

Table 6.4-30 Acoustic Receptor Sensitivity Ranking – Presence in Area of Influence

Project Component	Receptor				
	Very Low	Low	Moderate	High	Very High
RoW	X	X	X	X	X*
Construction access roads	X	X	X	X	-
MCPY	X	X	X	X	-

NOTES: *Very high for some biodiversity-related VECs (not for human receptors)

Very low – No human receptors other than pipeline workforce and visitors to the pipeline. Area is not considered frequented or used by fauna.

Low – Locations used for recreation and industrial activities, such as industrial units and workshops. Workers outside the pipeline site or not engaged in pipeline work (i.e., not part of the pipeline workforce). Fauna have the potential to pass through the area, but this is not a common occurrence. Area not known to be used for breeding, feeding, habitation or migration of fauna

Moderate – Locations used for work requiring concentration, such as offices. Area known to be used regularly by local fauna for regular movement.

High – Locations used for rest and sleep such as residential properties. Educational establishments and places of worship. Area known to be used for regular feeding or migration of local fauna.

Very High – Locations used by vulnerable people such as hospitals and homes for the elderly. Area known to be used for fauna habitation and breeding.

Key Considerations

The acoustic baseline study did not identify sensitive receptors classed as very high anywhere in the acoustic AOI, although very low to high sensitivity receptors were identified across the RoW and MCPY AOIs.

The noise environment across most of the AOIs is dominated by human induced sources such as road traffic, farming and general human interactions. Therefore, the addition of temporary noise sources during construction and operation of MCPY is unlikely to be of concern. There is an absence of industrial and commercial noise throughout the RoW AOI.

6.4.3 Socio-economic and Health Environment

This section describes the:

- socio-economic and health AOI
- baseline conditions of socio-economic and health along the route:
 - trend in condition and sensitivity to change
 - ecosystem services provided
 - sensitivity ranking.
- key considerations.

Baseline conditions are described for the following VECs:

- economy
- local economy (nonland-based livelihoods)
- land-based livelihoods
- river and lake-based livelihoods
- land and property
- workers' health, safety and welfare
- social infrastructure and services
- community health
- community safety, security and welfare.

The section also includes an overview of governance, demography and education.

For more information, see Appendix A9 Socio-economic and Health Baseline Report.

6.4.3.1 Area of Influence

The spatial AOI for the construction, operation and decommissioning phases of the pipeline is identified at three levels:

- national (includes the entire country)
- district (including the subdivisions of districts: county, subcounty and parish) through which the pipeline passes, in which pipeline facilities are located or which could be associated with other pipeline activities such as transportation
- potentially affected communities (PACs). PACs include hamlets, villages, trading centres and towns within a geographical boundary defined by pipeline land take requirements, construction and operation activities. Based on the adopted methodology of purposive sampling (see Section A9.3 and A9.3.2.2 in Appendix A9), the geographical boundary was determined as approximately 4 km on either side of the pipeline where PACs were identified to potentially experience a range of direct and indirect impacts, such as air and noise pollution, land take and project induced migration (PIIM).

There are two districts (Buliisa and Hoima), 11 parishes, five subcounties, two town councils (TCs) and an estimated 38 villages and hamlets traversed and passed by the pipeline.

6.4.3.2 Methods

Three teams – a social team, a health team and a human rights team – performed the study and collaborated to develop the socio-economic and health baseline.

The screening report and scoping stakeholder engagement report conducted by the social and health teams between 19 April and 1 June 2017 at national, district and PAC levels provided primary and secondary data on the main socio-economic and health characteristics relevant to the pipeline and enabled the identification and initial description of the VECs (see scoping report for details on the stakeholder engagement). During the scoping phase, 25 meetings were held.

Further secondary and primary data were collected at national and district levels through small group interviews (SGI) and key informant interviews (KII), which enabled further descriptions of the VECs.

The health team conducted two SGIs with health service providers, including the district health management teams, across the two districts traversed by the Tilenga feeder pipeline. The aim was to access quantitative and qualitative data on the main health concerns in the district, and to assess the capacity of district health facilities. The guide used for the interviews was based on the health management and information system (HMIS) and ensured that the environmental health areas (EHA) framework required by the IFC performance standards was followed. In addition, three district health services were assessed using the service availability and readiness assessment (SARA) tool.

Based on this data, PACs were identified. To develop a sample of PACs for inclusion in the social study, the following process was undertaken.

Sites (areas) within 4 km distance of the pipeline route and access roads were identified using a purposive sampling strategy. The following criteria were used to identify the sites:

- In each district and subcounty traversed by the Tilenga feeder pipeline, at least one site was identified.
- Sites within 4 km of planned Tilenga feeder pipeline facilities and activities were included.
- Sites representing all the characteristics listed below were included:
 - different levels of urbanisation: urban (town), rural (village, hamlet, trading centre)
 - different levels of isolation (remote and well connected)
 - different density of agricultural land parcels (dense and dispersed parcels)
 - presence of grazing land
 - presence of tourism facilities
 - presence of mining activities
 - presence of fishing activities (lake, river)
 - natural habitats (protected and designated areas).

Six sites were identified, which formed the sample sites for the data collection. In each of those sites, the PACs were identified. Figure 6.4-10 shows the sample sites and sample PACs for the social study. Figure 6.4-11 is a photograph of participatory mapping.

The PAC data provided qualitative and quantitative elaborations on the district data. In-depth data collected at PAC level were embedded in the district and national context to ensure both depth and breadth.

This methodology was adopted because a statistical random sampling approach was not appropriate owing to the initial lack of reliable data on the number and location of PACs in the AOI and the linear nature of the pipeline. In addition, statistical sampling could have led to a sample of PACs that did not necessarily include all socio-economic characteristics.

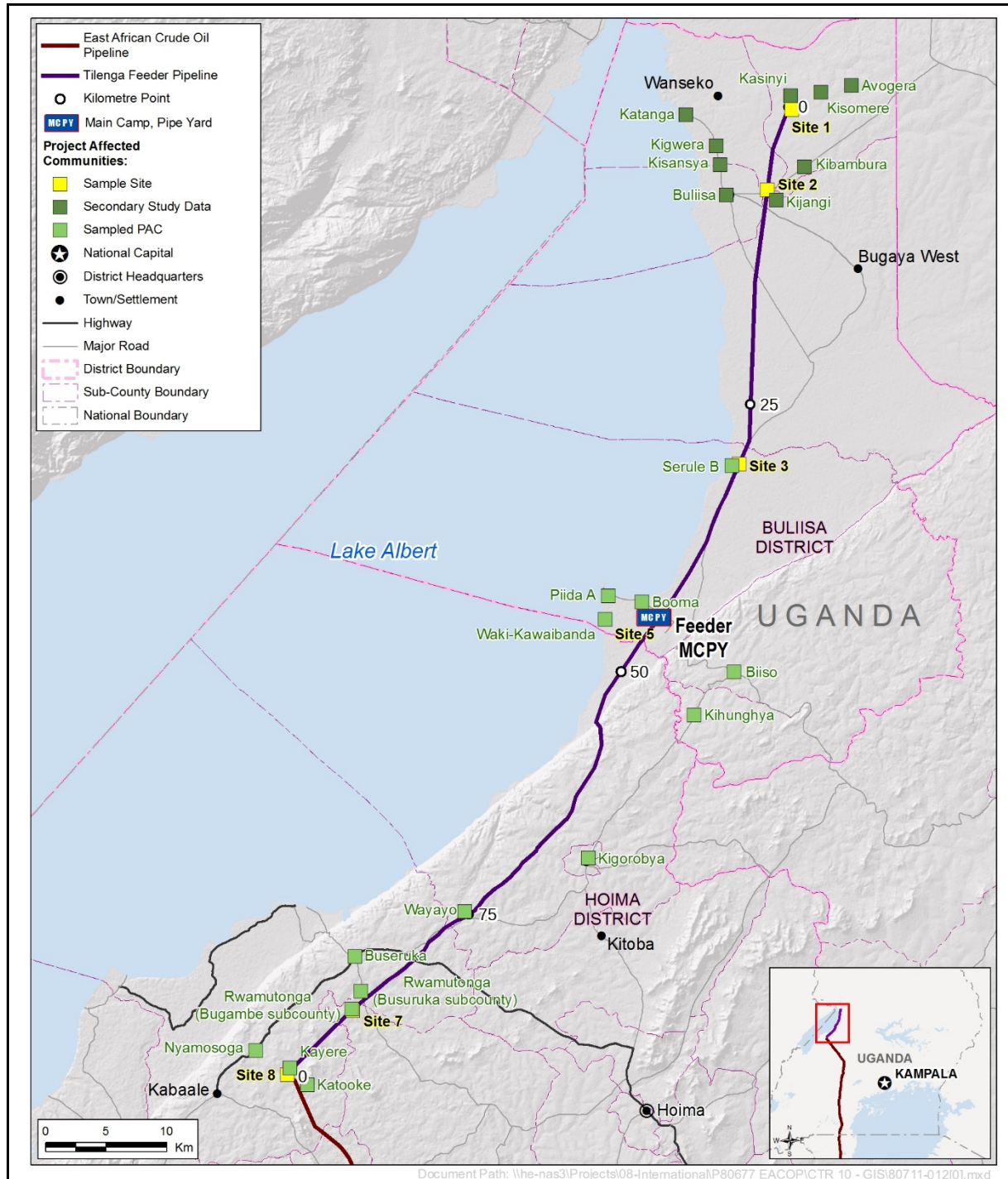


Figure 6.4-10 Sample Sites and Potentially Affected Communities

Primary data collection at sample site and sample PAC level included various steps, outlined below.

Step 1: Compilation of Factsheets for Each Sample Site

Based on satellite imagery (OpenStreetMap (and) contributors 2017) a factsheet was created for each sample site that provided initial information on the site. It shows the project components relevant to the sample site, the administrative

entities in which it is located, the main socio-economic features of the pipeline footprint, the PAC in the sample site, initial secondary data available for the sample site and a preliminary indication of the data collection tools to be used for baseline data collection.

Step 2: Reconnaissance Site Visits

Reconnaissance site visits were conducted to the sample sites and PACs during 26 October–21 November 2017 that included:

- a meeting with the village leaders, parish leaders and villagers to inform them about the ESIA and social baseline study. Posters and background information documents (BID) were used to explain the pipeline and the ESIA study (see Attachment A9.1 in Appendix A9). Concerns and questions of stakeholders were recorded and, where possible, responses were provided. This is reported in Section 7 Stakeholder Engagement.
- verifying and enhancing the data from the factsheet and developing a better understanding of the site and the PACs
- conducting a transect walk on the pipeline footprint to document land use features
- compiling a community socio-economic resources inventory through discussion with village leaders and field observation
- arranging the focus group discussions (FGDs), SGIs, KIIs and household interviews (HHIs) to be conducted during the social baseline survey

The information obtained was used to update the factsheets.

Step 3: Main Baseline Survey

The main survey, which was conducted between 2 November and 7 December 2017, included:

- FGDs, which were open discussions based on discussion guides with village community leaders, women and youth to obtain group knowledge, perceptions and attitudes about village livelihoods and to identify vulnerable groups in the community. The women's groups included widows, single mothers and women engaged in business activities. Based on the discussions, PAC profiles were developed (see Attachment A9.2 of Appendix A9). Figure 6.4-11 shows a photograph of an FGD. Two FGDs were organised in each sample PAC: one with women and one with community leaders (which also included some women).
- participatory mapping with the village community leaders and women's focus group participants, which involved drawing a map of infrastructure and land use in and around their village. The mapping facilitated discussion of village activities, local decision making and local community concerns.
- drawing a historical timeline of the important events in the village and discussing the changes these have brought about in the village over the years. The timelines are included in the PAC profiles.
- KIIs, which included interviews with informants with a particular expertise or knowledge
- SGIs to understand different livelihood strategies

- a community observation walk along a predetermined route, accompanied by community leaders, to gather information on community life, community infrastructure, land use types and patterns and natural resource use.



Figure 6.4-11 Focus Group Discussions and Participatory Mapping with Women in Waki-Kawaibanda, Buliisa District (KP47)

Figure 6.4-12 shows the number of different data collection tools used in the PACs and the districts by the teams.

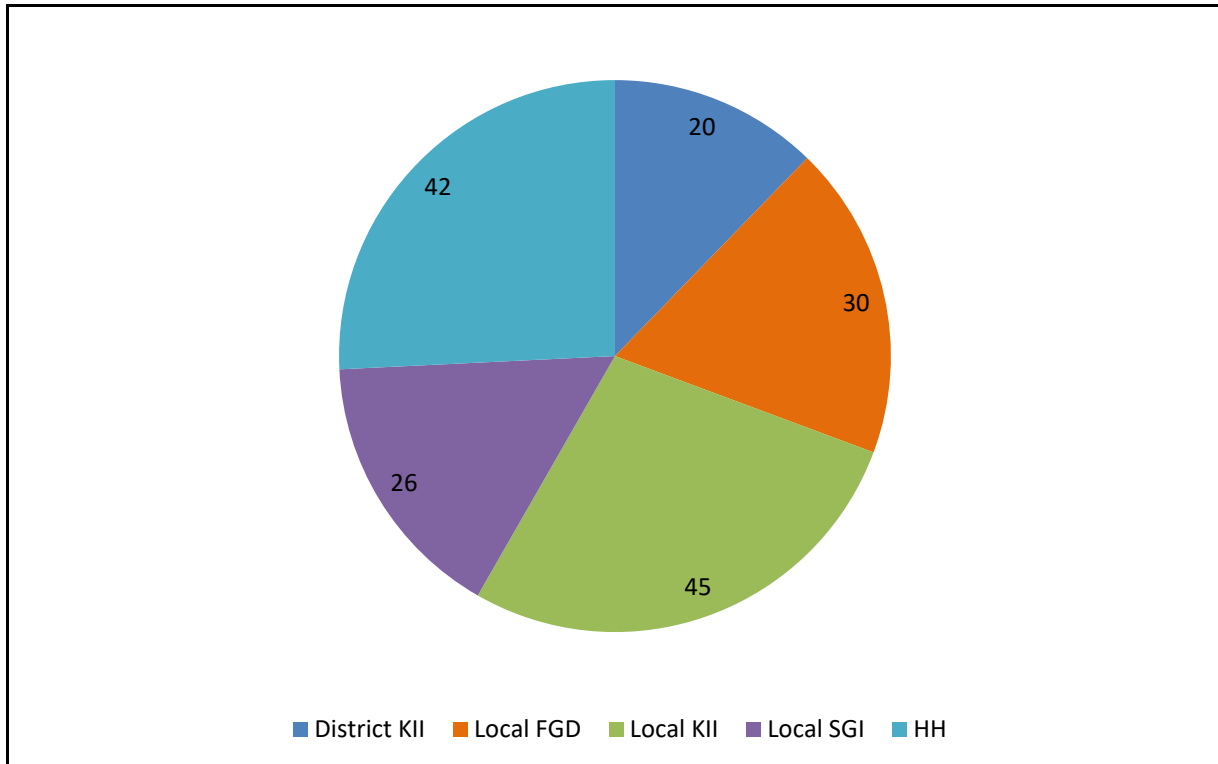


Figure 6.4-12 Data Collection at District and Potentially Affected Community Level

Data Analysis

The following data analysis was conducted:

- Data collected through KIIs, FGDs and SGIs were collated, tabulated, compared and triangulated for each VEC.
- Quantitative secondary and primary data were submitted to descriptive statistical analysis including averages and percentages.
- Historical data and data at the time of writing were compared with future projections to identify trends.

Main VECs were identified and their sensitivity ranked in accordance with the sensitivity tables for the socio-economic VECs in Appendix D.

The following were prepared:

- sample site profiles and sample PAC profiles (see Attachment A9.2 in Appendix A9)
- maps showing locations of the VECs which are described in the text.

6.4.3.3 Governance and Administration

The President of the Republic of Uganda is both Head of State and Head of Government. The Government of Uganda (GOU) has three branches:

- the executive, comprising the President, Vice President, Prime Minister and Cabinet. The President is responsible for implementing and enforcing the laws written by Parliament and appoints the Cabinet.

- the legislative, comprising Parliament that passes laws and reviews government policy and administration
- the judiciary, comprising the Magistrates' Courts, High Court, Court of Appeals (Constitutional Court) and the Supreme Court. The role of the judiciary is to administer justice by resolving disputes between citizens and between the State and citizens, contribute to the enforcement of law and order, and protect the human rights of individuals and groups.

The government structure of Uganda consists of six levels (see Figure 6.4-13). Through this structure, power and decision-making at the national level is decentralised.

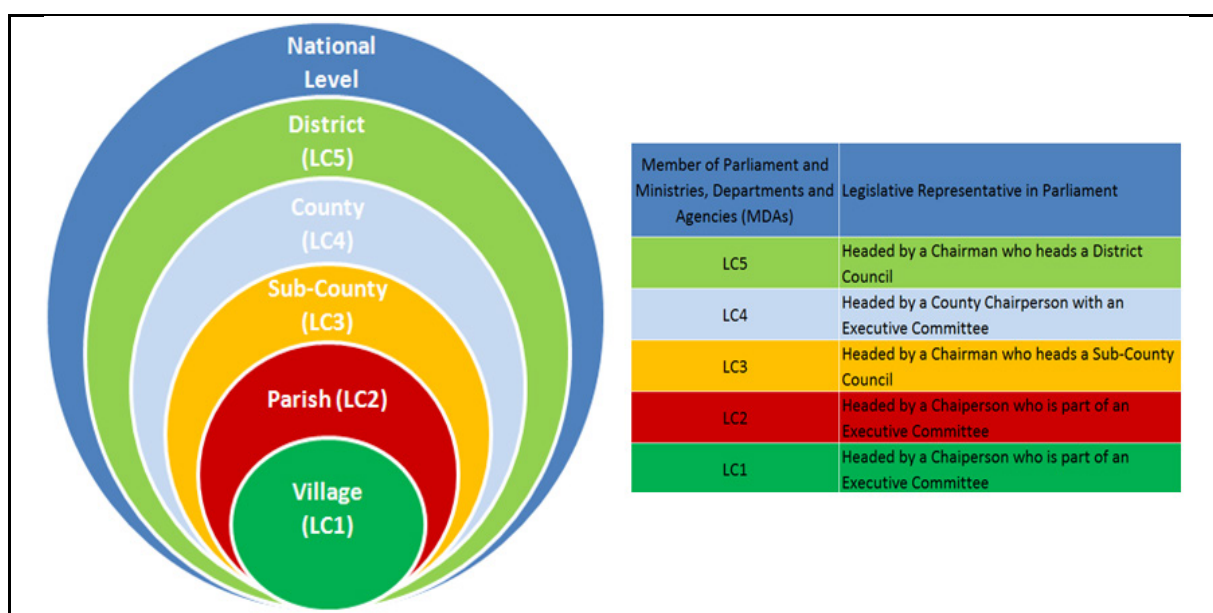


Figure 6.4-13 Government Structure of Uganda

SOURCE: Modified from Total E&P Uganda (2014)

The structure of local government differs between urban and rural settings. In urban settings, there are cities, municipal divisions or towns, wards and cell councils (CLGF 2016). In rural settings, there are district councils (Local Council (LC)5) which are subdivided into subcounty councils, parish councils and village councils (MOLG 2017). The role of the local government agencies is to implement and monitor government programmes and resolve disputes at the respective levels (UBOS 2016a).

Every district has an elected chairperson who is supported by a district council consisting of technical personnel and subcounty representatives. In every district council, at least one of the secretaries and one third of all councillors must be female (CLGF 2016). The district council is the planning authority of the district that prepares a comprehensive and integrated development plan, incorporating plans of lower level local governments, for submission to the national planning authority (GOU 1997).

A district technical planning committee chaired by the CAO includes heads of departments of that district.

There are 1403 subcounties (LC3) in Uganda (Electoral Commission 2016, Internet site). Subcounty governments are led by subcounty councils (headed by elected chairmen) and are responsible for service delivery and local economic development within their areas. Similar to the district administration, a team of technical personnel coordinates the activities and functions of the subcounty.

Each subcounty comprises parishes, which divide further into villages. Parish councils have elected executive committees.

At the village level, all village citizens aged 18 years and above are members of the council.

Ancient traditional kingdoms, also known as cultural institutions, are a key feature of Ugandan society. Within the AOI, there is one cultural institution:

- the Bunyoro-Kitara Kingdom.

Cultural institutions are not mandated to engage directly in the administrative roles of the local or central governments but can be instrumental in ensuring that government programmes succeed at the local level (John Paul II Justice and Peace Centre 2013). Representatives of cultural institutions play an active role in local communities by:

- assisting with the development of community infrastructure
- generating business opportunities (KIIIs with kingdom representatives)
- undertaking community sensitisation and awareness campaigns (KIIIs with kingdom representatives)
- preserving history (crafts, sites), cultural norms and identity.

The village council (LC1), which consists of the village chairperson, the vice chairperson, secretary and other prominent leaders such as village elders and elected leaders representing youth, women and religious leaders, are pivotal in decision-making at community level. An elected chairperson and vice chairperson head village councils. The responsibilities of chairperson and vice chairperson are to:

- represent the village at the subcounty level
- organise and chair village meetings
- make decisions on behalf of the community
- ensure village security and safety of residents
- resolve disputes between village members; disputes that cannot be resolved by village chairmen are referred to higher levels of government (i.e., the subcounty and district).

6.4.3.4 Demographics

Baseline Condition of Demographics

National Level

The population of Uganda grew by 3% annually between 2002 and 2014, reaching 34.6 million in 2014 (UBOS 2016a). The population size projection for 2018 is

approximately 38.8 million (UBOS 2016b). Females and males represent 51% (17.7 million) and 49% (16.9 million) of the population, respectively.

Figure 6.4-14 shows the age structure of the population in Uganda.

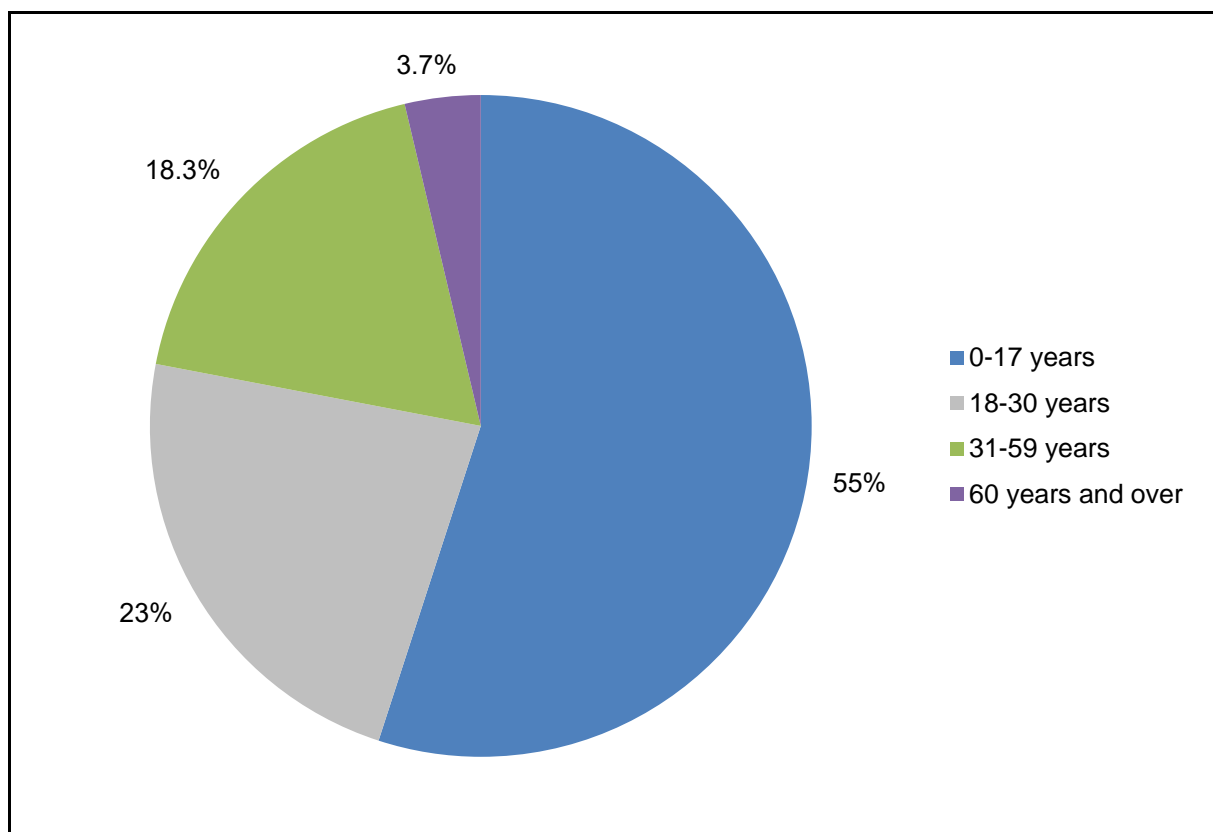


Figure 6.4-14 Age Profile of Uganda

SOURCE: UBOS (2016a)

As shown in the figure, Uganda’s population is predominantly young, with 0–17-year-olds constituting more than half of the total population.

Uganda’s population is predominantly rural, representing 79% of the overall population (MOLG 2017). However, the urban population has increased by 23% since the 2010 census (UBOS 2016a). This trend has been driven largely by rural–urban migration (World Bank 2015a, Internet site).

Uganda consists of more than 40 different ethnic groups and languages, each with their own cultural identity and customs. The largest ethnic group are the Baganda which consists of 16.9% of the population, followed by Banyankole (9.5%), Basoga (8.4%), Bakiga (6.9%), Iteso (6.4%), Langi (6.1%), Acholi (4.7%), Bagisu (4.6%) and Lugbara (4.2%). Those identified as others account for 32.3% (World Atlas 2018, Internet site).

While there is great ethnic and linguistic diversity, intermarriage, rural–urban migration and other migratory movements including transborder migration has meant that the different ethnicities, along with their cultural traditions, have intermingled to create a mixed multicultural nation.

There are at least 40 native languages in Uganda, grouped into three main language families: Bantu, Central Sudanic and Nilotic. English was adopted during colonisation as the common language and remains an official language. Swahili, which has regional significance, is also an official language, and Luganda is a commonly spoken language of a large proportion of the Ugandan population, particularly in the central region.

Migration

Uganda experiences both in and out migration. Migration to Uganda has been driven by civil war and political instability in the Democratic Republic of Congo (DRC), Rwanda and South Sudan (Danish Refugee Council 2016). At the time of writing, more than 800,000 refugees and asylum seekers are accommodated in the country's northern, southern and southwestern regions (Refuge & Hope International 2017, Internet site). Since the beginning of 2018, roughly 34,000 Congolese refugees have crossed Lake Albert to Uganda, driven by renewed violence in the DRC (UNHCR 2018, Internet site). Most refugees have entered Uganda through Kaiso and Sebagoro landing sites on the shores of Lake Albert in Hoima district (ReliefWeb 2018, Internet site).

Internal migration has occurred throughout Uganda's history and is driven mainly by employment. Internal movements are mostly toward urban centres or regions of high economic activity, such as plantation areas (IOM 2015) or locations where transient employment opportunities are available such as infrastructure developments. Evidence of migration for family and marital reasons has also been found in some regions and is more common among females (Nakiganda 2013).

District and PAC Level

The population in the districts traversed by the AOI is predominantly rural: 97% of people in Buliisa and 90% of people in Hoima live in rural areas (DDPs 2015). However, consistent with national trends, the districts experience urbanisation: Hoima municipality grew by 10.7% between 2002 and 2014 (Hoima DDP 2015).

Table 6.4-31 provides the demographic characteristics of the districts traversed by the AOI.

Table 6.4-31 Demographic Data, 2014

District	Population Size			Population Density (/km ²)	Population Growth (%/year)	Average Household Size
	Total	Male (%)	Female (%)			
Buliisa	115,506	51.3	48.7	36	4.9	5.3
Hoima	573,903	49.9	50.1	158.9	4.3	4.5

Ethnicity and Religion

The main ethnic groups in the districts traversed by the AOI are:

- Alur
- Bagungu
- Banyoro.

The population in the sample PACs varies in terms of size and gender composition. The household survey conducted in the sample PACs revealed substantial variation in household size ranging from 5 to 9 in Buliisa and from 3 to 14 in Hoima.

In Buliisa district, the highest population densities can be found in sample PACs along the lakeshore including Serule B (KP30.5) and Piida A (KP45.5). This can be generalised to all lakeshore communities in Buliisa (Artelia 2015a). The lowest population densities can be found in sample PACs with large grazing areas.

The main languages spoken among the PACs are:

- Alur
- Lugungu
- Runyoro.

The following languages are also spoken, but to a lesser extent:

- Lugbara
- Madi
- Rukiga
- Swahili.

Religion is important in the sample PACs. HHIs and KIIs with religious leaders indicated that:

- Christianity is the predominant religion in the study area, followed by Islam
- traditional beliefs are also practiced, often in combination with Christianity and Islam.

Indigenous People

According to International Finance Corporation (IFC) Performance Standard 7 (IFC 2012), the term 'indigenous people' refers to a distinct social and cultural group with the following characteristics in varying degrees:

- self-identification as members of a distinct indigenous cultural group and recognition of this identity by others
- collective attachment, i.e., whose identity as a group or community is linked, to geographically distinct habitats or ancestral territories in the pipeline area and to the natural resources in these habitats and territories
- customary cultural, economic, social or political institutions that are separate from those of the dominant society or culture
- an indigenous language, often different from the official language of the country or region in which they reside.

IFC Performance Standard 7 recognises that indigenous peoples may be more vulnerable to the adverse impacts of a pipeline than other communities (or non-indigenous communities). Ethnic groups in Uganda that may fulfil international definitions for indigenous peoples include the traditional hunter-gatherer Batwa and Benet communities, the Basongora and Banyabindi and pastoralist groups such as the Ik and Karamojong. These ethnic groups are not within the AOI. The pipeline does not traverse lands traditionally owned by, or under the customary use of, any of these ethnic groups. Furthermore, the government does not officially recognise these groups as indigenous (ILO 2009). The Uganda Constitution refers to

indigenous groups as vulnerable and marginalised, adopting the term “Vulnerable and Marginalised Groups” in place of “Indigenous Peoples” (GOU 2015).

Trend in Condition and Sensitivity to Change

Demographic trends are important as a context for understanding trends in the VECs. Demographic trends are as follows:

- Uganda’s population is growing rapidly and is projected to reach 130 million by 2050 (World Watch Institute 2018, Internet site). Population growth rates in the districts traversed by the AOI are 4.5–5.3% per year, above the world average of 1.2% (DDPs 2015).
- Uganda’s population is predominantly rural, but the prevailing trend is urbanisation. Growth in urban areas may accelerate consistent with the national vision to transform Uganda from a peasant to modern and prosperous society within 30 years (GOU 2013a). Under this vision, planned improvements in urban infrastructure and public service facilities may strengthen the appeal of towns and cities (GOU 2013a). Job opportunities in urban areas may also increase as industry and services become more prominent economic sectors.
- Uganda remains an important host country for refugees from neighbouring countries. Conflict and instability, if unresolved, may sustain the in-migration of large numbers into the country. The 2006 Refugee Act, one of the most progressive and generous in the world (World Bank 2016a, Internet site), supports the entry of refugees into Uganda.

Key Considerations

Key considerations are:

- there is a large young labour pool
- PIIM may cause added stress to infrastructure and social services
- migrants often stay in locations they have moved to for work opportunities in the hope of further work opportunities rather than returning to an agricultural income.

6.4.3.5 Education

Baseline Condition of Education

National Level

Education is a right enshrined in the constitution of the Republic of Uganda and is compulsory for 6–13-year-olds (NUFFIC 2016). The education system is divided into three years of nursery school, seven years of primary school, six years of secondary school and at least three years of higher education.

Figure 6.4-15 shows the national literacy rates.

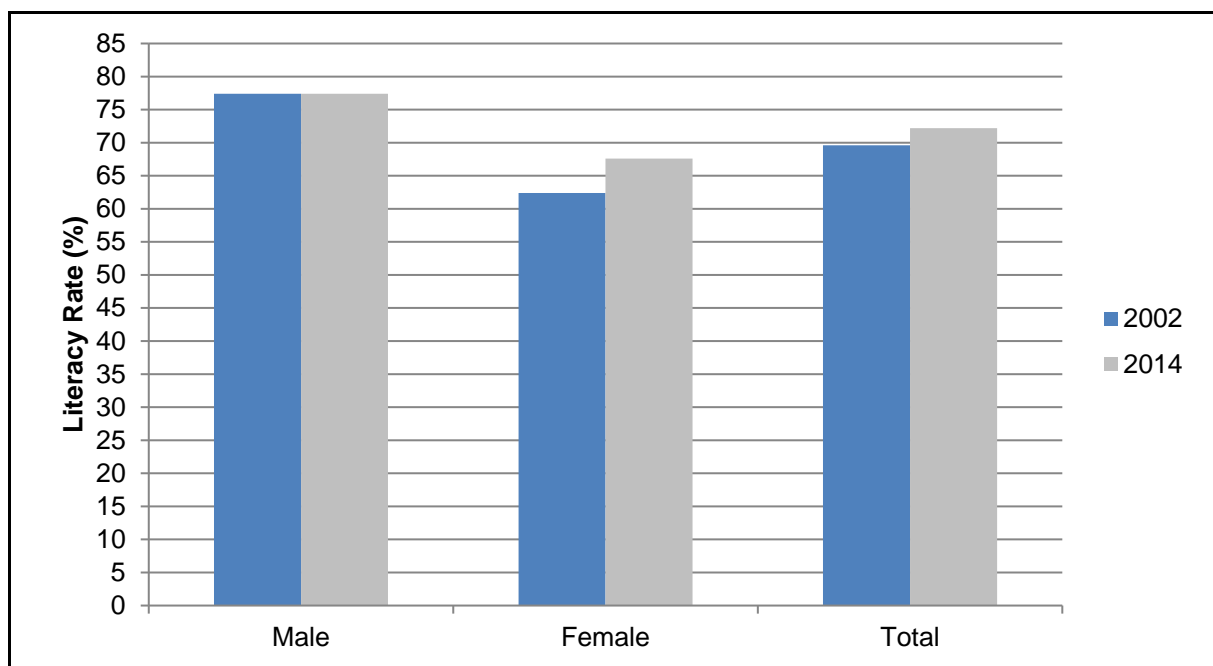


Figure 6.4-15 Literacy Rates for Persons Aged 10 Years and Above, 2002–2014

SOURCE: UBOS (2016a)

National school attendance at primary and secondary level is 81% and 17%, respectively (DHS 2011). The disparity in school attendance between males and females at the primary level is minimal in most regions.

There is a shortage of appropriately skilled and qualified workers in Uganda, particularly in sectors such as construction (Ministry of Education and Sports 2013). The mismatch between existing graduate qualifications and the skills required by industry results in high graduate unemployment and high levels of personnel turnover and retraining costs for companies.

District and PAC Level

Key points about school attendance rates in the districts traversed by the AOI include:

- primary school attendance ranges between 79.4% and 79.6%
- secondary school attendance ranges from 22% to 26.2%
- boys have slightly higher attendance rates compared to girls at primary school level.

Consistent with the national level, substantial skills gaps are present in the districts traversed by the AOI. Recognising the importance of human capital development, the DDPs place emphasis on increasing the skill level and productivity of the workforce through vocational training programmes (DDPs 2015).

The DDPs highlight challenges for district education departments including:

- personnel shortages

- high drop-out rates among girls due to early marriages, teenage pregnancies and domestic chores (Hoima and Buliisa DDPs 2015).

Students from Hoima and Buliisa districts attend technical institutes in Gulu (St Daniel Comboni, Gulu district), Masindi (St Kizito Vocational Centre, Masindi Vocational Training Institute and Kyema technical college; Masindi district) and Hoima districts (St Simon Peters Vocational Institute and Nile Vocational Training Institute) (Artelia 2015a).

The literacy rate of the population in the PACs varies. Interviews with PAC teachers reported literacy rates ranging from 0 to 45% in sample PACs such as Buseruka (KP84.5) and Katooke villages (KP95) in Hoima district and in Biiso village (KP44.5) in Buliisa district. High literacy rates of 80% were reported in Wayoyo (KP75) and Hoima villages (KP74.5) in Hoima district and Kihunghya village (KP75) in Buliisa district. Female literacy rates in the PACs were mostly estimated to be below 40% (women FGDs).

Children estimated to be attending primary school ranges from 40% to 80%. Teachers reported domestic chores, long travel distances from home to school, low value attributed to education by children and parents, and household income earning commitments as reasons for low attendance rates. In some sample PACs, attendance rates were found to be lower for boys than girls. This was attributed to peer pressure and engagement of boys in income-generating activities. For example, most boys in Booma village (KP44.5) are involved in fishing activities, and in Kayere village (KP94.5) boys are involved with cattle herding; both negatively affect school attendance. In the majority of PACs, however, attendance rates were found to be lower among girls.

Trend in Condition and Sensitivity to Change

Education trends are as follows:

- Education remains a key development priority in Uganda, and the districts traversed by the AOI make provisions for investment in education infrastructure and resources in the DDPs. However, the extent of improvements at the district level will be influenced by the financial and human resources available.
- High graduate unemployment and complaints from the private sector have increased the attention paid to Uganda's skills gap. At the national level, the Business Technical Vocational Education Training Strategic Plan 2011–2020 seeks to create employable skills and competencies relevant to the job market. At the district level, some DDPs outline plans to increase enrolment in tertiary institutions and offer vocational training programmes to citizens (Hoima DDP 2015).
- Uganda's oil reserves are mainly situated in Buliisa, Hoima and Nwoya districts. The discoveries have raised high expectations among the communities with regards to job creation. At the district level, the DDPs outline plans to increase enrolment in tertiary institutions and offer vocational training programmes to local people to ensure that they take advantage of the employment opportunities emerging in the districts (Buliisa and Hoima DDPs 2015).

Sensitivity Ranking

Table 6.4-32 presents the sensitive VECs for education identified during the social baseline study.

Table 6.4-32 Education VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Unemployed graduates	Positive	Unemployed graduates may benefit from the training opportunities and work experience with the pipeline
Children of primary and secondary school age	Moderate (3)	Attendance rates of children may fall due to jobs or opportunities indirectly created by the pipeline.

Key Considerations

Key considerations are:

- Uganda lacks skills in certain sectors, i.e., construction, and enrolment in science and technology programmes. Labour recruited for pipeline construction is likely to require considerable training and capacity building.
- TIs in the districts traversed by the AOI may be a potential source of construction labour for pipeline construction
- opportunities such as temporary work on construction sites and informal service industry (roadside shops and kiosks) may reduce school attendance by both girls and boys, affecting their human right to education.

6.4.3.6 Economy

Baseline Condition of the Economy

In 2016, Uganda's gross domestic product (GDP) was USD 24 billion, with a gross national income (GNI) per capita of USD 630. Uganda's GDP has been steadily growing since 2012, averaging 5.5% between 2010/11 and 2013/14, and is forecast to grow by 6.7% in 2018 (World Bank 2015). This growth is primarily due to growth in services and construction (African Development Bank, Organisation for Economic Cooperation and Development, United Nations Development Programme 2015). Uganda ranked 115 out of 140 in the 2015–2016 Global Competitiveness Index. Figure 6.4-16 represents Uganda's position in key areas compared to other factor-driven economies⁹.

⁹ Factor-driven economies are those whose growth is dependent on their factor endowments - primarily unskilled labour and natural resources.

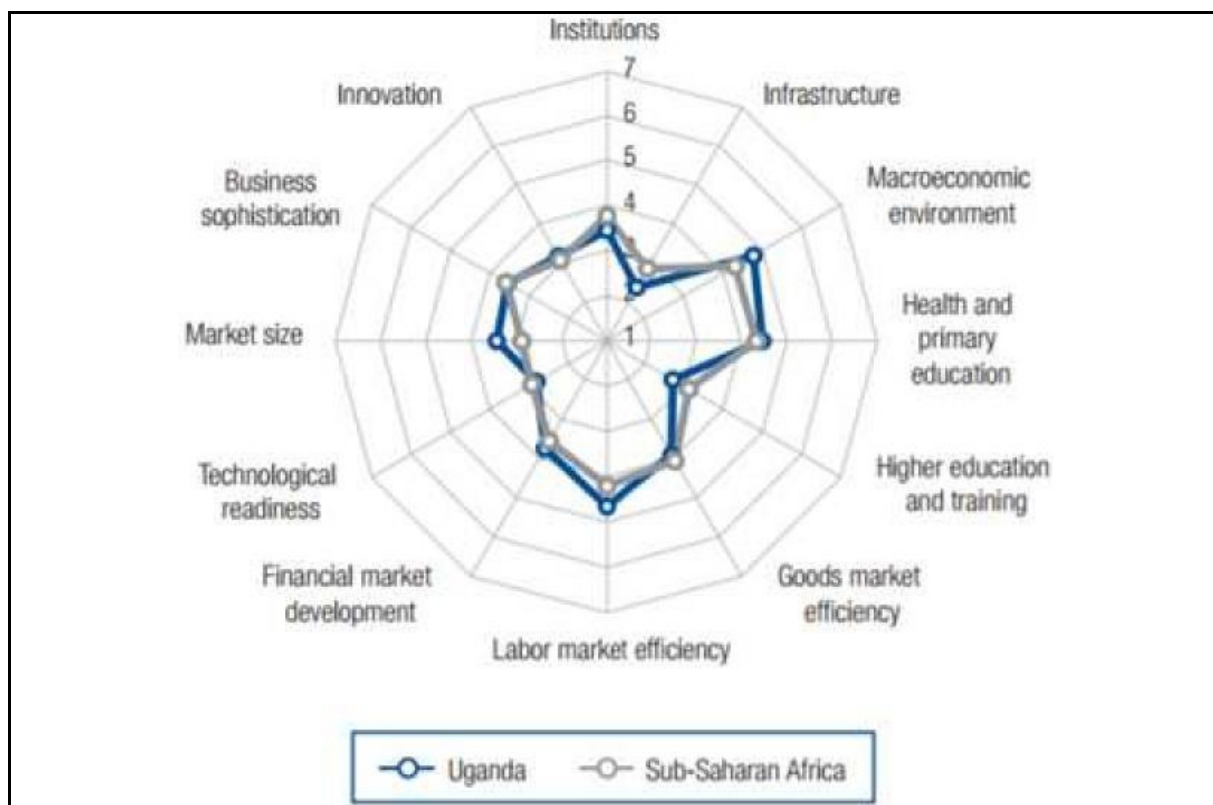


Figure 6.4-16 Comparison of Uganda’s Competitiveness Position Compared to Peers

Uganda’s exports per capita are among the lowest in the world and exports are dominated by primary products. Important exports include coffee, tobacco, fish and fish products, flowers, maize, cocoa, beans and other legumes, and gold and gold compounds. Coffee, fish and fish products are the highest value exports. According to the Second National Development Plan (NDPII) (National Planning Authority 2015), Uganda’s reliance on a relatively narrow range of exports increases Uganda’s vulnerability to fluctuations in world market prices and changes in weather and has led to a significant long-term decline in the country’s terms of trade.

Significant progress has been made in addressing poverty, and the national poverty rate¹⁰ has declined from 56% in 1992 to 19.7% in 2012/2013. Income inequality as measured by the Gini coefficient¹¹ reduced from 0.426 in 2009/10 to 0.395 in 2012/2013 and is higher in urban areas (0.41) compared to rural areas (0.34) (National Planning Authority 2015).

There are significant regional disparities in economic development. Uganda’s central and western regions have undergone considerable development when compared to the rest of the country. Poverty in the western and central regions is

¹⁰ Under the National Development Plan II, the rate of poverty is measured as persons living on less than a dollar per day (Ref. 16-34).

¹¹ The Gini coefficient is a commonly-used measure of income inequality in a country, where the higher the score between 0 and 1, the higher the income inequality (i.e., a score of 0 would represent perfect income distribution and a score of 1 would represent total inequality where one person has all the income).

estimated to be 9% and 5% respectively, whereas in the eastern and northern regions it is much higher, at 25% and 44% respectively (National Planning Authority 2015). In the study area, poverty is still widespread but the percentage of the population living below the poverty line has decreased. In the study area, Buliisa district has approximately 35% of the population living below the poverty line (Artelia Eau and Environment, 2015). In Hoima district, approximately 24.5% of the population were living below the poverty line in 2015.

The National Development Plan II for the period 2015 to 2020 is the second five year plan aimed at achieving Uganda's Vision 2040. This plan is aimed at moving the country into middle income status by 2020, by strengthening the country's competitiveness, sustainable wealth creation, employment and inclusive growth. The plan sets four key objectives to be attained during the five-year period. These are:

- increasing sustainable production, productivity and value addition in key growth opportunities
- increasing the stock and quality of strategic infrastructure to accelerate the country's competitiveness¹²
- enhancing human capital development
- strengthening mechanisms for quality, effective and efficient service delivery.

Five investment areas are prioritised: agriculture, tourism, oil and gas and minerals, infrastructure development, and human capital development. It is anticipated that implementation of the plan will lead to increased growth of 6.3% by 2020 (National Planning Authority 2015).

At the subcounty level in the study area, local government development plans (LGDPs) and five-year district development plans (DDPs) have been developed. These plans discuss the health and education status at the local level as well as the main livelihood activities of crop farming and livestock herding. They establish priorities for the district for local development and outline steps for poverty alleviation at the subcounty level.

Labour Force

The total labour force in Uganda in 2012/2013 was 16.3 million persons, and the labour force growth rate is estimated at 4.7% per annum. The majority of the working population are in the informal sector and are self-employed (81.5% in 2013) while the proportion of the labour force in paid employment was 18.5% in 2012/13. In 2013, 15% of the workforce had no formal education. Of the total working population, youth constituted a large proportion (4.4 million) with the majority living in rural areas (3.5 million) and working in nonwage employment in 2011. There is a projected job gap of 13 million people between the formal labour market size and the total employable labour force (National Planning Authority 2015).

The unemployment rate in 2013 was approximately 9% (Ugandan Bureau of Statistics 2016). The youth unemployment rate is high, estimated to be 78%, and

¹² Infrastructure spending is forecast at 8.6% of GDP in 2016/2017 to 2017/2018 and 4.8% in 2019/20. (Ref. 16-34)

youth dominate the informal sector. This has contributed to increasing urban poverty with high unemployment levels and lack of stable income (National Planning Authority 2015).

Information about labour and working conditions including aspects of gender and labour, persons with disability and child labour is provided in Section 6.4.3.11.

Key Economic Sectors

The services sector contributed 50.3% to Uganda's GDP in 2012/13, followed by agriculture with 23.5% and industry with 18.4%. The most significant subsector activities that have grown rapidly over the past five years are: Information and Communications, with a GDP share of 9% as at 2013/2014 and a growth rate of 16%; and Construction with a GDP share of 6.5% and a growth rate of 9.6% in 2013/14 (National Planning Authority 2015).

Agriculture

The agricultural sector grew considerably slower than the economy as a whole over the period 2010 to 2014. The annual average growth rate was 2.2% compared to the average annual GDP growth rate for the same period of 5.2%. This is below the 5.2% target for the period 2010 to 2015 under the Vision 2040. The contribution of the agricultural sector to GDP declined from 25.4% in 2010 to 23% in 2014. Of the agricultural subsectors GDP, the average contribution for the different subsectors was 1.7% of GDP for cash crops, 12.7% for food crops, 4.2% for livestock, 0.03% for Agriculture Support Services, 4.0% for Forestry and 1.2% for fisheries (Ministry of Agriculture, Animal Industry and Fisheries 2016).

The agricultural exports share in total exports has increased from 53.6% in 2010 to 57.2% in 2014. Considering the 2014 agricultural exports, Coffee is the main agricultural export commodity for Uganda that generated USD 410.1 million (UGX 1549 billion)¹³ (31.7%) of the agricultural export revenues. The second biggest agricultural export commodity is fish and fish products that generated USD 134.8 million (UGX 523 billion) (10.4%) of the agricultural export revenue during the period (Ministry of Agriculture, Animal Industry and Fisheries 2016). Table 6.4-33 summarises Uganda's agricultural exports during 2012 to 2016. The table shows that coffee was the largest agricultural export over the period and other main exports were fish and fish products, sugar and sugar confectionary, animal and vegetable fats and oil, and tea. The main agricultural imports are fixed vegetable fats and oils, processed, animal or vegetable waxes; cereals and cereal preparations; sugars, and sugar preparations and honey (Uganda Bureau of Statistics 2017).

¹³ Conversions based on exchange rate on 24/08/2018. Source: <https://www.xe.com/currencyconverter/>.

Table 6.4-33 Uganda's Agricultural Sector Exports (USD, 000)

Commodity	2012	2013	2014	2015	2016 (provisional)	Value of formal exports 2015 (%)
Coffee	372,166	425,407	410,064	402,634	371,674	17.8
Cotton	74,898	31,686	21,918	20,778	31,571	0.9
Tea	73,902	85,589	84,739	70,317	71,488	3.1
Tobacco	69,746	120,201	66,018	72,897	64,061	3.2
Fish and fish products	128,322	126,727	134,791	117,597	121,467	5.2
Animal or vegetable fats and oils	110,427	100,050	102,321	78,959	62,090	3.5
Sugar and sugar confectionary	122,672	85,304	68,937	65,724	100,251	2.9
Beer	25,317	23,698	13,305	10,041	10,977	0.4
Maize grain and maize flour	56,916	42,254	43,567	91,055	70,301	4.0
Cocoa beans	38,434	54,833	59,429	56,684	74,996	2.5
Roses and cut flowers	26,802	28,725	28,732	23,209	24,571	1.0
Rice	38,886	36,966	28,688	24,186	20,274	1.1
Beans and other legumes	14,237	20,577	26,191	63,167	50,519	2.8
Sesame seeds	11,714	28,468	55,165	50,677	14,572	2.2
Cattle hides and skins	41,632	64,352	73,758	63,018	51,375	2.8
Vegetables	8,306	11,730	14,655	14,127	16,753	0.6
Vanilla	2,362	2,731	2,651	3,440	3,246	0.2
Live animals	1,748	2,797	2,006	2,020	1,305	0.1
Soya beans	1,230	887	912	2,428	7,086	0.1
Fruits	1,190	1,502	2,077	3,200	4,505	0.1
Pepper	2,053	1,744	573	863	3,594	-
Bananas	466	239	587	860	1,020	-
Ground nuts	2,496	1,750	816	5,181	1,485	0.2
Sorghum	3,793	25,565	35,165	36,234	55,297	1.6

The Poverty Status Report (PSR) 2014 revealed that unreliable rainfall had large negative effects in rural areas (primarily engaged in agricultural activities) with household consumption reducing by around 14% if the main rainy season begins a month or more later or earlier than usual. This results in lower rural incomes and increases in rural poverty. This signifies the need to increase access to water for production as dependence on rain fed agriculture by most smallholder farmers

increases their vulnerability to poverty (Ministry of Agriculture, Animal Industry and Fisheries 2016).

Minerals

According to the NDPII, the minerals sector (including the oil and gas sector) contributed 0.3% to GDP in 2013. The government has prioritised attracting private investment in mineral resources exploration and development and recent discoveries have been made of iron ore reserves, marble/limestone, uranium, nickel-cobalt-copper-chromium, platinum-group-minerals, gold rich anomaly and rare earth elements.

In the oil subsector, more than a 100 exploration wells have been drilled since 2006 with a success rate of 89%. Total oil in place is estimated to be 6.5 billion barrels (with 1.5 billion barrels recoverable) and 100 billion cubic feet of gas in less than 20% of the Albertine Graben. Private-sector investment in the oil and gas sector has been increasing and between 2010 and 2012 cumulative investment in the sector amounted to approximately USD 1.8 billion. Key investments for this sector identified in the NDPII include: development of geological surveys; investment in more survey and exploration; faster acquisition of land; construction of three pipelines (export crude oil pipeline, refined products pipeline to Kampala, Eldoret and Kigali, and liquefied petroleum gas pipeline to Kampala and Gulu), construction of an oil and gas refinery, and increased prospecting and processing of the selected minerals (National Planning Authority 2015).

6.4.3.7 Baseline Condition of Local Economy (Nonland-Based Livelihoods)

District Level

Although agriculture and fishing are the most important livelihoods in the districts traversed by the AOI, the following economic activities are also important (Atacama Consulting 2017):

- small-scale processing of agricultural and fish products
- small-scale trade in retail merchandise and agricultural produce
- provision of services including tourism and transport.

Local economic activities are predominantly informal, meaning that they are neither taxed nor regulated by the state and offer little social protection to workers (WIEGO 2018, Internet site).

Artisanal fish processing (e.g., drying, smoking) takes place in Buliisa district with fish-handling facilities at Wanseko and Katala/Katolo landing sites on the shores of Lake Albert. Agro-processing facilities such as cassava and millet grinding mills were found in Avogera (KP0) and Kigwera (KP4) in Buliisa district (Artelia 2015c). Hoima district boasts several tea, coffee and tobacco estates with small-scale processing factories (NomoGaia 2012).

Small-scale trade occurs in both districts traversed by the AOI. The sale of retail goods and agricultural produce by micro-enterprises predominantly occurs on roadsides and at markets in trading centres, towns and cities owing to ease of access to customers.

The types of retail merchandise sold include agricultural products and general merchandise (i.e., clothes, manufactured goods, airtime, fuel wood) (Hoima DDP 2015). Traders travel to large urban settlements to source merchandise for their shops. The proximity of the districts to international borders has created great potential for import and export trade.

Tourism-based livelihoods are particularly important in the districts traversed by the AOI. Buliisa and Hoima districts are within the Albertine Graben region, which accounts for over 70% of Uganda's tourism revenue (Total E&P Uganda and Tullow Oil 2016). The main attractions in Buliisa are the Murchison Falls National Park (MFNP), River Nile and forest reserves (i.e., Budongo, Bugungu) (DDP 2015). Visitors are attracted to Hoima by the abundance of wildlife.

Hoima district is a hub for tourists travelling from Murchison Falls to Queen Elizabeth National Park. Hoima has hotels and guesthouses that have invested in facility upgrades to meet increasing tourist and oil industry requirements.

Plans are underway to construct the Kabaale International Airport in Hoima district which is intended to serve as a regional airport to cater for travel to the DRC, South Sudan, Rwanda and Burundi as well as serving regional tourist sites in Uganda.

PAC Level

Most households in the PACs have at least one family member engaged in some form of household-based enterprise such as petty trade or selling homemade food items. Women practice livelihoods peripheral to artisanal food processing such as operating restaurants and bars (IISD 2015).

Trade in retail merchandise and agricultural products and provision of services are livelihood strategies present in the sample PACs, particularly among women. Provision of services for visitors to the area for business and tourism was said to be increasing.

Programmes such as the Uganda Women Entrepreneurship Programme (UWEP) and the Youth Livelihood Programme (YLP) aim to facilitate the start-up of businesses for women and youth by providing them with zero- to low-interest government loans (KII with community development officers).

KIIs and FGDs with sample PAC members whose livelihoods are based on trade in goods and services revealed the following challenges:

- poor road network rendering transport of goods difficult
- lack of sufficient access to credit to buy bulk supplies and start up enterprises
- customers buying on credit and not paying when due
- fluctuating market prices for agricultural produce
- lack of affordability of electricity and piped water.

Focus groups with women and community leaders found that sex work takes place in several sample PACs.

Trends in Condition and Sensitivity to Change

Trends with regards to the local economy (nonland-based livelihoods) are as follows:

- Livelihoods based on small-scale agro-processing may benefit from the national calls for more foreign investment in this area (Export Gov 2017a, Internet site). Foreign investment, if attracted, may enable people to participate in more sophisticated post-harvest activities (i.e., packaging), thereby increasing the amount of value they capture from the overall product.
- Value-adding activities to fish and agricultural products are widely promoted in the DDPs. In the next five years, support to the private sector includes the provision of technical and advisory services in Buliisa (DDP 2015). Agro-processing will be expanded in Hoima with the procurement of 10 new fruit-processing machines (DDP 2015).
- Infrastructure development is a priority at the national and district level (DDPs 2015 and State House of Uganda 2018, Internet site). Investment in Uganda's road network, such as the oil field road upgrades, see Section 2.4.2.1, could lead to lower transportation costs, thereby improving market access for livelihoods based on the trade of retail goods and agricultural products.
- Women and youth engagement in business may intensify as the UWEP and YLP continue to be administered at district and local levels. With support, women and young people may be more empowered to start businesses.
- District governments view tourism as an important growth opportunity and have designated potential sites for future development (DDPs 2015). The development of tourism sites in the districts traversed by the AOI may contribute to the growth of tourism at the district level, increasing the number of job opportunities and income generated. However, funding shortages are a challenge often reported by district governments.
- Sex work in urban areas has increased with women travelling from other districts in Uganda to urban hubs such as Buliisa municipality (KP8) and Hoima municipality (KP74.5). Ongoing urbanisation may sustain increasing demand for sex work in these settlements.

Ecosystem Services Provided

Local economy (nonland-based livelihoods) does not provide ecosystem services. It does, however, rely on the ecosystem services described in Section 6.4.3.8 (land-based livelihoods).

Sensitivity Ranking

Table 6.4-34 presents the sensitive VECs with regards to the local economy (nonland-based livelihoods) identified during the social baseline study.

Table 6.4-34 Local Economy (Nonland-Based Livelihoods) VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Small business owners	Potentially positive	Potential increase in number of businesses and business activity
Employees in informal businesses	Potentially positive	Potential increase in number of businesses and business activity
Sex workers	High (4)	Vulnerable to physical abuse and communicable diseases. Sex workers are increasingly active in the districts traversed by the AOI.

Key Considerations

Key considerations are:

- small local companies may lose out on the economic benefits associated with the pipeline because they cannot comply with contract requirements to meet international standards
- women and young people seem to have fewer paid work opportunities and so the lack of start-up capital for the small business entrepreneur is more keenly felt by women and young people
- good road connections between rural communities and urban centres are crucial for business owners to source supplies and market their goods.

6.4.3.8 Land-Based Livelihoods

Land-based livelihoods include:

- crop farming
- livestock rearing
- mining
- natural resources use.

Baseline Condition of Crop Farming***National Level***

Uganda is an agriculture-based economy. About 72% of the working population is engaged in agricultural activities (World Bank 2017a, Internet site).

Households engaged in agriculture tend to undertake mixed farming activities to prevent shocks, such as drought or pest infestations, affecting household income. According to UBOS (2016a), 75% of agricultural households are engaged in crop growing, 58% in livestock farming and 69% are involved in both crop farming and livestock rearing.

The main cash crops grown are coffee, cotton, tea, tobacco and sugar cane. Maize, beans, plantain, cassava and sweet potato are grown by most of the agricultural households. Of these crops, maize has the highest uptake with 1.5 million households growing the crop (UBOS 2010b).

Agricultural production is predominantly at household level with household members, including children, assisting after school and during weekends. A World Bank study (2015b) found that male-managed plots were 60% larger than those managed by females and were more likely to be planted with cash crops. The UCA of 2008–2009 found that female farm labourers earned lower wages compared to their male counterparts for the same type of employment.

Commercial tree planting is increasingly important partially due to increasing construction industry, charcoal and firewood demand.

Commercialisation of agricultural produce is limited primarily by remote farms lacking access to local and regional markets (UBOS 2011b). Figure 6.4-17 shows a typical local market.



Figure 6.4-17 Buliisa Monthly Market, Buliisa District

The MAAIF Agricultural Sector Strategic Plan (2016) recognises the importance of agro processing and adding value to agricultural produce, and has highlighted several processing options for Uganda’s strategic commodities (MAAIF 2016).

Farmer groups are the main organisations through which the government supports household agricultural production and marketing services. However, Uganda Cooperative Alliance 2008–2009 found that only 16% of the 3.95 million respondents were members of farmer groups.

District and PAC Level

Both Buliisa and Hoima are rural districts, with households dependent on land- (and water) based livelihoods for income, nutrition and subsistence. Although most farming is subsistence, some large-scale commercial farming enterprises were identified in Hoima. The number of larger commercial farms is increasing, particularly in Hoima district. Commercial forestry is not common in the areas the

AOI traverses, despite government encouragement to promote tree planting. However, household smallholder plantations exist to a minor degree.

Agricultural activities are based on low-input, low-output family farming activities with trading of surplus crops. Crop farming in Buliisa district focuses on cassava (bitter and sweet) as the primary crop, followed by cotton and maize (Atacama et al. 2017; Artelia 2015a). Other crops include tobacco, sesame, sweet potatoes, potatoes, beans, groundnuts, matooke, cow-peas, sorghum and pumpkin (Buliisa DDP). In Hoima district, the main crops grown are tobacco, rice, cotton, coffee, maize, beans, sugar, bananas and tea.

Crops are grown for both income and domestic consumption in both districts. Mixed crop farming is undertaken to provide resilience from crop diseases, pest infestations, theft and poor harvests. Trees are usually interspersed with crops or near dwellings.

Farming Inputs

District agricultural officers have informed that agricultural activities remain dependent on rudimentary hand tools.

With increasing numbers of pests, pesticides have reportedly become a necessity. Yet costs associated with pesticides prevent most farmers in the PACs from using them. Soil fertility of agricultural plots was reported to be declining owing to intensive farming practices. However, chemical fertilisers were not commonly used because of the cost; instead, the practice of crop rotation, leaving plots fallow and mulching is reported.

Storage of agricultural goods is critical for sample PACs, and it was reported that, produce often spoils or needs to be sold in a hurry because of a lack of storage facilities in the household.

Labour

Farming in PACs is predominantly household based, with household members, including children, undertaking agricultural tasks such as tilling, planting, weeding and harvesting.

Households who have small plots or no land holdings provide labour (paid or in-kind payments) to other farmers. Where labour is not affordable traditional collective labour whereby households work on each other's plots on a rotational basis is used or labour is paid in kind and community members are hired as labourers and served a meal in payment. Hiring of labour is a necessity.

Migrant labour moves to the districts during the rainy season to assist and prepare the land. In Buliisa, it was reported that people travel from Nebbi and the DRC to labour on farms. Where labour was not affordable, the Artelia (2015a: 134) studies found several ways in which agricultural households assist each other:

- traditional collective labour (dici in Alur language)
- labour paid in-kind (koya in Alur language).

Role of Women in Crop Farming

Women and men are involved in all aspects of agricultural activities, such as tilling, sowing and harvesting. The Hoima DDP (2015) recognises that in rural agricultural households, women's workloads exceed those of men by several hours a day. It states that women are involved in crop production and are often responsible for post-harvest processing and storage, marketing of produce, processing staples such as maize and rice for consumption as well as being responsible for household tasks. However, women have limited access to land and productive assets, and there is a discrepancy between women's contribution to crop production and their control over crop marketing and decisions on the use of household funds.

At PAC level, there are minimal divisions of labour in crop farming, except for the high-value cash crops such as tobacco and sugar for which men take charge.

Marketing

With the absence of agricultural marketing cooperatives, individual farmers undertake their own marketing. Towns in the two districts hold a weekly market and district level markets are held in Buliisa and Hoima town.

Farm gate sales of crops to intermediaries for cash crops such as sim sim, cotton and maize are the most common way to market produce, along with tobacco and sugarcane.

Marketing of produce is cited by sample PACs as being a major challenge to agricultural livelihoods. The main challenges specified by KIIs at district level are:

- inadequate road infrastructure
- high transportation costs, which negatively affects produce prices
- lack of market price information from surrounding districts, preventing farmers from negotiating prices
- market gluts.

Contrary to the national trend, many PAC farmers interviewed are supported by either the National Agricultural Advisory Services (NAADS) through various programmes such as operation wealth creation, or support is provided via a registered farmer group.

Trends in Condition and Sensitivity to Change

Crop farming trends are as follows:

- The GOU has a five-year Development Strategy and Investment Plan to steer public actions and investments in the agriculture sector. The four key programmes of the plan are enhancing production and productivity; improving access to markets and value addition; creating an enabling environment; and institutional strengthening of the sector.
- Crop farmers, particularly tobacco and sugar farmers, are becoming more commercially orientated and are increasingly renting land to enlarge their plot size. These farmers tend to receive assistance from commodity buyers and processors.
- Crop farming is rain fed, low input and low output, therefore harvests are vulnerable to the effects of pests, diseases and climate variability. It is common

for a crop to be spoilt, thereby threatening household food security and ability to pay for school fees and health services.

- Available labour for farming activities is in decline because young people are migrating to urban areas.

Ecosystem Services Provided

The land-based livelihoods (crop farming) described herein provide the following ecosystem services:

Provisioning services:

- food for basic survival of the population
- income from selling surplus crops to pay for education, clothes and health-related items as well as other basic needs
- jobs for farm labourers
- products for agro-processing activities.

Crop farming is undertaken throughout the AOI PACs, sometimes being their only source of food.

In the sample PACs, most farming is subsistence and the agricultural produce is consumed within the family with a small portion being sold at the local market.

Sensitivity Ranking

Table 6.4-35 presents the sensitive VECs with regards to crop farming identified during the social baseline study.

Table 6.4-35 Crop Farming VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Agro pastoralists	Moderate (3)	Agro pastoralists have diversified income streams across crop farming and livestock rearing, therefore they are more resilient to external shocks such as pest infestations, animal diseases and climate change.
Commercial farmers (large scale) (tea, tobacco and crops)	Moderate (3)	Impacts to commercial farming could indirectly affect the livelihoods of the farm workers; however, commercial farmers would be more resilient to adverse conditions than subsistence farmers because of greater access to farming inputs, credit and land.
Intermediaries buying goods at farm gates	Moderate (3)	Road access is critical for movement of goods to markets in a timely manner before they spoil. Roads are often in bad condition.

Table 6.4-35 Crop Farming VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Crop buyers and agro processing	Moderate (3)	Crop buyers, including intermediaries and agro processors, are dependent on the supply of crops, vegetables and fruits to process and sell on. Without the supply of produce, processing will stop. Buyers are dependent on one income stream, but they are likely to have access to credit facilities based on their business.
Crop farming households engaged in subsistence and commercial crop farming activities	Very high (5)	Crop farming activities are mostly conducted without inputs and are rain-fed. Subsistence farmers have limited access to alternative sources of income due to rural location, lack of education, skills and experience. There is low resilience to external shocks such as crop failure. This can impact on food/nutritional status as well as cash for cost of education and health care.
Landless farm labourers on subsistence farms	Very high (5)	Landless farm labourers are particularly vulnerable; without income potential impacts will be felt on household food and nutritional status as well as income for living, education and health care.
Crop farming female headed households	Very high (5)	Women have limited access to improved farming inputs, have access to smaller sized plots to grow crops and are more likely to receive lower wages as farm labourers than men due to cultural norms. They are mainly confined to subsistence farming. Impacts on their crop farming will be felt in their food and nutritional status as well as on their budget for education and health care.

Key Considerations

Key considerations are:

- crop farming in the sample PACs is mostly undertaken on household allocated land holdings. The impacts of failed crops or loss of land can last for several years, as seedlings and seeds are produced each season for the subsequent season
- crop farming in the sample PACs is generally rain fed, low input and low output, therefore harvests are vulnerable to pests, diseases and climatic variability. It is not uncommon for entire crops to be spoilt, thus making households vulnerable in terms of food security and the ability to pay for school fees and health services.
- farmer groups have relatively low participation but are the government's preferred means of contact
- labour shortages may affect household agricultural capability; children are required to complete farm work and miss school when labour is required. This

situation may be exacerbated if household members are drawn away to temporary construction jobs.

- access to markets is a major challenge for crop farmers in rural areas. With poor road conditions and limited market information, farmers are dependent on selling goods in a timely manner locally or to middlemen buying at the farm gate. Any interruptions in the supply chain will affect their ability to market goods and receive a cash income.
- women are notably disadvantaged in crop farming with limited access to land holdings, capital to improve farming activities and constraints with household duties. With limited education and no other prospects of livelihood opportunities, they are reliant on crops farming as a main stay livelihood
- human rights to adequate food and standard of living are sustained.

Baseline Condition of Livestock Rearing

National Level

Livestock rearing is an important economic activity at household level. However, it does not feature prominently in the macro economics of the country (Artelia 2015a).

Domestic consumption of livestock products (meat and milk) is low compared to the country's neighbours with an average of 11 kg of meat and 23 L of milk per capita per year for all Ugandans compared to 41 kg meat and 26 L of milk in Sudan and 15 kg of meat and 198 L of milk per person in Kenya (ICPALD 2013). Figure A9.4-21 in Appendix A9 presents a national livestock inventory for 2009.

Livestock are reared on a commercial basis but also at household level for both cultural and economic reasons, including:

- prestige to illustrate family wealth
- investment and a means of savings
- cultural for payments of dowries
- income to pay for school fees and health services
- source of food (eggs, milk and meat)
- source of hide
- source of manure for crops.

Livestock rearing takes place under four types of livestock production systems: agro-pastoral, semi-intensive, commercial ranching and pastoral (FAO 2018). Breeds of livestock remain principally indigenous.

Agro pastoralists undertake livestock rearing alongside crop farming. A small number of animals are kept. Pasture lands, either in 'paddocked' areas (Boma) with informal hedging or fencing on privately owned land or on communal village land, are used to graze livestock.

Semi-intensive production systems are where livestock including fowl are kept in confined spaces and provided fodder, feeds and crop residues. These farming entities are mainly in the central and southwestern subregions and in peri-urban areas.

Commercial ranching production systems consist of large herds of animals, particularly cattle, which are grazed on expansive hectares of fenced private lands

and provided with supplementary feed inputs. Commercial ranching accounts for 10% of the national herd and this system is mainly found in the central and southwestern regions within the cattle corridor. Production is for beef and milk. Herd sizes can be as large as 10,000 heads of cattle and over 600 heads for goats. Within the system of commercial ranching, large herds of cattle, goats and sheep are tended by a herder, sometimes a family member, or herders are sought from pastoralist tribes such as the Karamojong from northeast Uganda or the Banyarwanda from southwest Uganda or Rwanda.

The fourth system, nomadic pastoral production, which is less common and remains in northeast Uganda, is a system where livestock are moved from one place to another in search of pastures and water on communal lands. Nomadic pastoralist practices have largely disappeared in Uganda owing to factors such as:

- government policies that prioritise modern livestock development
- climate change resulting in prolonged droughts
- land tenure matters.

Localised nomadism is still practiced. This involves movements of livestock herds, usually cattle, between villages within district borders and occasionally between districts during the dry seasons.

Localised nomadism, which enables pastoralists (agro-pastoralists and commercial ranching) to survive the increasingly unpredictable seasons, is undertaken in an organised manner with host pastures being rented. Herders, often family members, move the animals by road or by trucks to the pastures and remain with their herd for the duration of their stay in the host pasture. Livestock movements, however, are prohibited during disease quarantines.

Trading of livestock is undertaken at regional and district markets or farm gate sales with intermediaries buying live animals for onward sale to abattoirs or to private buyers.

District and PAC Level

The main livestock species in the districts traversed by the AOI are cattle, goats, pigs, donkeys, poultry, sheep and dogs. The most common livestock production system is agro pastoralism performed on a subsistence basis by the majority of households. To a lesser extent, but growing in popularity, semi-intensive production systems for chicken and pigs are put in place.

Cattle rearing is recognised as being the most economically important in both Hoima and Buliisa.

Cattle are particularly important to the livelihoods of households of the Bagungu majority villages of Kasinyi (KP0), Kigwera, (KP4), Kibambura (KP5) and Kibaambura (KP8) whereby cattle are the main livelihood activity, whereas the Alur are agro pastoralists undertaking a combination of crop farming and livestock rearing.

Herd sizes are large across the PACs and KIIs found that the sizes ranged from 80 to 1000. Artelia (2015c) found that average herd sizes were between 30 and 130.

KIIs found that the larger herds (up to 1000) are in Kibambura village (KP5), Buseruka village (KP84.5) and Kayere village (KP94.5), but these are exceptions.

Grazing takes place as a free-range system on communal lands with open access to the resources grassland and water or the animal is tethered at the household dwelling (Artelia 2015c). Grazing of larger herds is principally undertaken on the plains of the shores of Lake Albert as a free-range system. Animals are taken daily by herdsmen to grazing pastures and water sources, such as the Waiga River, and in the evening the animals are returned to the kraal as part of a sedentary lifestyle of settled pastoralists. KIIs with the district veterinary officers, pastoralists and a UWA officer found that cattle are taken to the peripheries of Murchison Falls, Budongo (Buliisa district) and Kaiso Tonya, Kyakaboga, Bujawe and Kahara Forest Reserves (Hoima district) by herders for grazing. A KII with Buliisa district veterinary officer also revealed that when there are extended droughts, herds are moved from Hoima, Kyankwanzi, Kiboga and Nakasongola districts to the shores of Lake Albert and protected areas in Buliisa. This often creates conflict between local livestock owners, crop farmers and the UWA.

Labour

The task of caring for livestock is shared by males, females and children (Figure 6.4-18). Women's involvement in livestock rearing are generally restricted to lesser activities such as cleaning out livestock kraals, caring for calves and milking.



Figure 6.4-18 A Mixed Herd of Cattle in Serule B, Buliisa District

Marketing

Marketing of livestock takes place at mixed markets and livestock byproducts are used both for subsistence and for sale. They are either farm gate sales or taken to dairies locally known as 'coolers'.

Challenges Facing Livestock Rearing

The following challenges to livestock rearing were cited across sample PACs:

- prevalence of diseases. Veterinary services were reported as unaffordable by livestock owners interviewed.
- quarantines enforced by the MAAIF. This has resulted in the closure of livestock markets, which has left livestock owners unable to market their animals and without access to cash.
- climate variability, which has lengthened the dry seasons, making access to water sources and pastures difficult
- livestock theft, especially of cattle, which is increasing owing to a population rise. Cattle are branded to identify livestock, but this does not act as a deterrent with many thefts never being reported or recovered. Cattle theft was occasionally blamed on herders or unemployed youth.
- absence of government support for livestock owners
- lack of available land to make livestock rearing commercially viable
- threats from animals such as snakes and baboons, as cited by interviewed livestock owners. Baboons were said to be a problem in Buseruka subcounty.
- increasing livestock injuries, including falling into excavations related to informal ASM, when moving animals to pastures and water sources
- fluctuating prices of livestock and their products as a result of the sellers' need for cash and condition of the animals
- conflict as a result of damage to crops when herds stray into farmland
- competition for resources such as water and land between pastoralists and host communities.

Trends in Condition and Sensitivity to Change

Trends in condition for livestock are as follows:

- Long-distance movements (more than 20 km) in search of water and pasture are no longer undertaken. Localised pastoralism is common with organised movements of livestock to host pastures.
- Livestock owners with large herds of cattle are increasingly reliant on pasture rental agreements and, in the dry season, scarce water sources.
- Government initiatives promote the introduction of exotic livestock breeds; however, livestock owners are slow to engage with these initiatives and the new breeds are less disease resistant.
- Despite an increased prevalence of livestock diseases, livestock owners lack access to veterinary services. During the survey, a foot and mouth disease quarantine prevented any livestock movements.
- Rural households invest in livestock as a means of saving for dowries, school fees and health treatment.
- Access to grazing land and watering points is decreasing because of increased use of land by activities including crop farming and building or improving roads and dwellings.
- Ongoing conflicts between farmers and livestock owners over land access is likely to worsen because of the growing population and changing weather patterns.

- Settlements that are better connected to markets have seen increased incomes from selling milk and animals.

Ecosystem Services Provided

The land-based livelihoods (livestock rearing) described herein provide the following ecosystem services:

Provisioning services:

- rural income from selling livestock
- food security for families and future generations (if managed in a sustainable manner)
- financial security (livestock rearing is part of a diversification strategy to ensure some cash will be available when other means of income fail).

Cultural services:

- preservation of cultural heritage and traditional knowledge where livestock rearing is inter-generational.

Key points to note are that within the districts traversed by the AOI, livestock are used for both subsistence and sale. Livestock rearing in the sample PACs is predominantly sedentary with grazing on owned or rented land.

Land provides a provisioning service as a resource for livestock keeping. It provides grazing resources, water sources, ground for movement and habitation of livestock herds, and trees for shelter and medicinal herbs.

Sensitivity Rating

Table 6.4-36 presents the sensitive in relation to livestock rearing identified during the social baseline study.

Table 6.4-36 Livestock Rearing VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Livestock owners with large herds (commercial production)	Moderate (3)	Livestock owners with large herds own large tracts of land and rear livestock commercially assisted by production inputs. As operations are large scale, they are more resilient to external shocks except for disease, climatic change and labour shortages (e.g., herdsmen and other farm workers).
Livestock keepers and their families including women, children and elderly, undertaking crop farming (agro pastoralism incorporating small-scale livestock production)	Moderate (3)	Livestock keepers, who are also crop growers, are vulnerable to loss of livestock but less vulnerable than those who rely solely on livestock rearing.

Table 6.4-36 Livestock Rearing VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Livestock owners and their families including women, children and elderly with herds, not undertaking crop farming in conjunction with livestock keeping	Very high (5)	Without free movements of large herds (cattle), animals may not have sufficient pasture and water sources. Herd owners are less resilient to external shocks as their main dependency is on their herd.
Hired herdsmen (often of Banyarawanda ethnicity or non-Ugandan nationals)	Very high (5)	Herdsmen, employed by cattle owners, have low or no education and some are without identity cards. They have no alternative livelihood means and are more vulnerable to external shocks.

Key Considerations

Key considerations are:

- livestock rearing activities in the sample PACs are under pressure owing to shortages of land and water resources
- livestock diseases are common, and increased movements of vehicles and people could increase the spread of diseases
- owners of large herds in the sample PACs often do not have diversified income
- human rights of access to food and a decent standard of living should be maintained.

Baseline Condition of Artisanal and Small-Scale Mining**National Level**

Deposits of gold, tin, tungsten, niobium, coloured gemstones, limestone, marble, kaolin, clay, granites, rock salt and sand are present in Uganda. In addition, construction materials such as sand, clay, lateritic soils (murrum), limestones, marble, kaolin and stone aggregates are quarried.

To date, Uganda's mining sector is characterised by a combination of officially registered local and international mining companies, and artisanal and small-scale mining (ASM).

The Mining Act (2003) provides legislation for prospecting, exploration and mining (Alchetron 2017, Internet site). Two aspects of the act applicable to ASM are the:

- prospecting licence: a one-year, non-exclusive licence granted to the holder to prospect for minerals around the country
- exclusive prospecting licence: mineral specific and limited to an area of 20.48 km² (7.91 square miles).

ASM provides livelihoods for almost 200,000 women and men, and over a million Ugandans benefit indirectly (EARF 2018). It is estimated that ASM has grown by 40% since 2008 (Spiegel 2012). However, ASM is associated with illicit activities,

environmental degradation, exposure to occupational hazards and other serious health and safety concerns for miners and their communities, displacement of people and in-migration of prospectors. At 6% growth per annum, the construction sector is strong, and the current market demand is the main driver, especially with the large number of current and imminent infrastructure projects in the country.

District and PAC Level

Full-scale geological studies have not been undertaken to determine the presence of minerals across the districts traversed by the AOI, and the mineral status of these districts is largely unknown. Known deposits are largely unexploited. Hoima DDP identifies the presence of gold.

Construction materials such as sand, stone for aggregates, laterite soils (murrum) for road and brick making are the main product of mining and quarrying in the districts.

Sand mining occurs in both districts, particularly in wetlands. It takes place year-round but increases in the dry season. Sand mining is performed alongside crop farming or fishing activities within a household and is a major source of income. Processing stone for aggregates was undertaken to a lesser extent. Salt is extracted at Kibiro fishing village on the shores of Lake Albert which is within the AOI. The site is an important archaeological and cultural heritage site and was placed on Uganda's Tentative List of World Heritage Sites in 1997.

Problems associated with artisanal mining as reported by district natural resource officers were:

- ASM being undertaken in an uncontrolled manner, without a licence, and often without the knowledge of the authorities
- environmental degradation. Open pits and uprooted trees can create drainage problems and stagnant water provides breeding grounds for mosquitoes. Open holes are dangerous for humans and animals.
- the low aesthetic value of abandoned or active mine sites
- safety matters
- women working in ASM obtaining fewer benefits than men
- prominent child labour, especially in extremely poor households in rural communities
- gaining access to the deposits creating conflicts and boundary disputes
- fluctuating demand for sand, clay and aggregate
- customers not always paying miners.

Trend in Condition and Sensitivity to Change

ASM trends include:

- the government increasingly acknowledging the importance of ASM and moving toward formalisation of the sector
- increasing extraction of construction materials such as sand, clay for bricks and stone for aggregate owing to an expanding construction industry in Uganda
- ASM activities providing increasingly major benefits to households and create multiplier effects in local communities

- ASM activities slowing down urbanisation and creating downstream employment.

Ecosystem Services Provided

The land-based livelihoods (ASM) described herein provide the following ecosystem services.

Provisioning services:

- income from sale of minerals and construction materials (e.g., sand, clay, gravel)
- materials for dwellings and shelter
- salt for livestock and domestic consumption.

ASM is an abiotic provisioning ecosystem service undertaken throughout the AOI by sample PACs, primarily in the dry season.

Sensitivity Ranking

Table 6.4-37 presents the sensitive VECs with regards to ASM identified during the social baseline study.

Table 6.4-37 Artisanal and Small-Scale Mining VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Non-Ugandan nationals undertaking ASM activities informally	Very high (5)	This category of people will be highly vulnerable, as they hold no identity papers and have no legal standing in Uganda.
Artisanal and small-scale miners engaged as casual labour on an informal basis, pursuing mining as a sole occupation	Very high (5)	These VECs do not have access to land for farming or livestock as an alternative livelihood and therefore have very high vulnerability.
Child artisanal miners engaged as casual labour on an informal basis, pursuing mining as a part-time occupation	Very high (5)	Children encounter high safety risks and lack access to education as a result of their mining activities.

Key Considerations

Key considerations are:

- large construction projects may require substantial quantities of construction materials. This would increase the pressure on existing sources of supply with the following potential results:
- price increases for construction material with indirect effects felt through the construction industry and possibly making housing less affordable
- opening of new (licensed and unlicensed) borrow pits to meet increased demand

- a surplus of borrow material, fall in prices and fall in employment after the demand is closed once construction is completed.
- because of the informal and hence often covert nature of ASM activities, it is difficult to assess the precise location of ASM sites at any time
- PACs' human rights to a decent livelihood, safety and security.

Baseline Condition of Natural Resources Use

National Level

Products such as biomass fuel (firewood and charcoal), wild foods (honey, insects, mushrooms and bush meat), timber (products made from trees harvested from forests, plantations and nonforest lands), medicinal plants and grasses play a vital part in the subsistence of rural communities in terms of energy for cooking, food security, construction materials for shelter, medicine and income.

Hunting occurs throughout rural areas in Uganda and requires a permit from the UWA under the Uganda Wildlife Act 1996. However, hunting often takes place without a permit. Apiculture is a fast-growing industry.

District and PAC Level

Figure 6.4-19 presents the natural resources use in the sample PACs.

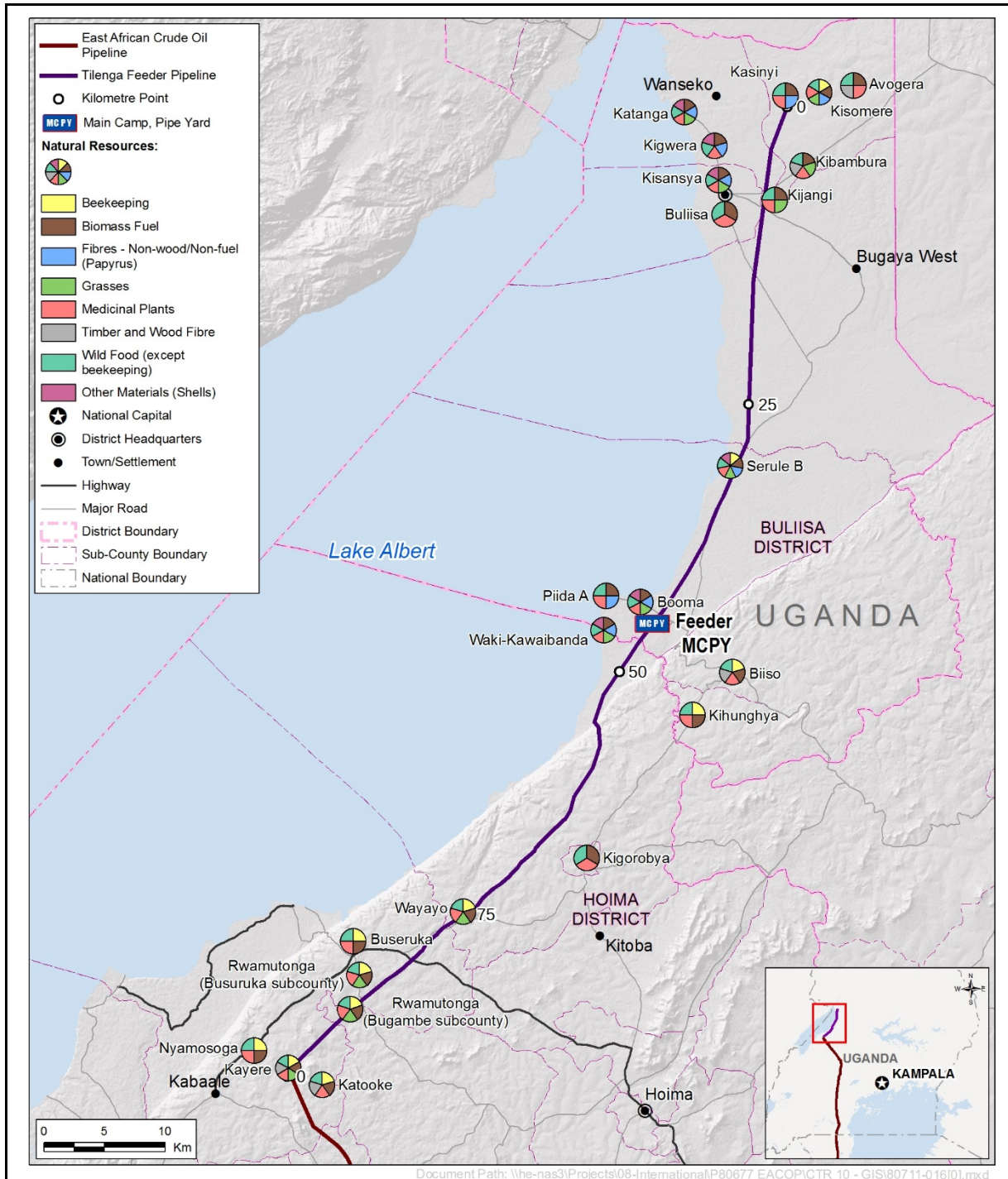


Figure 6.4-19 Natural Resources Harvested in the Sample Potentially Affected Communities

Trees, mainly lira and acacia trees (in Buliisa) and eucalyptus and pine in both districts, are used for construction with permission sought from the land owner.

Firewood, an important source of cooking fuel, is collected in communal land by communities in the districts traversed by the AOI. Firewood is collected daily by women in all sample PACs. Distances travelled to find firewood have reportedly increased owing to diminishing sources. Permission is sought from land holders

and firewood is sometimes collected from the protected areas (Wambabya, Budongo, Bugungu and Murchison Falls) on approval and, in such cases, wardens accompany the collectors. Stakeholder engagement also found that wood is taken illegally. Charcoal use is popular in the districts traversed by the AOI (see Figure 6.4-20).



Figure 6.4-20 Charcoal Sacks in Kayere, Hoima District (KP94.5)

Charcoal processing is found in a small number of sample PACs. Charcoal is predominantly being produced for marketing. With the increased population coming to the area and the improved road connectivity, this could increase demand for charcoal. Therefore, more suppliers undertaking charcoal production will emerge in the area (Artelia 2015d: 70).

Papyrus *Cyperus papyrus* grows in abundance in wetland areas in both districts. The papyrus is cut and dried to make sleeping mats, flooring and screens.

Shells are collected for lime production from the shores of Lake Albert and behind the shoreline. KILs with shell collectors found women and a small number of men undertake this activity, deemed by community members within which the activity is undertaken as the poorest.

Women and men collect elephant grass and spear grass mostly on village land. These grasses have several uses (Artelia 2015d) including:

- thatching for roofs. Grass for thatch is harvested on a regular basis during the rainy season in a small number of sample PACs in Hoima district.
- animal fodder, which is gaining importance owing to ongoing depletion of communal grazing areas and the shortage of pasture land during the dry season
- making brooms, which is a seasonal activity; brooms are generally sold at local markets.

There is a substantial reliance on locally sourced medicinal plants for common illnesses. People use both medicinal plants and modern medicine to treat illnesses. However, use of local medicinal plants is more prevalent in remote rural areas.

Wild fruit and vegetables are harvested by women and children in all sample PACs throughout the year and serve to supplement the diet. Surplus is occasionally sold in local markets or within the community. Edible wild plants are collected throughout the year from the peripheries of cleared land where crop farming is undertaken and tree-covered areas and are used to supplement the diet. Women and children mainly collect wild foods. Mushrooms are harvested March–May and August–October from open rangeland or forest and groves near communities.

Men, women and children harvest grasshoppers to supplement the diet. Grasshoppers are caught in open areas. Ants are collected February–April and March–June.

Hunting of wild animals was reported to occur on an infrequent basis in both Buliisa and Hoima districts. Key informants were reluctant to disclose if they engaged in hunting, as it is considered poaching with a heavy penalty. Where it was disclosed, it was often qualified as being near agricultural plots or communal lands. However, field studies and Artelia studies found that hunting is also undertaken in protected areas, such as Bugungu, Budongo, Wambabya and Kabywoya Wildlife and Forest Reserve areas. Animals hunted include buffalo, Ugandan kob, baboons, bush pig, monkey, rabbits; hippopotamus and wild rats (Artelia 2015d).

Apiculture is a livelihood activity in both Buliisa and Hoima districts. Beekeeping is undertaken in some sample PACs and is considered profitable.

Challenges Facing Natural Resources Use Across the Districts

- A growing population, particularly around the lakeshore, has put pressure on the natural resources owing to encroachment on wetlands and forest areas for dwellings, farming and grazing.
- Many timber and charcoal dealers are unlicensed, which makes regulation by the districts difficult.
- The high cost of alternative sources of energy for cooking and lighting (gas, solar and electricity) forces people to use wood and charcoal.
- The rate of tree cutting is much higher than the rate of reforestation.
- Honey production is inefficient. Traditional beehives and rudimentary equipment can contaminate the processed honey. Honey fermentation is common owing to a lack of appropriate equipment and storage facilities. Potentially valuable byproducts such as wax and propolis are discarded. To increase production,

beekeepers need more support in terms of equipment and ongoing practical training.

- The bee population is decreasing because:
 - hives are usually destroyed and colonies often killed when collecting honey
 - non-organic pesticides kill bees
 - there is habitat pressure for bees due to population increase
 - honey bee pests and predators affect traditional beehives.

Trend in Condition and Sensitivity to Change

Trends in natural resources use includes:

- Natural forest and scrubland is diminishing, and women need to travel increasing distances to collect wood. With few affordable alternatives to firewood and charcoal, the long-term sustainability of existing sources of biomass fuel is uncertain.
- Medicinal plants are widely used for human and animal illnesses; more so in remote rural areas owing to the inaccessibility of medical facilities. However, increased clearance for farming and infrastructure may threaten availability.
- Although hunting is only permitted with a licence, illegal hunting is practiced on a small scale. Hunting has, however, diminished because there is a decrease in game populations due to over-hunting, clearing of forests and scrubland areas for agriculture, and increased livestock grazing.

Ecosystem Services Provided

The land-based livelihoods (natural resources use) described herein provide the following ecosystem services:

Provisioning services:

- energy for cooking and food security
- construction materials for shelter
- income from selling natural resources
- traditional medicine.

The natural resources included in this section are obtained from a variety of ecosystems within or near the PACs including forests, wetlands and pasture rangelands. As such, these natural resources play a vital role in subsistence of rural communities. With an increasing population and a high demand and reliance on natural resources, continued protection of and access to these resources is essential.

Sensitivity Rating

Table 6.4-38 presents the sensitive natural resources use VECs identified during the social baseline study.

Table 6.4-38 Natural Resources Use and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Beekeepers	Low (1)	Beekeepers are more resilient to external shocks because beekeeping activities supplement farming activities.
Hunters	Low (1)	Hunters are generally not reliant on the bush animals they catch for food or as a main income.
Fibres and grass collectors	Moderate (3)	Access to fibres and grass, which is culturally important, may be reduced.
Medicinal plant users	Moderate (3)	Without access to medicinal plants, there may be limited means to treat illnesses in an affordable manner.
Wild food users	High (4)	Plants supplement diets and are used in 'hungry months' when households may not have sufficient access to food.
Firewood collectors (women)	High (4)	With limited access to firewood, household meals cannot be cooked, affecting the health of family members. Access to firewood is already diminishing and women must walk long distances.
Shell collectors	Very high (5)	Deemed the poorest in communities and mostly undertaken by women, shell collecting is the only means of income. Without such, the collectors will be more vulnerable than most.

Key Considerations

Key considerations are:

- communities, especially poorer households, are dependent on natural resources for providing wild food, traditional medicine and firewood for cooking
- a growing population and urban demand for firewood and charcoal has reduced their availability in the AOI
- a decline in bee population due to habitat destruction in favour of crop farming and animal grazing. Additional removal of land cover may affect the bee population further.
- PACs' human rights to a decent livelihood and food security.

6.4.3.9 River- and Lake-Based Livelihoods

Baseline Condition of River- and Lake-Based Livelihoods

National Level

The fisheries sector provides a livelihood to fisherfolk and those engaged in the supply chain which includes small-scale and industrial fish processing, fish trading, boat-building, net making, trading in fishing equipment and extension activities provided by the government. The current annual production from fisheries is about 461,000 tonnes and from aquaculture 111,000 tonnes (ACME 2017, Internet site).

Fisheries activities are mainly undertaken in open water such as major and minor lakes, rivers and wetlands. A major challenge facing lake fisheries is illegal fishing with use of indiscriminate fishing gear such as fine-mesh-gill and seine nets.

The Government is supporting the emergence of pond, dam and cage-based aquaculture.

District and PAC Level

River Fishing

The AOI crosses the Waiga River (KP23), Waisoke River (KP28), Sonso River (KP34), Waki River (KP47) and the Wambabya River (KP89).

Species found in these rivers are *Protopterus aethiopicus*, *Schilbe intermedius*, *Labeo* sp., small mormyrids and macroinvertebrate such as chironomids (see Appendix A2 Aquatic Biodiversity Baseline Report). KIIs found that fishing in the lake is favoured over fishing in rivers, as catches are more plentiful from the lake. Landless fishing households, or those with small agricultural plots, fishing in rivers are more dependent on fishing activities as a source of protein and to derive an income. Fish caught in rivers and wetlands are mainly consumed by the household.

Aquaculture

Aquaculture undertaken in the districts consists of pond fisheries and cage fisheries in lake waters. Aquaculture is a year-round activity, although other livelihood activities are usually undertaken alongside such as crop farming. Despite Government initiatives to encourage aquaculture, it has not been taken up on a large scale, possibly owing to readily available lake fishing opportunities.

FGDs and KIIs with district production officers and fisherfolk identified the following challenges associated with aquaculture:

- Low inputs and the low quality of fish fry and feeds constrain aquaculture, resulting in poor productivity.
- Major diseases including fungal infection and stunted growth are experienced because of poor feeds.
- Predators such as monitor lizards, snakes and herons further reduce yields (UBOS 2009b).

Lake Fishing

Lake Albert provide freshwater fishing grounds. Distributed along the shoreline are fish landing sites where boats and nets are stored, fish processing is undertaken, food stalls and traders operate and BMUs are established (Hoima DDP 2015; Uganda Nile Discourse Forum 2013, Internet site).

Fish-landing-site communities in both districts have expanded substantially in recent years. Fisheries act as a pull factor particularly to unemployed youth from inland as well as transborder from the DRC. Improved road networks associated with oil developments have facilitated movement to these areas that were previously difficult to access via roads.

Younger males dominate fishing (Hoima DDP). However, women are involved in the processing and marketing part of the fish supply chain. Studies found that some women had been able to invest in vessels through participating in saving circles (Artelia 2015a, 2015b). Diverse ethnic groups, including the Bagungu, Alur, Banyoro and Lugbar, engage in fishing activities with the Bagungu and Alur dominating. In some of the fishing communities in Buliisa, 80% of the population were migrants (Artelia 2015a).

The Alur constitute a large proportion of immigrants because many (both Congolese and Ugandan) migrated to landing sites in the districts in the 1940s and are now well established.

Lake fishing is predominantly a full-time occupation and most fishing households are therefore solely dependent on this income source.

A small proportion of those who fish do so on a part-time basis, sharing their time with other income-earning opportunities such as crop farming, livestock rearing or trading. Part-time fisherfolk travel to the lakes from inland villages.

Lake fishing is undertaken from the shore or from vessels. Boats are usually paddled, with only a minority having outboard engines.

The main fish caught in the lakes in the districts traversed by the AOI are Nile perch, tilapia, mud fish, *Clarias*, muziri, lung fish and *Bracynus nus* (see Appendix A2 Aquatic Biodiversity Baseline Report).



Figure 6.4-21 Fishers with Gill Nets in Piida A, Buliisa District (KP45.5)

Marketing and Processing of Lake Fish

A small percentage of fish caught is kept for the household. In Hoima, fisherfolk consume 20 to 30% of the fish caught (Hoima DDP 2015). On average fish prices are high owing to the high demand and the short supply. High market prices encourage fisherfolk to sell rather than consume or share their catches in the local fishing community.

Marketing of fish is undertaken in the following ways:

- fresh or processed to local individuals in communities or in local markets such as Ngwedo town centre, Biiso and Wanseko, Kabolwa, Bugoigo or Hoima municipality, transported by bicycle
- fresh to buyers who come with refrigerated trucks from beyond the districts to sell to supplies in Kampala or other larger towns (reported at Katanga and Kigwera N/E (KP4) and Waki Kawaibunda (KP47))
- fresh or processed at regional markets such as Panyimur, which is then transported to North Uganda or the DRC.

Fish processing is undertaken by sun drying the fish on makeshift dryers made from papyrus or by smoking the fish in mud ovens fuelled by firewood. Women undertake these fish processing activities. Salting, a male activity, is also undertaken to preserve and sell fish.



Figure 6.4-22 Fish Salting in Piida A, Buliisa District (KP45.5)

Trend in Condition and Sensitivity to Change

The following trends were identified for river- and lake-based livelihoods:

- Lake fish stocks are decreasing due to overfishing, which encourages the use of illegal fishing gear (fine-meshed nets).
- Population growth is increasing pressure on natural resource use, including river fishing; additionally, this is causing more wetlands to be drained for agriculture and other land use thus further constraining fish availability.

Ecosystem Services Provided

The river- and lake-based livelihoods described herein provide the following ecosystem services.

Provisioning services:

- income from selling catch and fishing equipment
- food to supplement diets
- products for fish processing activities.

Fishing has been an important activity for generations and is a major part of the PACs' way of life, particularly for the lake fisherfolk.

Sensitivity Rating

The social baseline identified sensitive VECs for river and lake-based livelihoods. These are presented in Table 6.4-39.

Table 6.4-39 River and Lake-Based Livelihoods VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Lake fisherfolk who fish part time	Moderate (3)	This category of fisherfolk undertakes fishing activities alongside crop farming or informal trading activities. Therefore, they are less vulnerable to a reduction of one of their income streams.
River fisherfolk	Moderate (3)	River fishing is often undertaken alongside other income-generating activities. Therefore, river fisherfolk are less vulnerable to a change in status of one of the income streams.
Lake fisherfolk who fish full time	Very high (5)	This category of fisherfolk is dependent on fishing as a sole livelihood and subsistence activity. There are few other income-generating opportunities available and without land holdings they are particularly vulnerable.
Women who are dependent on lakeshore fishing	Very high (5)	Women fishing from lakeshores are considered highly vulnerable with low resilience to external shocks, as they have no alternative means of livelihood and are dependent on shore fishing for food security and income generation.
Women who process and market fish	Very high (5)	Women have limited income earning opportunities; however, fish processing and marketing provides a substantial income stream on which households depend.
Employed workers of aquaculture enterprises	Very high (5)	Often landless and exclusively dependent on their job

Key Considerations

Key considerations are:

- lake fishing and aquaculture are small-scale subsistence activities
- those whose livelihoods are dependent on fishing are poor and do not have access to credit, and so their resilience is low
- there is pressure on the fisheries sector due to increasing crop failures caused by drought or floods forcing crop farmers to look for alternative means of generating an income

- young people are becoming more attracted to fishing activities as the size of farming plots for the younger generations is diminishing, rendering crop farming less profitable
- human right to access to food and an adequate standard of living for communities.

6.4.3.10 Land and Property

Baseline Condition of Land and Property

National and District Level

The Land Act (1998) identifies four forms of land tenure: customary, leasehold, freehold and mailo (see below) (MLHUD 2013). Most citizens hold their land under customary tenure, which applies to specific land areas that are governed by customary laws. Land under this tenure system is communally, jointly or individually owned, often without land titles and often presided over by elders, clan leaders or figureheads within communities. In the laws of Uganda, customary tenure is defined as, “A system of land tenure regulated by customary rules which are limited in their operation to a particular description or class of persons”.

Over 60% of land is held under a customary tenure system, most of which is found in the northern, western and southern parts of the country and in Buliisa and Hoima. Key problems associated with this tenure include lack of security for landowners and disadvantages for women (MLHUD 2013).

The Land Act (1998) provides for two mechanisms in which rights held under customary tenure can be formally recognised:

- acquiring a certificate of customary ownership (CCO). Any person, family or community holding land under customary tenure on former public land may acquire a CCO. A CCO can be acquired through a tiered application process. The area land committee reviews applications and the district land board eventually issues the certificates.
- forming a communal land association (CLA) by any group of persons under the Land Act for any purpose connected with the communal ownership and management of land, whether under customary law or otherwise (GOU 2013b).

Under the mailo tenure system, land is registered under the Registration of Titles Act, which grants the holder a land title and absolute ownership in perpetuity. This tenure system recognises occupancy by tenants (known as *Bibanja* holders), whose relationship with the landlords is governed and guided by the provisions of the Land Act 1998. Land held under mailo tenure (approximately 23,300 km²) is confined to Buganda (central Uganda) and Bunyoro (western Uganda). At present, there are more than 250,000 mailo land title holders in Uganda (MLHUD 2013).

The third land tenure system (freehold) is similarly governed by the Registration of Titles Act. Under this system, a registration of title in perpetuity and conferment of full powers of ownership is provided to the land holder, who may use the land for any legal purposes. Only national citizens are legally entitled to own land under the freehold system and there is little land held under freehold tenure. Where it is held, the majority has been issued to church missionaries, academic institutions and

some individuals. This system is not common in Buliisa or Hoima districts (MLHUD 2013).

Land conflicts form the highest percentage of disputes reported both in formal and informal dispute resolution systems in Uganda. Common concerns reported are landlord–tenant relations on mailo land, land tenure insecurity in post-conflict northern Uganda, disputes over land expropriation by the Government and the implications of oil exploration and mining for local land tenure systems and rights (MLHUD 2013).

Foreigners cannot own freehold land, although they may obtain leases for 49 or 99 years. Foreign individual or corporate investors cannot acquire land for crop or animal production. Foreigners can either rent or lease land from citizens or the Government (Global Property Guide 2016, Internet site).

The Land Act seeks to protect equitable ownership of land for women and vulnerable persons through three dispositions:

- women and vulnerable persons cannot be excluded from customary ownership (all customs that exclude them are regarded as null by the law)
- land committees must protect the interests of women, children and disabled persons
- women must be represented in land committees, CLAs and tribunals.

District and PAC Level

At the district level, land is administrated by the district land office, district land board and district tribunal (not functional). The district land management officer (DLO) provides technical services to the district administration and the district land board (DLB). The DLB is responsible for holding and allocating land in the district, facilitating the registration and transfer of interests in land and compiling and maintaining rates of compensation payable (i.e., crops and nonpermanent buildings).

Buliisa does not have a fully functioning DLO; the district relies on a physical planner who also assumes the functions of the land officer and natural resources officer.

At the subcounty level, an area land committee and a recorder administrate land. In 2016, an online cadastre (register of land ownership) was launched for the mining sector, which aims to reduce conflicts between different landowners involved in mining activities.

Institutions like the church and kingdoms own large tracts of land that they lease out to individuals on a leasehold basis. Regional and field offices manage this land centrally and handle land matters on behalf of the responsible institution. The Uganda Peoples' Defence Forces also own land crossed by the Tilenga feeder pipeline, which is used as an army barracks, and the Ministry of Energy and Mineral Development (MEMD) owns the land allocated for the Kabaale Industrial Park, which includes the proposed refinery and international airport at the end of the feeder pipeline. The UPDF and MEMD land is managed centrally from their respective head offices in Kampala.

Table 6.4-40 shows the problems that hamper land management.

Table 6.4-40 Land Management Challenges

Challenge	Description of Challenge
Land titling	Few land holdings are titled. This can be attributed to factors including the protracted process required to register land officially and the associated cost.
Speculation	Speculation is a common consequence of publicly disclosed land acquisition. Speculative behaviour is often initiated and may be funded by resourceful individuals with access to information on potential development areas (information which is otherwise not publicly available). Acting on such information, speculators extort land from desperate landowners (usually parcels held under customary tenure) often at below-market prices and without consent from family or clan members who have interest in the same land. In addition, due to the large number of unregistered land parcels in the area, land is often transferred and registered without consent or due process by individuals who do not share interests in the targeted land and who have access to the land administrative system. Legitimate landowners (with customary tenure rights) are thus deprived of their land rights, often without their knowledge.
Contested land ownership	Weaknesses in the land administrative system give rise to land ownership disputes, not least because of incomplete transactional processes, including title registrations.
Recognising and formalising rights under customary tenure	Customary tenure does not give clan leaders any land ownership rights; however, these institutions have the power to establish rules for people claiming their rights and interests on specific parcels of land. Increasingly, land is being parcelled into individual plots, even in clan-held areas, and there is therefore evidence of a move toward individual ownership. CCO linked to membership of a given clan may not be relied on as stable instruments because social migration and community dynamics change family and community composition.

SOURCE: Adapted from LARF (2016)

Land and Gender

Despite policy and legal safeguards, the head of the household, predominantly male, is usually perceived as the rightful owner and custodian of the land. In Uganda, women formally own 16–26% of the land, informal (customary) ownership is approximately 15% and conjugal ownership 3% (LANDac 2016). As the value of land is increasing, male dominance over land-related decisions is increasing.

Women and young men are dependent on the head of the household for their access to land. Teenage sons can participate in land management as heirs and are entitled to decide what to do with their inheritance. Women and girls do not typically participate in land-related decisions.

Land Holdings

National data relating to average land holding size is scarce. However, UBOS (2009) states that the national holding size is 1.1 ha (equivalent to 2.7 acres). Average land holdings in the districts traversed by the AOI are small and fragmented, i.e., between 1 and 10 acres in Buliisa and roughly 6.2 acres in Hoima.

Land Conflicts

Land conflicts are the most common source of dispute, and are mainly due to:

- inheritance of land and land partitioning among the heirs
- nonconsented land sales within the family
- exclusion of women from land ownership
- fraud over land purchase or illegal land sales
- disputes over land boundaries
- expansion of settled and ranching farming, national parks, towns and settlements encroaching on village land
- land use plans that deny local communities access to land and natural resources needed for livelihoods
- village boundaries not being properly set
- land being acquired by the government for public purposes, but subsequently being used for other purposes, causing dissatisfaction with the original landowners.

The Land Act (1998) created a dedicated judiciary system to solve land conflicts through district land tribunals, although this resulted in numerous problems and the approach was abandoned in 2006. Land cases are handled by the judiciary system through civil magistrate courts.

Trend in Condition and Sensitivity to Change

The following trends and sensitivities were identified:

- An increase in population and in-migration in certain areas with accompanying purchase of land by migrants is increasing scarcity of land. The overall number of disputes involving land-related cases is growing.
- Long-standing discrimination that excludes women from owning, inheriting and controlling land is causing a high level of inequality. Furthermore, as the value of land increases, the male dominance over land-related decisions is likely to increase.
- Recognition of land value and the enactment of land legislation have increased the quantity of land being registered, sold and purchased. Consequently, there is less land being inherited and more land being sold.
- Land is often bought by outsiders of the village with higher purchasing power. During these transactions, there are an increasing number of fraud cases. The sale of land for private use is reducing the availability of communal village land, which was in the past used for grazing.

Ecosystem Services Provided

The ecosystem services provided by land have been considered in Section 6.4.3.8, Land-Based Livelihoods.

Sensitivity Ranking

The social baseline study has identified several sensitive VECs with regards to land and property. These are listed in Table 6.4-41.

Table 6.4-41 Land and Property VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Livestock rearers practicing localised nomadism	Moderate (3)	Without access to land or water, livestock quality and quantity will be adversely affected; localised nomadism has become increasingly important because of recent droughts and climate variability.
Landholders without title deeds (Kibanja or other)	High (4)	Without formal acknowledgement land holders will not have land ownership rights and will not be eligible to compensation (except where ownership is through customary rights), only for crops grown and property.
Youth	High (4)	Youth have limited access to land outside their customary rights as a member of a clan or family and inheritance protocols mean that parcels of land are becoming smaller and less viable.
Female headed households	Very high (5)	Without land ownership rights and long-standing discrimination that excludes women from owning, inheriting and controlling land causing a high level of inequality and without access to productive capital, women are particularly vulnerable.
Previously displaced/resettled HH/individuals	Very high (5)	Households or individuals who have undergone resettlement or compensation within the AOI will be particularly vulnerable to further change and have low resilience to additional shocks.

Key Considerations

Key considerations are:

- the increasing scarcity of land because of a growing population
- the vulnerability of most landowners owing to a lack of formal title deeds
- women being disadvantaged in terms of access to land. Compensation for loss of land is usually paid to the head of household (men)
- the existence of numerous land conflicts exacerbated by land shortages
- the lack of land management plans, which impact on the distribution of land
- the existence of vulnerable groups in terms of land take, such as illegal users of the land, including hunters and natural resource collectors (see land-based livelihoods, Section A9.4.6 of Appendix A9)
- an increase in land-grabbing schemes used to obtain land unlawfully or under false pretexts, high amounts of land speculation and reports of speculators extorting land from people creates fear and insecurity
- resettlement activities have previously taken place in the study area associated with development activities undertaken by the Uganda National Roads Authority (UNRA), Uganda Electricity Transmission Company Limited (UETCL) and other government agencies (CNOOC et al. 2016). Legacy concerns associated with these resettlement activities may impede the resettlement process for the Tilenga feeder pipeline. If unavoidable, secondary displacement of some

households may occur because of Tilenga feeder pipeline resettlement activities.

- the return of former assets to the Bunyoro-Kitara Kingdom by the GOU could render land acquisition in Buliisa and Hoima more complex (Artelia 2015a).

6.4.3.11 Workers' Health, Safety and Welfare

Baseline Condition of Workers' Health, Safety and Welfare

The majority of the International Labour Organisation (ILO) conventions have been incorporated into Ugandan national legislation. The Ministry of Gender, Labour and Social Development (MGLSD), through the district administration, oversees workplace conditions and worker–employer relations. Every employer is required to provide their employees with a written contract of employment from their first working day. However, in practice workers are not always provided with adequate information on their terms of employment and labour rights (DTCIDC 2016).

Informal workers lack written employment contracts, and most are paid daily after the work is completed. Workers' entitlements to job security, sick pay, support in case of work injury, paid holidays, access to grievance mechanisms and regular working hours are largely absent. Basic rights, such as the right to paid leave, maternity leave (with 60 days leave at full wages) and safe working conditions, are often violated (ISER 2017).

A culture of unionisation in the pipeline area is largely non-existent. Some employers reportedly ignore legal requirements to enter collective bargaining agreements with registered unions. Workers have limited power to negotiate with their employers. This is exacerbated by poor awareness of labour rights among workers. High levels of illiteracy and the complexity of laws governing labour in Uganda makes it difficult for people to understand their rights, rendering them vulnerable (ISER 2017).

Women face numerous challenges in the workplace, including sexual harassment, abuse and exploitation. Such challenges limit women's prospects and opportunities for advancement in the workplace (UHCHR 2016). Women's limited access to education and early marriage restrict them from obtaining equal pay within the formal and informal sectors of the economy.

In addition to women, other groups, including those living with HIV/AIDS, casual or temporary workers and child-headed households, also experience workplace discrimination.

Social security schemes consist of contributory and/or compulsory social insurance for formal workers. These are known as the National Social Security Fund (NSSF) and the Public Service Pension Schemes that cover all public servants and exclude people active in the informal sector (ILO 2018). The government is planning to introduce a nationwide social health insurance scheme, which would also cover workers from the informal economy. The proportion of the population covered by government or private social protection is estimated at 3.5%, which is lower than the 4.3% average across SSA.

The MGLSD, through the Department of Occupational Safety and Health (DOSHS), is responsible for administering and enforcing the Occupational Safety and Health

(OSH) Act 2006. Despite government efforts to improve the safety and health of all workers in the country, limited change has occurred owing to a lack of regulators enforcing the act. Business owners and personnel supervisors do not prioritise managing OSH risks in the workplace, and Uganda's labour productivity is the lowest in East Africa owing to poor working conditions. The Danish Institute for Human Rights reports that, in 2011, Uganda had the highest rate of construction incidents in the world, with 4200 major injuries taking place each year purportedly because of inadequate construction materials and high numbers of workers on sites (2016). Employers and employees do not consistently report workplace incidents, and workers do not commonly use legal processes to claim their entitlement for injury.

A national survey on child labour completed between 2011 and 2012 (ILO 2013) indicated that 39% of children were involved in an economic activity (93% in the agricultural sector); this is higher than the SSA average of 28%. Over the last ten years, the prevalence of child labour has decreased substantially and has been linked to higher school attendance at a national level. However, child labour in areas such as ASM and family work (i.e., crop farming, livestock rearing) is still prevalent. Many families have unstable livelihoods and need every family member to be earning an income.

While there is no documented information available at a local level associated with worker safety and welfare, anecdotal information collected from KIIs indicates small business do not provide adequate welfare or OHS controls to the workforce in the sample PACs.

Trend in Condition and Sensitivity to Change

The following trends could be identified:

- The ongoing expansion of the informal mining sector across the country is resulting in greater OSH risks, as this sector is largely unregulated and awareness of OSH among the workforce and employers is low.
- There is no culture of unionisation in Uganda; workers often do not have the power to negotiate with their employer.
- People work in unsafe and unhealthy conditions and often do not have access to personal protective equipment (PPE). Employers do not offer insurance or medical care in case of work-related injury or disease. There is no grievance mechanism for employees who have this type of claim.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Table 6.4-42 provides the sensitivity ranking for the local workforce.

Table 6.4-42 Local Workforce Health, Safety and Welfare VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Local workforce health and safety and welfare	Very high (5)	The local workforce has a low occupational health and safety awareness.

Key Considerations

Key considerations are:

- unscrupulous recruitment agencies exist in Uganda and potential workers may be asked to pay fees to 'register' their interest in being part of a workforce
- low level of awareness of health and safety and worker rights in the PACs
- low levels of understanding of a nondiscriminatory work culture such as with a mixed gender workforce in the PACs
- the human rights of workers with regards to health and safety.

6.4.3.12 Social Infrastructure and Services**Baseline Condition of Social Infrastructure and Services*****National Level******Electricity***

The liberalisation of Uganda's power sector in the late 1990s resulted in splitting the state-owned Uganda Electricity Board into three state companies: the Uganda Electricity Generation Company Limited (UEGCL), the Uganda Electricity Transmission Company Limited (UETCL) and the Uganda Electricity Distribution Company Limited (UEDCL) (Norton Rose Fulbright 2015, Internet site).

A large proportion of Uganda's rural population remains without access to electricity. To address the lack of electrical power in rural areas, the GOU approved the 10-year Rural Electrification Strategy and Plan (RESP-2) in 2013.

The Rural Electrification Agency (REA) was established at this time to facilitate the government's goal of achieving universal access to electricity by 2035 (REA 2018, Internet site). The country generates its own electricity supply, predominantly from hydroelectric power stations (GOU 2018, Internet site).

In the absence of electricity, wood and charcoal provide almost all the energy required to meet the basic energy needs for cooking in rural areas and many urban households (UNDP 2014).

Telecommunications

Uganda's communications sector is growing fast, driven by the rapid expansion of mobile telephony (ITU 2009, Internet site). There are more than 19 million mobile phone subscribers, equivalent to 50% of the population.

The number of people with mobile internet subscriptions is far greater than fixed Internet subscriptions.

Mobile money services were first introduced in Uganda in March 2009 and have grown substantially since (Bank of Uganda 2016). A 2015 survey found that 43% of Ugandan adults have access to, and 26% actively use, mobile money accounts (CGAP 2015, Internet site).

The benefits of mobile money in Uganda include:

- increased accessibility to financial services
- agricultural commercialisation, rural development and poverty reduction (Baganzi and Lau 2017).

Media

There are 24 daily and weekly newspapers in Uganda (Freedom House 2015, Internet site). There has been a general decline in newspaper circulation in Uganda, partly resulting from the growing popularity of social media (e.g., Facebook, Twitter and YouTube) as a means of disseminating news and information.

Radio broadcasting, which began in 1952, is the most widely accessed news medium in Uganda (Freedom House 2015, Internet site). There has been tremendous growth in Uganda's radio industry since the liberalisation of broadcasting in the 1990s and over 180 private radio stations are now in operation (UNESCO 2015, Internet site). Community radio stations are also popular, particularly in rural areas where individuals have few media sources available (UNESCO 2018, Internet site).

There has been a substantial growth in Uganda's television industry. In urban areas, roughly 80% of the participants reported watching television at home; in rural areas, this figure dropped to 44.6%.

Waste Management

Local government authorities are responsible for providing waste management services according to the Local Government Act 1997 (Komakech 2014). Rapid population growth and higher levels of economic activity in urban areas has led to a substantial increase in waste generated.

Inadequate waste collection and disposal in Uganda's major towns and cities has exacerbated many of the environmental hazards associated with urban areas and generated public health risks. Field studies found considerable amounts of waste dumped in open areas, streams and drainage canals, burnt near to homesteads or buried. Domestic liquid waste in Uganda is mainly disposed of via pit latrines.

District and PAC Level

Electricity

The number of households with access to electricity in Buliisa and Hoima is 7.6% and 16.8%, respectively (DDPs 2015).



Figure 6.4-23 Power Cables in Buliisa, Buliisa District (KP8)

In the absence of electricity, people in the districts traversed by the AOI rely on alternative energy sources for lighting including fuel lamps, solar power, candles, batteries and torches.

Telecommunications

Mobile phones are used to call family members in urban areas, transfer money and negotiate market prices with buyers and intermediaries. Charge-up cards are bought in the local shops. These shops tend to have electricity and serve as mobile phones charging points.

Internet use in the sample PACs is considerably less common than mobile phone ownership.

Media

Leading national newspapers such as the New Vision, the Daily Monitor and the *Bukedde* are widely available in Buliisa and Hoima districts. Radio is the most widely used type of media in the districts traversed by the AOI and in the PACs. There is one radio station in Buliisa district called Biso FM, which opened in 2016. Radio stations from neighbouring districts can also be picked up, including Gulu (Mega FM, Choicera, King FM and Rupiny FM), Pakwach town (Radio Puchane and Pakwach FM, which opened in 2016), Radio Hoima, and Kings Broadcasting Service, Masindi.

The popularity of radios in the districts may reflect low literacy levels and limited disposable incomes; these factors may limit access to newspapers and television.

Waste Management

Waste management in the districts traversed by the AOI is poor (DDPs 2015). Lack of effective waste management systems, designated dumping sites and low levels of waste collection are widely reported, particularly in town councils and trading centres.

KIIs found that the sample PACs mainly burnt waste in the open air and buried waste in private pits near homesteads.

Trends in Condition and Sensitivity to Change

Trends for social infrastructure and services include the following:

- Under the efforts of the RESP-2, rural access to electricity may continue to improve. Uganda's overall electricity generation capacity will also likely improve once the construction of new HPPs in Kiryandongo district and Jinja district are complete.
- Renewables may play an increasingly important role in Uganda's energy sector as the national government continues to support renewable project developers. The share of the sector is projected to grow considerably as 157 MW of feed-in-tariff supported projects are expected to be commissioned by the end of 2018 (Climate Scope 2017, Internet site).
- Uganda's telecommunications infrastructure is rapidly expanding consistent with growing demand for mobile and internet services nationwide. Mobile operators have installed 4G networks around Kampala and there are plans to make 4G available in other cities and urban settlements going forward (Export Gov 2017b, Internet site). Mobile phone and internet subscriptions are expected to reach 28.7 million and 11.9 million in 2021 respectively (Business Sweden 2017).
- The mobile money market in Uganda may grow with the rising number of internet subscriptions and mobile phone owners. Mobile money operators may also provide customers with new and diverse opportunities. Ugandans can now also pay for petrol, TV subscriptions, purchase airline tickets and play the lotto using mobile money.
- The use of social media in Uganda has proliferated in recent years in urban areas and among the youth. Internet use and penetration is still very low in rural areas. Popular platforms such as Facebook and Twitter are commonly used to access the latest news and communicate with others (Freedom House 2015, Internet site). The proliferation of social media is likely to be an ongoing trend, particularly if the number of mobile Internet subscriptions continues to rise (Uganda Business News 2017, Internet site).

Ecosystem Services Provided

The social infrastructure and services described herein provide the following ecosystem services:

Provisioning services:

- electricity from hydro, fossil fuels and solar energy

- cooking fuel from biomass and firewood (see Section 6.4.3.8, land-based livelihoods – natural resources use).

Sensitivity Ranking

Table 6.4-43 provides the sensitivity ranking for infrastructure and social services.

Table 6.4-43 Social Infrastructure and Social Services VECs and Sensitivity Rankings

VEC	Sensitivity Ranking	Rationale for Rating
PACs – media (radio, television, newspapers)	Low (1)	All households in the PACs have access to one or more media information source.
PACs – electricity	Moderate (3)	Most PACs do not have access to grid electricity and rely on other means of energy for cooking and lighting. Lack of grid electricity limits the PACs' economic development. Population growth and in-migration increase competition for the few available connections.
Households without mobile phone and Internet	Moderate (3)	These households may become increasingly vulnerable, as information is increasingly shared using these media.

Key Considerations

Key considerations are:

- PACs rely on radio as a main means of receiving information
- mobile 'phones and the Internet are becoming increasingly important to exchange information
- rural electrification is low, limiting general development.

6.4.3.13 Community Health

The community health baseline section is based on the format presented in the IFC good practice note for health impact assessment (HIA). In accordance with this note, several environmental health areas (EHAs) are described:

- health system
- communicable diseases linked to the living environment (termed respiratory and housing issues under the EHAs)
- vector-related diseases
- soil-, water- and waste-related diseases
- sexually transmitted infections (STIs), including human immunodeficiency virus (HIV) and acquired immune deficiency syndrome (AIDS)
- food and nutrition related concerns
- noncommunicable diseases
- accidents and injuries
- veterinary medicine and zoonotic diseases

- exposure to potentially hazardous materials, noise and offensive odours
- social determinants of health
- social cultural health practices.

Exposure to potentially hazardous materials, noise and offensive odours have not been considered in the baseline but are considered in the impact assessment.

Baseline Condition of Health Systems

National Level

Health care in Uganda is delivered by both public sector (government) and private entities that include private-not-for-profit (PNFP) and private-for-profit (PFP) organisations, and complementary health service providers such as traditional healers. The government (MOH 2014) owns the majority of the health facilities in the country. The national target for access to services is that everyone should have a health facility within 5 km of their residence. Access measured against this indicator stood at 72% nationally in 2015 (MOH 2016).

A target of having a hospital or a level IV (see Table 6.4-44) primary care facility per 100,000 people was met in 2014, with a national census of health facilities recording 147 hospitals and 188 level IV primary care facilities (MOH 2014).

Provision of public health care has been decentralised with districts and subcounties having a key role in the planning, delivery and management of health services in their respective areas. The health service delivery structure is organised in tiers starting from the community level up to the national level, including the role of the Ministry of Health (MOH) as described below in Table 6.4-44.

Table 6.4-44 Health System Delivery Structure

Structure	Level	Description of Role Function in Structure
Village health teams (VHTs) or health centre (HC) I	Village Target population of 1,000 people	VHTs are the first level of health care delivery and mainly consist of volunteers in villages facilitating health promotion, service delivery, community participation and empowerment.
HCs II, III and IV	Village Target population of 5,000 people	This is the second level of service delivery. HC IIs provide a first level of interaction between the formal health sector and communities. They only provide health prevention and promotion services, community outreach services and links with VHTs. Curative services include outpatient care, emergency care and emergency deliveries.
	Village Target population of 20,000 people	HC IIIs provide basic preventive, health promotion and curative services, and support and supervision to lower level units. There are provisions for limited inpatient services, laboratory services for diagnosis, maternity care and first referral cover for the subcounty.
	Health subcounty	HC IVs provide the same broad level of care as HC III, with the addition of more advanced inpatient care, and blood transfusion, laboratory, emergency and other services. HC IVs were introduced in some areas as a strategy to address poor access to health care services.

Table 6.4-44 Health System Delivery Structure

Structure	Level	Description of Role Function in Structure
General hospitals (GHs)	Target population of 500,000 people	This includes all services offered at HC IV and other general services including surgery, imaging services and inpatient care. In-service training, consultation and research to community-based health care programmes also occurs at this level. The district government manages GHs.
Regional referral hospitals (RRHs)	Target population of 2,000,000 people	This level consists of more specialised clinical services in addition to services offered at GHs. Specialist services may include paediatrics, psychiatry, ophthalmology, dentistry, intensive care, radiology, pathology, and higher level surgical and medical services. These institutions are also generally involved in teaching and research. While RRHs are managed by the MOH, they manage and develop their own operating budgets. Each district has a designated RRH that provides services not available at the GH level.
National referral hospitals (NRHs)	Target population of 35,000,000 people	This is the highest level and provides the most comprehensive and specialised level of care level. They provide advanced tertiary services in addition to all the other clinical services, as well as providing teaching and research. These facilities are fully autonomous.
Health subcounty	Subcounty	Health subcounties are mandated with planning, organisation, budgeting and management of the HC III, II and I services and private providers.
District health systems	District	District health systems are responsible for delivering health services and the management of human resources, the development and passing of health-related bylaws and monitoring of sector performance. Local district governments manage public GHs and HCs and supervise and monitor all health activities (including those in the private sector) in their respective areas. Health service delivery is decentralised at the district level, with the DHMT, led by a district health officer, mandated to implement programmes and policy.
Ministry of Health	National	The MOH is responsible for: <ul style="list-style-type: none"> • policy analysis, formulation and dialogue • strategic planning and resource mobilisation • setting standards and quality assurance • advising other government departments and agencies on health concerns • capacity development, and technical support and supervision • provision of nationally coordinated services and coordination of research • monitoring and evaluation of the overall health sector performance.

The country has an estimated 1.55 health workers per 1000 persons, which is below the WHO ratio of 2.28 per 1000 persons. Below this point, a country is considered to have a critical shortage of personnel. According to 2015 statistics, nurses and midwives are staffed to 83% and 76% respectively. Other staffing levels are also sub-optimal, notably pharmacists (8%), anaesthetic personnel (30%), health administrators (33%) and cold chain technicians (40%). Overall, staffing levels are skewed in favour of specialised health institutions and larger health facilities: RRH (81%), GH (69%), HC IV (85%), HC III (75%) and HC II (49%) (MOH 2014).

District and PAC Level

The distribution and types of health facilities available in the pipeline districts are included in Table 6.4-45 and Figure 6.4-24.

Table 6.4-45 Health Facilities

ID	Facility Name	Facility Type	Location (Settlement Name)
1	Buliisa Health Centre IV, Buliisa Town Council	HC IV	Buliisa
2	Uganda Martyrs Health Centre	Health Centre	Buliisa
3	Buliisa Hospital	Hospital	Buliisa
4	Bugana Health Centre III	HC III	Bugana
5	Serule	Clinic	Serule B
6	Butiaba Kawaibanda	HC III	Booma
7	Health Centre III	HC III	Booma
8	Butiaba Health Centre III	HC III	Booma
9	Health Centre	Health Centre	Booma
10	Health Centre Butiaba	Health Centre	Booma
11	Health Centre III, Biiso Trading Centre	HC III	Biiso Centre
12	Biiso Health Centre	Health Centre	Biiso Centre
13	St Jude Dispensary, Katana Catholic Church	Dispensary	Kigorobyia
14	St Jude Dispensary, Kigorobyia	Dispensary	Kigorobyia
15	Health Centre IV, Kigorobyia	HC IV	Kigorobyia
16	Pro Farm	Health Centre	Kigorobyia
17	Bwikiriza	Health Centre	Kigorobyia
18	Kigorobyia Health Centre IV	Hospital	Kigorobyia
19	Drug shop - Faith	Dispensary	Wayayo
20	Buseruka Angelina Medical Centre (Private Clinic)	Clinic	Buseruka
21	Buseruka Health Centre	HC III	Buseruka

Table 6.4-45 Health Facilities

ID	Facility Name	Facility Type	Location (Settlement Name)
22	Health Centre III	HC III	Buseruka
23	Pearl Medical Centre	Health Centre	Buseruka
24	Zam Zam Health Facility	Clinic	Katooke

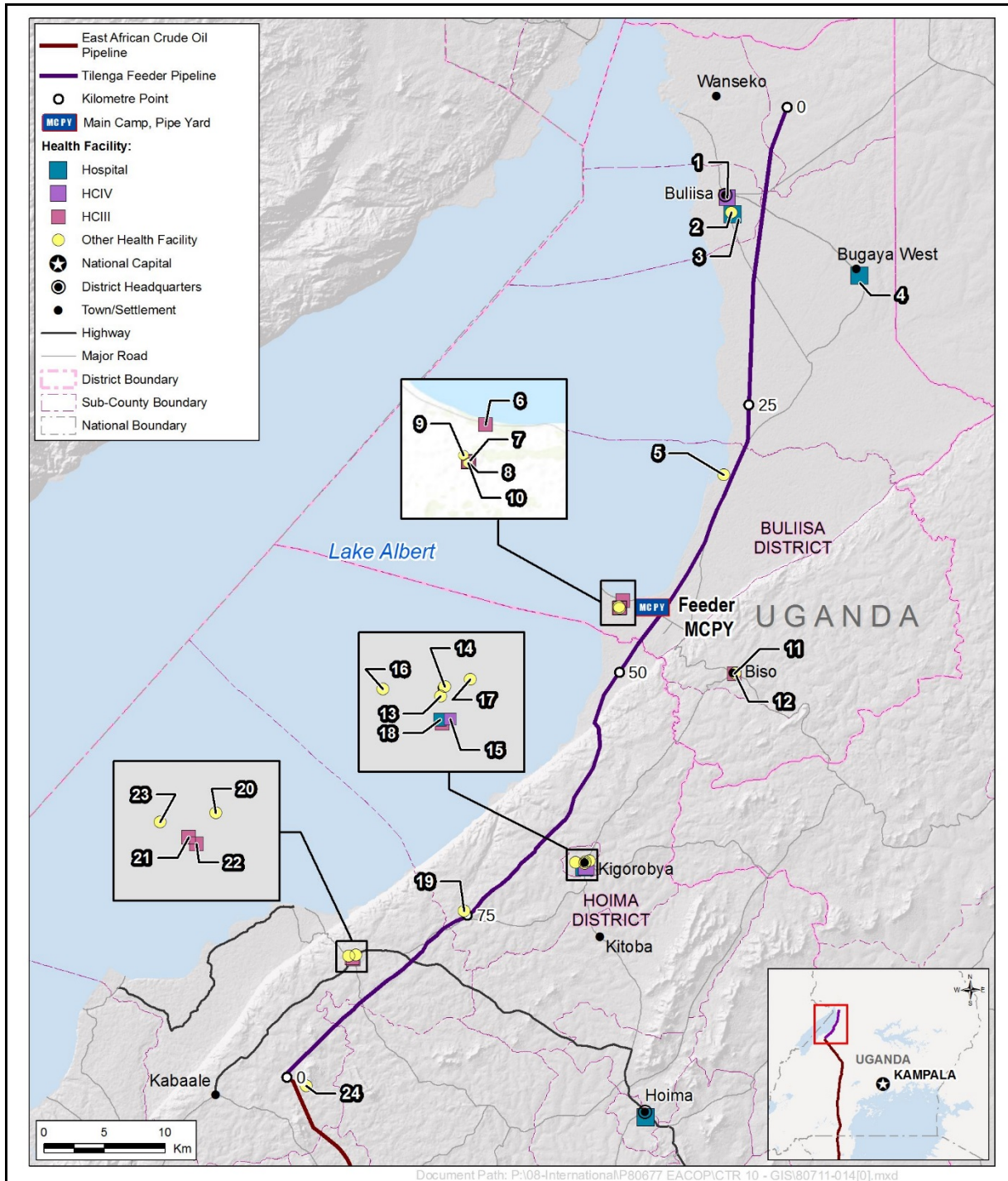


Figure 6.4-24 Health Facilities by District

Health System Challenges

The baseline assessment identified the following health system challenges in the districts traversed by the AOI:

- shortage of skilled health personnel
- inadequate financial resources
- high burden of communicable and infectious diseases

- increasing burden of noncommunicable diseases
- inadequate and inequitable distribution of health facilities
- inadequate solid waste management facilities
- inadequate water and sanitation facilities
- shortage of medical supplies and equipment
- delay in seeking medical care
- inadequate emergency care services.

These challenges were common throughout the pipeline districts.

Trends in Condition and Sensitivity to Change

- Despite the improvement in some parameters, the sensitivity to change of the health systems in the pipeline districts is considered high. The majority of the DHMT respondents noted that the existing structures and systems only managed to partially manage existing challenges and did not have the required capacity to meet any additional requirements brought about by pipeline-associated changes. This includes short-term changes, for example, infective outbreaks, and longer-term impacts associated with chronic conditions.
- The VECs' ability to respond to the change would likely be insufficient, slow and compromised by the bureaucratic processes required to necessitate an adequate response. It is likely that external assistance would be required to effectively address any changes. The anticipated decrease in available services may have long-term impacts on general morbidity and mortality.
- Despite a high sensitivity to change, pipeline-related activities are not expected to effect a substantial change to VECs owing to the relatively short temporal duration.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Table 6.4-46 presents the sensitive health systems VECs.

Table 6.4-46 Sensitive VECs with Regards to Health System Facilities

VEC	Sensitivity Ranking	Rationale for Ranking
PACs in the districts of Hoima and Buliisa	High (4)	Difficult access to appropriate health care and services

Key Considerations

A key consideration is:

- population growth (natural and because of PIIM) may lead to local health care facilities being further over-stretched.

Baseline Condition of Communicable Diseases Linked to the Living Environment

Acute Respiratory Infections

Acute respiratory infections (ARI) were identified as the leading cause of disease burden in the districts traversed by the AOI and the country in general. Reports indicated an ARI prevalence of 9–12% in the central region and 17% in the western region (UBOS 2012b). Lower respiratory infections are the second leading cause of disease burden in Uganda, after HIV and AIDS, and are responsible for nearly 10% of all deaths (WHO 2015a). HMIS data (2017) show that ARI contributed 21% of outpatient load in Hoima district and 33% in Buliisa district with variation across subcounties.

Tuberculosis

Tuberculosis (TB) remains a major public health challenge in Uganda with an incidence rate of around 200 new cases per 100,000 (2015 estimate) (WHO 2016a). Like most countries in SSA, Uganda is battling with the dual epidemic of TB, and HIV and AIDS. It is estimated that approximately 42% of TB patients in the country are co-infected with HIV and AIDS (WHO 2015b, 2016a). Multidrug resistant TB (MDR-TB) is also an emerging challenge at a prevalence of 1.6% for new cases and 12% of retreatment cases (WHO 2015).

Baseline findings show that TB is endemic in the two pipeline districts. HMIS data from 2017 show that Hoima district recorded a high number of 505 bacteriological confirmed TB cases compared to 55 cases in Buliisa district.

Measles

Measles is a highly contagious, infectious disease caused by a paramyxovirus. The disease remains a public health challenge in all parts of Uganda, despite ongoing immunisation efforts. Overall, Hoima and Buliisa districts registered 2506 and 668 measles cases in 2017, respectively. In FGDs conducted in communities in the pipeline districts, women revealed that measles is common among children.

Meningitis

Meningitis is a viral or bacterial infection. Analysis of HMIS data show that the bulk of the burden of disease is largely due to nonbacterial meningitis, estimated to be responsible for more than 99% of all diagnosed cases. In 2017, only 19 cases of bacterial meningitis were recorded in the pipeline districts.

Leprosy

There is a target to eliminate leprosy in all countries by 2020 (WHO 2012). Whereas Uganda has largely succeeded in eliminating leprosy as a public health problem, 300 new cases continue to be notified each year according to the National TB and Leprosy Programme. Baseline findings show that Buliisa district recorded just one new case of leprosy over the preceding three years (from 2015 to 2017) while Hoima district recorded 263 new leprosy cases over the same period.

Trend in Condition and Sensitivity to Change

The national trend in the annual incidence of TB has shown a progressive decline over the past 10 years.

The sensitivity to diseases related to living conditions in the districts traversed by the AOI varies from moderate to very high. These are based on the existing BOD in the districts, the available health services, trends in disease, stakeholder concerns and in-migration into high burden areas.

The sensitivity to change in both pipeline districts is considered very high. These ratings were determined based on the existing BOD in the districts, the available health services, trends in disease, stakeholder concerns and population in-migration into high burden areas.

Should a change in the baseline status occur, it will likely manifest itself as an increase in disease burden which, in turn, will place additional pressure on and potentially overwhelm the capacity of the existing health system.

Sensitivity Ranking

Several sensitive VECs were identified for communicable diseases due to living conditions. These are presented in Table 6.4-47.

Table 6.4-47 Communicable Disease VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Households close to roads	Moderate (3)	Increased exposure to diesel particulate matter and other pollutants that have a detrimental effect on the respiratory system.
Children, especially under five years old	High (4)	Immature immune systems and low herd immunity
Elderly	High (4)	Lower immune response and greater risk for contracting communicable diseases
Households using biomass fuel for indoor cooking and lighting	High (4)	Poor indoor air quality associated with higher risk of ARIs
Individuals living in overcrowded areas associated with poor housing and low socio-economic standards	High (4)	Higher likelihood of disease spread and inadequate ventilation
Immuno-compromised individuals	Very high (5)	Poor immune response and clear link between TB and HIV

Key Considerations

Key considerations are:

- interaction between PACs and an expatriate labour force may increase the risk of transmission of communicable diseases

- given the high incidence of communicable diseases and the poor health facilities, PIIM into the PACs will likely increase the prevalence of communicable diseases.

Baseline Condition of Vector-Related Diseases

Malaria

Malaria remains the leading cause of disease burden in Uganda and poses a substantial challenge to socio-economic development. The entire population is at risk of infection, though children under five years and pregnant women are particularly vulnerable (MOH 2014a, Internet site).

The districts of Hoima and Buliisa have a very high malaria transmission level and malaria cases account for 20–50% of outpatient cases at health facilities in the pipeline districts. HMIS data from 2017 indicate that malaria case load, confirmed by rapid diagnostic tests, was highest in the subcounties of Kigwera, Ngwedo and Buseruka, constituting at least 40% of outpatient load.

Findings from FGDs and household surveys also show that malaria was reported among the most common ailments experienced in sample PACs. This was further corroborated by findings from health facilities where malaria consistently ranked among the top five causes for morbidity.

All the pipeline districts benefit from periodic mass distribution of insecticide treated nets. They also received targeted distribution of insecticide treated nets to pregnant mothers and children under-five years, and malaria prophylaxis in pregnancy. Malaria case management with rapid diagnostic test and artemisinin in combined therapy is routinely available in all health facilities.

Dengue

Dengue is endemic in Uganda.

Human African Trypanosomiasis

Human African trypanosomiasis (HAT), commonly known as sleeping sickness, is endemic in parts of Uganda. Two forms of the parasite occur: *Trypanosoma brucei gambiense* is dominant in the northwest and *T. b. rhodesiense* in the southeast (Simarro et al. 2012). The rural populations whose livelihoods depend on agriculture, fishing, animal husbandry or hunting are at the highest of risk of exposure to the tsetse fly bites that transmit the parasite. Approximately 7% of the country, over two million people, is at risk of HAT. The districts traversed by the AOI are in a low-risk area for sleeping sickness transmission.

Onchocerciasis

Onchocerciasis, commonly known as river blindness, is caused by the parasitic worm *Onchocerca volvulus*. It is transmitted to humans through exposure to repeated bites by infected blackflies of the genus *Simulium*. Data obtained from the HMIS, show that Hoima recorded 245 cases of onchocerciasis in 2017 while Buliisa district recorded 73 cases. Both districts implement an onchocerciasis elimination strategy, which includes biannual mass treatment with ivermectin. Results indicate that transmission of the disease has been interrupted.

Trend in Condition and Sensitivity to Change

Confirmed malaria cases increased in the pipeline districts in 2016 when compared to statistics from 2015. The number of cases remained high in 2017, with minimal changes across all pipeline districts. Other vector-related diseases generally show a decreasing trend indicating some gains from interventions.

The sensitivity of the districts traversed by the AOI with regards to vector-related diseases varies from moderate to high. Owing to a high burden of disease in conjunction with an increase in disease trends, the districts of Buliisa and Hoima are considered highly sensitive to change. Table 6.4-48 details sensitive VECs in the AOI.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Table 6.4-48 presents the sensitive VECs for vector-related diseases.

Table 6.4-48 Vector-Related Diseases and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Children (especially under five years of age)	High (4)	Immature immune systems
Pregnant women	High (4)	Potential of disease affecting unborn child
Individuals living in overcrowded areas associated with poor housing and poor sanitary conditions	High (4)	Higher likelihood of disease spread and increased mosquito densities
Rural populations	High (4)	Poorer access to medication and health facilities

Key Considerations

Key considerations are:

- construction activities may create standing water, in which malaria-spreading mosquitoes can breed
- vector management activities, if not aligned with national strategies, may increase vector resistance and compromise local authority interventions
- PIIM may promote vector breeding, disease transmission and an increased burden on health systems
- environmental sanitation, health care services and prophylaxis, vector control programmes and the management of PIIM are key for controlling malaria.

Baseline Condition of Soil, Water and Waste-Related Diseases

The prevalence of soil-, water- and waste-related diseases is highly dependent on sanitation facilities and access to safe drinking water.

Access to Drinking Water and Sanitation

Access to safe drinking water was higher in Buliisa (71%) than in Hoima (58%) (Ministry of Water and Environment Sector Performance Report 2017). Baseline findings show that groundwater, in the form of boreholes or wells, is the most common water source for households. Others rely on surface water, in the form of Lake Albert, rivers and dams, for all their domestic needs. In general, the availability of water decreases during the dry season. Concerns relating to the reliability, quantity and affordability of water were reported in the FGDs.

Nearly a third (32%) of households in Buliisa district have no access to sanitation facilities, compared to just 9% in Hoima. In the absence of acceptable sanitation facilities, it is common for these households to practice open defecation.

Diarrhoeal Disease

Diarrhoeal disease is still a major public health concern in Uganda. According to district-level HMIS data, 3–4% of outpatient cases presented with diarrhoea. The prevalence is much higher among young children. Butiaba subcounty contributed over a third (36%) of all the diarrhoeal cases in Buliisa district according to the HMIS data.

Cholera

Cholera outbreaks are particularly common among fishing communities around the lakes and remains a major risk in the districts traversed by the AOI. In 2016, cholera outbreaks occurred in both Hoima and Buliisa districts, recording 202 and 97 cases, respectively. Outbreaks were noted to be more common in the Buseruka, Butiaba and Kigorobya subcounties.

The key underlying factors leading to higher vulnerability are:

- limited access to safe drinking water
- inadequate sanitation
- poor hygienic practices.

Typhoid Fever

Typhoid fever continues to be a public health concern in many developing countries, including Uganda. Typhoid is commonly over-reported because of a lack of required diagnostic facilities. HMIS data show that the districts traversed by the AOI record several cases annually. FGD participants in PACs consistently listed typhoid among common ailments in their community.

Schistosomiasis

Schistosomiasis, also known as bilharzia, is prevalent in tropical and subtropical areas, especially in poor communities without potable water and adequate sanitation. Therefore, the prevalence of schistosomiasis is a good indicator of the level of sanitation in a potentially endemic area.

The Lake Albert area shows a very high prevalence of up to 80% (Kabatereine 2004). In 2017, Hoima and Buliisa recorded 197 and 196 schistosomiasis cases, respectively. The cases in Buliisa district came from just two subcounties: Butiaba

(162 cases) and Buliisa (34 cases), while most cases in Hoima came from Kigorobyia (150 cases). KIIIs found that schistosomiasis was the main hazard for fisherfolk and shell collectors working in and on the shores of Lake Albert.

Trend in Condition and Sensitivity to Change

Trends with regards to soil-, water- and waste-related disease management include:

- access to safe drinking water and basic sanitation facilities is improving
- the districts traversed by the AOI reported a decrease in the burden of diarrhoeal diseases. This was partly attributed to improvements in hygiene behaviour. In addition, WASH programmes are coordinated and implemented by the Uganda Sanitation Fund. Most programmes focus on behaviour change communication programmes about open defecation. Programmes target approximately 5.6 million people in more than 9000 villages to live in open-defecation-free environments and to adopt good hygienic practices. A particularly effective initiative is community-led total sanitation.
- potential for cholera, dysentery and typhoid outbreaks remain high in all pipeline districts because of underlying challenges in environmental health conditions.

Ecosystem Services Provided

Water-related diseases are linked to safe water, which provides the following ecosystem services.

Provisioning services:

- general health
- form of livelihood (see Section 6.4.3.9 on river- and lake-based livelihoods)

Sensitivity Ranking

Several sensitive VECs were identified in relation to soil-, water- and waste-related diseases (see Table 6.4-49).

Table 6.4-49 Soil, Water and Waste-Related Disease VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Children	High (4)	Undeveloped immune response and greater risk for contracting diseases
Elderly	High (4)	Compromised immune response
Immuno-compromised individuals	High (4)	Poor immune response
Communities with existing poor access to safe water and adequate sanitation	High (4)	High likelihood of infection

Key Considerations

A key consideration is:

- PIIM into PACs may influence the availability of water, exacerbate unsanitary conditions and increase disease spread and BOD.

Baseline Condition of Sexually Transmitted Infections**HIV and AIDS**

The HIV epidemic in Uganda continues to be generalised and stable, without a substantial change of pattern over the last decade. Uganda achieved impressive success in controlling HIV during the 1990s, bringing down the prevalence among adults 15–49 years from a high of 18.5% in 1992 to 6.4% in 2005 (MOH 2017b).

An estimated 52,000 new HIV infections were recorded and 28,000 people were estimated to have died from AIDS-related illnesses. While there have been increased efforts to scale up treatment initiatives, there are still many people living with HIV who are not treated, including possibly high-risk groups such as commercial sex workers. Punitive laws and stigmatising attitudes toward sex workers, people who inject drugs and gay men has meant that these people, who are most vulnerable to infection, are far less likely to engage with HIV services (AVERT 2017, Internet site).

Baseline findings indicated that the HIV prevalence in Hoima and Buliisa districts were estimated at 6.8% and 5.6% in 2016–17, respectively. These rates have been inferred from programme data and weighted HIV prevalence among pregnant women visiting antenatal clinics and, therefore, may not necessarily reflect the true prevalence in the population. Butiaba subcounty recorded the highest HIV positivity rate in Buliisa district, with an estimated prevalence of 7.9% in 2015. Fishing communities and trading centres were identified as the major hot spots for HIV transmission. The following determinants for HIV infection were identified by informants in the AOI:

- high population mobility
- location along major transport routes with rest stops for truck drivers
- fishing communities
- trade hubs
- existence of most-at-risk populations (most urban centres)
- cultural practices such as wife inheritance
- road construction that has increased in migration to the area
- high-risk sexual behaviour.

HIV care and treatment services were generally available and freely accessible. There were reports of shortages of first line drugs in some districts linked to supply chain inefficiencies.

Sexually Transmitted Infections

Sexually transmitted infections (STIs) such as gonorrhoea, syphilis and chlamydia are prevalent in Uganda.

Baseline findings show that STIs are common in the districts traversed by the AOI. Hoima district recorded over 11,000 cases in 2017, while Buliisa recorded 1628 cases. The subcounties of Kigorobya, Bugambe, Butiaba and Buseruka recorded the highest number of STI cases. Unsafe sex practices, especially among the youth and adolescent populations, were seen as the key underlying contributing factor to these high rates. Analysis of HMIS data showed that 6–11% of the STI cases stemmed from sexual violence, more especially in Butiaba and Buliisa subcounties.

Findings from KIIs and facility assessments indicated that STI services were free of charge and generally readily available in most of the public health facilities, although the continuity of effective stock management is a challenge.

Trend in Condition and Sensitivity to Change

The following trends were identified:

- The national trend in HIV prevalence showed a decrease over the previous two decades, from a high of >18% in the 1990s to a record low of 6.4% in 2005. The current picture, however, shows stagnation and pockets of increasing prevalence.
- Both Hoima and Buliisa districts reported a decrease in HIV prevalence over the past three years. This was attributed to scaling up interventions including health education, free condom distribution, safe male circumcision and increased availability and use of HIV care and treatment. It is important to note that there are challenges in determining the actual trend of HIV prevalence in the districts because of reliance on facility-based data which are less accurate compared to population-based surveys.
- Buliisa and Hoima are considered highly sensitive to change with regards to HIV, AIDS and other STIs. None of the receptors are considered resilient to change.
- Any pipeline-related change may result in a substantial deviation from the baseline status, while the duration and associated challenges brought about by these changes are typically considered longer term. As with other EHAs, any substantial change has the potential to overwhelm the existing capacity of district health services and may result in a permanent negative change.
- As the potential pipeline-related changes to incidences of HIV and STIs are typically observed in communities near pipeline infrastructure, in larger trading centres and along pipeline access roads, specific types of communities have been identified and, where possible, referenced to KPs.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The social baseline identified several sensitive VECs with regards to sexually transmitted diseases. These are presented in Table 6.4-50.

Table 6.4-50 Sexually Transmitted Disease VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Women and young girls	High (4)	High risk group for disease spread due to high level of GBV and rape
PACs along transport routes and access roads	High (4)	Truck driver stops linked to transactional sex
PACs close to artisanal mining activities	High (4)	Artisanal miners linked to transactional sex
Commercial sex workers	Very high (5)	High risk group for disease spread due to unsafe sex

Key Considerations

A key consideration is:

- districts with a high prevalence of STDs, PIIM and a growing population are likely to have increased STI prevalence.

Baseline Condition of Food and Nutrition Related Considerations

Uganda produces more food than it consumes. Yet, poverty still limits people's access to nutritious food, especially in the north and east of the country. Rapid population growth and the presence of a large refugee population pose further challenges to the country's food security. Inadequate diets are a root cause of persistent nutritional problems which undermine the health, growth and development of Ugandan children (WFP 2017, Internet site).

Food security is not a major concern in the districts traversed by the AOI with the both districts reporting sufficient food availability throughout the year.

Malnutrition and Anaemia

Acute malnutrition is generally not regarded as a major public health concern in the districts traversed by the AOI, with clinical data reporting a prevalence among children under five of only 0.8% in the district of Buliisa and 1.2% in Hoima.

FGD participants reported reduced food availability in some months, especially in March and April. Findings from KIIs with district health authorities, indicated that cases of malnutrition do occur in the two districts, but these are generally confined to a few localities and are largely associated with poor feeding habits and other disease co-morbidities.

Trend in Condition and Sensitivity to Change

Available data shows that chronic malnutrition rates have decreased while acute malnutrition rates have generally remained low and stable at the district level. The 2016 UDHS shows that stunting prevalence has declined to 29% from 33% in 2011 and 46% in 1995. The proportion of underweight children has also declined to 11%, from 14% in 2011 and 21% in 1995. Acute malnutrition rates (wasting) have remained low at around 4–6%. There were concerns for future food insecurity related to weather patterns, especially drought, and rapid population growth in urban centres. Data on the trend of anaemia was inconclusive.

Ecosystem Services Provided

Ecosystem services related to food and nutrition are included in land-, river- and lake-based livelihoods, Sections 6.4.3.8 and 6.4.3.9.

Sensitivity Ranking

The social baseline identified VECs in relation to food and nutrition (see Table 6.4-51).

Table 6.4-51 Food and Nutrition Related VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
Landless	Moderate (3)	May have less access to subsistence crops and wild foods
PAC households	Moderate (3)	Vulnerable to price inflation
Elderly	High (4)	Elevated level of vulnerability to food price inflation due to lower ability to bolster income
Women-headed households and children	High (4)	Elevated level of vulnerability related to income insecurity, land tenure and food price inflation
Hunter gatherers	High (4)	May have less access to wild foods due to reduced access to hunting and gathering areas

Key Considerations

Key considerations are:

- the majority of farmers in the AOI are subsistence farmers and any increase in external demand will need to be managed
- PIIM into the AOI may increase food prices and, as a result, affect food security of vulnerable groups.

Baseline Condition of Noncommunicable Diseases

The BOD attributable to noncommunicable diseases (NCDs) is on the increase worldwide, with cardiovascular diseases (CVD), diabetes, cancer and chronic respiratory conditions responsible for most deaths. In SSA, it is predicted that NCDs and injuries may cause up to 60% of morbidity and 65% of mortality by 2020 (WHO and AFRO 2011). It is estimated that NCDs account for 27% of all deaths in the country, of which CVD contributes 9%.

Hypertension and Diabetes

In 2017, 11,691 cases of hypertension and 5586 cases of diabetes were recorded in Hoima district, while Buliisa district recorded 881 and 208, respectively. Diabetes care and treatment services were generally available at hospitals but very limited at lower level facilities.

Cancer

Analysis of district-level HMIS data show that several cases of cancers were recorded in the pipeline districts. The diagnoses were limited to cervical and breast

cancers in women and prostate cancer in men. Most of these suspected cancer cases were, however, referred to higher level facilities.

Asthma

The available HMIS data indicated that asthma is the commonest diagnosis related to chronic respiratory diseases. Despite being the most common condition, only a relatively low number of cases have been recorded in 2017 with 90 cases diagnosed in Hoima and 14 cases diagnosed in Buliisa district during this period.

Trend in Condition and Sensitivity to Change

NCDs, particularly heart disease, hypertension and diabetes, are showing an upward trend nationally and in the districts traversed by the AOI. This increase is largely attributed to urbanisation and changes in lifestyle.

While NCDs are considered an important risk factor with regards to community health, the sensitivity to change in all pipeline districts is rated as moderate with little variation between districts.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The social baseline did not identify any sensitive NCD VECs.

Key Considerations

Unless there is a sustainable growth of the districts' economies, an increase in NCD is unlikely.

Baseline Condition of Accidents and Injuries

Physical Assault and Domestic Violence

Domestic violence is widely acknowledged to be of great concern in Uganda, from human rights, economic and health perspectives. Baseline findings show that gender-based violence (GBV) including physical and sexual assault is a common cause of injuries in the pipeline districts. Substance (alcohol) abuse, social and economic challenges were identified as contributing factors.

In 2017, Hoima recorded 469 injuries from GBV while Buliisa district recorded 88 cases. At the local level, Butiaba and Bugambe subcounties recorded the highest number of injuries resulting from GBV. In addition, all sex workers interviewed reported that they had been subjected to GBV at some point. FGDs indicate that women generally do not have support networks for victims of domestic violence.

Trend in Condition and Sensitivity to Change

Trends in traffic accidents are described in the traffic baseline report (see Appendix A10). Trends in workers' health are described in Section 6.4.3.11 (workers' health, safety and welfare) and in the socio-economic and health baseline report (Appendix A9).

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

Sensitivity for traffic-related injuries are ranked in the traffic baseline report (see Appendix A10). Women, particularly sex workers, are considered highly vulnerable (4) in terms of GBV.

Baseline Condition of Veterinary Medicine and Zoonotic Diseases***Viral Haemorrhagic Fever***

Viral haemorrhagic fever (VHF) is a general term for a severe illness, sometimes associated with bleeding and that may be caused by different viruses especially Lassa fever, Crimean-Congo, Marburg and Ebola viruses. Uganda has experienced repeated outbreaks of VHFs, particularly Ebola, Marburg and, more recently, Crimean-Congo viruses (Mbonye et al. 2012).

In 2017, Hoima recorded 13 suspected cases of VHFs. Buliisa did not record any cases during the same period. Neither of the pipeline districts have the capabilities to diagnose VHFs and relies on the national laboratory to confirm suspected cases.

Rabies

Rabies is a public health problem in many developing countries, although it is often under-reported because of limited awareness, public veterinary health services and diagnostic ability. Many cases of dog bites are recorded in the local health facilities. These are often promptly managed with post-exposure prophylaxis to prevent progression to full-blown rabies.

Brucellosis

Brucellosis is common among pastoral communities in Uganda. Both districts traversed by the AOI recorded at least 100 cases of brucellosis in 2017.

Trend in Condition and Sensitivity to Change

Rabid dog bites have increased in the districts traversed by the AOI, leading to an increase in demand for post-exposure prophylaxis for rabies, with the vaccine often out of stock. The risk from VHFs remains high given their occurrence in the country and potential for spontaneous outbreaks.

Although the conditions are prevalent throughout the AOI, the estimated BOD remains low at the time of writing.

However, potential for outbreaks is a substantial challenge that imparts a measure of risk in the AOI. Owing to the low-grade re-occurrence of potential VHF cases in the AOI, both districts are considered to have a high sensitivity to change.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The social baseline identified that all PACs are equally sensitive VECs with regards to veterinary and zoonotic diseases.

Key Considerations

A key consideration is:

- VHF and the associated outbreak potential remains a risk to PACs, particularly those that are impacted by PIIM.

Baseline Condition of Social Determinant of Health***Mental Health***

Uganda has recognised mental health as a serious public health concern and recently implemented reforms aimed at strengthening the country's mental health system.

Although mental illness is recognised as a public health burden in all the pipeline districts, reliable data are scarce. Baseline findings show that epilepsy, bipolar disorder and major depression are the most common mental disorders in the districts traversed by AOI. Substance use disorders, anxiety and psychotic disorders were also reported to be common.

Substance Abuse and Social Ills

Substance misuse is a growing public health concern in Uganda. A recent study found that at least 20% of high school students in the country have used drugs.

Findings from FGDs indicated that alcoholism, 'smoking drugs', prostitution, theft and gambling are among the social challenges in the pipeline districts.

Gender-Based Violence

GBV creates both a health and psychological burden for women. Baseline findings show that GBV is common in the study area. The highest number of cases were recorded in Butiaba, Bugambe and Kigoroby subcounties.

Teenage Pregnancy and Early Marriages

A recent national survey shows that 24% of 15–19-year-old girls in Uganda have given birth or are pregnant with their first child (UBOS 2017b). Baseline findings show that teenage pregnancies and early marriages are a concern in all pipeline districts and are increasing.

Lack of formal education, cultural norms (acceptance in society, religious beliefs) and poverty (dowry and failure to pay for education) are some of the drivers of increase in teenage pregnancy. The government has identified this as a key challenge to Uganda's development. Several campaigns by government and other donor agencies toward preventing teenage pregnancy and abuse and educating female children are ongoing at most public and private media outlets.

Trend in Condition and Sensitivity to Change

Data on the trend of mental disorders were not conclusive, but the perception of health officials is that cases are increasing. Psychosocial stressors such as economic strife, poverty and other social challenges, and alcohol and drug abuse were identified as contributing factors. In FGDs with health personnel, 48% felt that social problems have increased, particularly alcoholism and prostitution.

Based on the available data, the VECs' sensitivity to change as it relates to social ills is considered high in both Hoima and Buliisa districts. Based on feedback from stakeholders, the VECs' resilience to change was not considered high, increasing the risk for pipeline-related changes. Any substantial changes from baseline activity will have a marked influence on population morbidity and mortality, and the duration of the impact will most likely be long term owing to the substantial overlaps between social ills and other conditions (e.g., HIV).

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Ranking

The social baseline identified two sensitive VECs related to social determinants to health as shown in Table 6.4-52.

Table 6.4-52 Socially Determined Diseases Related VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
PACs employed by the pipeline	High (4)	Disposable income increases alcohol, drug use and commercial sex work.
PACs where PIIM is expected	High (4)	Decrease in social structure and social cohesion

Key Considerations

A key consideration is:

- PAC households that experience a sudden increase in disposable income may be affected by a loss of cohesion through increased use of substances such as alcohol and drugs, and sex workers.

Baseline Condition of Social Cultural Health Practices

Culture and spirituality may influence health-seeking behaviour as well as the type and perceived severity of an illness.

Baseline findings show that most of the population in the districts traversed by the AOI make use of formal health care services. However, self-medication and use of traditional medicine is used and can negatively affect treatment outcomes owing to the delay in treatment.

Findings from baseline FGDs show that traditional medicine is most often used in the treatment of pregnancy complications, infertility, epilepsy and those who have

been 'bewitched'. Traditional beliefs and practices, poor awareness of health matters as well as challenges in the health care system (e.g., accessibility, affordability and availability of services) were reported as key contributing factors.

Trend in Condition and Sensitivity to Change

The following trends were identified:

- Health-seeking behaviour has improved and most of the population in the districts traversed by the AOI now use the formal health care system as well as traditional medicine. This was attributed to health education and system strengthening, including provision of outreach services.
- There is an increasing demand for services and high utilisation rates for maternal and child health services.
- Use of traditional medicine has generally decreased as people embrace modern health care.

Ecosystem Services Provided

Social cultural health practices are linked to the use of wild plants, which provides the following ecosystem services:

Provisioning services:

- ingredients for treatment of common illnesses (traditional medicine).

Sensitivity Ranking

The social baseline identified a sensitive VEC with regards to social cultural health practices, presented in Table 6.4-53.

Table 6.4-53 Social Cultural Health Practice Related VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Ranking
PACs where PIIM is anticipated	Moderate (3)	Higher burden on health systems may lead to adverse health seeking behaviour

Key Considerations

A key consideration is:

- PIIM may lead to pressure on health care services.

6.4.3.14 Community Safety, Security and Welfare

Baseline Condition of Community Safety, Security and Welfare

Community Wellbeing

To understand a PAC's sense of wellbeing and sensitivity to change, it is important to understand how they perceive key events in their communal history. In FGDs, PACs identified the following important historical events (Attachment A9.5 in Appendix A9):

- New infrastructure and services are regarded as substantial positive events. PACs recalled the dates of construction of HCs, dams, tarmac roads, boreholes and vaccination campaigns.
- The discovery of oil and the potential development it would bring to the area.
- Health epidemics were remembered as key negative events. These included measles outbreaks, and the onset of HIV and AIDS and animal diseases such as foot and mouth disease.
- Major natural disasters, earthquakes and droughts also form a substantial part of communal history.

Community Aspirations

FGDs with PAC leaders and women's groups shared that the most often expressed aspirations were related to infrastructure and service improvement, for example, schools, health facilities, roads and electricity. This is in line with the data obtained for the historical events.

Community Cohesion and Social Support

Field survey data indicated a strong social fabric for all PACs with well-developed social networks and a sense of place.

In PAC households, bonds and commitment to support one another are strong. Households generally work as a unit on agricultural plots and ties to ancestral land are strong and traditional inheritance protocols for land allocation to family members maintain their connection. Unspoken kinship allegiances extend to patrilineal clans and tribal affiliations.

Maintaining the traditional relationship with land is becoming increasingly difficult, as plots are becoming too small to remain viable, forcing younger generations to migrate to urban areas. In addition, over recent years, mutual support in PACs appears to be decreasing, possibly because of migrations, emerging use of technology and intermarriage.

In multicultural Uganda with its diversity of tribes and religions, burial ceremonies are a ritual deeply rooted in cultural beliefs and traditions. With few public cemeteries, families of the deceased bury their dead in locations available to the household. This is commonly within the curtilage of the family's landholdings; however, some communities have allocated burial grounds such as Waki-Kawaibanda (KP47).

Little outside assistance from Government initiatives or NGOs was observed in the sample PACs. However, NGOs such as BIRUDO, Build Africa, World Vision, Hoima Catholic Development Organisation, Action AID and World Bank were mentioned during KIIs with CDOs and FGDs in PACs. These organisations have a wide remit, focusing on the environment, land matters, human rights, education, community sensitisation and livelihood support. NGOs in Hoima play a particularly important role in supporting orphan and vulnerable children (OVC). Other active NGOs in the district include Global Rights Alert, National Association of Women's Organisations in Uganda (NAWOU) and Hoima Caritas Development Organisation (HOCADAO) (KII with CDO). These organisations focus on several areas including livelihoods, female empowerment and environmental issues.

Community-based organisations (CBOs) were prominent in all PACs. Savings and credit cooperative organisations, commonly referred to as 'savings circles', are prevalent CBOs. The existence and functioning of the savings and credit cooperative organisations in PACs shows the social capital of communities, and trust and mutual reciprocity.

Safety and Security

The Uganda Police Force (UPF), established under Article 212 of the 1995 Constitution of the Republic of Uganda, is headed by the Inspector General of Police who provides oversight to regional and district commanders.

At community level, the rule of law is enforced by community leaders and by police officers at police stations or police posts (smallest unit). However, not all rural communities boast a police station. There are major police stations at Hoima and Buliisa municipalities.

In addition, the national approach to community policing includes establishing community 'crime preventers'. These individuals are proposed by local communities and their leaders to be trained in policing and assist the police force in maintaining law and order in the community.

Recognising the importance of the oil and gas industry in Uganda, the Oil and Gas Police Protection Directorate was established and charged to maintain security of the routes, wells and any oil-related installations in the Albertine Graben area (UPF 2017, Internet site; Oil in Uganda 2013, Internet site).

Crime

The Uganda Annual Crime Report (2014) indicated that serious crime rates have increased by 13% since 2013. The most common serious crime was reported to be defilement, accounting for more than half of all serious crimes in 2014 (GOU 2014). The total number of cases that were investigated in 2014 represented an increase of 25.8%, while reported cases of rape increased by 5.4% since 2013.

The Overseas Security Advisory Council (OSAC) (2017) reports that organised crime syndicates operate on a small scale, carrying out robberies or roadside assaults, stealing valuables and attacking individuals. Gang crime is on the increase with groups such as the Kifeesi gang operating in Kampala and in other urban towns and trading centres. Gangs are popular among disengaged youth, and the number of the members is increasing despite Government arrests and crack downs on leaders and members.

While there is relative stability and prosperity in the country, Uganda still has some underlying conditions that could result in internal conflict such as grievances over land and oil, and ethnic divisions (USAID 2018, Internet site).

The importance people attach to ethnic groups, area of origin, religious affiliations and cultural institutions often predominate over national identity. Youth particularly fall within this category (International Alert 2014).

Conflict

Over the past 30 years, the GOU has instated a decentralised governance structure. This has assisted in reducing national-level conflict. However, it has incited local-level conflict through highly competitive races for district leadership positions and altering relations between local ethnic groups (Green 2015).

Even though communities are generally peaceful, conflicts were reported in KIIs and FGDs. Conflicts or disputes mentioned are related to:

- land concerns (trespassing, destruction of crops by livestock, land grabbing and boundary disputes)
- criminal acts (theft, defilement, rape and GBV).

The most often mentioned disputes related to theft and land. The latter is described in Section A9.4.8 of Appendix A9, Land and Property. Land conflicts are generally resolved with the assistance of the community leaders (see Section 6.4.3.3 on governance and administration). In the case of theft, defilement and rape, the police would occasionally be called. However, PAC members said that community leaders would initially endeavour to resolve any dispute or conflict.

Household domestic quarrels were mentioned often and reportedly resolved through family meetings supported by clan members. If the matter cannot be resolved, the village chairperson or another village leader relevant to the matter will get involved. Where resolution could not be reached at this level, the subcounty community development officer may be called upon to mediate, but this was not a frequent occurrence.

In Buliisa district, the historic discord against the herdsmen known as the Balaalo, associated with land grabs and the oil discoveries between the Bagungu and Banyoro, was rarely mentioned. The herdsmen were expelled from Buliisa by a Supreme Court ruling in 2010 that was over ruled in 2013 by the High Court in Masindi. The court ruling stated that Buliisa district authorities should compensate those herdsmen affected for the loss of their land assets, although the Court order prevented them settling back in Buliisa.

Gender

FGDs with women in the sample PACs revealed the task and role divisions between men and women. Only cooking and cleaning within the household are the sole responsibility of women; women and men share all other tasks. Women have the largest responsibility for child upbringing; collecting water, wood and wild plants and fruit; cultivating land; household budgeting; buying goods; and selling produce. Men mostly undertake tasks related to house construction, hunting and fishing. Males mostly inherit and own land. Women are mostly regarded as the protectors of the household. The above shows that women are important members of the household and wider community. They are highly entrepreneurial and their substantial contribution to the informal economy through labour, much of it unpaid, cannot be underestimated.

However, women are considered vulnerable in many ways:

- GBV against women is common in the districts traversed by the AOI. The highest number of cases was recorded in Hoima district. Substance abuse, especially alcohol, was seen as a major contributing factor.
- Women are also vulnerable in marriage. This vulnerability relates to the noncontractual nature of some types of marriage and the resulting inability to claim spousal rights in the event of mistreatment, divorce or abandonment.
- In Buliisa district, under customary law, it is assumed that the widows and their children will be taken care of by the kin of the deceased. The subordinate wife will be dispossessed of the family's assets and forced to return to her parents' or brother's home, or merely play a minor role in looking after the children. She would not be able make decisions regarding the future use of the deceased husband's land.
- The low quality and accessibility of policing, health and education facilities in very poor areas exacerbate women's situation. The lack of police service resources acts as a constraint on women trying to extricate themselves from abusive situations.

Other Vulnerable Groups

PAC members identified the following potential vulnerable groups.

Widow-Headed Households

Several widow-headed households were encountered in PACs. It was reported that widows find it difficult to meet basic needs to maintain a household. Elderly widows were said to be subject to theft of property and land from relatives and often found it difficult to obtain sufficient food because they could not tend to crops.

Children

Children are the single largest group (59%) of Ugandans living in absolute poverty. Children were deemed vulnerable, particularly those from poor households. Poor children were reported to be less likely to attend school.

AIDS orphans kept by guardians were regarded as particularly vulnerable, as they have limited opportunity to attend school or access health care and may be discriminated compared to the guardians' own children.

Children were also vulnerable to child labour, particularly in livestock-rearing households where it was traditionally seen as a child's role to tend to livestock.

Orphans were regarded as especially vulnerable, facing challenges such as lack of education and parental guidance, as stated during FGDs in Biiso (KP44.5), Piida A (KP45.5) and Rwamutonga (KP86).

Elderly

Elderly people are deemed vulnerable, as they are unable to work the land and dependent on remittances sent by family members.

Youth

Youth were reported to be vulnerable, as they had limited access to productive assets, such as land or capital, and many lacked vocational skills. With few

employment opportunities in rural PACs, it was common for youth to turn to alcohol and substance abuse.

People Living with Disabilities

People living with disabilities, including those living with mental, hearing and sight impairment, were said to be vulnerable. This was attributed to lack of ability to work the land effectively and reliance on other people for financial and food security.

People with Ill Health or Living with a Chronic Illness

People with illnesses such as epilepsy, TB, and HIV and AIDS were classified as vulnerable, as they were unable to work their land and relied on other people for financial and food security.

Land Users Who Have No Land Title

Land users who have no land title, no customary status or who have not yet acquired an 'interest in the land' were deemed vulnerable.

Ethnicities

FGD and KII in PACs found that the Alur population, particularly those non-Ugandans who had travelled from the DRC and settled in the districts, were not accorded the respect given to others in the community. This was also the case for herdsmen (Bahimba, Banyankole, Bunyarawanda and Karamajong).

Trend in Condition and Sensitivity to Change

The following trends were observed:

- Communities consisting of mixed ethnicities and religions generally live in harmony. However, increasing migration and arrival of outsiders in PACs threatens this equilibrium. With improvements in infrastructure and increasing migration, communities will diversify.
- Traditions are gradually decreasing in prevalence. The Government is promoting traditions through the re-establishment of Kingdoms, encouraging people's valuation of cultural heritage.
- Savings circles are popular in rural PACs in the absence of banks and borrowing facilities. With improved infrastructure, micro-credit borrowing may be more accessible, thus the number of savings circles that also foster social cohesion and thus wellbeing may reduce.
- Despite Government policies and actions, gender inequality prevails in all aspects of life for women and girls, which continues to stymie the females in society.
- Despite Government efforts to combat discrimination against females, women still have a precarious legal status, lack political power and still suffer from 'overburden' of unpaid tasks and chores and high levels of sexual violence.

Ecosystem Services Provided

This VEC does not provide ecosystem services.

Sensitivity Rating

The social baseline study has identified sensitive VECs in relation to community safety, security and welfare. These are listed in Table 6.4-54.

Table 6.4-54 Community Safety, Security and Welfare VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Marginalised ethnicities (Alur, Bahimba, Banyankole, Bunyarawanda and Karamajong)	Moderate (3)	Marginalised from community decision making and access to information or support systems, marginalised groups are vulnerable to change.
Women	Very high (5)	Cultural attitudes toward women and their role within the household hinder many females in PACs. Disadvantaged through a lack of education and with limited access to land and support mechanisms such as access to credit facilities and agricultural inputs, women are deemed particularly sensitive to change.
Widow-headed households	Very high (5)	Widows are challenged to meet basic needs of the household in terms of food security, shelter, welfare and ability to pay for schooling and health care. The gender aspect compounds their situation. Elderly widows are reported as being subject to theft of property and land.
Children, particularly in poor households, AIDS orphans and boys from cattle keeping and plantation agriculture communities	Very high (5)	As minors in society, children are particularly vulnerable. Children from poor households will be less likely to attend school. They are more likely to be relied on to perform household tasks and generate income, exposing them to child labour which prevents them from accessing school.
Elderly (men and women)	Very high (5)	The elderly find it difficult to meet basic needs and afford health care. Unable to work the land, they depend on family to provide support and remittances, and exchange what little they own for food.
Youth	Very high (5)	Young people are particularly sensitive to change, as they have limited access to productive assets such as land or capital, they lack education and vocational skills and their situation is compounded by a lack of employment opportunities.

Table 6.4-54 Community Safety, Security and Welfare VECs and Sensitivity Ranking

VEC	Sensitivity Ranking	Rationale for Rating
Disabled	Very high (5)	Disabled people find it difficult to meet basic needs and afford health care. Unable to work their land, they depend on family to provide support and remittances, and exchange what little they own for food.
People living with illnesses	Very high (5)	People with illnesses such as epilepsy, TB, HIV and AIDS are unable to work their land and rely on other people for financial and food security.
Land users without land titles	Very high (5)	Land users who have no land title, without formal acknowledgement of land ownership, will not be eligible for compensation, only for crops grown.

Key Considerations

Key considerations are:

- there are effective established mechanisms for conflict resolution and support groups at village level; however, lack of land and migrations, emerging use of technology and intermarriage are reducing their effectiveness
- although PACs are generally peaceful, conflicts arise because of changing demographics and decentralisation, underlining the requirement for effective stakeholder engagement
- there are vulnerable groups that will need special considerations.

6.4.3.15 Traffic

This section describes the:

- traffic area of influence (AOI)
- baseline condition of the transport network, including:
 - ports, airports, the road network, public transport, walking and cycling
 - trends affecting traffic conditions and sensitivity to change
 - traffic sensitivity rankings
- key considerations.

For more information, the traffic baseline report is included in Appendix A10.

AOI

The potential traffic impacts give an AOI that connects key population centres, ports and airports to the pipeline right-of-way (RoW).

The traffic AOI will be the roads that will be used by the project.

AGIs will remain operational over the project lifetime, so the temporal AOI will be approximately 25-years. At other locations the temporal AOI is the construction period.

Traffic Baseline Condition

The baseline traffic conditions relate to four valued environmental or ecosystem components (VEC): social infrastructure and services; community safety, security and welfare; workers' health, safety and welfare; and community health. These VECs are associated with the transport network, including ports, airports, road network, public transport, walking and cycling, road safety and traffic flows.

Ports

Uganda is a land-locked country and relies on goods being transported through neighbouring countries. Ugandan ports handle a negligible amount of cargo, with 95% of total cargo being transported by road. However, the following shipping routes offer the potential for cargo arriving by road to travel across Lake Victoria or Lake Albert with onward travel via road and rail:

- Lake Victoria offers shipping cargo routes to Kenya and Tanzania, including a ferry that transports train wagons from Kampala to each of these countries.
- Nonrailhead ferries operate across Lake Victoria for standard cargo.
- Commercial boats are used to transport goods on Lake Albert between Uganda and Congo.
- An UNRA ferry operates from Wanseko in Buliisa district to Panyimur in Nebbi district.

Airports

Airports are an entry point into land-locked Uganda for people and nonbulk goods, including specialist components.

Uganda's capital, Kampala, is served by Entebbe International Airport, 40 km southwest of the city. At the time of writing, the airport was being upgraded and expanded to modernise and improve its passenger and cargo facilities. The airport provides connections to countries across Africa, the Middle East and Europe, and offers opportunities for freight and specialist workers to be transported to Uganda with onward transport by road.

Kabaale International Airport in the Hoima district of Uganda is being developed to serve the region's oil industry, including the planned oil refinery in Kabaale. The airport will handle large passenger and cargo aircraft for the transport of equipment and workers to the construction site and nearby oilfields.

There are also airstrips across the country that can accommodate smaller passenger and cargo aircraft. These can be used to reach more remote parts of Uganda, including the Tilenga development area which is served by existing airstrips at Bugungu and Pakuba in Murchison Falls National Park.

Road Network

The project will use a variety of road types across Uganda. In Uganda, the road classification system has five levels, A–E, with A representing international trunk

roads and E representing minor roads. In this baseline report, roads have been described in relation to the function they perform and the environment through which they pass as being:

- trunk roads
- urban roads
- rural roads.

At the time of writing, many of Uganda's unsealed trunk roads are being upgraded to become roads with sealed surfaces. In addition, enabling road networks are being put in place by UNRA to support oil and gas infrastructure development. This will include an upgrade to 11 roads and several bridges to become sealed roads. One of these roads (the Parra-Buliisa road) will be intersected by the Tilenga feeder pipeline.

In addition, the Hoima-Butiaba-Wanseko road is being upgraded at the time of writing. This road is intersected by the Tilenga feeder pipeline at KP15 and is close to the pipeline route between KP8–18 and KP28–40.

Uganda has a wide range of urban roads, which vary in condition, with sealed and unsealed surfaces, and are often poorly maintained.

Nontrunk rural roads are typically unsealed and can often be a single lane track or footpath of varying condition.

Public Transport

Because of the low population density, and demand, and poor road condition, there is very little public transport in Uganda outside major urban areas. Therefore, many people in rural areas walk long distances to use public transport.

The social baseline survey showed that motorcycle taxis, boda boda, and three-wheeled motorcycle taxis, bajaj, are the most common form of transport, being used by the average Ugandan household for 75% of all journeys within urban areas. The survey also showed that a further 11% of household transport was by private motorcycle.

There is no formal bus rapid transit (BRT) system in place in Uganda; however, Kampala is preparing to introduce a BRT service which should improve travel times within the city (*National Transport Master Plan 2008–2023*). For intercity journeys, most towns have a form of taxi-park, with longer-haul minibuses departing to various destinations. Larger buses also make intercity journeys.

There are no railways close to the Tilenga feeder pipeline that are available for freight or passenger use. The Kampala service is a passenger network covering the Kampala urban area.

Walking and Cycling

Cyclists and pedestrians are the most vulnerable road users, having no physical protection against motor vehicles. Many urban roads in Uganda have little or no infrastructure for pedestrians and cyclists, creating safety risks for these road users.

In rural areas, walking and cycling are extremely important for people's livelihoods. Often, rural people travel along footpaths before they can access roads; these

paths range in importance but can link whole communities with the road network. The conditions of footpaths and roads, and the traffic density, can therefore have an important effect on rural livelihoods. The condition of Uganda's rural footpaths is highly variable and may change depending on the season.

Road Safety

Uganda has experienced significant growth in recorded road crash fatalities over the last decade with 24 people killed per 100 road crashes, although trends appear to show stabilisation in the most recent five-year period. On average, Uganda loses 10 people per day in road traffic crashes, which is the highest level in East Africa.

Careless driving and reckless and dangerous driving are the principal causes of road accidents in Uganda.

Traffic Flows

The data collected by the traffic survey was analysed to determine:

- traffic with peak hour and directional distribution
- traffic composition
- percentage of HGV traffic at peak hours.

Two-way traffic flows at Biiso were 429 on a weekday and 395 on a weekend during the 10-hour survey period. The proportion of HGVs was between 6% and 9%. Motorcycles represented over 50% of all traffic.

Traffic flows recorded at Hoima were significantly higher than Biiso with two-way volumes totalling almost 7000 on a weekday. The proportion of HGVs was lower at around 3%, while motorcycles represented almost 75% of all traffic.

Trend in Condition and Sensitivity to Change

Road Condition

The Ugandan government is currently upgrading trunk road sections that are unsealed. The upgrades will focus on the trunk road network and roads to be used for oil industry activities.

Sealed roads are less likely than unsealed roads to degrade as traffic levels increase. Those parts of the network not being upgraded have the potential for higher rates of deterioration and are considered most sensitive to a change in traffic flows.

Road Safety

Various initiatives have been implemented over recent years to promote road safety in Uganda. These have included advertising campaigns on radio and television, and road safety literature. The number of people killed or seriously injured fell between 2011 and 2013 but has, at the time of writing, risen to levels similar to 2011. This is likely to reflect the increase in motorcycles for private or boda boda use, which have a poor safety record.

Accident rates should generally fall on roads that are upgraded, although increased speeds can affect the severity of accidents. Accident rates on roads that are not

upgraded are likely to be most sensitive to increased traffic flows, with a likely detrimental impact on road safety.

Traffic Congestion

The key areas for congestion in Uganda are in major settlements such as Kampala and on the approach to border crossings. Congestion can also be experienced in local towns such as Hoima, which is the municipal town for the Hoima district and a commercial centre. Congestion can be experienced daily within Kampala and Hoima owing to the:

- volume of private traffic
- lack of public transport
- volume of boda boda and bajaj, which has increased as they offer a low-cost and effective means of travel and to avoid congestion.

In other areas of the country, congestion only occurs when vehicles are travelling along routes with high volumes of pedestrians walking in the road as the volume of vehicles is relatively low.

The roads most sensitive to change will be those already congested as small increases in traffic may increase journey times. Other roads across Uganda are less sensitive to change, as they have spare capacity.

Sensitivity Rankings

Based on the traffic survey, engagement with stakeholders, trend in condition and sensitivity to change, the sensitivity of the traffic-related receptors within the AOI has been ranked and is shown in Table 6.4-55.

Table 6.4-55 Traffic-Related Receptor Sensitivity Ranking

Traffic-related Receptor	Sensitivity Ranking	Rationale for Ranking
Road condition: National roads (upgraded or planned upgrade)	Medium (3)	The national road network is generally in moderate condition with some sealed roads experiencing deteriorating conditions.
Road condition: Access roads	Very high (5)	The road network is generally in poor condition with the majority of nontrunk roads being unsealed.
Road safety: National roads (upgraded or planned upgrade)	High (4)	Sealed roads have a lower risk of accidents because of the sealed surface. Poor road conditions are a major cause of accidents in Uganda. However, settlements are usually alongside the road, with vulnerable road users (pedestrians and cyclists) being particularly sensitive to increases in the number of heavy goods vehicles.

Table 6.4-55 Traffic-Related Receptor Sensitivity Ranking

Traffic-related Receptor	Sensitivity Ranking	Rationale for Ranking
Road safety: Access roads	Medium (3)	Accident rates are very high in Uganda. Vulnerable road users (pedestrians and cyclists) are particularly sensitive to increases in the number of heavy goods vehicles; however, access roads within the Tilenga feeder pipeline AOI are lightly trafficked.
Traffic congestion: Kampala, Hoima and major towns, Uganda–Tanzania border, Hoima–Buliisa road through Biiso where it runs along the eastern shore of Lake Albert and traverses an escarpment	Very high (5)	Where congestion is already experienced, a small change can be detrimental to journey times, compared to roads that have spare capacity. The Hoima–Buliisa road is being upgraded at the time of writing as part of the Hoima–Butiaba–Wanseko road upgrade which should reduce congestion.
Traffic congestion: Other roads	Medium (3)	Localised congestion can occur through areas of settlement where stalls, dwellings and pedestrians can cause narrowing of the road. Moderate increased traffic volumes could be detrimental to journey times in these areas.

Key Considerations

Within the AOI, the condition of many sections of the road network will be upgraded by the government as part of its ongoing improvements or by the project for construction purposes.

Accident rates in Uganda are high, with pedestrians, children and cyclists considered particularly vulnerable.

Traffic levels are low, so congestion is rare, except at the border with Tanzania, in Kampala and Hoima, and in other large towns.

The traffic baseline study identified the road at Biiso to be sensitive to changes in volumes of heavy goods vehicles owing to the low existing levels of traffic.

6.4.3.16 Tangible and Intangible Cultural Heritage

This section describes the intangible and tangible cultural heritage:

- AOI and study area
- baseline condition:
 - trends in condition and sensitivity to change
 - ecosystem services
 - sensitivity rankings
- key considerations.

Tangible cultural heritage (TCH) is defined as moveable or immovable objects, sites, structures or groups of structures having archaeological, palaeontological, historical, cultural, artistic and religious values (IFC 2012a).

Intangible cultural heritage (ICH) is defined as cultural resources, knowledge, innovations and practices of local communities embodying traditional lifestyles (IFC 2012b).

Cultural heritage provides continuity between tangible and intangible forms and between the past, present and future. People identify with cultural heritage as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. Cultural heritage, in its many manifestations, is important as a source of valuable scientific and historical information, as an economic and social asset for development, and as an integral part of people's cultural identity and practice (World Bank 2017).

Appendix A11 contains the baseline report.

AOI

The TCH AOI for the construction phase includes all construction areas:

- the RoW
- MCPY
- access roads
- temporary work spaces (at crossings).

The area affected visually or by noise, dust and vibration or restriction of access beyond the physical footprint is also included in the AOI. This distance extends to 100 m from the project footprint. It is unlikely that there will be discernible effects from noise, vibration or dust or restriction of access beyond this distance. This will be checked as part of the proposed programme of cultural heritage construction planning survey and assessment, based on the findings of the impact assessment for noise and air emissions.

During the operational phase, the TCH AOI includes:

- the RoW.

Visual and noise impact on TCH beyond the physical footprint is also included in the operational phase AOI, which extends to 100 m beyond the pipeline. It is unlikely that there will be discernible effects from noise beyond this distance. This will be checked as part of the proposed programme of cultural heritage construction planning survey and assessment, based on the findings of the impact assessment for noise emissions.

The AOI for ICH is more difficult to define. For example, a sacred site may have no clear boundaries, worshippers may come from various areas and it may not be clear whether the RoW or other project components will affect access. The construction and operation AOI for TCH has been used as a basis but has been extended in cases where, based on professional judgement, sites may be affected.

The study area is 2 km wide, 1 km either side of the pipeline.

Baseline Condition of Tangible and Intangible Cultural Heritage

Three categories of cultural heritage were defined based on the features identified by the studies:

- Category 1 – tangible cultural heritage:
 - archaeological sites
 - areas of high archaeological potential
- Category 2 – tangible cultural heritage with strong intangible elements:
 - cemeteries and graves, including kingdom burial sites and regalia
 - religious places where worship associated with the main established religions is practised (such as churches or mosques)
- Category 3 – intangible cultural heritage with a less-well-defined tangible component:
 - sites with an intangible component and/or traditional value, the importance of which is not always a factor of geography, but of belief and ritual. Such sites may be used for music making, dance, storytelling and other rituals. This category may also include rituals that are not linked to any particular site, but to a particular group of people.

Religious and other intangible cultural heritage VECs are more difficult to define, as these may have no fixed or easily mapped location, boundary or physical entity, and when they do (e.g., a sacred tree) the importance may be shared by people over a wider area. All the Category 3 features identified were identified during the social baseline field survey.

Within the 2-km-wide study area (see Appendix A11), 49 potential features were located through secondary data reviews and by the field surveys:

- 17 within the project footprint (inside)
- 3 within 100 m of the 30-m RoW and project components and may be susceptible to some form of impact (close)
- 29 beyond 100 m of the RoW, and project components, i.e., beyond the area expected to be affected (outside)¹⁴.

Potential sites identified from an examination of light detection and ranging (LIDAR) are excluded from the totals above, as the surveys showed a large proportion of the identified features were likely to be the result of natural processes or recent agricultural activity. However, the LIDAR sites that yielded no additional information during the field survey will be included in cultural heritage construction planning survey and assessment.

Based on the baseline data collected, the following examples of cultural heritage features were identified for Categories 1, 2 and 3; see summary below, the figures in Attachment A11.1 and tables in Attachments A11.2 to A11.4 of Appendix A11.

¹⁴ The location of each site in the study area was categorised:

- **inside** the project footprint resulting in a direct physical impact
- **close**, within 100 m of the 30-m RoW and project components: MCPY, access roads and temporary work spaces
- **outside**, over 100 m from the 30-m RoW and project components and not expected to be affected.

Category 1

- Palaeo fossil sites: Lake Albert is known for deposits of palaeo fossils. As the study area for most of the project does not include the edge of the lake shoreline, no fossil deposits have been identified in the study area. However, it is possible that deposits containing fossils may be encountered on the first 55 km of the pipeline route, which is closer to the water level of Lake Albert.
- Sites with pottery remnants: there are 17 locations with pottery, all directly on the RoW, including three potential high sensitivity sites where the evidence suggests the presence of Early to Late Iron Age settlement.
- Ironworking sites: while no evidence of ironworking has been identified at the time of writing, it is expected that features will be found during construction planning surveys and assessment.
- Rock art sites: no sites of rock-art have been found in the study area. It is possible that examples may be found during cultural heritage construction planning survey and assessment.

Category 2

- Churches and mosques: 24 churches and mosques have been identified within the study area.
- Graves and cemeteries: One grave site has been identified within the study area.

Category 3

- Sacred natural sites and trees: Sacred trees were identified in the communities of Booma (the Mulolo tree at Booma-Kakere) and the Bujawe forest at Wayoyo as the focus of ceremonies. Sacred places, not specifically mentioning trees, were mentioned at Serule B (Wambiringitya, and at Kamawamboki) and at Katooke (place not named) and at Kigorobyia.
- Traditional dances were recorded in Serule B and implied by descriptions of rituals at Waki-Kawaibanda and Katooke.
- Rituals to interact with ancestor for good health and prosperity were identified in Piida A and at Busingiro Hill in Kihunghya, rituals were identified for fertility and community property.
- Traditional healing: widely practised, for example, at Katooke, Hoima and Kigorobyia. Traditional healing is also covered in the socio-economic and health baseline report (see Appendix A9).
- Syncretism, the amalgamation of established religions (Islam and Christianity) and traditional African belief systems was mentioned explicitly in many PACs including Katooke, Kigorobyia, and Kihunghya.
- Sacred meeting places still used for meetings were mentioned at Mugasa (in Katooke) for Bunyoro Kingdom officials) and at Katooke and Buseruka.
- Twins: the birth of twins is commonly surrounded by a degree of spiritual ambivalence and this was mentioned at Rwamutonga (Hoima).

Trend in Condition and Sensitivity to Change

Limited information exists on trends in condition of cultural heritage sites in the regions traversed by the project. Agriculture, expanding and new settlements, infrastructure, mining and other developments affect the cultural heritage baseline.

Based on professional experience and opinion, and a precautionary principle that acknowledges that archaeological sites may be unique even if superficially similar to others, the definition adopted is that tangible cultural heritage is a finite resource and loss is considered nonreplicable by the project, but not under IFC definitions. IFC Performance Standard 8 (2012) defines replicable heritage as “tangible forms of cultural heritage that can themselves be moved to another location or that can be replaced by a similar structure or natural features to which the cultural values can be transferred by appropriate measures. Archaeological or historical sites may be considered replicable where the particular eras and cultural values they represent are well represented by other sites and/or structures.”

Nonreplicable cultural heritage is defined by the IFC in that it “may relate to the social, economic, cultural, environmental, and climatic conditions of past peoples, their evolving ecologies, adaptive strategies, and early forms of environmental management, where the (i) cultural heritage is unique or relatively unique for the period it represents, or (ii) cultural heritage is unique or relatively unique in linking several periods in the same site.”

Based on professional experience, no sites within the AOI meet IFC criteria as nonreplicable. However, this does not diminish the potential archaeological interest of sites and using a precautionary principle that acknowledges that archaeological sites may be unique, the approach adopted is that tangible archaeological heritage is a finite resource.

Intangible cultural heritage is closely linked to individual and group identity and to all parts of a culture. ICH practices are not static: change is ongoing and further change is inevitable. ICH assets of value to the PACs are sensitive to change. This may be due to the movement of people in or out of the area, so that the resource loses value as the belief systems that gave the asset value are replaced. Intangible cultural heritage assets may have little resilience and can be lost entirely to a new generation.

The older established religions like Islam and Christianity presently have an ambivalent relationship with traditional African beliefs in ancestral spirits, which may be further eroded.

Ecosystem Services Provided

Cultural heritage generates a range of cultural ecosystem services as set out below.

Cultural services include:

- provide a sense of self and the role of communities and individuals in the world. A sense of place or way of life is central to the effective functioning of many social systems in terms of agricultural production, craft production and trade, land ownership and inheritance, and are based upon and maintained by intangible heritage practices.
- provide spiritual, sacred or religious values, inspiration for culture and design, and cognitive development
- support the effective functioning of other social activities in terms of agricultural production, craft production and trade, land ownership and inheritance.

- building resilience in terms of ability to adapt to continuous social changes without loss of basic social functions.

Sensitivity Rankings

Sensitivity rankings for Category 1 and 2 sites are provided in Attachments A11.2–A11.4 of Appendix A11.

Key Considerations

Key considerations are:

- the tangible and intangible cultural heritage identified is considered a representative sample. The sample represents the full range of features for categories 1, 2 and 3 likely to be encountered, but there is less certainty for Category 3
- religious structures are the most common Category 2 sites
- no known nationally or internationally designated sites or critical cultural heritage have been identified within the study area
- three high sensitivity Category 1 sites have been identified within the RoW. These are potential sites of Early to Late Iron Age settlement
- the remaining Category 1 and 2 sites affected by the RoW are considered low to moderate sensitivity
- deposits containing palaeo fossils that could include early hominids may be encountered within the RoW, on the first 55 km of the pipeline route, which is close to the water level of Lake Albert
- Category 3 is closely linked to individual and group identity and therefore sensitive to cultural change
- many more features for each category are likely to occur in the AOI
- identification of further Category 3 features requires active participation of local key informants based on establishing a sufficient degree of trust.

The Convention for the Protection of the World Cultural and Natural Heritage, 1972 and the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage refer to international human rights in respect of tangible and intangible cultural heritage and the importance of:

- the tangible and intangible cultural heritage as mainsprings of cultural identity and diversity
- maintaining access to and right to practice traditional cultural heritage and beliefs.

6.4.3.17 Climate

This section describes the:

- AOI
- baseline conditions:
 - air temperature, precipitation, humidity, solar radiation, wind and greenhouse gas (GHG) emissions
 - trends in the climate and GHG emissions
 - ecosystem services provided
- key considerations.

For more information, the climate baseline report is included in Appendix A12.

Area of Influence

The spatial AOI climate change boundary is global. However, for the purposes of assessing the pipeline contributions to national emissions, Uganda's borders are considered the spatial AOI.

The temporal AOI will extend throughout the life of the pipeline, from construction to decommissioning, as all these phases will generate GHG emissions.

Baseline Condition of Climate

The tropical climate in Uganda is determined by large-scale monsoon and the Intertropical Convergence Zone systems as they move north and south following the sun. In addition, the medium-scale systems influenced by the extensive physical features in the East African region like the Lake Victoria Basin, mountain ranges and the associated rift valleys, and the Congo Basin forest to the west play an important role in the temporal and spatial distribution and intensity of the weather systems in Uganda.

Air Temperature

Air temperature in Uganda is moderate throughout the year, with a mean daily temperature of 28°C (MWE 2014).

Between 1951–1980 and 1981–2010, there has been an increase in average annual minimum temperatures of 0.5–1.2°C and 0.6–0.9°C for average maximum temperature (USAID 2013).

Average maximum air temperature within the pipeline route peaks at approximately 35°C in February–March and September–October. The average minimum temperature varies little throughout the year, ranging between approximately 9°C (June–July) and 11°C (March) (Actimar 2016a).

Precipitation

Rainfall in Uganda ranges from 400 to 2200 mm/a (MWE 2014). The southern regions of the country receive 600–2200 mm/a, while the north receives 400–1600 mm/a. Nationwide, Uganda receives an average of 1180 mm/a of rainfall.

Precipitation in Uganda is seasonal and its timing, intensity and duration vary considerably across the country. In general, Uganda experiences two modes of rain

seasons: one long rainy season from late March to mid-October in the north and a bimodal season, from March to May and then from September to November, in the western, central and eastern regions. Droughts sometimes occur in the dry season, affecting water availability for agriculture and the population.

Uganda also experiences the El Niño–Southern Oscillation (ENSO)¹⁵ teleconnection pattern, which is the principal driving force of annual to inter-annual rainfall variability in the tropics. The effects of ENSO are most pronounced in Uganda during the period between September and December, where El Niño is often associated with floods, whereas La Niña is associated with droughts (MWE 2014).

The timing of rainfall can vary considerably from year to year. The onset of rainy seasons can be 15 to 30 days earlier or later, while the duration of the rainy season can change by 20 to 40 days (USAID 2013).

The area that the pipeline route traverses experiences two rainy seasons per year: March–May and August–November. During these two seasons, the monthly mean precipitation exceeds 100 mm/month and the maximum can exceed 250 mm/month. Rainfall occurs on 17 days/month on average (Actimar 2016a).

Humidity

Uganda's climate is equatorial, with moderate humid and hot climatic conditions throughout the year. The maximum of relative humidity reaches 100% almost everywhere throughout the year.

Solar Radiation

Local conditions play an important role in variability of the daily solar radiation. The maximum daily peak of solar radiation occurs during the equinox periods: September–October and March–April (the latter period has a slightly lower maximum daily peak due to a rainy season). The maximum daily peak of solar radiation along the pipeline route ranges between 800 W/m² in June to 950 W/m² in October.

Wind

Wind speeds in the region of the pipeline are “especially low”, with maximum 1-hour mean wind speeds along the pipeline route being 3–8 m/s, and not varying considerably throughout the year (Actimar 2016a).

GHG Emissions

Uganda has one of the lowest levels GHG emissions per capita in the world, estimated at 1.6 tCO₂e per capita for 2014, totalling absolute emissions of 59.9 MtCO₂e which is approximately 0.12% of the world total (Climate Watch 2018, Internet site).

¹⁵ El Niño and La Niña are terms for climatic events originating in the tropical Pacific that recur every few years as part of a naturally-occurring cycle. The name ‘El Niño’ is used specifically for the anomalous sustained warming of sea surface temperature that occurs every few years, typically concentrated in the central-east equatorial Pacific. ‘La Niña’ is the term adopted for episodes of cooler-than-normal sea surface temperature in the equatorial Pacific. (Met Office 2017, Internet site)

The same data show that land use change and forestry (LUCF) was the leading source of GHG emissions, accounting for 43%, with agriculture close behind at 40%.

Approximately 93% of Uganda's energy needs are met by biomass, with 6% met by oil and 1% by electricity. Agriculture sector emissions are primarily driven by livestock production, inefficient animal waste management systems and the cultivation of organic soils (MWE 2014). Forested land has been shown to be decreasing, with forest degradation highest outside protected areas and in areas where agriculture expanded (MWE 2015).

Trend in Condition and Sensitivity to Change

Since 1960, mean annual temperatures have risen by 1.3°C and annual and seasonal rainfall has decreased considerably across Uganda. Rainfall has also become more unpredictable and evenly distributed over the year. Extreme events such as droughts, floods and landslides are increasing in frequency and intensity (MWE 2015).

From 1970 to 2000, minimum and maximum temperatures have increased, with minimum temperature having risen faster than the maximum temperatures.

Climate change is affecting a wide variety of sectors, particularly agriculture, water, health and human settlements. In the 2007–2008 fiscal year, climate change damages were equivalent to 4.4% of the national budget, exceeding the budget allocation for the Environment and Natural Resource Sector (MWE 2015).

Climate variability and change in Uganda affect seasonal to inter-annual rainfall. This is reflected in variations or shifts in the timing and duration of seasonal rainfall and intra-seasonal dry spells, and the intensity of rainfall, thunderstorms, lightning and hailstones. This can lead to floods, droughts and famine.

Climate projections developed for the country using the models used in the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report indicate an increase in near-surface temperature for the country. These are in the order of +2°C in the next 50 years and +2.5°C in the next 80 years under representative concentration pathway (RCP) 4.5 (intermediate level of GHG emissions). Under RCP 8.5 (very high GHG emissions), the increases are approximately +2.5°C in the next 50 years and +4.5°C in the next 80 years. The models also predict a slight decrease in total annual rainfall in most of the country, with slightly wetter conditions over the west and northwest under both RCP 4.5 and RCP 8.5. Rainfall totals might drop considerably (–20% from present levels) over Lake Victoria (MWE 2015).

Floods lead to secondary impacts of landslides, soil erosion, silting of dams and drainage channels, bursting of dams and riverbanks, water logging in low-lying valleys and wetlands, outbreaks of epidemics in animals, crop diseases and pests. Droughts lead to secondary impacts including degraded grazing and agricultural lands, leading to desertification.

Anthropogenic GHG emissions, with other anthropogenic drivers, are extremely likely to have been the dominant cause of the observed warming since the mid-20th century. In recent decades, changes in climate have affected natural and human

systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to a changing climate (IPCC 2014).

Between 1990 and 2014, Uganda's GHG emissions increased by 71% (Climate Watch 2014, Internet site).

Uganda's Intended Nationally Determined Contribution (INDC) report (MWE 2015), sets out long-term goals and adaptation strategies relating to climate change mitigation. It prioritises specific measures in energy supply, forestry and wetlands to provide GHG emission reductions and adaptation measures. The cumulative impact of the emission reduction measures is predicted to be a 22% reduction of overall national emissions in 2030 when compared to the business-as-usual (BAU) projection. The BAU emissions baseline for Uganda is 77.3 MtCO₂e per year in 2030; a 22% reduction would result in emissions of approximately 60.3 MtCO₂e, close to the 2014 level.

Continued GHG emissions will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in GHG emissions which, with adaptation, can limit climate change risks (IPCC 2014).

Ecosystem Services Provided

Although this VEC does not provide ecosystem services directly, climate influences VECs that do provide services.

Key Considerations

Key considerations related to the climate baseline are:

- the global climate has undergone unprecedented change¹⁶ and continuing change is predicted by climate scientists. Uganda's climate has changed and further change is predicted.
- Uganda is vulnerable to increased climate variability and climate change. For example, the severity and frequency of extreme events such as droughts and floods are projected to increase.
- global anthropogenic GHG emissions, with other anthropogenic drivers, are extremely likely to have been the dominant cause of the observed warming of the global climate since the mid-20th century
- the Ugandan government has put in place measures to reduce the risks of the changing climate. These include mitigation measures (reductions in GHG emissions relative to a BAU scenario) and adaptation measures (reduction of the vulnerability of social and biological systems).

¹⁶ "Since the 1950s, many of the observed changes are unprecedented over decades to millennia" (IPCC 2014).

6.5 Ecosystem Services

6.5.1 Ecosystem Service Coverage

The above descriptions of VEC baselines have included ecosystem services with each reference summarised in Table 6.5-1.

Table 6.5-1 Ecosystem Service References

Ecosystem Service*	Reference
Provisioning services	
Crops	6.4.3.8 Land-Based Livelihoods
Livestock	6.4.3.8 Land-Based Livelihoods
Capture fisheries	6.4.1.4 Aquatic Biodiversity, 6.4.3.9 River- and Lake-Based Livelihoods
Aquaculture	6.4.3.9 River- and Lake-Based Livelihoods
Wild foods	6.4.1.2 Protected Areas, 6.4.1.3 Botany, 6.4.1.4 Aquatic Biodiversity, 6.4.1.5 Avifauna Biodiversity, 6.4.1.6 Fauna Biodiversity, 6.4.3.8 Land-Based Livelihoods
Live trade in wildlife	6.4.1.2 Protected Areas, 6.4.1.6 Fauna Biodiversity
Timber and wood products	6.4.1.1 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.3.8 Land-Based Livelihoods
Fibres and nonwood products	6.4.1.3 Botany Biodiversity, 6.4.1.5 Avifauna Biodiversity, 6.4.3.8 Land-Based Livelihoods
Aggregates and minerals	6.4.3.8 Land-Based Livelihoods
Biomass fuel	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.3.8 Land-Based Livelihoods
Energy (e.g., hydro-power)	6.4.2.2 Surface Water, 6.4.3.12 Social Infrastructure and Services
Ornaments and other products	6.4.1.5 Avifauna Biodiversity, 6.4.1.6 Fauna Biodiversity
Freshwater	6.4.2.2 Surface Water, 6.4.2.3 Groundwater
Medicinal products	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.1.6 Fauna Biodiversity, 6.4.3.8 Land-Based Livelihoods
Regulating services	
Local air quality regulation	6.4.1.3 Botany Biodiversity
Global climate regulation	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.2.1 Geology and Soil
Local climate regulation	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity
Water regulation	6.4.1.1 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.1.4 Aquatic Biodiversity, 6.4.2.1 Geology and Soil, 6.4.2.2 Surface Water, 6.4.2.3 Groundwater
Erosion regulation	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity
Waste assimilation	6.4.1.3 Botany Biodiversity, 6.4.2.2 Surface Water
Pest control	6.4.1.5 Avifauna Biodiversity
Soil quality regulation	6.4.1.3 Botany Biodiversity, 6.4.2.1 Geology and Soil

Ecosystem Service*	Reference
Cultural services	
Recreation and ecotourism	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.1.5 Avifauna Biodiversity, 6.4.1.6 Fauna Biodiversity
Aesthetics, landscapes	6.4.2.4 Landscape
Sense of place	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.3.8 Land-Based Livelihoods, 6.4.3.9 River- and Lake-Based Livelihoods, 6.4.3.16 Tangible and Intangible Culture
Spiritual, sacred and religious values	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.1.5 Avifauna Biodiversity, 6.4.3.16 Tangible and Intangible Culture
Ethical and biodiversity non-use values	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.1.6 Fauna Biodiversity
Supporting services	
Habitats and species support	6.4.1.2 Protected Areas, 6.4.1.3 Botany Biodiversity, 6.4.1.4 Aquatic Biodiversity, 6.4.1.5 Avifauna Biodiversity, 6.4.2.2 Surface Water, 6.4.2.3 Groundwater

NOTE: *The order of ecosystem services is based on a standard list of ecosystem services in WRI (2012) Corporate Ecosystem Services Review Version 2.0.