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## CNOOC UGANDA LTD.

# Biodiversity Impact Assessment for the Proposed Kingfisher Development Area and Feeder Line, Hoima District, Uganda

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REPORT

Golder Associates

# Executive Summary

CNOOC Uganda Limited ("CNOOC") has identified an opportunity to develop the Kingfisher Oil Field on the eastern shore of Lake Albert, Hoima District, Uganda. In accordance with Ugandan law, it is necessary for CNOOC to determine the potential environmental and social impacts of the project, and to demonstrate how these will be mitigated and managed. This chapter of the Environmental and Social Impact Assessment (ESIA) presents an assessment of the potential impacts of the Kingfisher development project (the Project) on biodiversity, and sets out recommendations for their avoidance and reduction, where necessary. This impact assessment has been developed with reference to the baseline terrestrial and aquatic biodiversity surveys, completed between February and March 2014, May and June 2014 and October and November 2014.

The aim of this biodiversity assessment was to collect scientifically defensible, high quality data of sufficient breadth that could be used to characterise the baseline conditions of the area and assess how the Project could affect that biodiversity. This was undertaken in consideration of Uganda's Wildlife Bill (2017) and *Wildlife Policy 2014* and *National Biodiversity Strategy and Action Plan* (NEMA 2016), and with reference to the IFC PS6, which seeks to protect biodiversity and ecosystem services from the adverse impacts of project activities, and support its conservation and sustainable use. Consequently, the objectives of the biodiversity impact assessment, as reflected in the Scoping Report (Golder Associates 2014c), were to:

- Characterise the ecological integrity of the terrestrial and aquatic (including wetland) ecosystems in the Project's area of influence and ascertain seasonal variation.
- Identify sensitive or unique habitats and species (as protected under Ugandan legislation and international obligations), which could suffer irreplaceable loss due to the Project.
- Identify species of concern that could trigger critical habitat (as defined by IFC PS6).
- Identify populations and trends of exotic and invasive species in the Project's area of influence.
- Identify and describe potential sources of risk and impact associated with the development that could affect biodiversity of the Project's area of influence.
- Identify the potential direct, indirect and cumulative effects (Volume 5: Cumulative Impact Assessment) on biodiversity associated with the Project.
- Recommend suitable mitigation measures where applicable.
- Develop a monitoring programme and action plan for the biodiversity affected by the Project's development.

Spatial Boundaries

For this assessment, and in order to satisfy IFC requirements, two areas of influence were considered in relation to assessing the potential effects on biodiversity:

a) Biodiversity local study area:

- The assessment of impacts within the local area of the Project, or biodiversity local study area (LSA), was based on the spatial extent of a Project's footprint and an associated buffer zone that includes potential immediate, direct effects on the receiving environment. It was derived as a focus for the development of a baseline case where potential direct effects were predicted to occur.
- The LSA incorporates: the wells, flowlines, central processing facility (CPF) and supporting infrastructure associated with the production facility including in-field access roads and flowlines, an upgraded jetty, and a water abstraction station on Lake Albert, a permanent camp, a material yard (or 'supply base'), and a safety check station at the top of the escarpment.; and the feeder line easement to Kabaale, roughly 46 km to the northeast of the field.

- A 1 km buffer was incorporated around the infrastructure in order to capture all potential direct effects, including those from noise, dust, changes to surface water quality (that is, streams and wetlands). At Lake Albert, the buffer was extended to 2 km in order to capture direct impacts on aquatic ecosystems of concern.

b) Critical habitat area of analysis.

- Critical habitat is present in many places globally, but is only relevant to a development project where the project may affect that habitat (both directly and indirectly) (IFC 2012a). Importantly, the determination of critical habitat is independent of the specifics of the proposed project footprint, and is present under baseline conditions and is not defined by the size of the project footprint, or other project effects.
- For the critical habitat area of analysis, an ecologically-relevant area of analysis surrounding, and including, the anticipated extent of the Project's influence, including broader or regional effects from the Project, in association with other anthropogenic activities (such as other projects) and natural factors was identified (ref. Volume 5: Cumulative Impact Assessment). These include indirect, induced and cumulative effects. The CHAA was defined as that area.
- The boundaries of the CHAA were devised cognisant of the need for an area where the ecological and land management issues have more in common with each other than they do with those in adjacent areas, and constitutes a sensible ecological and political boundary within which critical habitat can be defined (IFC 2012b, paragraph 65).
- This area was also used as the geographical extent to screen biodiversity features to be assessed for critical habitat based on discrete management units (DMU). Critical habitat was therefore identified and mapped at the CHAA-scale, which was inclusive of the LSA.

A baseline of the terrestrial and aquatic ecology of the LSA was determined through a desktop assessment and comprehensive, seasonal surveys. These assessments and surveys were then used as the basis for the description of the biodiversity of the CHAA. The detailed baseline study reports for the terrestrial and aquatic ecology are presented in Appendix C.

One of the main purposes of an impact assessment is to provide answers to questions that people have about how a project could affect something that matters to them, such as a valued component. To ensure that this impact assessment clearly addressed the key issues raised by the stakeholders and the objectives set for this impact assessment, questions were formulated that captured the concerns relative to a particular issue. In this report, those concerns are expressed as 'key questions', and they form the basis of the investigations of potential effects and impacts of the Project.

Two key questions were established:

**1) What effect could the Project have on habitats and ecosystem integrity?**

**2) What effect could the Project have on species of concern?**

Under each of these key questions, sub-questions were developed that focused on the specific phases of the Project, in particular, the construction, operation and decommissioning phase.

Indicators for the impact assessment were selected to assess the level of potential impact. Changes to the indicators were analysed to determine the effectiveness of the mitigation hierarchy, and identify Project constraints and opportunities for additional avoidance and mitigation. Indicators and context for impact assessment are outlined for the key questions and associated valued components in the table below.

**Key questions and indicators**

| Key Question | Valued Component | Indicator | Indicator Description | Context |
|---|---|---|---|---|
| What effect could the Project have on habitats and ecosystem integrity? | Ecosystem integrity<br><br>Priority habitat | ¡ regional representative -ness | The uniqueness of an ecosystem or habitat in the CHAA and wider landscape. This rarity factor is related to the concepts of irreplaceability and vulnerability. | The persistence of species of concern in the CHAA and wider area.<br><br>Maintain the distribution and abundance of species of concern such that self-sustaining and ecologically effective populations can be maintained.<br><br>Achieve net gains for species of concern for which critical habitat is affected by the proposed Project, and at least no net loss for all other valued components.<br><br>Maintenance of ecosystem processes and functions and connectivity. |
| | | ¡ changes in soil, water flows and quality, and vegetation | Drivers of change affecting key processes | |
| | | ¡ ecosystem composition | The diversity and complexity of an ecosystem or habitat – what is there and how abundant. Relates to species composition and abundance – keystone species are of particular relevance; changes in populations of these species have greater impacts on ecosystems than would be expected from its relative abundance or total biomass | |
| | | ¡ ecosystem configuration | The structure or pattern of an ecosystem: the spatial structure and scale of the ecosystem in relation to the scale of the human intervention; food-web structure and interactions that shape the flow of energy and the distribution of biomass (relates to changes in food-web, e.g. those caused by introduction of invasive species); linkages and corridors to habitat of the same or different ecosystems | |
| What effect could the Project have | All species of concern | ¡ habitat quantity and quality | The extent and integrity of preferred foraging and breeding habitat | |

| Key Question | Valued Component | Indicator | Indicator Description | Context |
|---|---|---|---|---|
| on species of concern? | | ¡ habitat connectivity | Connectivity to adjacent areas of suitable habitat and potential for dispersal | |
| | | ¡ abundance and distribution | Expected vs actual population numbers and distribution | |
| | | ¡ survival and reproduction | Likelihood of continued survival/reproduction compared to baseline | |

As identified through stakeholder consultation, review of background biodiversity and environmental reports, published ecological literature, and consideration of the IFC's Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development (IFC 2007b) and the performance standards (that is, IFC 2012a, b and c), broadly, the key issues pertaining to the CHAA's biodiversity include:

- Habitats and ecosystems
  - Construction and operation of the pipeline and the potential effects that the construction and operation could have on wetlands, streams, woodlands, bushland and grasslands (including potential critical habitat), agricultural areas, and soils.
  - Construction and operation of the wells and CPF on the environment of the Buhuka Flats and Lake Albert.
  - The potential effects the construction and operation of the Project could have on Lake Albert, wetlands and environment of the Buhuka Flats. These include: vibration; pollution (oil, erosion and sedimentation, other run-off, effects to groundwater); increased fishing pressure from in-migration; long-term damage to the lake ecosystem.
  - Potential induced effects to the Bugoma Central Forest Reserve due to upgrade of the existing road, including the possible need for offsets.
  - Potential effects the construction and operation of the Project could have on the escarpment vegetation corridors connecting the wild areas along Lake Albert from Semliki to Murchison Falls National Park.
- Species of concern
  - Concern for the loss of animal species from the Buhuka Flats. Potential effects to the populations of Hippopotamus (*Hippopotamus amphibius*), Nile Crocodile (*Crocodylus niloticus*), and Grey Crowned Crane (*Balearica regulorum*), amongst others.
  - The identification of migratory and threatened species inhabiting the CHAA.
  - Potential effects to the populations of Chimpanzees (*Pan troglodytes*), Nahan's Francolin (*Ptilopachus nahani*) and African Elephant (*Loxodonta africana*) in Bugoma Central Forest Reserve.

In summary, the main issues related to potential effects to the biodiversity of the CHAA from the construction and operation of the Project relate to the potential changes in ecosystem composition (for example, species composition), configuration (for example, patch size and connectivity) and function of the wider CHAA through the direct loss, disturbance or change in condition of natural and modified habitats, including critical habitat.

The impact assessment was conducted separately for the Production Facility and the feeder pipeline. For each component, the possible interactions of biodiversity valued components with the Production Facility /feeder pipeline infrastructure and activities, and the resulting impacts during the construction, operation and decommissioning phases of the Project were addressed.

The biodiversity valued components for both the Production Facility impact assessment and Feeder Pipeline Impact Assessment are listed below. They include all of the species and habitats that trigger critical habitat designation within the CHAA, that have potential to interact with the Production Facility infrastructure and activities. In addition, ecosystems of concern that will be potentially affected by the Project, and Grey Crowned Crane, were also included as valued components for impact assessment, for reasons outlined in the Table below.

**Biodiversity Valued Components for Impact Assessment**

| Valued Component | Confirmed CH Trigger? (see Table 4) | Reasoning |
|---|---|---|
| Near-shore aquatic habitats of Lake Albert | • Yes – Criterion 13<br>• Possibly Criterion 1 and Criterion 2 (G. candida) | • The near-shore habitats are important fishing grounds that support 11 fishing villages on the Buhuka Flats and surrounds (see Ecosystem Services Review)<br>• May support the CR and range-restricted species *Gabbiella candida* |
| Wetlands | • No | • Natural habitat – priority habitat according to IFC (2012)<br>• Supports Endangered Grey Crowned Crane<br>• Important in supply of ecosystem services to local communities (see Ecosystem Services Review) |
| Escarpment vegetation corridor | • No | • Natural habitat – priority habitat according to IFC (2012)<br>• Forms part of a contiguous vegetation corridor that is part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor<br>• The location of caves and cavities along the escarpment that could be important for cavity-roosting bats |
| Bugoma Central Forest Reserve | • Yes –<br>• Criterion 4<br>• Criterion 1<br>• Criterion 2 | • Triggers CH on the basis of being a highly threatened and unique ecosystem (Criterion 4)<br>• Triggers Criterion 1 Tier 1 CH on the basis of support of a population of Eastern Chimpanzee, that is recognised as being one for the four largest in the region; apart from being an Endangered species, chimpanzees are also recognised as key stone species and ecosystem engineers<br>• Triggers Criterion 2 Tier 2 CH on the basis of support of range-restricted Nahan's Francolin<br>• Recognised area of old growth forest<br>• The forest is recognised for its unique biodiversity values, including biome restricted species |

| Valued Component | Confirmed CH Trigger? (see Table 4) | Reasoning |
|---|---|---|
| | | • Is an important ecosystem service supply area for local people who harvest timber, fibre, fuel wood and charcoal, and non-timber forest products from the forest.<br>• Bugoma Central Forest Reserve is recognised as an Important Bird Area<br>• Nationally recognised as a high conservation priority area (NEMA 2010) |
| Mud Snail (*Gabbiella candida*) | • Possibly Criterion 1 and Criterion 2 | • Could occur on near-shore aquatic habitats (Bugoma Lagoon, large bays, open sandy shores, shallow river-associated water)<br>• Has not been confirmed in LSA to date and is included on basis of precautionary principle |
| Grey Crowned Crane | • No | • Although Grey Crowned Crane is not present in numbers that would trigger CH designation, it is an Endangered species and has been confirmed present on the Buhuka Flats during baseline fieldwork in 2014 and 2017<br>• Any potential Project impacts on a globally-recognised and nationally-protected Endangered species are unacceptable and warrant addressing via the impact assessment process |
| Nahan's Francolin (*Ptilopachus nahani*) | • Yes – Criterion 2 | • Occurs in Bugoma Central Forest Reserve, possibly one of less than 10 DMUs globally (including DRC)<br>• Potential for CHAA to support >10% of this species' known global population |
| Eastern Chimpanzee (*Pan troglodytes schweinfurthii)* | • Yes – Criterion 1 | • Occurs in Bugoma Central Forest Reserve<br>• Great apes are an iconic species of anthropological and evolutionary significance<br>• They generally immediately trigger CH designation (see GN 74 and footnotes in PS6, IFC 2012a and b) |

During construction of the Production Facility, significant residual impacts on ecosystems of concern were predicted for near-shore habitats of Lake Albert, wetlands, and vegetation communities of the escarpment. For species of concern, significant residual impacts were predicted for the mud snail (*G. candida*) (based on the precautionary principle), and Grey Crowned Crane during construction of the Production Facility, largely as a factor of habitat loss and deterioration.

During the operation phase of the Production Facility, significant residual impacts on ecosystems of concern were predicted for near-shore habitats of Lake Albert due to potential water quality contamination by stormwater and the induced effect of increased population on the flats. Significant residual effects were also predicted for the escarpment vegetation corridor and Bugoma Central Forest Reserve, principally as a result of the induced effect of population influx to the locality and region. Similarly, significant residual effects were predicted for Grey Crowned Crane in the Buhuka Flats, due to habitat loss and degradation, physical and sensory disturbance and exacerbated by the induced effect of population influx to the area. For Nahan's

Francolin and Eastern Chimpanzee, significant residual impacts were also predicted, again largely as a result of the difficult-to quantify project-induced effect of human population influx to the area.

During construction of the Feeder Line, significant residual impacts on ecosystems of concern were predicted only for wetlands, again in the context of the difficult-to quantify project-induced effect of human population influx to the area. For species of concern, significant residual impacts were predicted for Grey Crowned Crane only, principally as a result of the induced effect of population influx to the local study area.

During the operation phase of the Feeder Line, significant residual impacts on ecosystems of concern were predicted for the vegetation communities of the escarpment, again due to the fact that the indirect effects of population influx to the region are likely to result in further loss and degradation of escarpment vegetation communities, in particular in the vicinity of the short-stretch of easily traversed, grassed pipeline route which will be kept free of trees and shrubs. Moderate residual impacts on wetlands in the feeder line LSA are also predicted, again largely due to the induced effect of population influx to the area. For species of concern, significant residual impacts were predicted for Grey Crowned Crane only, again principally as a result of the induced effect of future population influx to the local study area.

In line with the IFC's PS6, offsetting has been considered as an option to achieve no net loss and, preferably, net gain, when residual impacts are identified for valued components that trigger critical habitat and/or natural habitat designations, and where reclamation following the Project's decommissioning are expected not to meet the no net loss philosophy for a valued component. Possible offsetting strategies for each affected valued component are discussed in Section 13.0. Actual offsetting strategies will be developed on a landscape-scale, in liaison with other partners and as part of a Biodiversity Action Plan.

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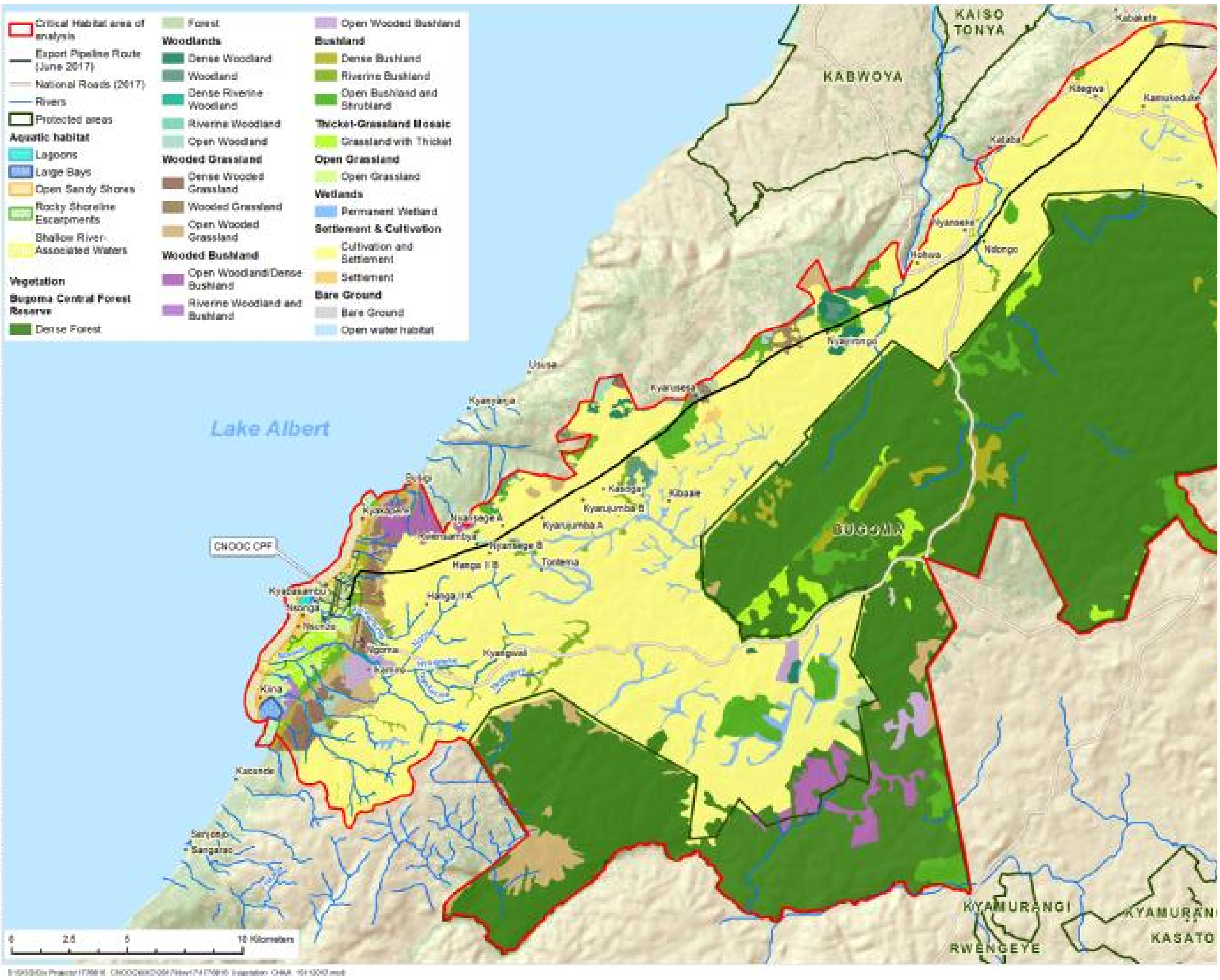
Critical Habitat area of analysis
Export Pipeline Route (June 2017)
National Roads (2017)
Rivers
Protected areas
Aquatic habitat
Lagoons
Large Bays
Open Sandy Shores
Rocky Shoreline Escarpments
Shallow River-Associated Waters
Vegetation
Bugoma Central Forest Reserve
Dense Forest
Forest
Woodlands
Dense Woodland
Woodland
Dense Riverine Woodland
Riverine Woodland
Open Woodland
Wooded Grassland
Dense Wooded Grassland
Wooded Grassland
Open Wooded Grassland
Wooded Bushland
Open Woodland/Dense Bushland
Riverine Woodland and Bushland
Open Wooded Bushland
Bushland
Dense Bushland
Riverine Bushland
Open Bushland and Shrubland
Thicket-Grassland Mosaic
Grassland with Thicket
Open Grassland
Open Grassland
Wetlands
Permanent Wetland
Settlement & Cultivation
Cultivation and Settlement
Settlement
Bare Ground
Bare Ground
Open water habitat
Lake Albert
KAISO TONYA
KABWOYA
BUGOMA
CNOOC CPF
KYAMURANGI
RWENGEYE
KASATO
0 2.5 5 10 Kilometers

**APPENDICES**

# 1.0 INTRODUCTION

CNOOC Uganda Limited ("CNOOC") has identified an opportunity to develop the Kingfisher Oil Field on the eastern shore of Lake Albert, Hoima District, Uganda. In accordance with Ugandan law, it is necessary for CNOOC to determine the potential environmental and social impacts of the project, and to demonstrate how these will be mitigated and managed. This chapter of the Environmental and Social Impact Assessment (ESIA) presents an assessment of the potential impacts of the Kingfisher development project (the Project) on biodiversity, and sets out recommendations for their avoidance and reduction, where necessary. This impact assessment has been developed with reference to the baseline terrestrial and aquatic biodiversity surveys, completed between February and March 2014, May and June 2014 and October and November 2014. The baseline was required to enable an appropriate assessment of the Project's potential impacts on biodiversity. The detailed results of the baseline surveys are included in the Appendices and summarised in Section 6.0.

Uganda is a signatory to the Convention on Biological Diversity (CBD); as such there is a governmental requirement to implement policies to protect biodiversity at all its different levels, including ecosystems, species and genes. That protection is embodied in the obligations the country imposes on entities operating within its borders. Nevertheless, as mentioned, biodiversity as a concept is very broad, and is typically defined as the variety of life at different levels of biological organisation and all the ecological and biological processes through which they are connected (for example, see Hill et al. 2005; Secretariat of the CBD 2006). In line with that definition of biodiversity, this impact assessment focuses on those different levels, as defined below.

Ecosystems are a dynamic complex of plants, animals, micro-organisms, and their non-living environment, interacting as a functional unit. Ecosystems can vary greatly in size, and in the biotic and abiotic elements of which they are comprised. However, ecosystems usually encompass specific, defined spaces. Ecosystems are distinct from communities in that the term "community" typically only refers to coexisting biotic populations, whereas ecosystems can include abiotic (that is, non-living) components and an array of environmental processes (Begon et al. 1990). Species can be defined as groups of morphologically similar organisms that have descended from a common ancestor, with common genetic make-up, and which produce fertile offspring only amongst themselves (Begon et al. 1990). Species are the basic components of ecological communities and are the most recognisable units of biodiversity. Efforts to conserve biodiversity often focus at the species level, and the efforts to conserve species diversity go some way to include the genetic component of biodiversity.

A fourth level of biodiversity has been derived fairly recently in the scientific and wider literature. This is the concept of ecosystem services (see Millennium Ecosystem Assessment 2005). Ecosystem services are the benefits to people generated by a functioning natural environment, the recognition of which has become increasingly important. The assessment of ecosystem services is primarily covered under the International Finance Corporation's (IFC) Performance Standard 6 (PS6), although it is also covered under PS1, PS3, PS4, PS5, PS7 and PS8. Nevertheless, for the intents of this impact assessment, the assessment of ecosystem services has been given its own report in recognition that the assessment is a cross-over discipline covering social, biological and physical disciplines, as reflected in its assessment requirement across multiple performance standards. That assessment can be found in Golder Associates (2014i). As such, the concept of ecosystem services, as a component of biodiversity under the IFC PS6, is not discussed further in this document.

In light of the above, and for the purposes of this assessment, "biodiversity" encompasses terrestrial and aquatic ecosystems (at the habitat, species and genetic level), and is in line with the definitions set out by Uganda's *National Environment Act 1995*, the CBD (Secretariat of the CBD 2006), and the IFC's PS6 (2012). Further clarification is set out in Section 2.0. Ecosystems services, although recognised as being part of, or dependent upon biodiversity, and covered under the IFC's Performance Standard 6, are not covered in this chapter. Instead, Golder Associates (2014i) is devoted to describing the baseline and impact assessment for ecosystem services.

This specialist study report includes the following sections:

- Section 2.0 describes the terms of reference for the report.

- Section 3.0 presents the methods used for the study that entail examining the study objectives, the approach employed and the limitations encountered.
- Section 4.0 sets out the legislative background applicable to the study.
- Section 5.0 Summarises the key issues in relation to biodiversity.
- Section 6.0 summarises the results of the baseline studies.
- Section 7.0 assesses the impacts to biodiversity arising from the CPF, wells and associated infrastructure.
- Section 8.0 assesses the impacts to biodiversity arising from the Feeder line.
- Section 9.0 recommends mitigation and management measures.
- Section 10.0 provides recommendations for offsetting.
- Section 11.0 includes a complete list of references consulted.

This assessment report is a preliminary version produced for client review.

# 2.0 TERMS OF REFERENCE

Historically, the biodiversity of the area has been assessed, in part, as part of the Environmental Impact Assessments (EIA) for various oil-related projects and developments over the last decade. However, those assessments tended to focus only on the footprint of the particular project components; for example, drill pads, access roads, etc. In the wider Albertine-Graben region, broad-scale landscape assessments have been completed (for example, NEMA 2010, AECOM 2013, MEMD 2013; TBC & FFI, 2017). Nevertheless, no comprehensive biodiversity impact assessment has been completed that covers the full scope of the developments on Buhuka Flats, the escarpment and feeder line corridor, which is the focus of this ESIA.

In determining the requirements of the biodiversity assessment, reference was made to the appropriate Ugandan legislation and guidance, as well as international standards and guidance. National policy and international standards pertaining to the Project are detailed in Section 4.0.

The biodiversity impact assessment concentrates on assessing changes in ecosystems, habitat and ecosystem function, changes in populations of species, including species of conservation concern, invasive species and species of high value to people.

## 2.1 Objectives

The aim of this biodiversity assessment was to collect scientifically defensible, high quality data of sufficient breadth that could be used to characterise the baseline conditions of the area and assess how the Project could affect that biodiversity. This was undertaken in consideration of Uganda's Wildlife Bill (2017) and *Wildlife Policy 2014* and *National Biodiversity Strategy and Action Plan* (NEMA 2016), and with reference to the IFC PS6, which seeks to protect biodiversity and ecosystem services from the adverse impacts of project activities, and support its conservation and sustainable use. Consequently, the objectives of the biodiversity impact assessment, as reflected in the Scoping Report (Golder Associates 2014c), were to:

- Characterise the ecological integrity of the terrestrial and aquatic (including wetland) ecosystems in the Project's area of influence and ascertain seasonal variation.
- Identify sensitive or unique habitats and species (as protected under Ugandan legislation and international obligations), which could suffer irreplaceable loss due to the Project.
- Identify species of concern that could trigger critical habitat (as defined by IFC PS6).
- Identify populations and trends of exotic and invasive species in the Project's area of influence.
- Identify and describe potential sources of risk and impact associated with the development that could affect biodiversity of the Project's area of influence.

- Identify the potential direct, indirect and cumulative effects on biodiversity associated with the Project.
- Recommend suitable mitigation measures where applicable.
- Develop a monitoring programme and action plan for the biodiversity affected by the Project's development.

## 2.2 Scope of Work

In order to address the above objectives, and in line with the Scoping Report (Golder Associates 2014c), a description and regional contextualisation of the baseline terrestrial and aquatic ecology was undertaken. Using available regional ecological data and dedicated baseline studies, an assessment of the effects on the biodiversity of the Project's area of influence (i.e. the Local Study Area, and the Critical Habitat Area of Analysis – ref. Sections 3.1.1 & 3.1.2) was conducted to meet the requirements of IFC PS6.

The scopes for the baseline terrestrial and aquatic ecology, and overall biodiversity effects assessment are presented in the following sections.

### 2.2.1 Terrestrial Biodiversity

The baseline terrestrial biodiversity studies focussed on describing the seasonal variation (that is, the two wet seasons and a dry season) of:

- Vegetation communities and habitats within the Project's area of influence, including structure, condition, species composition, representativeness, irreplaceability and vulnerability.
- Populations of vertebrates, and selected invertebrates in the Project's area of influence, including their representativeness, irreplaceability and vulnerability.
- Current drivers of change in the terrestrial ecosystems of the Project's area of influence, including populations of pest and invasive species.

### 2.2.2 Aquatic Biodiversity

The baseline aquatic biodiversity studies focussed on describing the seasonal variation (that is, the two wet seasons and a dry season) of:

- Abiotic factors (that is, physical and chemical characteristics of the water quality) influencing the aquatic habitats and ecosystems supported in Lake Albert, wetlands on the Buhuka Flats, and watercourses draining the escarpment and flats.
- Aquatic habitats and ecosystems within the Project's area of influence, including structure, condition, species composition, representativeness, irreplaceability and vulnerability.
- Biotic components of the various aquatic habitats and ecosystems in the Project's area of influence; in particular, macrophytes, phytoplankton, zooplankton, macro-invertebrates and fish, and the condition of the populations of these groups, their representativeness, irreplaceability and vulnerability.
- Current drivers of change in the aquatic ecosystems of the Project's area of influence, including populations of pest and invasive species.

### 2.2.3 Overall Biodiversity Value

The effects that the Project could have on the terrestrial and aquatic ecosystems, habitats, and species in the Project's area of influence were identified and assessed at the scale of the overall biodiversity, that is, a landscape ecology and ecosystems approach, *viz.*, Secretariat of the CBD (2006), as embodied in IFC PS6 (IFC 2012a), the International Petroleum Industry Environmental Conservation Association's (IPIECA) (IPIECA 2005, 2007, 2010), and the Energy and Biodiversity Initiative's (EBI) (EBI 2006) guidance documents. Furthermore, in line with the requirements of IFC PS6 (IFC 2012a, b), the consideration of the effects of the Project on the biodiversity were based on the findings of the baseline terrestrial and aquatic ecology assessments and focussed on:

- The identification of modified and natural habitat within the Project's Local Study Area (LSA), and the implications for no net loss of biodiversity.
- The identification of species of concern occurring within the Critical Habitat Area of Analysis (CHAA) surrounding the Project, and the potential for these to trigger critical habitat.
- The identification of protected areas, and other internationally recognised areas within and surrounding the Project's area of influence, and the potential for the Project to affect these.
- Assessing the potential effects of the Project on the functions and processes of the ecosystems of the Project's area of influence.

### 2.2.4 Impact Assessment

The approach for impact assessment used in the biodiversity specialist study is described in detail in Appendix F, and incorporates the sensitivity of a species or ecosystem in the assessment matrix. For the intents of this biodiversity impact assessment, sensitivity represents the valued component's irreplaceability and vulnerability. It was based on, amongst other aspects, the valued components resilience, as well as national and global conservation status. As such, sensitivity was based on scientific principles of biodiversity conservation and human values regarding valued components associated with ecosystem services.

The valued component sensitivity was combined with the CHAA-level magnitude classification to obtain an overall impact significance for the construction, operation and decommissioning cases, for each valued component. Comprehensive details on the impact assessment terms of reference for biodiversity are provided in Appendix F.

This approach was agreed in principle over the course of meetings held between Golder and NEMA during 2014/2015. It is recognised that this approach deviates slightly from the general impact assessment method outlined in the Scoping Report (Golder Associates Africa, 2014); however, the ratings presented in the ESIA chapters (Volumes 3 and 4) were aligned with the findings of this biodiversity specialist study and are deemed to be representative of the specialist study outcomes.

## 3.0 METHODOLOGY

This section presents the methods used to identify and assess the potential effects and impacts to the biodiversity values of the Project's area of influence. This followed a six-part process, broadly following those outlined in Treweek (1999) and Secretariat for the CBD (2006):

1) Identify key issues.
2) Delineate study areas.
3) Identify the timeframe for the assessment.
4) Describe the baseline (including current direct and indirect drivers of change to ecosystem processes and functions, composition and structure).
5) Identify valued components, key questions, and indicators.
6) Conduct the impact assessment:
    a) identify Project interactions with the environment;
    b) consider environmental design features and mitigation;
    c) assess effects and classify direct and indirect impacts;
    d) describe the confidence in the impact predictions; and
    e) determine follow-up and monitoring activities.

The impact assessment shows clearly to the reader all of the steps taken to arrive at the overall impact level score for any key issue or question. Hence, a reader should be able to use these same tools to repeat the analysis if they desired to do so.

The methods used for each of these steps are presented below.

## 3.1 Key Issues

Key issues in relation to the biodiversity within the immediate footprint of the Project, and the wider region surrounding the Project footprint, were identified through stakeholder consultation (Golder 2014a), review of background biodiversity and environmental reports (that is: RPS (2006); AWE (2008a, b, c, 2013a, b, 2014a, b); AECOM (2012, 2013); EACL (2013, 2014), NEMA (1996, 2002, 2010), MEMD (2013), and TBC & FFI (2017)), published ecological and social literature, consideration of the IFC's Performance Standards (IFC 2012a), and applying the expertise of the biodiversity impact assessment team.

### 3.1.1 Delineation of the Study Area

As with any environmental impact assessment, the spatial and temporal boundaries for the analysis need to be set. Described below are those bounds.

### 3.1.2 Spatial Boundaries

The spatial boundaries within which potential effects arising from the Project may have on biodiversity were set. For this assessment, and in order to satisfy IFC requirements, two areas of influence were considered in relation to assessing the potential effects on biodiversity:

c) Biodiversity local study area.

d) Critical habitat area of analysis.

For the assessment of local impacts, the area should be large enough to analyse and mitigate efficiently the potential effects from the project on the receiving environment, but not too large as to dilute or confound the potential project-related effects with other human-induced and natural influences.

Described below are how the spatial bounds for each of those areas were determined.

a) Local Study Area

- The assessment of impacts within the local area of the Project, or biodiversity local study area (LSA), was based on the spatial extent of a Project's footprint and an associated buffer zone that includes potential immediate, direct effects on the receiving environment. It was derived as a focus for the development of a baseline case where potential direct effects were predicted to occur.
- The LSA incorporates: the wells, flowlines, central processing facility (CPF) and supporting infrastructure associated with the production facility including in-field access roads and flowlines, an upgraded jetty, and a water abstraction station on Lake Albert, a permanent camp, a material yard (or 'supply base'), and a safety check station at the top of the escarpment.; and the feeder line easement to Kabaale, roughly 46 km to the northeast of the field.
- A 1 km buffer was incorporated around the infrastructure in order to capture all potential direct effects, including those from noise, dust, changes to surface water quality (that is, streams and wetlands). At Lake Albert, the buffer was extended to 2 km in order to capture direct impacts on aquatic ecosystems of concern.
- The LSA is depicted in Figure 1.

b) Critical Habitat Area of Analysis (CHAA)

- Critical habitat is present in many places globally, but is only relevant to a development project where the project may affect that habitat (both directly and indirectly) (IFC 2012a). Importantly, the determination of critical habitat is independent of the specifics of the proposed project footprint, and is present under baseline conditions and is not defined by the size of the project footprint, or other project effects.

- For the area, a first step in defining critical habitat was to identify an ecologically-relevant area of analysis surrounding, and including, the anticipated extent of the Project's influence, including broader or regional effects from the Project, in association with other anthropogenic activities (such as other projects) and natural factors. These include indirect, induced and cumulative effects. The CHAA was defined as that area.
- The boundaries of the CHAA were devised cognisant of the need for an area where the ecological and land management issues have more in common with each other than they do with those in adjacent areas, and constitutes a sensible ecological and political boundary within which critical habitat can be defined (IFC 2012b, paragraph 65).
- This area was also used as the geographical extent to screen biodiversity features to be assessed for critical habitat based on discrete management units (DMU). Critical habitat was therefore identified and mapped at the CHAA-scale, which was inclusive of the LSA.
- The screening was initially undertaken at a desktop level using the following attributes:
  - Presence, abundance, and distribution within, or relevance to, the area associated with the CHAA.
  - Potential for interaction with the area and proposed project development.
  - Conservation status or concern; in particular, IUCN-listed Critically Endangered and Endangered species, range restricted and endemic species, congregatory and migratory species, as well as, nationally listed threatened and priority species.
  - Ecological and/or socio-economic value.
  - Identified importance to interested public, government agencies, the scientific community, NGOs and/or CNOOC.
- secondary data sources were used, especially for the CHAA away from the LSA; these included:
  - SPOT6 imagery for the determination of land cover, land use, natural and modified habitats.
  - Global Biodiversity Information Facility (GBIF) (GBIF 2014; GBIF 2017).
  - Integrated Biodiversity Assessment Tool (IBAT), including the available data on Red List species, Key Biodiversity Areas (KBA), Endemic Bird Areas (EBA), Important Bird Areas (IBA), protected areas, wetland areas (IUCN 2014b).
  - Catchments and hydrology.
  - Soils and geology mapping.
  - Existing infrastructure and disturbance.
  - Proposed Project infrastructure.
- A biodiversity constraints/sensitivity map of the wider area was then generated, which became the CHAA. This map also formed the basis to identify modified and natural habitats (as per IFC 2012b), focus the assessment of the valued components, and guide field surveys.
- For the intents of this biodiversity impact assessment, the CHAA encompasses: the Buhuka Flats; the catchments of: the Masika River, the two unnamed watercourses to the south of the Masika River, the Kamansinig River, and the four unnamed watercourses to the north of the Kamansinig River; the pipeline corridor, extending to the eastern boundary of the natural vegetation on the escarpment (as derived from SPOT6 imagery); and the Bugoma Central Forest Reserve (CFR).

- DMUs are defined as an area with a clearly demarcated boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas (IFC 2012b).
- DMUs forming the CHAA included: the Buhuka Flats; the catchments of the Masika River, the two unnamed watercourses to the south of the Masika River, the Kamansinig River, and the four unnamed watercourses to the north of the Kamansinig River; the Bugoma Central Forest Reserve; the subsistence agricultural areas between the escarpment and the Bugoma Central Forest Reserve.

§ Figure 2 depicts the CHAA.

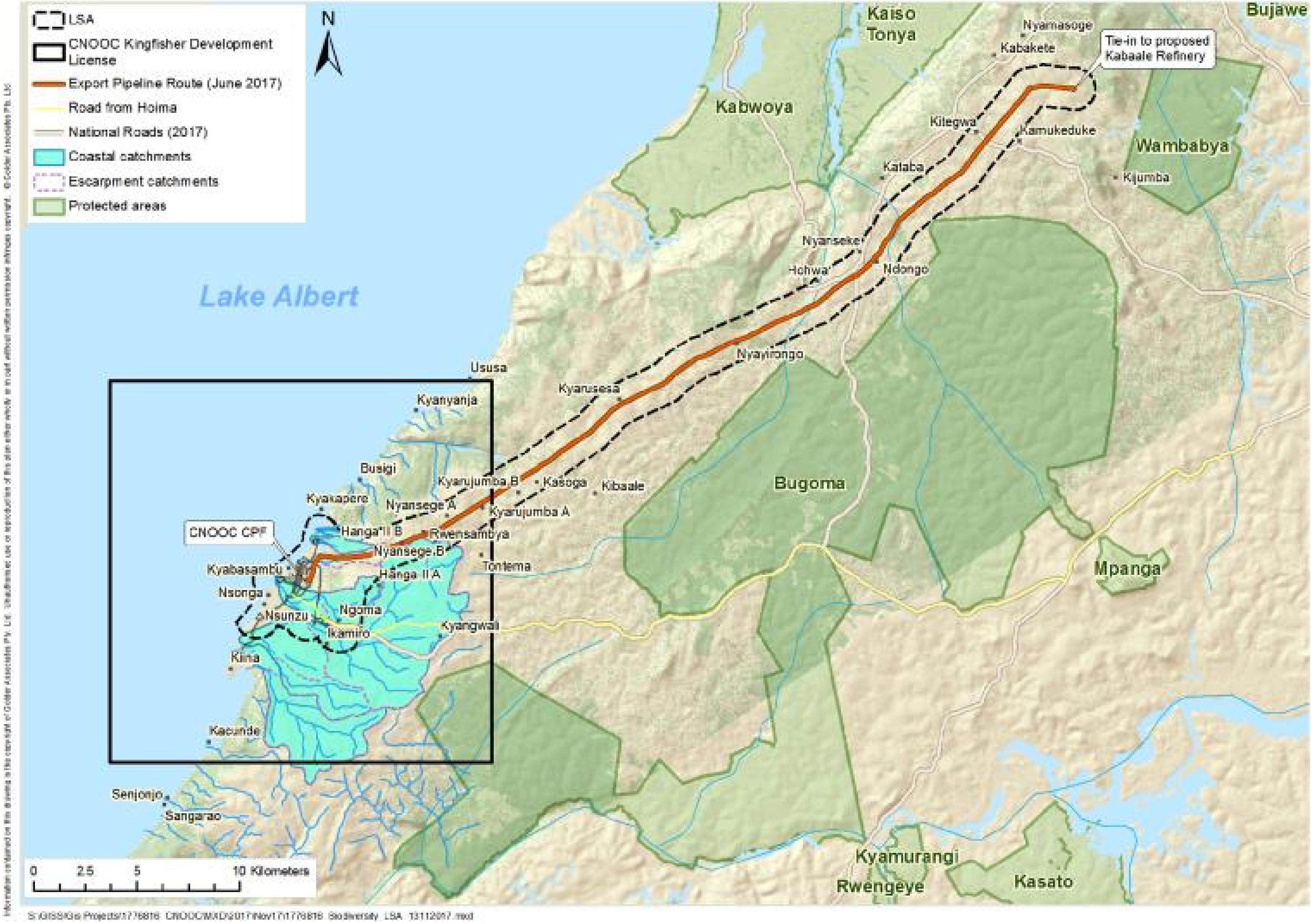


*Figure 1: Biodiversity LSA*

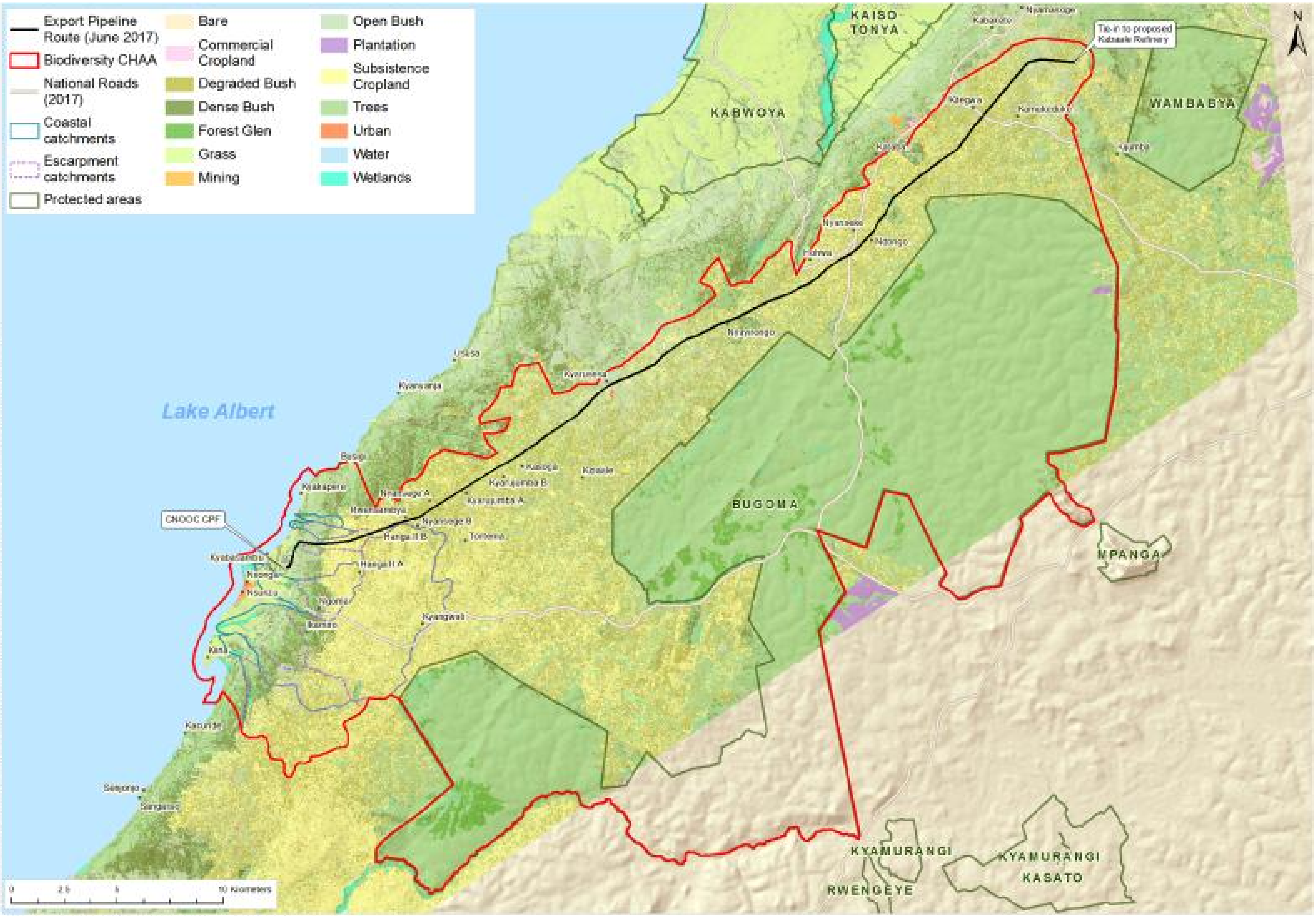


*Figure 2: Biodiversity CHAA*

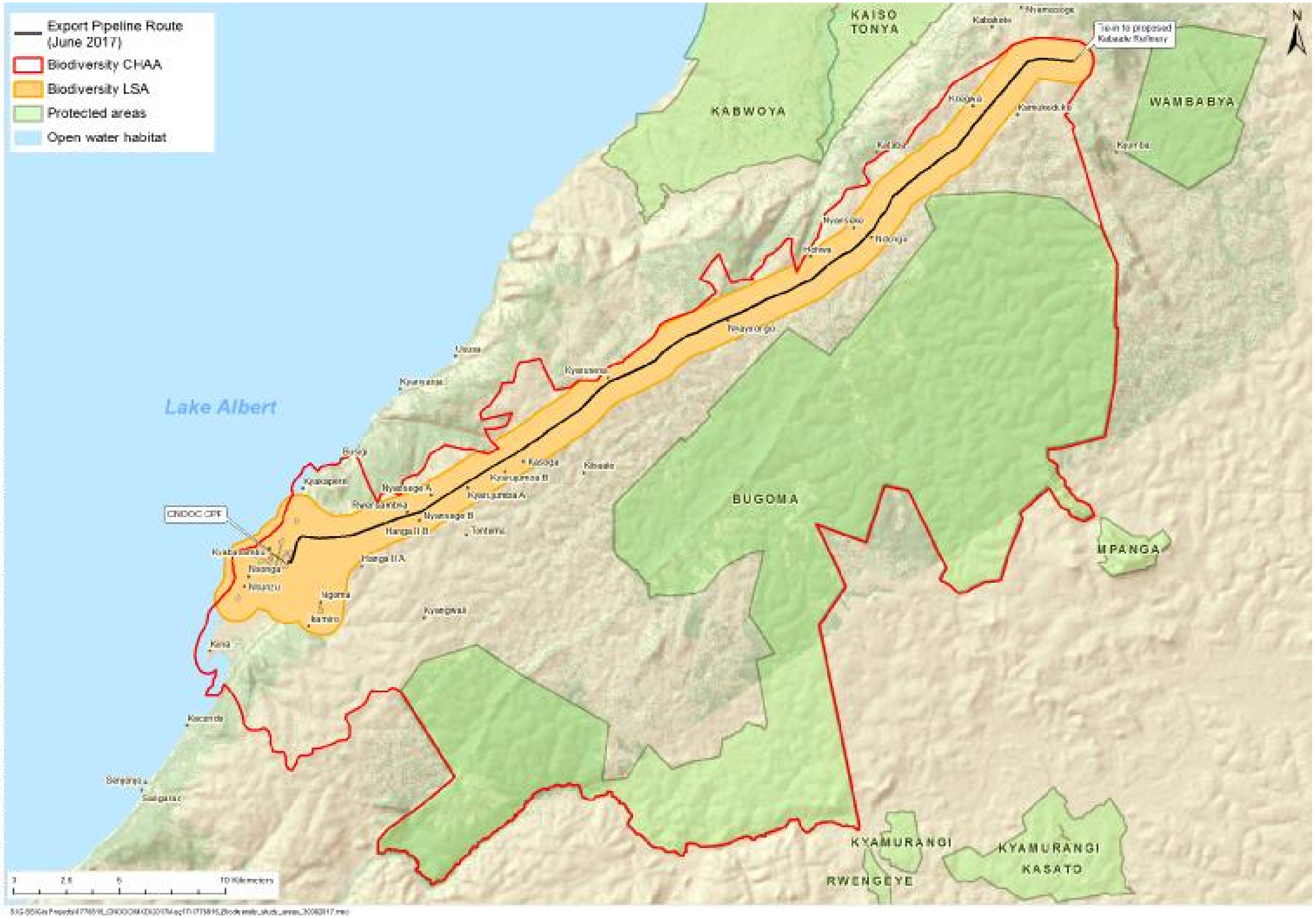


*Figure 3: Biodiversity LSA and CHAA*

## 3.2 Baseline

A baseline of the terrestrial and aquatic ecology of the LSA was determined through a desktop assessment and comprehensive, seasonal surveys. These assessments and surveys were then used as the basis for the description of the biodiversity of the CHAA. The approach and methods for those baseline surveys and derived studies are presented below. The detailed baseline study reports for the terrestrial and aquatic ecology are presented in Appendix C.

### 3.2.1 Terrestrial Biodiversity

In addition to a detailed review of existing literature and databases, multi-season surveys of the terrestrial ecology of fixed sampling locations within the LSA were completed to describe the baseline conditions. The field surveys focused on the Production Facility areas of the wells, central processing facility (CPF) and supporting infrastructure associated with the production facility including in-field access roads and flowlines, the upgraded jetty, the water abstraction station on Lake Albert, the permanent camp, the material yard (or 'supply base'), and the safety check station at the top of the escarpment; and the feeder line easement to Kabaale.

Seasonal variation in terrestrial ecology was assessed through multi-season surveys. The first field surveys captured the dry season, and occurred from 25 February 2014 to 8 March 2014. The second set captured the first wet season, and occurred from 28 May 2014 to 23 June 2014. The third set captured the second wet season, and occurred from 28 October to 20 November 2014.

The surveys focussed on:

- vegetation communities and flora species;
- invertebrates;
- reptiles and amphibians;
- birds; and
- mammals.

The methods of survey for each of these groups are summarised below, and presented in detail in the Appendices.

#### *3.2.1.1 Vegetation Communities and Flora Species*

A desktop search and review was made of available literature about the vegetation and flora of the CHAA, in particular the vegetation communities of the Albertine Graben, the escarpment and beyond, and the conservation status of species. Data sources included: Langdale-Brown et al. (1964); Plumptre et al. (2003, 2007); Kalema and Beentje (2012); and the IUCN's RedList (IUCN 2017). The data thus obtained were used to identify sampling and survey sites on satellite imagery for later ground-truthing during the field surveys. These data were also used to inform the assessment of the probability of species of concern occurring in the CHAA (see Section 3.3.3.2 Species of Concern).

Two-hundred-and-seventy-five sampling plots were identified for survey; in particular: on the Buhuka Flats, 13 line-transects were run, with 150 sample plots; on the escarpment, seven transects were run, with 40 sample plots; and along the pipeline route, 23 transects were run with 153 plots.

The precise locations of each of those plots are displayed in the baseline reports in Appendix C.

Areas of natural and modified vegetation were surveyed in the wet and dry seasons, with focus given to the main vegetation communities on the Buhuka Flats, the escarpment and along the pipeline route. Along the pipeline route, only relic patches of vegetation were selected for survey that were deemed natural or near-natural, because most of the area along the route is under cultivation and settlement. Sampling was undertaken based on the gradsects approach (after Gillison and Brewer 1985), taking into consideration the variation in such aspects as slope, observable indicators of soil moisture and soil type, as well as the plant community assemblages. All species of plants present were identified and recorded, and their relative abundance was assessed using the DAFOR scale (D = dominant, A = abundant, F = frequent, O = occasional, R = rare) (after Kent and Coker 1992). Azonal habitats believed to be unique within a given area were also sampled. These included such areas as shallow depressions, old termite mounds, drainage channels, and others. This sampling regime was chosen with a view of capturing as wide a range of the vegetation types and species in the area as possible (Gillison and Brewer 1985, Økland 1990, Austin and Heylingers 1989 in Wessels et al. 1998, de Blois et al. 2002).

The general vegetation type in each of the selected sites was characterised. This characterisation was based on the floristic and landscape features observed in the different habitat types. Dominant species of plants in the woody and herbaceous layers were identified and used for this purpose. The general terrain and proximity to important features, such as the lake or streams were noted. From this sampling, species of conservation concern and invasive species occurring in the area were identified and the geographical coordinates of their areas of occurrence recorded.

Specimens that could not be identified in the field were collected as vouchers for subsequent identification and deposition in the Makerere University Herbarium (MHU).

#### *3.2.1.2 Invertebrates*

Insects and other invertebrates dominate the terrestrial and aquatic ecosystems in terms of species richness, individual abundances and biomass (Wilson 1985, Stork 1988, Gaston, 1991). Their temporal and spatial distributions span the ranges occupied by many vertebrate and plant species, including finer-grained patch sizes and geographical distributions, more complex seasonal and successional sequences and patch dynamics with more rapid turnover (Gaston and Lawton 1988). Insects are also highly susceptible to the adverse effects of disturbance and land use change; this makes them useful as indicators of ecosystem change (Terborgh 1992).

Although insects and other invertebrates dominate the terrestrial and aquatic ecosystems, including the savannah and forest systems of the CHAA, and they are useful indictors, there are often severe limitations in terms of sampling and assessing the insect populations in biodiversity impact assessments. Of primary concern are the taxonomic restrictions for most invertebrate groups; specifically, the lack of a complete catalogue of knowledge of species, and the paucity of experts able to identify invertebrate taxa.

Although all species occurring in an area of interest are a component of overall ecological value, it is neither practicable, nor necessary, to assess potential effects of a project on every species that might be affected. This is particularly the case for most invertebrates, and lower plants (that is, bryophytes and pteridophytes), where, as mentioned, the taxonomy and ecology is often poorly established. As such, and in line with global conservation priority-setting, for this biodiversity impact assessment, vertebrates were largely used as a surrogate for all animal species, and vascular plants as a surrogate for all plants (Secretariat of the CBD, 2006). The selection was based upon a higher level of knowledge (ecology and conservation status) of these surrogates, and adopts the hypothesis that conditions which support restricted range vertebrates and/or vascular plants are likely to also support rare species of other taxonomic groups. Although this is an approximation of the likely situation, it provides manageable and meaningful conclusions.

Nevertheless, Uganda and the Albertine Graben are fortunate in that detailed taxonomy is available for some invertebrate groups. In particular, the butterflies (Order: Lepidoptera) and the dragonflies and damselflies (Order: Odonata).

Butterflies are known sensitive indicators of environmental change associated with natural and human-induced disturbances. Their populations are influenced by changes in local climatic conditions and the availability of host plants for larval and adult stages (Ehrlich et al. 1972, Thomas et al. 1998). Frequently disturbed environments are considered unstable and unpredictable and, as a result, have low species diversity, whereas less disturbed, more stable environments are expected to promote high species diversity (Odum 1985).

Dragonflies and damselflies utilise both aquatic and terrestrial habitats, and hence these groups can contribute greatly to the evaluation of environmental quality (Miller and Miller 2003). They are known to be very sensitive to structural habitat quality, and are used as indicator groups to evaluate landscape degradation.

Given their established taxonomy (*viz.*, Kielland (1990), Larsen (1991, 2005), Davenport (1996, 2003), Carder and Tindimubona (2002), Clausnitzer (2002), Miller and Miller (2003), and Picker et al. (2004), Molleman (2012), and the resources available at www.africa-dragonfly.net), a baseline of butterflies, dragonflies and damselflies was established for the LSA. The IUCN's RedList (IUCN 2014a) was consulted to establish a list of potential species with conservation significance, which informed the analysis of probability for these species to occur in the CHAA (see Section 3.3.3.2 Species of Concern).

Butterfly, dragonfly and damselfly surveys were carried out at 12 sites across the LSA in suitable habitat, including: locations corresponding to the various pieces of Project-related infrastructure on the Buhuka Flats, encompassing the stream and seasonally flooded wetland located near the airstrip, and the well pads; the lake shore of Lake Albert and the Bugoma Lagoon area; the lower reaches of the Masika River and the associated wetland; the escarpment; and along the pipeline route to the refinery area and Kabaale (which consists mainly of cultivated land, fairly degraded seasonal wetlands, riverine vegetation along Hohwa River and pockets of natural woodlands) (Appendix C, Table 2.1).

For butterflies, at each sampling site, survey methods employed included time- and distance-constrained sweep netting and baited traps (after Samways et al. 2010). Eighteen traps, baited with fermenting banana, were set along transect lines at each sampling location and left in place for two days. All specimens captured in the sweep nets and traps were identified in the field and released; only specimens with difficult identification were collected for further processing at Makerere University. Each of the butterfly species was assigned to one of the ecological categories as described by Davenport (1996); that is, forest-dependent species (F), forest edge/woodland species (f), open-habitat species (O), widespread species (W), migratory species (M), and wetland species (S).

Adult dragonflies and damselflies were sampled at each sampling site using time- and distance-constrained sweep netting (after Samways et al. 2010). In most instances, only mature males were sampled to minimise impacts on breeding populations. Familiar local species were recorded by observation only or by catch-and-release after confirmation. Voucher specimens were collected and preserved for further laboratory identification. Particular attention was given to the local habitat where the species were found.

### *3.2.1.3 Amphibians and Reptiles*

A desktop search and review was made of available literature about the reptiles and amphibians of the CHAA. Data and information sources included: Plumptre et al. (2003, 2005, 2007); RPS (2006); AWE (2008a, b, c, 2013a, b, 2014a, b); AECOM (2012); EACL (2013, 2014), IUCN (2017); and GBIF (2017). The data thus obtained were used to identify sampling and survey sites on satellite imagery for later investigation during the field surveys. These data were also used to inform the assessment of probability of species of concern occurring in the CHAA (see Section 3.3.3.2 Species of Concern).

Nineteen survey sites were selected across the LSA as a representative sample of habitats that could be affected by the Project development (Appendix C, Tab. 3.1, Fig. 3.1). Eight of these were surveyed for amphibians and reptiles, five exclusively for amphibian fauna, and six exclusively for reptilian fauna. A control site within Bugoma Forest Reserve was selected, because several sites surveyed along the pipeline route, outside the forest, were considered to be analogous with the habitats present within the forest, yet were severely degraded and under heavy cultivation. The reptile and amphibian species composition of the Bugoma Forest Reserve was expected to be close to the original composition, while that along most of the pipeline and refinery areas could constitute a mixture of a few forest and grassland generalists.

Visual encounter and opportunistic survey approaches (after Heyer et al. 1994, and McDiarmid et al. 2012) were the main methods employed at each sampling site during the survey. These methods are well-tested and robust methods for surveying reptiles and amphibians. Visual encounter surveys are time constrained and are effective for most amphibians in most habitats. The data gathered using this method provides information on species richness of a habitat, with the best results for amphibians achieved in the evening between 7 pm and 9 pm, when most amphibian species expected to occur in the CHAA (refer to Channing and Howell 2006) would be active. Opportunistic surveys recorded those species outside of the systematic sampling locations and times.

Species estimators (as species accumulation curves) were used to calculate the possible maximum number of species that could occur in the LSA. Four estimators: Chao 1, Chao 2, Jacknife 1, and Jacknife 2 were used (after Gotelli and Colwell 2011).

#### 3.2.1.4 Birds

Birds can represent a significant component of the biodiversity of an area, and they are ecologically versatile, representing herbivores, carnivores and omnivores, as such, they have been shown to be effective indicators of general biodiversity (Sutherland et al. 2004). They also lend themselves well to the identification of conservation priorities (Pain et al. 2005), and are a good indicator group for monitoring (Pearson 1994, Pearson and Carroll 1998).

A desktop search and review was made of available literature about the birds of the CHAA. Data and information sources included: Bennun and Njoroge (1996); Byaruhanga et al. (2001); Plumptre et al. (2003, 2007); RPS (2006); AWE (2008a, b, c, 2013a, b, 2014a, b); AECOM (2012); EACL (2013, 2014), IUCN (2017); and GBIF (2014; 2017). The data thus obtained were used to identify sampling and survey sites on satellite imagery for later investigation during the field surveys. These data were also used to inform the assessment of the probability that species of concern could occur in the CHAA (see Section 3.3.3.2 Species of Concern).

Birds, being highly mobile, tend to reflect the nature of larger areas rather than points within the landscape, except in instances where there are key nesting or roosting sites. Land birds and their habitats were generally surveyed along 2 km transects, each of ten 200 m sections (NatureUganda 2010). Each transect was predominantly within a single habitat, and collectively covered each of the main habitats in the LSA. Waterbirds and waders were recorded at fixed time-constrained, point-count sites (after Gregory et al. 2005). Data were recorded in a standard format, as used by Nature Uganda (2010) for the national bird monitoring programme. Field surveys were conducted during February, March, May, October and November 2014.

All birds were identified by sight (or sound) in the field, with taxonomy following Stevenson and Fanshawe (2002).

#### 3.2.1.5 Mammals

A desktop search and review was made of available literature about the mammal fauna of the CHAA. Data and information sources included: Kityo et al. (2003), Plumptre et al. (2003, 2005, 2007); RPS (2006); AWE (2008a, b, c, 2013a, b, 2014a, b); AECOM (2012); EACL (2013, 2014), IUCN (2017); and GBIF (2017). The data thus obtained were used to identify sampling and survey sites on satellite imagery for later investigation during the field surveys. These data were also used to inform the assessment of the probability that species of concern could occur in the CHAA (see Section 3.3.3.2 Species of Concern).

Standard survey methods, as described in Isabirye-Basuta and Kasenene (1987), Wilson et al. (1996), and Claustinitzer & Kityo (2001), were employed to sample the mammal fauna and their habitats in the LSA. Due to the paucity of large mammals in the LSA due to human disturbance (for example, see AWE (2008a, b, c, 2013a, b, 2014a, b)), intensive surveying was only conducted for small mammals.

In particular, rodents and insectivores (e.g. shrews) were surveyed using Sherman traps deployed in 11 trap lines of 40 traps each on the Buhuka Flats, and 80 traps each in the Bukona area. The trap lines were open for three to five days in the Buhuka Flats, two days in the Bukona area, and baited with a standard bait mixture (after Claustinitzer and Kityo (2001), Isabirye-Basuta and Kasenene (1987)). Traps were re-baited every evening, while checking, recovering and processing any captured animals completed in the morning. Bats were surveyed using mist nets, harp traps and acoustic methods (using the AnaBat II and SM2 bat detectors). Surveys started at dusk and continued until 10 pm on nights when this was possible. Surveys for large mammals were largely opportunistic, that is, tracks and signs (spoor or faecal material), observation, and informant interviews with local people. Informant interviews with local people were the main methods used along the pipeline route.

### 3.2.2 Aquatic Biodiversity

In addition to a detailed review of existing literature and databases, multi-season surveys of the aquatic ecology of fixed sampling locations within the LSA were completed to describe the baseline conditions. The field surveys focused on the near-shore zone of Lake Albert opposite the well pads (that is, Pad 1, Pad 2, Pad 3, Pad 4A, the upgraded jetty, the water abstraction station on Lake Albert), and the general Kingfisher Development area (that is, the wells, CPF and supporting infrastructure associated with the production facility including in-field access roads and flowlines, the permanent camp, and the material yard (or 'supply base'). Watercourses and wetlands of the Buhuka Flats were sampled, including the Masika River (upper, mid and lower reaches and wetland), the Kamansinig River[1] (upper, mid (airfield wetland) and lower reaches, including the lagoon), and Well Pad 2 stream[2].

Seasonal variation in aquatic ecology was assessed through multi-season surveys. As mentioned above, the region of the CHAA experiences two wet seasons . The first field surveys captured the dry season, and occurred from 23 February to 8 March 2014. The second set of field surveys captured the wet season, and occurred from 23 to 28 May 2014. The third set of surveys captured the second wet season, and occurred from 15 to 20 November 2014.

The surveys focussed on Lake Albert and the watercourses and wetlands, and included:

- water quality;
- phytoplankton;
- zooplankton;
- macro-invertebrates; and
- fish.

The precise methods of survey for each of these groups are summarised below, and presented in detail in Appendix D.

### 3.2.2.1 Water Quality

Data for studies on lake water quality were collected at two fixed sites on each of five transects of 2 km length (from the shore lake-ward) opposite each of the five well pads. Samples from each transect were collected at about 10 m from the shoreline (inshore) and at the end of the transect, 2 km from shore (offshore).

In the Bugoma Lagoon, the samples were taken about 10 m from the shore and at a point approximately midway across the lagoon. Within the other wetlands associated with Kamansinig River, Masika River and Well Pad 2 stream, samples were collected in the water column.

For each transect and sampled site, the following physical characteristics were recorded: shoreline topography; soil type; vegetation cover; water depth, nature of bottom sediments and GPS location.

Water quality samples were collected using a 5 L van Dorn sampler from a depth of ~50 cm. In-situ and laboratory physical and chemical parameters were recorded at each sampling location. In-situ parameters included: dissolved oxygen ($mg.L^{-1}$), temperature ($^{o}C$), pH and conductivity ($\mu S.cm^{-1}$) as measured using a Hach HQ40d Multiprobe. Laboratory-determined parameters included: ammonia-nitrogen and nitrate-nitrogen; ortho-phosphate; total phosphorus (TP); total nitrogen (TN); soluble reactive silica; chlorophyll a; and faecal coliform.

### 3.2.2.2 Phytoplankton and Macrophytes

Data for studies on phytoplankton were collected at two fixed sites on each of the five transects of 2 km length (from the shore lake-ward). Samples from each transect were collected at about 10 m from the shoreline (inshore) and at the end of the transect, 2 km from shore (offshore).

In the Masika and Kamansinig Rivers, phytoplankton samples were collected mid-stream in the upper, mid and lower reaches. In the Bugoma Lagoon, which is in the lower reaches of the Kamansinig River, the samples

[1] This watercourse is referred to as the Airfield Stream in the baseline studies.

[2] This stream is not formally named on any maps; it drains off the escarpment and flows to the immediate south the

were taken about 10 m from the shore and at a point approximately midway across the lagoon. Macrophytes were assessed in conjunction with the vegetation and flora assessments, and focused on major vegetation formations and the extent of surface water flows.

Twenty millilitres of water were sampled at each location from a depth of ~50 cm. Each sample was fixed with Lugol's solution (Utermöhl 1958), and stored away from light (Wetzel and Likens 2000). The sedimentation method of Utermöhl (1958) was used to count the phytoplankton under an inverted microscope, while taxonomic identification was made with the help of Komarek and Anagnostidis (1999) and John et al. (2002).

#### 3.2.2.3 Zooplankton

Data for studies on zooplankton were collected at two fixed sites on each of five transects of 2 km length (from the shore lake-ward). Samples from each transect were collected at about 10 m from the shoreline (inshore) and at the end of the transect, 2 km from shore (offshore).

In the Masika and Kamansinig Rivers, samples were collected mid-stream in the upper, mid and lower reaches. In the Bugoma Lagoon, which is in the lower reaches of the Kamansinig River, the samples were taken about 10 m from the shore and at a point approximately midway across the lagoon.

Vertical zooplankton hauls were taken from ~50 cm above the bottom sediments to the surface using a conical net of 0.25 m mouth opening and 60 µm mesh. Three hauls were taken to make a composite sample for each site, which was preserved with 4% sugar-formalin solution. In the laboratory, samples were identified based on published keys (*viz.*, Rutner-Kolisko 1974, Brooks 1957, Pennak 1953, Sars 1985).

#### 3.2.2.4 Macro-invertebrates

A desktop search and review was made of available literature about the macro-invertebrate fauna of the CHAA. Data and information sources included: AECOM (2012), IUCN (2017); and GBIF (2014, 2017). The data thus obtained were used to guide sampling and survey sites on satellite imagery for later investigation during the field surveys. These data were also used to inform the assessment of the probability that species of concern could occur in the CHAA (see Section 3.3.3.2 Species of Concern).

Data for studies on macro-invertebrates were collected at two fixed sites on each of five transects of 2 km length (from the shore lake-ward). Samples from each transect were collected at about 10 m from the shoreline (inshore) and at the end of the transect, 2 km from shore (offshore).

In the Masika and Kamansinig Rivers, samples were collected mid-stream in the upper, mid and lower reaches. In the Bugoma Lagoon, which is in the lower reaches of the Kamansinig River, the samples were taken about 10 m from the shore and at a point approximately midway across the lagoon.

In Lake Albert, at each sampling site, composite, triplicate sediment samples were collected using a Ponar grab sampler (after APHA 1992). The physical characteristics (for example, soft mud, sandy, stony, etc.) were noted for each composite sample. The samples were processed in the laboratory according to published methods (that is, APHA 1992, Ferraro and Cole 1992, Ochieng 2006, and Ochieng et al. 2008) in order to sort, identify and quantify the macro-invertebrates. Identification was undertaken based on Mandal-Barth (1954), Merrit and Cummins (1984), and de Moor et al. (2003).

Three indices, namely: EPT (Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddis flies)) taxa richness; total taxa richness; and abundance of macro-invertebrate individuals (after Wenn 2008, Oghenekaro 2011) were determined and used for a description of macro-invertebrate status as indicators of environmental quality. EPT taxa are considered the least tolerant of pollution (for example, organic pollution) and, therefore, aquatic environments with the presence of a high richness of EPT taxa, are regarded to be of good quality. Total taxa richness refers to the total number of all macro-invertebrate taxa (for example, genera) in a sample, with a higher taxa richness having better environmental quality. Based on the works of Wenn (2008), samples with: an EPT score of two to three, and total taxa score of ten to 12, are considered to be indicative of moderate to good environmental conditions; those with EPT scores of one, and total taxa scores between five and 10, were considered to be indicative of fair environmental conditions; while those with EPT scores of zero and varying total taxa scores of one to seven, were considered to be of poor environmental condition.

#### 3.2.2.5 Fish

Data for studies on fish were collected at two fixed sites on each of five transects of 2 km length (from the shore lake-ward). Samples from each transect were collected at about 10 m from the shoreline (inshore) and at the end of the transect, 2 km from shore (offshore).

In the Masika and Kamansinig Rivers, samples were collected mid-stream in the upper, mid and lower reaches. In the Bugoma Lagoon, which is in the lower reaches of the Kamansinig River, the samples were taken about 10 m from the shore and at a point approximately midway across the lagoon.

Data were obtained using multifilament gillnets, set perpendicular to the shore, ranging from 1 to 6 inches, increasing by ½ inch increments. Gillnets were set in the evening and hauled at dawn. On retrieval, fish species were identified using Greenwood (1966) and morphometrics (length, weight, and sexual maturity) recorded. Gut content and diet of individuals was determined in the laboratory. Species composition, relative abundance, population structure and relative condition were calculated from the catch statistics.

### 3.2.3 Overall Biodiversity Value

Biodiversity value is a term used by the IFC in PS6 *Biodiversity Conservation and Sustainable Management of Living Natural Resources* (IFC 2012a, 2012b), as well as by a number of other industry bodies; for example, The Energy and Biodiversity Initiative (EBI 2014), and the International Council on Mining and Metals (ICMM) (ICMM 2010). Those publications, together with the CBD's *Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment* (Secretariat of the CBD, 2006), are recognised as standards of good practice for biodiversity impact assessment. Biodiversity values represent components of biodiversity at various levels of biological organisation, such as species or ecosystems that are important for conservation. Those values are reflected in CNOOC's corporate philosophy towards biodiversity conservation (see CNOOC 2014a, b).

To focus in on the key issues relating to biodiversity, as identified by stakeholders, the stakeholder's values placed on components of the biodiversity in the CHAA, and the potential risks posed to those biodiversity values by the Project, the concept of valued components was used. Valued components are physical, biological, economic, social, cultural, and health properties of the environment that are considered important by the proponent, public, government agencies, and/or the scientists involved in the assessment process (that is, the stakeholders) (Treweek 1999). These valued components identified and described during the baseline then become the focus for the impact assessment. In terms of the biodiversity of the CHAA, valued components are defined as the elements of an ecosystem that are identified as having scientific, social, cultural, economic, or aesthetic importance.

The biodiversity baseline concentrated on identifying two levels of biodiversity valued component in the CHAA, which are akin to the requirements of IFC PS6 (IFC 2012a) and the Secretariat of the CBD (CBD 2006); *viz.*: ecosystems and habitat and species of concern. It also describes the direct and indirect drivers of change to those values. In particular:

c) The ecosystem and habitats level:

This focussed on the broad description and identification of natural and modified terrestrial and aquatic ecosystems and habitat and critical habitat in the CHAA, and the direct and indirect drivers of change to those ecosystems and habitats at the spatial and temporal scale, and the processes and functions that drive those ecosystems and habitats; particularly, the integrity of those systems.

d) The species level:

The focus was on populations of species of concern; in particular, species of high value to people. These species included, amongst others: species of high conservation concern, as gazetted under Ugandan legislation, and the IUCN's Red List (IUCN 2014a); culturally important species; and invasive species.

The assessment of ecosystem services, often seen as a third component of biodiversity, is covered in.

#### 3.2.3.1 Ecosystems and Habitats of Concern

The intrinsic values of ecosystem functions and processes, and habitats, supported in the CHAA were assessed on two levels: ecosystem integrity and priority habitat (including critical habitat). The methods used for each of these are discussed below.

The assessment of ecosystem integrity broadly followed the guidance provided by the CBD's *Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment* (Secretariat of the CBD 2006) and Treweek (1999). For the identification and assessment of priority habitats, natural and modified habitats were identified initially based on remote imagery, then verified with field data. For critical habitat, the IFC's approach was followed (refer to IFC PS6 (IFC 2012a, b)).

These guidance documents are complementary, and are recognised as a leading-practice approach for the assessment of impacts to biodiversity through a focus on the protection and conservation of biodiversity values of key conservation concern.

##### 3.2.3.1.1 Ecosystem Integrity

Ecological integrity refers to the abundance and distribution of species and the ecological patterns and processes that maintain biological diversity and ensure ecosystem resilience (Woodley et al. 1993). The major ecosystems and habitat types within the CHAA were initially identified at the desktop level based on the works by: RPS (2006); AWE (2008a, b, c, 2013a, b, 2014a, b); AECOM (2012); EACL (2013, 2014); as well as a land cover assessment undertaken based on SPOT6 data (Appendix E). Thereafter, those ecosystems and habitats were confirmed by field verification undertaken during the terrestrial and aquatic field studies (see Section 3.3.1 and 3.3.2 respectively).

The area of each ecosystem and habitat was determined based on the land cover assessment data built on the SPOT6 and aerial imagery data analysis, and the mapping of communities done during the terrestrial ecology field surveys. A quantitative and qualitative assessment of the integrity of each of the identified ecosystems and habitats was determined from field data (see Appendix C and D). For the purposes of this impact assessment, the integrity of the ecosystems was determined based on the following criteria (after: Kent and Coker 1992, Treweek 1999, Tucker 2005, Secretariat of the CBD 2006):

- Composition

  Diversity and complexity - what is there and how abundant (in a particular time frame) it is.

- Structure (or pattern)

  How biological units are organised in time and space. Ecosystem 'scale' refers to the space it occupies and the way it changes over time. The structure and interactions that shape the flow of energy and the distribution of biomass.

- Linkages and corridors

  To habitat of the same or different ecosystems, which provide an important 'playing field' for ecological processes and enable the goal of their persistence. These linkages are in contrast to a highly-fragmented landscape where patches of natural habitat are effectively isolated.

- Key processes (including ecosystem function)

  Which natural (that is, physical and/or biological) and/or human-induced processes are of key importance for the creation and/or maintenance of ecosystems. These are termed drivers of change, and include direct and indirect drivers. Examples of direct drivers include: changes in land use and land cover; fragmentation and isolation; extraction, harvest, or removal of species; external inputs such as emissions, effluents, chemicals; disturbance; introduction of invasive, alien and/or genetically modified species; and restoration. Examples of indirect drivers of change include: demographic; economic; socio-political; cultural; and technological processes or interventions.

- Representativeness in the landscape.

The uniqueness of the ecosystems within the CHAA and the wider landscape; this rarity factor is related to the concepts of irreplaceability and vulnerability. The concept of irreplaceability relates to rarity or uniqueness in the landscape, while vulnerability refers to degree of threat (for more detailed definitions, see Section 3.3.3.1.2).

- Resilience and stability

  The ability of the ecosystem to absorb change and persist, and maintain the same form.

Based on the assessment of these criteria, the condition of the ecosystems and habitats was estimated and assigned a subjective class, that is, pristine, near-pristine, slightly-degraded, moderately-degraded, heavily-degraded.

Two key drivers for this condition designation were: to aid in the identification of modified and natural habitat (see below), and the IFC's requirement of no net loss of natural habitats within the LSA (IFC 2012a); and the philosophy of net positive impact (NPI) in areas of critical habitat (IFC 2012a, see below). Where NPI is primarily measured in terms of quality hectares, which can be determined as a derivative of the area of an ecosystem multiplied by the condition of different habitat types.

### *3.2.3.2 Species of Concern*

Although all species occurring in an area of interest are a component of overall biodiversity and ecological value, it is neither practicable, nor necessary, to assess potential effects of a project on every species that might be affected. This is particularly the case for most invertebrates and lower plants (that is, bryophytes and pteridophytes) where the taxonomy and ecology is often poorly established. As such, and in line with global conservation priority setting, terrestrial and aquatic vertebrates and selected invertebrates were used as a surrogate for all animal species, and vascular plants as a surrogate for all plants (Secretariat of the CBD, 2006). The selection was based upon a higher level of knowledge (that is, ecology and conservation status) of these surrogates, and adopts the hypothesis that conditions that support restricted-range vertebrates and selected invertebrates, and/or vascular plants, are also likely to support species of other taxonomic groups, including rare and threatened species. Although this is an approximation of the likely situation, it provides manageable and meaningful conclusions.

For the intents of this biodiversity impact assessment, a species of concern was defined as a plant or animal species that requires special conservation consideration based on certain characteristics, or one which may be particularly sensitive to Project effects. Those characteristics were then used to gauge the sensitivity of the particular species to the development, and how best to manage those sensitivities as part of the development.

The following selection criteria were used to screen and identify terrestrial and aquatic species of concern for the assessment, which are in line with the criteria for critical habitat designations (IFC 2012a):

a) Threatened and restricted-range/endemic species (Criteria 1 and 2).

b) Statutory species (national/international legislation, agreements, conventions) (Criteria 1, 2 and 3).

c) Species of economic and/or cultural importance (Criteria 5 and 13).

d) Convention on the International Trade in Endangered Species (CITES)-listed species (Criterion 1, 2 and 3).

e) Evolutionarily distinct species (Criterion 5)

f) Species that play a critical ecological role, represent guilds of species, or capture effects to other species with similar habitat requirements and sensitivities (Criterion 10).

g) Invasive or potentially invasive species.

The determination of which level the species of concern was placed at, was used for determining the level of sensitivity of the particular species. A similar approach was used for assessing the sensitivity of the valued components. As an example,

- A species of concern with a moderate sensitivity could be one that is a regional endemic, a species whose distribution is significantly reduced from former extent but currently stable.
- A species of concern with a very high sensitivity may have an IUCN status of critically endangered or endangered, a local endemic, or its range is restricted to the CHAA. Or local temporal concentrations of individuals significant to global population, or much reduced and/or highly fragmented species distribution compared to its former extent, or ecosystem representation whose presence or processes support critically endangered or endangered species' habitat, or buffers it, keystone species, and/or species new to science.

The identification of a list of potential species of concern for the CHAA was determined from the species lists and known distribution records contained in: AECOM (2012, 2013); AWE (2008a, b, 2013a, b, 2014a, b); Emerton and Muramira (1999); GBIF (2017); Lamprey (2009); NEMA (2010); Plumptre et al. (2003, 2007, 2010, 2011); and the findings of the field surveys (see Appendix C and D). For those species where actual records of occurrence did not exist, yet were identified as potentially occurring in the area (based on habitat preferences and knowledge of the species), inferred distributions were derived from: Kalema and Beentje (2012) (plants); Mandahl-Barth (1954) (freshwater molluscs); Greenwood (1966) (fish); Carder and Tindimubona (2002), Davenport (2003) (butterflies); Miller and Miller (2003) (Odonata); Channing and Howell (2006) (amphibians); Spawls et al. (2004) (reptiles); Stevenson and Fanshawe (2002) (birds); and Butynski et al. (2013), Happold (2013), Happold and Happold (2013), Kingdon and Hoffman (2013a, b), Kingdon et al. (2013) (mammals).

It is recognised that some species of concern would not actually occur in the CHAA for various reasons, such as unsuitable habitat. Therefore, a screening of the probability of the various species of concern actually occurring in the CHAA was determined through a probability analysis based on:

- Knowledge and experience of the CHAA, and the wider area, as determined based on observations made during the Scoping Study (Golder Associates 2014c).
- Findings of previous studies and published scientific literature.
- Species records stored in the GBIF (2017).
- Knowledge of the life histories of the species, habitat preferences, and known ecological requirements as determined through published information and information presented in the species profiles on the IUCN's Red List (IUCN 2017).
- Consultation with experts and professional judgement and experience of the assessors.

Three levels of probability were used: possible, probable and unlikely. These were defined as:

e) Possible: the species may occur in the CHAA, or move through the CHAA (in the case of migratory and highly mobile species) due to potential habitat and/or resources.

f) Probable: the species is likely to occur in the CHAA due to suitable habitat and resources being present, and/or known records from the CHAA.

g) Unlikely: the species will not likely occur in the CHAA due to lack of suitable habitat and resources.

The probability assessment was used as the starting point for the screening of species of concern to occur in the CHAA as per the criteria set out above. Only those species with a possible and probable likelihood of occurrence within the CHAA were considered for inclusion in the valued component assessment. Nevertheless, the other species were not ignored; rather, it was assumed that the species chosen could act as proxies for many of the other species, should they occur, however remote the possibility. As such, a precautionary approach was adopted where there was an uncertainty that a species could potentially occur in the CHAA.

#### 3.2.3.3 IFC Priority Habitat

Under the IFC's approach (see IFC 2012b), three classes of habitat are used to assign value to biodiversity: modified habitat; natural habitat; and critical habitat. Modified habitats are found in areas that have been altered by human activity and may contain large portions of non-native plants and animals. Examples include agricultural landscapes and reclaimed areas (IFC 2012b). Modified habitats may or may not retain ecological functions that support significant biodiversity value. Natural habitats are those where the species composition and primary ecological functions of the area have not been fundamentally altered by human activity (IFC 2012b). The definition of "fundamentally altered" is undertaken on a case-by-case basis; however, for the intents of this biodiversity impact assessment, natural habitats were defined as those habitats where the key processes, composition, and structure were largely intact. Critical habitats are a subset of either modified or natural habitats that constitute areas of significant importance for biodiversity conservation. The identification of natural, modified and critical habitat is discussed below.

Different mitigation standards are recognised for development occurring in each of the three habitat classes. Consequently, identifying the types of habitat that might be affected by a development project is a central aspect of understanding baseline conditions.

##### 3.2.3.3.1 Natural and Modified Habitat

As mentioned in Section 3.3.1, the identification of modified and natural habitats was initially based on secondary data sources using SPOT6 imagery as a basis. Although it is recognised that the modified and natural components of particular ecosystems and habitats within land cover classes cannot be accurately determined directly from spectral classes, using SPOT6 data does provide a very good indication of modified and natural habitats. For more information on the approach and methods for the determination of land cover, see Appendix E. Following that initial land cover assessment, each land cover class was assigned to the natural or modified categories, as per the IFC's criteria (see IFC 2012b), as relevant to the CHAA, and based on initial observations made during the scoping visit (Golder Associates 2014c). Areas within protected and managed areas (for example, Central Forest Reserves) were automatically assumed to be natural habitat, as were the near-shore (that is, within 1 km of the shore) environments of Lake Albert. These classes were then refined using the data collected as part of the terrestrial and aquatic ecology baseline studies (see Appendix C and D).

##### 3.2.3.3.2 Critical Habitat

The identification and assessment of critical habitat followed the approach defined by the IFC (refer to IFC PS6 (IFC, 2012a, b)). The IFC's PS6 uses the concept of critical habitat as an important means to identify biodiversity values of key conservation concern. The purpose of defining critical habitat is to identify areas of a particularly sensitive nature that deserve special attention for avoidance and may require supplementary mitigations, including offsetting.

The IFC's critical habitat concept considers and expands on a variety of pre-existing ideas and definitions of priority sites for biodiversity conservation; for example: Key Biodiversity Areas (IUCN 2010); Endemic Bird Areas and Important Bird Areas (BirdLife International 1998); Alliance for Zero Extinction sites (AZE 2010); World Heritage Sites (UNESCO 2014); and Ramsar Convention on wetlands of international importance (Ramsar 2014). This approach is also supported by a broad array of conservation organisations, and is increasingly accepted and applied by a variety of private companies (as developers) and financial institutions (the Equator Principles Banks as lenders).

As mentioned, critical habitats are a subset of either modified or natural habitats that constitute areas of significant importance for biodiversity conservation. For a development to occur in a critical habitat, the IFC requires that the following criteria are met:

- No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical.
- The project does not lead to measurable, irreversible and adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological process supporting those biodiversity values.

- The project does not lead to a net reduction in the global and/or national/regional population of any species of concern, for which critical habitat was identified in the CHAA, over a reasonable period of time.
- A robust, appropriately-designed, and long-term biodiversity monitoring and evaluation programme is integrated into the project's management programme to achieve net gain or net positive impact (NPI).

If these conditions can be met, it is reasonable that a mitigation strategy can be designed to achieve net gains, over a reasonable period of time, for the biodiversity values for which the critical habitat has been designated; that is, a no net loss in natural habitat and NPI philosophy in critical habitat. Consequently, projects proposed in areas containing critical habitat face challenges not faced by projects in natural or modified habitats that are not classified as critical.

Critical habitat was identified by delineating spatial units of analysis (DMUs), screening biodiversity features (that is, at the species, ecosystem and landscape scales), and evaluating the distribution of critical habitat in the CHAA. For a detailed discussion of the methods and approach used, see Appendix B.

## 3.3 Impact Assessment

The impact assessment process identifies the magnitude of a particular impact from the project and then compares that magnitude with the sensitivity of the receiving environment to derive an overall significance for the impact. This method relies on a detailed description of both the impact and the biodiversity valued component that is the receptor. The magnitude of an impact depends on its characteristics, which may include such factors as its duration, reversibility, area of extent, and nature in terms of whether positive, negative, direct, indirect or cumulative.

### 3.3.1 Key Questions and Indicators

One of the main purposes of an impact assessment is to provide answers to questions that people have about how a project could affect something that matters to them, such as a valued component. To focus this assessment and ensure that the impact assessment clearly addressed the key issues raised by the stakeholders (see Section 3.1), and the objectives set for this impact assessment (see Section 2.1), questions were formulated that captured the concerns relative to a particular issue. In this report, those concerns are expressed as 'key questions', and they form the basis of the investigations of potential effects and impacts of the Project.

Two key questions were established:

3) **What effect could the Project have on habitats and ecosystem integrity?**

4) **What effect could the Project have on species of concern?**

Under each of these key questions, sub-questions were developed that focused on the specific phases of the Project, in particular, the construction, operation and decommissioning phase.

Indicators for the impact assessment were selected to assess the level of potential impact. Changes to the indicators were analysed to determine the effectiveness of the mitigation hierarchy, and identify Project constraints and opportunities for additional avoidance and mitigation. Indicators and context for impact assessment are outlined for the key questions and associated valued components in Table 1.

**Table 1: Key questions and indicators**

| Key Question | Valued Component | Indicator | Indicator Description | Context |
|---|---|---|---|---|
| What effect could the Project have on habitats and ecosystem integrity? | Ecosystem integrity<br><br>Priority habitat | - regional representative-ness | The uniqueness of an ecosystem or habitat in the CHAA and wider landscape. This rarity factor is related to the concepts of irreplaceability and vulnerability. | The persistence of species of concern in the CHAA and wider area.<br><br>Maintain the distribution and |

| Key Question | Valued Component | Indicator | Indicator Description | Context |
|---|---|---|---|---|
| | | • changes in soil, water flows and quality, and vegetation | Drivers of change affecting key processes | abundance of species of concern such that self-sustaining and ecologically effective populations can be maintained.<br><br>Achieve net gains for species of concern for which critical habitat is affected by the proposed Project, and at least no net loss for all other valued components.<br><br>Maintenance of ecosystem processes and functions and connectivity. |
| | | • ecosystem composition | The diversity and complexity of an ecosystem or habitat – what is there and how abundant. Relates to species composition and abundance – keystone species are of particular relevance; changes in populations of these species have greater impacts on ecosystems than would be expected from its relative abundance or total biomass | |
| | | • ecosystem configuration | The structure or pattern of an ecosystem: the spatial structure and scale of the ecosystem in relation to the scale of the human intervention; food-web structure and interactions that shape the flow of energy and the distribution of biomass (relates to changes in food-web, e.g. those caused by introduction of invasive species); linkages and corridors to habitat of the same or different ecosystems | |
| What effect could the Project have on species of concern? | All species of concern | • habitat quantity and quality | The extent and integrity of preferred foraging and breeding habitat | |
| | | • habitat connectivity | Connectivity to adjacent areas of suitable habitat and potential for dispersal | |
| | | • abundance and distribution | Expected vs actual population numbers and distribution | |
| | | • survival and reproduction | Likelihood of continued survival/reproduction compared to baseline | |

Valued components were assessed in the context of maintaining self-sustaining and ecologically effective populations (or sub-populations) (in the case of species of concern), or a functioning and resilient ecosystem, at the scale of the CHAA. A self-sustaining population is one that will be maintained into the future with a low risk of loss (that is, extirpation). Long-term population persistence is the outcome of maintaining self-sustaining, ecologically effective populations, and population persistence is frequently applied as a conservation target by conservation biologists and resource managers (Ruggiero et al. 1994, With and Crist 1995, Fahrig 2001, Nicholson et al. 2006).

Maintaining self-sustaining and ecologically effective populations often will result in the protection of the ecological services humans benefit from when ecosystems are functional. Such benefits include the continued opportunity for consumptive and non-consumptive use of non-timber forest products by people that value those resources as part of their culture and livelihood (Hooper et al. 2005). For more information on the assessment of impacts to ecosystem services, see the Ecosystem Services Review.

### 3.3.2 Impact Assessment

Key questions were answered using a two-step process. Firstly, an overall written analysis, also known as a reasoned narrative, identified the indicators used for the assessment, and walks the reader through the logic of the assessment and the conclusions reached. Secondly, a formal impact classification was applied.

For a detailed explanation of the approach and method used for the reasoned narrative and the impact classifications, see Appendix F.

## 3.4 Limitations

This biodiversity impact assessment has been undertaken based on historical data and field surveys focusing on the current extent of the proposed Project. Any subsequent design changes and or alterations may require new surveys to be conducted (for example, if infrastructure layout is changed and extended beyond the current CHAA). Additionally, this biodiversity impact assessment should be read with the following limitations in mind:

- In a few instances, access limited the areas that could be sampled during the terrestrial ecology field campaigns. The escarpment area, for example, was extremely steep in many places and it was not practical to access some of the natural habitats.
- Comprehensive field trapping and sampling programmes were limited in many instances due to theft and/or vandalism of traps. Therefore, multiple-trap-night surveys were not always able to be employed, nor were trapping regimes for reptiles and small mammals.
- A dedicated assessment of the migratory species of bird in the CHAA has not yet been completed. A survey needs to be completed in late September or October to assess the importance of the area for migrants.
- The selection of species of interest for the impact assessment was based on the level of knowledge (that is, ecology and conservation status) of the species to act as surrogates for all species in the area, and adopts the hypothesis that conditions which support restricted range vertebrates and/or vascular plants are likely to also support rare species of other taxonomic groups.

Despite these limitations to baseline data, the conclusions contained within this report are based upon a robust and transparent procedure, and represent an accurate evaluation and assessment of likely impacts.

Your attention is also drawn to Appendix A of this report for further limitations.

# 4.0 RELEVANT LEGISLATION

This chapter presents a summary of Ugandan national legislation, associated regulations and policies that are pertinent to biodiversity, to assist and guide the ESIA. It describes international conventions and regional frameworks to which Uganda is a signatory; and also includes a summary of the international standards and guidelines that represent good industry practise, to which CNOOC wishes to adhere. Publicly available documents, and reports supplied by CNOOC were used to compile this review.

## 4.1 Uganda's Policy, Legal and Institutional Framework on Biodiversity

### 4.1.1 The Constitution of the Republic of Uganda (1995)

The over-arching government policy on natural resource conservation in Uganda is provided for in the Constitution of the Republic of Uganda. The relevant constitutional provisions in the National Objectives and Directive Principles of State Policy include the following:

- **Principles of State Policy XXVII (iv)**: mandates the State (both central and local government) to create and develop parks, reserves and recreational areas, and to ensure conservation and promote the rational use of natural resources so as to safeguard and protect the bio diversity of Uganda.
- **Article 237 (2) (b)**: the Government or local government, as determined by Parliament by law, shall hold in trust for the people and protect, natural lakes, rivers, wetlands, forest reserves, game reserves, national parks and any land, to be reserved for ecological and touristic purposes for the common good of all citizens.
- **Article 245**: the utilisation of natural resources of Uganda shall be undertaken in such a way as to meet the development and environmental needs of present and future generations of Ugandans and, in particular, the State shall take all possible measures to prevent or minimise damage and destruction to land, air and water resources resulting from pollution and other causes.

### 4.1.2 Uganda Wildlife Bill (2017)

The primary objectives of the Uganda Wildlife Bill are to provide for the conservation and sustainable management of wildlife, to strengthen wildlife conservation and management; to continue the Uganda Wildlife Authority; and to streamlines roles and responsibilities for institutions involved in wildlife conservation and management.

The Bill re-aligns the Uganda Wildlife Act Cap. 200 with the 2014 Uganda Wildlife Policy, the Oil and Gas policy and laws, the Land use policy and law, the National Environment Act, the Uganda Wildlife Education Centre Act, the Uganda Wildlife Research and Training Institute Act and all other laws of Uganda and developments which came into force after the enactment of the Uganda Wildlife Act in 1996.

For the first time, nationally-protected species were declared in the 2017 Uganda Wildlife Bill. Wildlife species listed in the Third Schedule of Act V are protected species in Uganda, in addition Act V states that wildlife species protected under any international convention or treaty to which Uganda is a part (and to which the regulations set out in section 86 applies), are protected species.

#### *4.1.2.1 Uganda Wildlife Act (1996)*

The Uganda Wildlife Act defines two types of conservation areas: "wildlife protected" and "wildlife managed" areas. Although the Act *made provision for* the declaration of protected species, no protected species were declared in the Act.

***Wildlife Protected Areas***

- **National Park**: these are protected areas of international and national importance because of their biological diversity, landscape or national heritage, and in which biodiversity conservation, recreation, scenic viewing, scientific research and other economic activity may be permitted.
- **Wildlife Reserve**: these are protected areas of importance for wildlife conservation and management and in which conservation of biological diversity, scenic viewing, recreation, scientific research, and regulated extractive utilisation of natural resources are permitted.

***Wildlife Management Areas***

- **Community Wildlife Areas**: these are wildlife management areas where wildlife is protected, whilst taking into account the continued use of the land and the sustainable exploitation of wildlife in the area by people and communities ordinarily residing there. Sustainable exploitation of the natural resources of the area, including by mining and other methods, is permitted - providing that it is in a manner compatible with the continued presence of wildlife in the area.

#### 4.1.2.2 Uganda Wildlife Act Cap 200 of 2000

The Uganda Wildlife Act cap 200 of 2000 was enacted by an Act of Parliament to provide for sustainable management of wildlife (UWA 2014). The Act consolidated wildlife management law in Uganda and established the Uganda Wildlife Authority (UWA) as the responsible authority for wildlife management and conservation, and enforcement of wildlife laws and regulations. The Act covers all wildlife protected areas (PAs) and wildlife outside PAs, and specifically mandates UWA to control and monitor industrial and mining developments in wildlife protected areas.

#### 4.1.2.3 Uganda Wildlife Policy (1999, 2014)

The Uganda Wildlife Policy generally promotes long-term conservation of wildlife and biodiversity in a cost-effective manner, which maximises the benefits to the people of Uganda in terms of ecology, economy, aesthetics, science and education. The policy aims at achieving this through promoting conservation and sustainable utilisation of wildlife throughout Uganda. The policy seeks to exclude industrial development, including mineral exploration and extraction, from wildlife protected areas (that is, national parks and wildlife reserves).

The Ugandan Government resolved to review Uganda's Wildlife Policy, to harmonise it with related instruments like the National Environment Policy, the Wetland Policy and the Constitution, in the form of the 2014 Uganda Wildlife Policy. New aspects incorporated in the policy included:

- To provide for incentives that supports the private sector to invest more in wildlife development in Uganda.
- To guarantee safety for tourists by enhancing security in in national parks and game reserves, under the expanded anti-terror surveillance in Uganda.
- To increase resource allocation to the tourism sector, specifically for extending and improving infrastructure to, within and around tourism sites.
- To reconcile the needs for wildlife conservation and human beings, particularly in areas that have been affected by insurgency and civil strife.
- To ensure that any infrastructural development within and around wildlife conservation areas does not compromise the support eco-systems for flora and fauna in the respective areas.
- Demands for land in national parks will not be entertained, except in very exceptional circumstances where survival of communities is involved.

#### 4.1.2.4 Uganda Forestry Policy (2001) and the National Forestry and Tree Planting Act (2003)

The Forestry Policy is implemented through the National Forestry and Tree Planting Act (2003). The Act provides for:

- The conservation, sustainable management and development of forests.
- The declaration of forest reserves for the purposes of protection and production of forests and forest produce.
- The sustainable use of forest resources and enhancement of productive capacity of the forests.
- The promotion of tree planning.
- Consolidation of the law relating to the forestry sector and trade in forest produce.

Parts of Uganda's permanent forest estate carry dual status as National Parks, Wildlife Reserves and Animal Sanctuaries; such areas are subject to additional regulations under the Uganda Wildlife Act (1996).

Declared forest reserve categories include Central Forest Reserves (CFRs), Local Forest Reserves, Community Forests, private forests, and forests forming part of a wildlife conservation area (declared under the Uganda Wildlife Act, Cap 200).

CFRs fall in two main categories, namely those designated for production and those for protection. Such forest reserves are subsequently managed in a manner consistent with the purpose for which they were declared:

- **Production forests**: includes savanna bushland and grassland areas - reserved for supply of forest products and future development of industrial plantations.
- **Protection forests:** includes all the tropical high forests, savanna woodlands and/or grasslands – reserved forests include those that protect watersheds and water catchments, biodiversity, ecosystems and landscapes that are prone to degradation under uncontrolled human use.

CFRs are held in trust for the people of Uganda and managed by the National Forestry Authority (NFA) and are classified according to the following categories:

- Site of special scientific interest;
- Strict nature reserve;
- Joint management forest reserve;
- Recreation forest for purposes of eco-tourism; and
- Any other area, for a purpose prescribed in the order.

In a forest reserve, it is prohibited to cut, disturb, damage, burn or destroy any forest produce, remove or receive any forest produce, or undertake activities not consistent with the specific management plan except under conditions set out in the Act or in accordance with a licence granted under the Act. The Act also makes provision for classification of trees as reserved/protected and therefore subject to specific controls. In addition, Section 38 of the Act requires that an environmental impact assessment be undertaken for any project or any activity which may, or is likely to have a significant impact on a forest.

#### *4.1.2.5 The Land Act (1995)*

Section 43 of the Land Act provides for management and utilisation of land in accordance with the Uganda Wildlife Act, and other laws. Section 44 (i) mandates the government or local governments to protect national parks, wetlands and forest reserves (amongst others) for ecological and tourism purposes, and hold these in trust for the people of Uganda.

#### *4.1.2.6 Uganda National Land Policy (2013)*

The Uganda National Land Policy makes provisions in relation to natural resource management and biodiversity. These include Government resolutions to ensure that land use practises conform to land use plans, and that the principles of sound environmental management including biodiversity preservation, soil and water protection, conservation and sustainable land management are applied. The policy commits the Government to take measures including to

- Provision of special protection for ‘fragile’ ecosystems (that is, unique and sensitive biodiversity features).
- Development of harmonised criteria for gazetting and de-gazetting conservation areas.
- Establishment and implementation of effective mechanisms for management of wildlife outside protected areas.
- Incentivise community participation in conservation on privately-owned land and co-management of conservation on public land.
- Regulate the use of hilltops and other sensitive ecosystems.
- Develop mechanisms to resolve human-wildlife conflict.

### 4.1.3 Uganda National Biodiversity Strategy and Action Plan (2015-2025)

Published by the Ugandan National Environmental Management Authority (NEMA) in October 2016, the National Biodiversity Strategy and Action Plan (NBSAP) provides a framework to guide the setting of conservation priorities, channelling of investments and building of the necessary capacity for the conservation and sustainable use of biodiversity in the country.

The overarching principles of the NBSAP are:

a) Sustainable development and environmental sustainability

b) Mainstreaming of biodiversity conservation, sustainable use of biological resources and equitable sharing of benefits from biological resources into existing policy, legislative, institutional and development frameworks as appropriate;

c) Stakeholder participation in the development and implementation of biodiversity strategy and action plans;

d) Awareness creation, education, training and capacity building at local, national and institutional levels to enhance effective participation and implementation of biodiversity measures;

e) Recognition, promotion and upholding of traditional and indigenous knowledge of biological resources and sustainable resource management and where benefits arise from the use of this knowledge;

f) Engagement and collaboration with international partners to enhance conservation and sustainable use of Uganda's biological diversity;

g) Integrated implementation of Multi-Lateral Environmental Agreements;

h) Equal consideration of the three objectives of the Convention on Biological Diversity – conservation; sustainable use; and benefit sharing arising from the use of biological resources

The Uganda NPSAP is a useful policy guide for addressing Uganda's concerns in biodiversity conservation and the utilisation of its components, as well as for implementation of the requirements of the Convention on Biological Diversity.

## 4.2 Conventions and International Agreements

Uganda is a signatory to the following international conventions and agreements:

- Convention on Biological Diversity: Under the convention, each contracting party is expected to develop national strategies, plans or programs for the conservation and sustainable use of Biological diversity.
- Convention on International Trade in Endangered Species (CITES).
- Convention on the Conservation of Migratory Species of Wild Animals, (the Bonn Convention).
  - African-Eurasian Water-bird Agreement (AEWA).
  - International Gorilla Agreement (Uganda is in the process of acceding to this agreement – it has been signed but is not yet ratified).
- Convention on Wetlands of International Importance (the Ramsar Convention).
- UNESCO World Heritage Commission.
- Lusaka Agreement on the Cooperative Enforcement Operations Directed against Illegal trade in Fauna.

## 4.3 International Guidance

### 4.3.1 International Finance Corporation's Performance Standards

At the project financing level, the management of biodiversity is addressed by PS6: *Biodiversity Conservation and Sustainable Management of Living Natural Resources*. PS6, and the associated GN6 relates to:

- The protection and conservation of biodiversity.
- Maintenance of ecosystem services.
- Sustainable management of living natural resources.

The requirements set out in PS6 have been guided by the Convention on Biological Diversity. PS6's main priority is that the Project should seek to avoid impacts on biodiversity and ecosystem services. When avoidance of impacts is not possible, measures to minimise impacts and restore biodiversity and ecosystem services should be implemented.

However, when a project occurs in critical habitat supporting exceptional biodiversity value, a net gain in biodiversity value is required.

PS6 sets specific biodiversity protection and conservation standards relating to potential project impact. The specific requirements are separated according to the following categories:

- **Modified Habitat**: areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. PS6 relates to areas of modified habitat that have significant biodiversity value, and requires that impacts on such biodiversity must be *minimised, and mitigation measures implemented* as appropriate.
- **Natural Habitat**: viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition. In such areas, the conservation outcome required by PS6 is *no-net-loss of biodiversity* **value** achieved using the "like-for-like" or better principle of biodiversity offsets, where feasible.
- **Critical Habitat**: areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes. When a project occurs in critical habitat supporting exceptional biodiversity value, a *net gain in biodiversity value* is required by PS6. This is achievable through appropriate biodiversity offsets.
- **Legally Protected and Internationally Recognised Areas**: such areas often have high biodiversity value; when this is the case these areas are likely to qualify as critical habitat and, as such, the conservation outcome required by PS6 is also a *net gain in biodiversity value*, as well as obtaining the relevant legal permits, following standard governmental regulatory procedures, and engagement of affected communities and other stakeholders.
- **Invasive Alien Species**: the development project should not intentionally introduce any new alien species (unless carried out within the appropriate regulatory permits) and should not deliberate any alien species with a high risk of invasive behaviour under any circumstance. PS6 requires that any introduction of alien species be the subject of a *risk assessment* for potential invasive behaviour, and that the project should *implement measures to avoid* the potential for accidental or unintended introductions.
- **Management of Ecosystem Services**: where a project is likely to adversely impact ecosystem services, an *ecosystem service review to identify priority ecosystem services* is required. Priority ecosystem services are (i) those services on which project operations are most likely to have an impact and, therefore, which result in adverse impacts to Affected Communities; and/or (ii) those services on which the project is directly dependent for its operations (for example, water). If adverse impacts on Priority

ecosystem services are unavoidable, these must be *minimised and mitigation measures* that aim to maintain the value and functionality of priority services implemented. With respect to impacts on priority ecosystem services on which the project depends, *impacts on ecosystem services should be minimised and measures that increase resource efficiency* of their operations implemented. For a full assessment of ecosystem services, see Golder Associates (2014i).

### 4.3.2 Regional Frameworks

At the regional level, Uganda is a member of the **African Union** and one of its objectives is to promote sustainable development at the economic, social and cultural level.

In the East African region, Uganda is obliged to implement the articles of the Treaty for the establishment of the **East African Community**, which it ratified together with other member states in 2000. In article 119, Partner States agreed to promote close cooperation in culture and sports.

Uganda is signatory to the **Nile Basin Initiative** (NBI). The NBI was established in 1999 by the Nile basin countries, to oversee the implementation of the Nile River Basin Action Plan. This process is still ongoing; once concluded, the resulting agreement will supersede all the existing Nile water agreements, pending establishment of a permanent legal and institutional framework for the Nile Basin.

Uganda is also a member of the **Lake Victoria Basin Commission** (LVBC). Releases from Lake Victoria have a controlling role on the water balance and level of Lake Albert, and hence on the flows within the Victoria and Albert Niles. The LBVC was established by the East African Community as a mechanism for coordinating the various interventions on the Lake and its Basin. The LBVC also serves as a centre for promotion of investments and information sharing among the various stakeholders.

## 5.0 KEY ISSUES RELATING TO BIODIVERSITY

As identified through stakeholder consultation, review of background biodiversity and environmental reports, published ecological literature, and consideration of the IFC's Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development (IFC 2007b) and the performance standards (that is, IFC 2012a, b and c), broadly, the key issues pertaining to the CHAA's biodiversity include:

- Habitats and ecosystems
  - Construction and operation of the pipeline and the potential effects that the construction and operation could have on wetlands, streams, woodlands, bushland and grasslands (including potential critical habitat), agricultural areas, and soils.
  - Construction and operation of the wells and CPF on the environment of the Buhuka Flats and Lake Albert.
  - The potential effects the construction and operation of the Project could have on Lake Albert, wetlands and environment of the Buhuka Flats. These include: vibration; pollution (oil, erosion and sedimentation, other run-off, effects to groundwater); increased fishing pressure from in-migration; long-term damage to the lake ecosystem.
  - Potential induced effects to the Bugoma Central Forest Reserve due to upgrade of the existing road, including the possible need for offsets.
  - Potential effects the construction and operation of the Project could have on the escarpment vegetation corridors connecting the wild areas along Lake Albert from Semliki to Murchison Falls National Park.
- Species of concern
  - Concern for the loss of animal species from the Buhuka Flats. Potential effects to the populations of Hippopotamus (*Hippopotamus amphibius*), Nile Crocodile (*Crocodylus niloticus*), and Grey Crowned Crane (*Balearica regulorum*), amongst others.

- The identification of migratory and threatened species inhabiting the CHAA.
- Potential effects to the populations of Chimpanzees (*Pan troglodytes*), Nahan's Francolin (*Ptilopachus nahani*) and African Elephant (*Loxodonta africana*) in Bugoma Central Forest Reserve.

In summary, the main issues related to potential effects to the biodiversity of the CHAA from the construction and operation of the Project relate to the to changes in ecosystem composition (for example, species composition), configuration (for example, patch size and connectivity) and function of the wider CHAA through the direct loss, disturbance or change in condition of natural and modified habitats, including critical habitat.

# 6.0 BASELINE ENVIRONMENT

This section describes the baseline biodiversity environment of the LSA and CHAA. It draws upon existing, published information, local knowledge and comprehensive, multi-season field surveys. The detailed baseline study reports for the terrestrial and aquatic ecology are presented in Appendix C and D respectively.

## 6.1 Terrestrial Biodiversity

This section focuses on describing the baseline terrestrial biodiversity of the LSA. It summarises the findings reported in the terrestrial ecology baseline report, as presented in Appendix C.

### 6.1.1 Vegetation Communities and Flora Species

A summary of the baseline of the vegetation communities and flora species of the CHAA are presented based on the findings of the desktop study and the field investigations of the LSA.

#### *6.1.1.1 Vegetation Communities*

According to Langdale-Brown et al. (1964), the CHAA is mapped as supporting the following vegetation communities:

a) Dry *Hyparrhenia* Grass Savanna, with undifferentiated deciduous Thicket (Q3/V1) on the Buhuka Flats.

b) *Themeda-Chloris* Grass Savanna (Q4) on the Buhuka Flats.

c) Dry *Combretum-Hyparrhenia* Savanna (N2) on the escarpment.

d) Moist *Combretum-Terminalia-Albizia-Hyparrhenia rufa* Savanna/Medium Altitude Forest/Savanna Mosaic (K/F2) beyond the escarpment, towards Bugoma Central Forest Reserve along the pipeline route.

e) Moist *Combretum-Terminalia-Albizia-Hyparrhenia rufa* Savanna (K) beyond the escarpment, towards Bugoma Central Forest Reserve along the pipeline route.

f) *Cynometra-Celtis* Medium Altitude Moist Semi-deciduous Forest (D2) beyond the escarpment, towards Bugoma Central Forest Reserve along the pipeline route.

It is noted that the delineation of these communities is 50 years old. Since that time, large tracts of vegetation have been altered in the CHAA, in particular, along the pipeline route, and, therefore, strict alignment with Langdale-Brown et al.'s (1964) classification was not possible. These areas have been subjected to high-intensity, subsistence agriculture, which has altered much of the original natural landscape (Forest Department 2002). These drivers of change, together with widespread cattle grazing and charcoal manufacture, have put pressure on the natural vegetation communities in the CHAA as compared to Langdale-Brown et al.'s (1964) original work. This is particularly noticeable in the areas on the escarpment, between the escarpment proper and the Bugoma Central Forest Reserve (see Figure 4). These areas have, for the most part, been converted to subsistence agricultural fields.

Nevertheless, significant natural vegetation still exists long the escarpment (Figure 5). This corridor extends from the areas south of the CHAA, northwards toward the Kabwoya Wildlife Reserve and the Kaiso-Tonya Community Wildlife Area. Indeed, Plumptre et al. (2007) identified these corridors to be part of an important linkage from the Semliki/Toro Wildlife Reserve in the south, the Budongo–Bugoma–Kagombe–Itwara Forest Reserves, right through to the Murchison Falls National Park in the north.

The field surveys (Appendix C) identified seven broad vegetation communities within the LSA (as depicted in Figure 5 and Figure 6):

a) Wooded Grassland;

b) Woodland;

c) Thicket-Grassland Mosaic;

d) Open Grassland;

e) Bushed Grassland;

f) Bushland and Shrubland; and

g) Wetlands (including permanent wetlands of *Phragmites, Typha,* and *Cyperus*, and seasonally flooded grassland (floodplains) of *Sporobolus pyramidalis* and *Cynodon dactylon*).

These communities broadly align with those described by Langdale-Brown et al. (1964); however, their current distributions are different to those originally described, primarily due to the increased pressures from agriculture and human disturbance over the last 50 years. The characteristics and condition of each of these communities is summarised below.

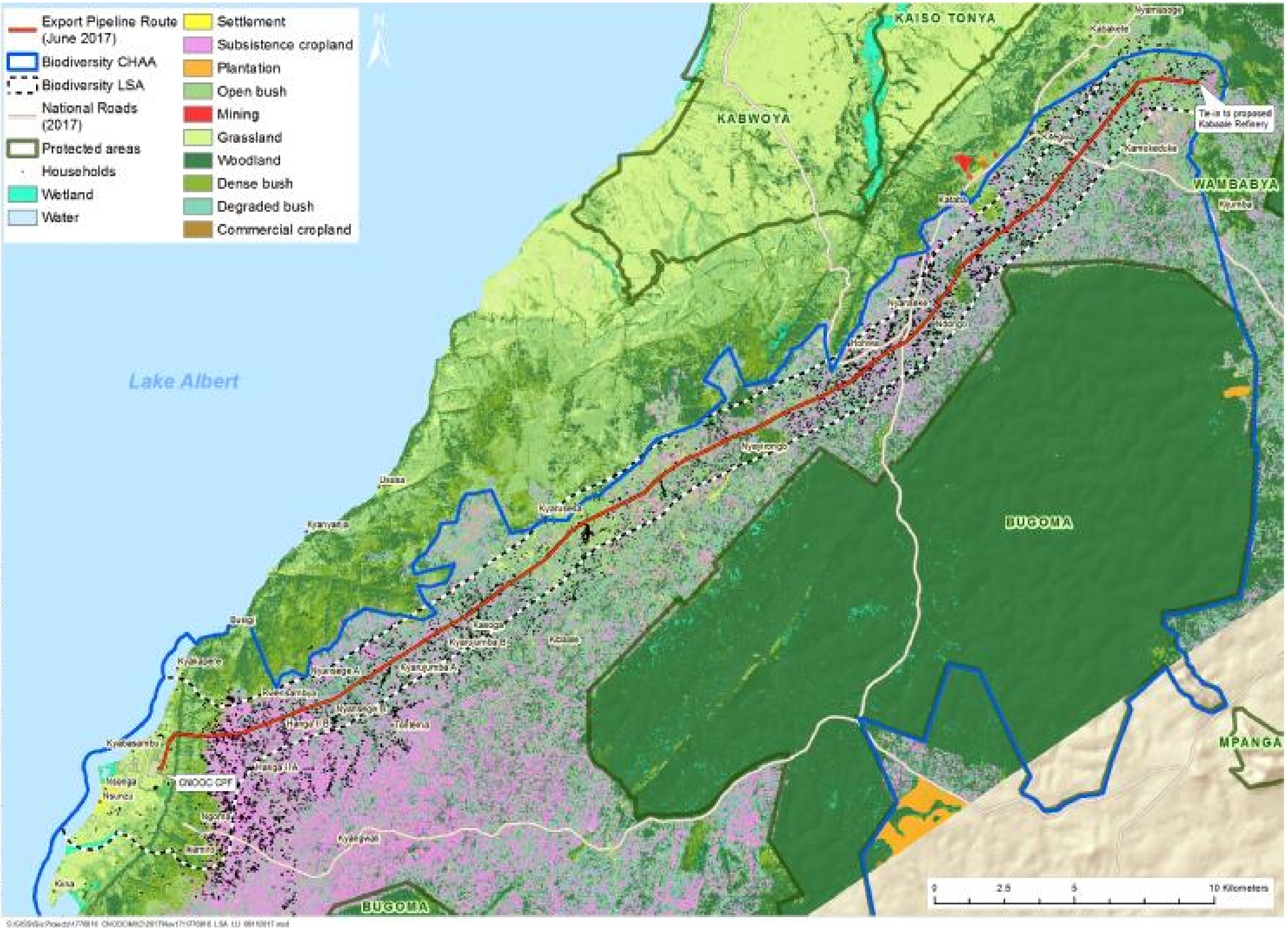


*Figure 4: Land cover and land use in the CHAA*

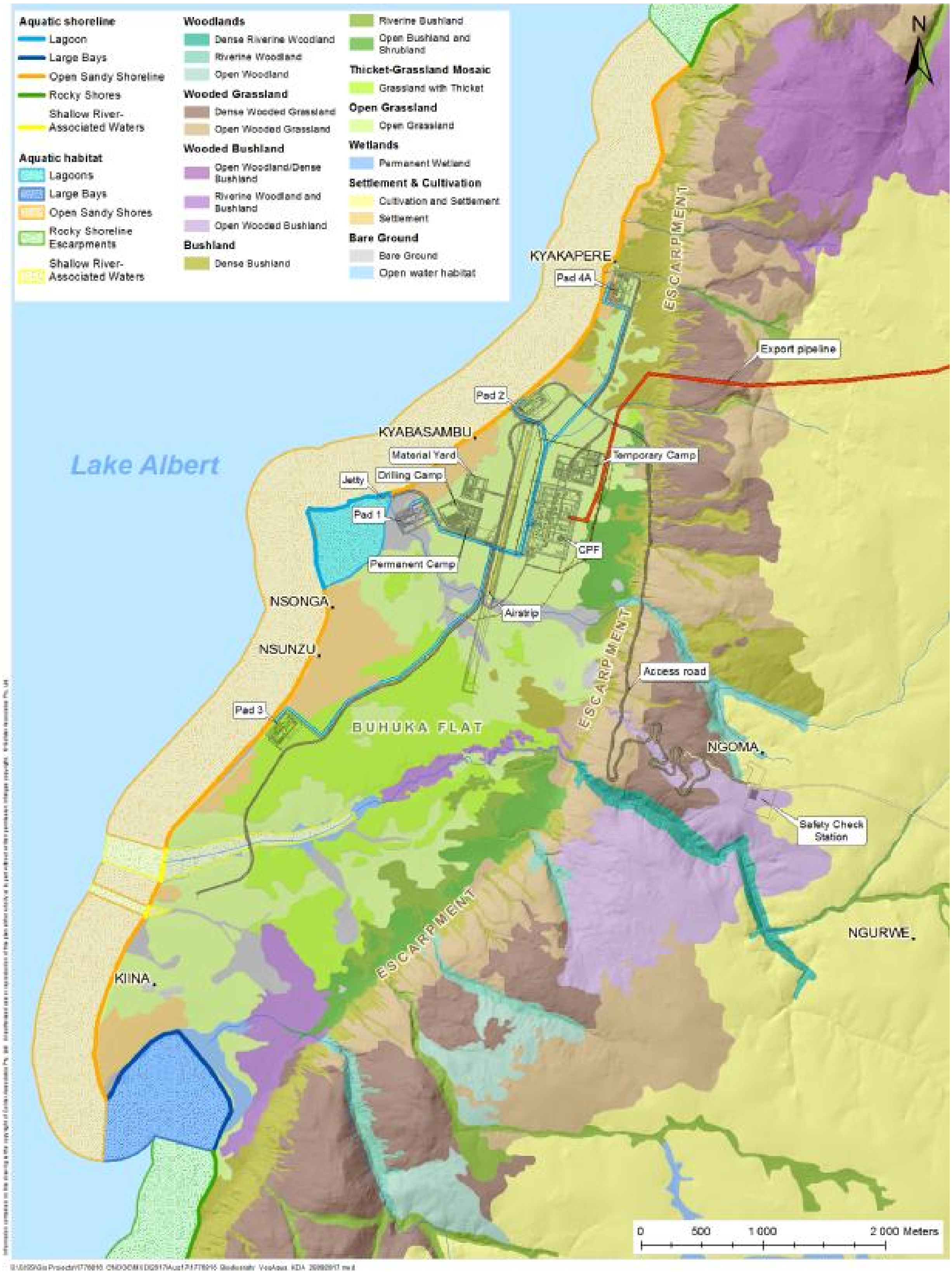


*Figure 5: Vegetation communities of the CHAA (focus on Buhuka Flats)*

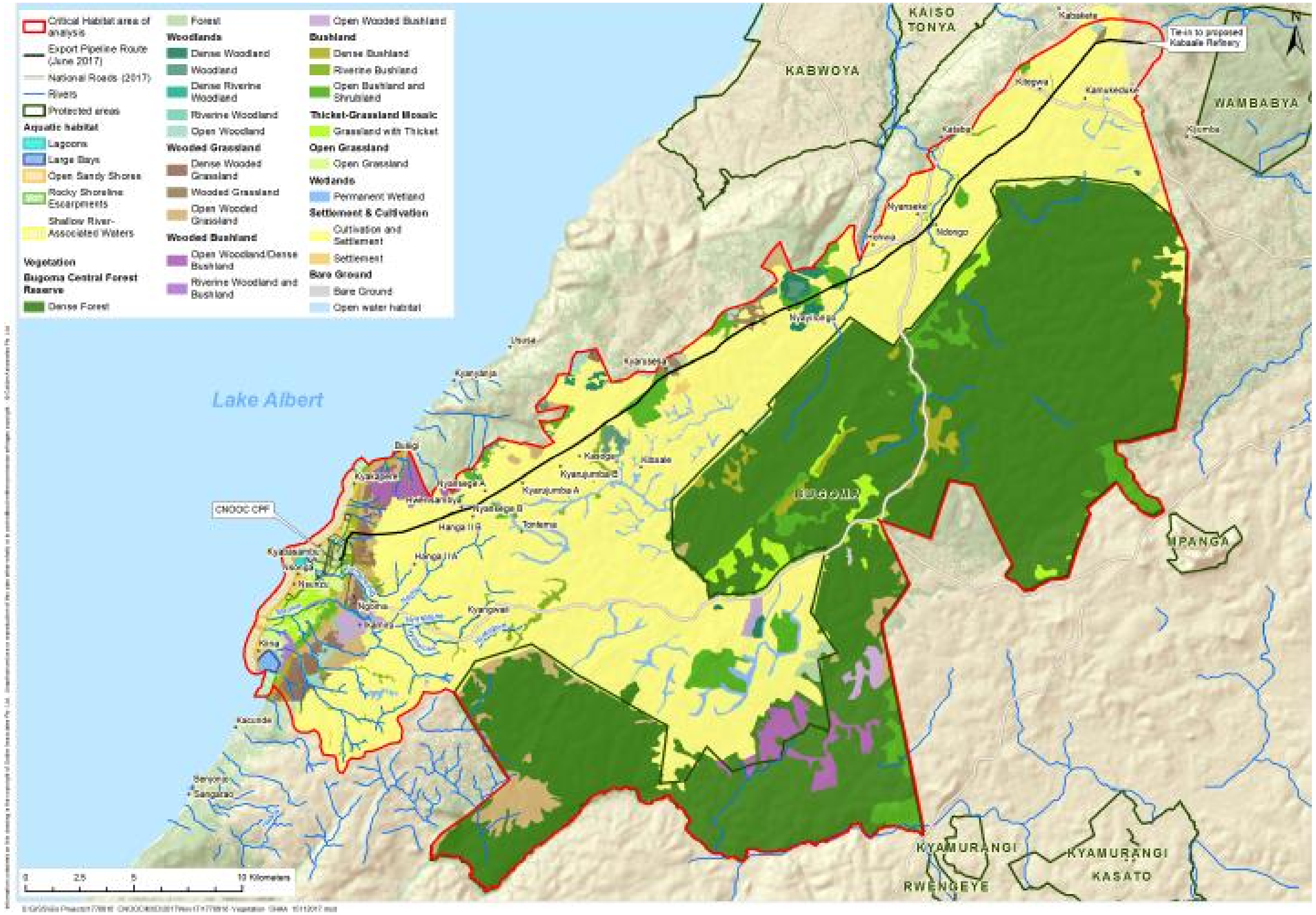


*Figure 6: Vegetation communities of the CHAA*

#### 6.1.1.1.1 Wooded Grassland

*Figure 7: Typical wooded grassland in the CHAA*

Aligns with the Dry *Combretum-Hyparrhenia* Savanna (N2) of Langdale-Brown et al. (1964); the ground layer in these communities is dominated by grasses, while woody plants comprise 10% to 50% of the upper storey structure (Langdale-Brown et al. 1964). In the LSA, the ground layer is dominated by *Hyparrhenia rufa* and *Sporobolus pyramidalis* (Figure 7). The woody plant fraction was dominated by *Rhus natalensis*, *Combretum collinum*, *Acacia hockii* and *Annona senegalensis*.

These communities comprise about 3.35% of the CHAA, and included the sub-communities of: wooded grassland (WGl): open wooded grassland (OWGl); and dense wooded grassland (DWGl) (Figure 4a). These communities are largely restricted to the escarpment and beyond. The original extent of these communities on the plateau above the escarpment appears to have been significantly reduced in the last 50 years due to subsistence agricultural practices. On the escarpment, clearing for agricultural fields, and grazing by cattle are the primary drivers of change, together with frequent fires.

#### 6.1.1.1.2 Woodland

*Figure 8: Typical woodland along a watercourse in the CHAA*

Aligns with the *Cynometra-Celtis* Medium Altitude Moist Semi-deciduous Forest (D2) of Langdale-Brown et al. (1964); these communities are characterised by an upper storey canopy layer that does not interlock and remains open, which allows for the growth of herbaceous vegetation; however, the herbaceous layer lacks a multi-layered structure (Langdale-Brown et al. 1964).

Within the CHAA, these communities were mostly dominated by *Acacia* species, while some were mixed with *Crateva* sp. and *Acalypha* sp. (Figure 7). The most abundant species in these communities were typically *Tamarindus indica*, *Rhus natalensis* and *Acacia sieberiana*, while the understorey was typically dominated by *Grewia trichocarpa* and *Azima tetracantha*. *Hypoestes forskaolii*, *Panicum deustum* and *Sporobolus pyramidalis* were common herbaceous layer species.

These communities comprise about 0.70% of the CHAA, and included the sub-communities of: open woodland (OWo); and riverine woodland (RiWo) (Figure 8), and they tend to be restricted to the riverine areas along the mainly seasonal watercourses. Harvesting of large trees for the manufacture of charcoal is a noticeable driver in these communities, as well as trampling and grazing by cattle.

#### 6.1.1.1.3 Thicket-Grassland Mosaic

*Figure 9: Typical Thicket-grassland mosaic community in the LSA*

Aligns with the Dry *Hyparrhenia* Grass Savanna, with undifferentiated deciduous Thicket (Q3/V1) of Langdale-Brown et al. (1964); these communities are characterised by thickets of 2 to 4 m height, with a dominance of much-branched, thorny, woody species that form dense clumps or continuous thickets sometimes approaching 100% cover (Langdale-Brown et al. 1964).

Within the CHAA, particularly on the Buhuka Flats, these thickets are interspersed with grassland, forming a mosaic (Figure 9). The most abundant species were *Acacia brevispica*, *Acalypha fruticosa*, *Azima tetracantha*, *Euphorbia candelabrum*, *Cadaba farinosa* and *Dichrostachys cinerea*. Common species in the herbaceous and ground layer include *Sansevieria* spp., *Sporobolus pyramidalis*, *Cynodon dactylon*, *Aloe* sp. and *Cissus oliveri*.

These communities comprise about 1.37% of the CHAA, and included the sub-communities of: grassland with thicket (GlWT), which is largely restricted to the Buhuka Flats (Figure 5). Within this area, noticeable effects of heavy cattle grazing were observed, which appears to be the primary driver for maintaining the mosaic nature of this community, which also limits bush encroachment.

#### 6.1.1.1.4 Open Grassland

*Figure 10: Typical grassland community of the LSA*

Aligns with the *Themeda-Chloris* Grass Savanna (Q4) of Langdale-Brown et al. (1964); these communities are dominated by a grass layer, with woody species typically constituting less than 5% (Langdale-Brown et al. 1964).

Within the CHAA, the dominant grass species in these communities included *Sporobolus pyramidalis*, *Pennisetum purpureum*, *Imperata cylindrica*, *Cynodon dactylon* and *Panicum maximum* (Figure 10). Occasional woody species included *Acacia polyacantha* subsp. *campylacantha* and *Vernonia amygdalina*. Often, these grasslands supported some thicket communities.

These communities comprise about 0.71% of the CHAA, and included the sub-communities of: open grassland (OGl) (Figure 5) and were largely restricted to the Buhuka Flats. Livestock grazing is by far the most dominant driver affecting the structure of the community, keeping it at very low stature.

#### 6.1.1.1.5 Modified Habitats

Most areas of modified habitat occur along the proposed feeder line route. These areas are modified from their original, natural habitat - having been converted to cultivation. Patches of natural vegetation occur within these modified areas, although most have been largely altered from their original state. These remnants show affinities to the various vegetation communities identified in the wider area, including woodland, bushland, wooded grassland and wetland.

#### 6.1.1.2 *Flora Species*

Few studies have focused specifically on the flora of the CHAA. Those studies that do exist tend to focus on protected areas and forest reserves. For example: Plumptre et al. (2009), in a study of Kabwoya Wildlife Reserve, which is about 30 km north of Buhuka Flats and the same ecoregion as the CHAA, identified 167 flora species in that reserve; NEMA (2010) identifies the Bugoma Central Forest Reserve as a particularly species rich area; while Kalema (2005) compiled a list of species for the Semliki Wildlife Reserve, which is about 40 km south of the CHAA. These studies do provide useful references for species assemblages of the wider area, and formed a good basis upon which to develop a list of potential species for the CHAA. These lists, together with those provided by the IUCN (2017), formed the basis of the identification of threatened species occurring in the CHAA.

**Species Richness, Diversity and Abundance**

In the area of the Buhuka Flats, the most abundant species were *Cynodon dactylon*, *Sporobolus pyramidalis*, *Acalypha fruticosa*, *Phragmites kirkii*, *Capparis erythrocarpos*, *Senna* sp., *Asparagus africanus*, *Cissus oliveri*, *Typha capensis*, *Cyperus articulatus* and *Dichrostachys cinerea*.

On the escarpment, where the soil conditions are more marginal and fragile, the most abundant species were *Acalypha fruticosa*, *Rhus natalensis*, *Hypoestes forskaolii*, *Terminalia brownii*, *Acacia brevispica*, *Cissus oliveri*, *Sporobolus pyramidalis* and *Enteropogon macrostachyus*.

Beyond the escarpment, on the plateau, soil conditions (including drainage) were better, with only localised areas of water-logging. Within these areas, however, there is a strong element of human influence in the form of agricultural activities. Here, *Pennisetum purpureum*, *Acacia polyacantha*, *Imperata cylindrica*, *Vernonia amygdalina*, *Panicum maximum*, *Combretum collinum*, *Acanthus polystachius* were the most abundant species.

*Sporobolus pyramidalis* had the highest relative abundance across all the LSA and all communities sampled. This was followed by *Acalypha fruticosa*, *Cynodon dactylon*, *Panicum maximum*, *Vernonia amygdalina* and *Rhus natalensis*. This indicates that grasses form a substantial proportion of all the vegetation communities within the LSA.

Ninety-four species were uncommon in the LSA. These include *Cordia africana*, *C. millennii*, *Cynometra alexandrii*, *Pterygota mildbraedii*, and *Markhamia lutea*. These are all good timber tree species, which are under intense pressure from logging. *Cordia millenii* is listed under Uganda's National Forestry Authority as a Reserved Species (Kalema and Bleentje 2012), and is, therefore, flagged for protection owing to excessive felling for its high-grade timber. None of the other species are listed under Ugandan legislation, or the IUCN's Red List (IUCN 2017). These species are widespread in the region and Africa (Kalema and Beentje 2012).

Overall, 96 families and 635 species were recorded in the LSA (Appendix C). Although the highest species richness was recorded in bushland (369 species), woodland (318 species) and wetland communities (301 species), with thicket-grassland and bushed grassland communities recording 91 and 202 species respectively, the number of species recorded was strongly correlated with sampling effort. In particular, the latter two communities had less sampling effort applied than the aforementioned communities (see Appendix C). A better measure was the mean number of species per survey plot, which identified bushed grassland (13.47 spp./plot), wooded grassland (8.89 spp./plot) and woodland (6.91 spp./plot) to have the highest species richness, while the lowest was wetland (5.02 spp./plot) and open grassland (5.79 spp./plot).

The general observation from these findings is that the more wooded vegetation communities recorded higher species richness per sampling unit. Accordingly, the least wooded communities of wetland and open grassland had the lowest species richness per sampling unit.

Across the LSA, woody species contributed 38.6% of species richness as compared to 61.4% for the non-woody species (Appendix C). On the Buhuka Flats, herbs and shrubs dominated; while on the escarpment, shrubs dominated; beyond the escarpment, herbs and trees dominated.

### Species of Concern

Four species of conservation interest were recorded in the LSA. These were the: *Milicia excelsa* (Mvule Tree) (listed as Lower Risk/Near Threatened by the IUCN, and a restricted species on the Ugandan list of Reserved Tree Species, as promulgated under Uganda's *National Forestry and Tree Planting Act 2003*); *Tamarindus indica* (Tamarind Tree) (Not Evaluated by the IUCN, yet a restricted species on the Ugandan list of Reserved Tree Species, as promulgated under Uganda's *National Forestry and Tree Planting Act 2003*); *Cordia millenii* (Drum Tree) (listed as Lower Risk/Least Concern by the IUCN); and the CITES Appendix II-listed *Euphorbia candelabra* (Candelabra Tree) and *Aloe* sp. (Aloe) (both Not Evaluated by the IUCN).

Five invasive species were recorded in the LSA, although they were uncommon. *Mimosa pigra* (Giant Sensitive Tree), *Lantana camara* (Lantana), and *Eichhornia crassipes* (Water Hyacinth) were the commonest species recorded, predominantly on the Buhuka Flats and the shore of Lake Albert (Appendix C). These species are recognised as some of most noxious weeds in the world (Lowe et al. 2000).

Other invasive species recorded included: *Pistia stratiotes* (Water Lettuce) (in a wetland community on the Buhuka Flats, where it was locally abundant); *Parkinsonia aculeata* (Parkinsonia) (recorded on the Buhuka Flats in open grassland); and *Ricinus communis* (Castor Oil Plant) (recorded from Wetland and Woodland communities).

For further discussion and assessment of these species, see Section 7.2.

## 6.1.2 Invertebrates

As mentioned, the sampling of terrestrial invertebrates was limited to butterflies, dragonflies and damselflies for the reasons discussed. Summarised below are the findings of the baseline surveys presented in Appendix C.

### *6.1.2.1 Butterflies*

A summary of the baseline of the butterfly species of the LSA is presented, based on the findings of the desktop study and the field investigations. The detailed baseline studies are presented in Appendix C.

#### Species Richness, Diversity and Abundance

One-hundred-and-fifty-five species of butterfly were recorded in the LSA. Of these: 38 are forest-dependent species, including one forest highland species; 27 forest edge/woodland species; 25 migrant species; 20 open habitat species; 42 widespread species; and two wetland-dependent species (Appendix C). Based on their ecological preferences, 27.3% of the butterfly species recorded were those that are typically widespread; 13% were typical of open habitats; 16.2% were migrants; 17.5 % were forest edge/woodland species; 24.7% were characteristic of forest habitats; and 1.3% were wetland dependent.

The habitat mosaic of the escarpment area was the most species rich, along with the Kamansinig River, and the Hohwa River along the pipeline route, as well as the Kibale-Butoole area.

#### Species of Concern

No Albertine Rift endemic species were recorded in the LSA. Only four of the species recorded have been evaluated by the IUCN, and are all listed as Least Concern; these were:

- Jeffry's Bush-brown (*Bicyclus jefferyi*)

  This widespread species favours forest clearings and edges of relatively wet forests, and although it is common, its population trend is unknown (Larsen 2011a).

- Small Grass Yellow (*Eurema brigitta*)

  This species is one of the most common butterflies of Africa and the Oriental region, thus having a vast EOO (Larsen 2011b). It is believed to have a stable population trend and favours a wide variety of savanna and grassland habitats.

- Dark Blue Pansy (*Junonia oenone*)

This species occurs across the entire African continent, and, although its population trend is currently unknown, there are no present threats to its global population (Larsen 2011c).

- Dark Grass Blue (*Zizina antanossa*)

  This species is one of the most widely distributed butterflies in Africa. It inhabits grassy, open areas in savannah, and disturbed areas of forest. Its population trend is unknown, but it is not known to be affected by any major threats at present (Larsen 2011d).

For further discussion and assessment of other species that may potentially occur in the CHAA, see Section 7.2.

### Habitats

Although no IUCN-listed, or Uganda-listed threatened species were recorded in the LSA, it does support a rich diversity of species. Habitats of importance for butterflies within the LSA, based on species richness and diversity, were the watercourses draining off the escarpment and along the pipeline route, the vegetation communities of the escarpment, and forest. It is noted that the forest patches may represent relicts of the original habitat in the wider area. However, it is noted too that the majority of species recorded are habitat generalists or ecotone species, and are not dependent upon intact habitat for their survival. Nevertheless, forest dependent species did constitute ~25% of the species recorded, and ~1.5% were wetland dependent. Therefore, certainly for butterflies, the array of habitats supported in the LSA is important to maintain species diversity.

For further discussion and assessment of habitats, please refer to Section 7.1.

### *6.1.2.2 Dragonflies and Damselflies*

A summary of the baseline of the dragonfly and damselfly species of the LSA is presented based on the findings of the desktop study and the field investigations. The detailed baseline studies are presented in Appendix C.

### Species Richness, Diversity and Abundance

Forty-six species of dragonflies and damselflies were recorded from the LSA. The seasonally flooded wetlands along the Kamansinig River and the permanent wetlands of Masika River were the most species rich.

### Species of Concern

All the species recorded have been assessed by the IUCN, and all are categorized as being of Least Concern, with stable or unknown population trends. One species, the Common Riverjack (*Mesocnemis singularis*), although listed as Least Concern, is recommended by the IUCN for further monitoring due to possible declining population trends (Clausnitzer et al. 2010).

For further discussion and assessment of other species that may potentially occur in the CHAA, see Section 6.3.2.

### Habitats

Although no IUCN-listed, or Uganda-listed threatened species were recorded in the LSA, it does support a rich diversity of species. Habitats of importance for dragonflies and damselflies within the LSA, based on species richness and diversity, were the seasonally flooded and permanent wetlands on the Buhuka Flats and along the pipeline route.

For further discussion and assessment of habitats, please refer to Section 7.1.

## 6.1.3 Reptiles and Amphibians

A summary of the baseline of the reptile and amphibian species of the LSA is presented based on the findings of the desktop study and the field investigations. The detailed baseline studies are presented in Appendix C.

#### 6.1.3.1 Amphibians

##### Species Richness, Diversity and Abundance

Twenty-three amphibian species were recorded from the LSA; this is between 76% and 100% of the expected species in the CHAA (Appendix C). These represent seven families and ten genera. The most species rich sites for amphibians were along the pipeline route: Kabakete, near the proposed Kabaale refinery site, had 12 species; and Zorobe had eight species. On the Buhuka Flats, the wetland on the lower reaches of the Masika River had eight species, with the wetlands of the Kamansinig River having up to seven species.

The most common species was a Ridged Frog (*Ptychadena* sp.1[3]), which was recorded at 42% of the sampling sites. This was followed by the Cinnamon-bellied Reed Frog (*Hyperolius cinnamomeoventris*) at 37% of the sites, the Kivu Reed Frog (*H. kivuensis*), and the Crowned Bullfrog (*Hoplobatrachus occipitalis*) at 32% of sites, while the Banded Banana Frog (*Afrixalus fulvovitattus*), Common Toad (*Amietophrynus regularis*) and Anchieta's Ridged Frog (*Ptychadena anchietae*) were found at 26% of the sites.

##### Species of Concern

All the species recorded are listed as Least Concern by the IUCN, with the majority believed to have stable population trends, or unknown trends, except one. The Lake Victoria Toad (*Amietophrynus vittatus*) is listed as Data Deficient by the IUCN, with an unknown population trend (IUCN SSC Amphibian Specialist Group 2014a). This species was recorded on the Buhuka Flats in the seasonally flooded wetlands associated with the Kamansinig River (Appendix C, AWE 2008a, 2008b, 2013a). DeSaeger's River Frog (*Amietia desaegeri*), although listed as Least Concern by the IUCN, is a range restricted species (IUCN SSC Amphibian Specialist Group 2014b).

For further discussion and assessment of this species, see Section 7.2.

##### Habitats

Habitats of importance for amphibians within the LSA, based on species richness and diversity, were the seasonally flooded and permanent wetlands on the Buhuka Flats and along the pipeline route, and watercourses draining off the escarpment.

For further discussion and assessment of habitats, please refer to Section 7.1.

#### 6.1.3.2 Reptiles

##### Species Richness, Diversity and Abundance

Twenty-one reptilian species, belonging to eight families and 11 genera, were recorded in the LSA (Appendix C), which could account for ~70% of the species in the CHAA. Generally, however, the reptilian diversity for each sampling site was poor, which may be an artefact of the sampling effort (see Section 3.5). The most diverse site was the area where the CPF will be located with five species, followed by Kasoga/Buhumurro-Nsanga on the pipeline route (four species), Masika River and wetlands associated with the Kamansinig River, each with three species. The rest of the sites had one, two or no reptiles recorded at them.

The most common species were the Speckle-Lipped Skink (*Trachylepis maculilabris*), recorded at 56% of the sites, followed by the Ground Agama (*Agama agama*) at 44% of the sites, and the Tree Agama (*Acanthocercus atricolis*) and the Striped Skink (*Trachylepis striata*) at 33% of the sites.

##### Species of Concern

The majority of species recorded were of Least Concern or Not Evaluated by the IUCN, and tended to be common species in the area. Four species, the Nile Crocodile (*Crocodylus niloticus*), Nile Monitor (*Varanus niloticus*), Smooth Chameleon (*Chamaeleo laevigatus*), and Graceful Chameleon (*C. gracilis*) are listed under CITES Appendix II (UNEP-WCMC 2018).

[3] This species is noted to not be new to science; however, it is difficult to separate from other species. Therefore, a specimen was sent to the museum for determination, the results of which were not available at the time of writing this report (M. Behangana, pers. comm.)

The Nile Soft-shelled Turtle (*Trionyx triunguis*) is known from Lake Albert, however it was not recorded from the LSA during baseline data gathering surveys. Although the species has been assessed as Vulnerable by the IUCN (2017), and populations in central and north-eastern Africa are understood to be stable (van Dijk et. al., 2017), it is facing pressures from human exploitation within Lake Albert, where adults and eggs are hunted for food and medicinal purposes; the carapace can fetch a high price in the markets of Kampala (Appendix C).

For further discussion and assessment of these and other species that may potentially occur in the CHAA, see Section 7.2.

#### Habitats

Habitats of importance for reptiles within the LSA, based on species richness and diversity, were the seasonally flooded and permanent wetlands on the Buhuka Flats and along the pipeline route, and wooded grasslands. The wetlands associated with Lake Albert's shoreline (in particular, the lagoon, and the lower reaches of the Masika River) are important breeding and nursery areas for the Nile Soft-shelled Turtle and the Nile Crocodile. The ravines associated with the watercourses draining off the escarpment are important habitats for a variety of reptiles. Importantly, the heterogeneity of habitats in the wider LSA is important for maintaining reptile diversity.

For further discussion and assessment of habitats, please refer to Section 7.1.

### 6.1.4 Birds

A summary of the baseline of the bird species of the LSA is presented based on the findings of the desktop study and the field investigations. The detailed baseline studies are presented in Appendix C.

#### Species Richness, Diversity and Abundance

Two-hundred-and-eighty-three species were recorded in the LSA; mostly composed of species typical of the area. However, no forest specialists were recorded, and only a few forest generalists, reflecting the almost total loss of the original forest cover of the escarpment and the land above it. The seasonally flooded and permanent wetlands of the Buhuka Flats supported a wide variety of waterbirds, while grassland species were well-represented in the open areas. Interestingly, the diversity of aerial feeder species (like martins, swifts and their kin) was low, but the number of individuals was high.

The richness of species along the pipeline route was less than the flats; however, the diversity was still quite high, with 29 species recorded that were unique to that area.

Fifty-five species of waders and waterbirds were recorded in the LSA, primarily from the shore of Lake Albert and the wetlands on the Buhuka Flats. Notable species include: the first record of the Terek Sandpiper (Xenus cinereus) from Lake Albert; the second record of the Lesser Sandplover (*Charadrius mongolus*) for Uganda.

The species richness and abundance of individuals increased as expected during the peak migratory period of September/October. Some Palearctic migratory stragglers were still present in February-March in some numbers. Although very large numbers of migratory species were not recorded, it is conceivable that Lake Albert as a whole could support significant numbers. For example, a 1 km count along the shores of the lake, south from the jetty, produced over 400 birds of 27 species. Given this, and the fact that the lake is ~180 km long, it is conceivable that the shores of Lake Albert could support as many as 100,000 birds, just on the Ugandan side. The number of these species and individuals had significantly dropped during the May-June survey indicating that the majority of individuals had migrated away from the lake. Therefore, it can be expected that during the peak migratory period, the numbers of birds in the area will be substantial.

Interestingly, 16 raptor species were recorded. The Albertine Rift is a known migratory route for raptors, yet all the species recorded were residents.

#### Species of Concern

The majority of species recorded in the LSA were of Least Concern status, and tended to be common species in the area. Two species listed as Endangered by the IUCN were recorded; these were Grey Crowned Crane (*Balearica regulorum*) and White-backed Vulture (*Gyps africanus*).

Grey Crowned Crane was recorded on the Buhuka Flats, where up to 14 individuals were regularly seen. (Appendix C). Indications were that breeding pairs were beginning to form at the end of May. Twenty White-backed Vultures were seen overflying the LSA in February.

Twelve regionally listed species were recorded in the LSA. These included: the vulnerable Martial Eagle (*Polemaetus bellicosus*), African Skimmer (*Rynchops flavirostris*), Grosbeak Weaver (*Amblyospiza albifrons*), Saddle-billed Stork (*Ephippiorhynchus senegalensis*), Great White Egret (*Ardea alba*); and the near threatened Purple Heron (*Ardea purpurea*), Grey Heron (*Ardea cinerea*), Goliath Heron (*Ardea goliath*), Brown Snake-eagle (*Brown Snake-eagle*), African Marsh Harrier (*Circus ranivorus*), Black-bellied Firefinch (*Lagonosticta rara*), and Vieillot's Black Weaver (*Ploceus nigerrimus*). Interestingly, individuals of most of these species were encountered throughout the entire LSA; that is, the Buhuka Flats, the escarpment and the pipeline route.

Other species of interest included the east African endemics: Spotted-flanked Barbet (*Tricholaema lacrymosa*), White-headed Saw-wing (*Psalidoprocne albiceps*), Black-lored Babbler (*Turdoides sharpie*), Red-chested Sunbird (*Cinnyris erythrocercus*), Baglafecht's Weaver (*Ploceus baglafechtii*), Red-headed Quelea (*Quelea erythrops*), and Grey-headed Oliveback (*Nesocharis capistrata*).

Palearctic migratory species were more abundant during the dry season and the second wet season (corresponding to the peak migratory period of September/October), when 39 species were recorded. These included: Black-winged Stilt (*Himantopus himantopus*); Common Ringed Plover (*Charadrius hiaticula*); Lesser Sandplover (*Charadrius mongolus*); Little Stint (*Calidris minuta*); Ruff (*Philomachus pugnax*); Common Snipe (*Gallinago gallinago*), Common Greenshank (*Tringa nebularia*), Green Sandpiper (*T. ochropus*); Wood Sandpiper (*T. glareola*); Terek Sandpiper (*Xenus cinereus*); Common Sandpiper (*Actitis hypoleucos*); White-winged Tern (*Chlidonias leucopterus*); Eurasian Reed Warbler (*Acrocephalus scirpaceus*); Great Reed Warbler (*A. arundinaceus*); Willow Warbler (*Phylloscopus trochilus*); Garden Warbler (*Sylvia borin*); Black Stork (*Ciconia nigra*); Black Kite (*Milvus migrans*); Eurasian Marsh Harrier (*Circus aeruginosus*); European Honey Buzzard (*Pernis apivorus*); Lesser Spotted Eagle (*Aquila pomarina*); Tawny Eagle (*Aq. rapax*); Booted Eagle (*Hieraaetus pennatus*); Great Spotted Cuckoo (*Clamator glandarius*); Blue-cheeked Bee-eater (*Merops persicus*); Eurasian Bee-eater (*M. apiaster*); African Hoopoe (*Upupa epops*); Sand Martin (*Riparia riparia*); Eurasian Swallow (*Hirundo rustica*); Yellow Wagtail (*Motacilla flava*); Red-throated Pipit (*Anthus cervinus*); Whichat (*Saxicola rubetra*); Northern Wheatear (*Oenanthe oenanthe*); Isabelline Wheatear (*O. isabellina*); Pied Wheatear (*O. pleschanka*); Woodchat Shrike (*Lanius senator*); Spotted Flycatcher (*Muscicapa striata*); Semi-collared Flycatcher (*Ficedula semitorquata*); and Nightingale (*Luscinia megarhynchos*). Overall, numbers of both Palearctic and Afrotropical species were quite high; however, the majority of waterbirds are resident in Uganda, making only local movements in response to rainfall.

For further discussion and assessment of these and other species that may potentially occur in the CHAA, see Section 7.2.

## Habitats

The bird recorded in the LSA represent guilds that are closely tied to the various habitats of the area, as well as many generalist species. For example, woody vegetation associated with wooded grassland and woodland communities was important for a variety of tree-dependent species; while the more open areas are important for species such as Temminck's Courser (*Cursorius temminckii*), Grey Crowned Crane (*Balearica regulorum*) and a variety of plovers and lapwings, whilst the seasonally flooded and permanent swamps, support a wide variety of bird species.

Nevertheless, habitats of importance for birds within the LSA, based on species richness and diversity, included: the ecotonal habitat at the foot of the escarpment and the escarpment face; the permanent wetlands associated with the Masika and Kamansinig Rivers; and the shore of Lake Albert. The proposed pipeline route passes through predominantly agricultural country. Although largely disturbed and modified, these habitats are, nevertheless, species rich.

For further discussion and assessment of habitats, please refer to 7.1.

### 6.1.5 Mammals

A summary of the baseline of the mammal species of the LSA is presented based on the findings of the desktop study and the field investigations. The detailed baseline studies are presented in Appendix C.

#### Species Richness, Diversity and Abundance

Generally, the LSA supports a depauperate community and populations of medium to large-sized mammals, presumably due to the strong influence of human disturbance and associated pressures (*viz.*, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). The mammal fauna assemblage is dominated by small to medium-sized species such as rodents, shrews, bats, mongoose, rabbits, duiker, bushbuck and primates.

Thirteen species of non-volent small mammals (that is, rodents and shrews) were recorded on the Buhuka Flats and escarpment area, which comprised 11 species of rodent and two shrews. Those areas surveyed along the pipeline route only recorded two species of rodent. These low figures for species richness and diversity may be an artefact of the sampling effort (see Section 3.4). The Pygmy Mouse (*Mus minutoides*) was the most abundant and common, followed by the Multimammate Mouse (*Mastomys natalensis*).

Two species of fruit bat (Sub-order: Megachiroptera), the Ethiopian Epauletted Fruit Bat (*Epomophorus labiatus*) and Peter's Dwarf Epauletted Fruit Bat (*Micropteropus pusillus*) were recorded from Buhuka Flats. Sixteen confirmed species of insectivorous bats (Sub-order: Mircochiroptera) were recorded from the Buhuka Flats, with possibly another two unconfirmed species. These represent the majority of species expected to occur in the CHAA.

The most common and abundant species were the Yellow House Bat (*Scotophilus dingani*), the Dark-winged Lesser House Bat (*Scotoecus hirundo*) and the Banana Pipistrelle Bat (*Neoromicia nanus*) appeared to occur in survey areas at higher levels of activity.

Thirteen medium-sized mammals were recorded in the LSA. These species tended to be habitat generalists, and included four primates: Vervet Monkey (*Cercopithecus aethiops*), Red-tailed Monkey (*C. ascanius*), Colobus Monkey (*Colobus guereza*) and Olive Baboon (*Papio anubis*); three viverrids: African Civet (*Civetta civetictis*), African Palm Civet (*Nandinia binotata*) and Small-spotted Genet (*Geneta tigrina*); a herpestid: the Marsh Mongoose (*Atilax paludinosus*); three rodents: Lesser Cane-rat (*Thryonomys gregorianus*), Bunyoro Rabbit (*Poelagus marjorita*) and Stripped Ground Squirrel (*Xerus erythropus*); and two bovids: Bush Duiker (*Sylivicapra grimmia*), and Bushbuck (*Tragelaphus scriptus*). These species appear to be sparsely distributed throughout the LSA. Of interest though is the relatively high diversity of carnivores and omnivores. The populations of all the species recorded within the LSA are unknown.

A small population of Hippopotamus occurs on the Buhuka Flats. No accurate counts of the number of individuals occur, however, it is doubtful that more than five animals exist in this isolated population (pers. obs.).

#### Species of Concern

As discussed, the majority of species recorded were cosmopolitan, generalist species with a Least Concern status and stable populations, as assessed by the IUCN. The notable exception being the small population of Hippopotamus on the Buhuka Flats; this species is listed as Vulnerable by the IUCN, with a decreasing population (Lewinson and Oliver 2008). Within Uganda, this species is recognised as having a restricted distribution, although it is locally abundant; as such, it is fully protected under the law (Lewinson and Oliver 2008).

Five species of bats recorded in the LSA are potentially cave or cavity roosting species. These include the Little Free-tailed Bat (*Chaerephon pumila*), Angolan Free-tailed Bat (*Mops condylura*), a Bent-wing Bat (*Miniopterus* sp.), the Dark-winged Lesser House Bat and Yellow House Bat. Although no caves were identified within the LSA that could house colonies of these species, there is a possibility that such features could exist, particularly on the escarpment. Of most interest is the Bent-Wing Bat. This species is listed in CITES Appendix II (UNEP-WCMC 2018), and is known to roost in caves housing hundreds or even thousands of individuals (Monadjem et al. 2010).

For further discussion and assessment of these and other species that may potentially occur in the CHAA, see Section 6.3.2.

### Habitats

As mentioned, the majority of the species recorded in the LSA are habitat generalists and quite wide ranging. There are obvious exceptions. The Bugoma Lagoon area and swamps of the lower reaches of the Masika River are important daytime refuges for the local Hippopotamuses, along with many other small and medium-sized mammals. Similarly, the seasonally flooded wetlands of the upper reaches of the Masika River and its tributaries, and the ones associated with the Kamansinig River, as well as those along the pipeline route, are important habitats for the small mammal assemblages in the LSA.

The escarpment is an important habitat for all the mammal species recorded in the LSA. It not only forms a continuous corridor along the length of Lake Albert, but it also offers important refugial sites for many of the small mammal species; notably the cavity and cave roosting bat species. The escarpment is dissected by numerous watercourses draining off the plateau; these watercourses form incised ravines in the escarpment that have the potential to support significant roosting sites for bats.

The thicket communities on the Buhuka Flats, and remnant vegetation patches along the pipeline route form important refuges and resource areas for small mammals.

For further discussion and assessment of habitats, please refer to Section 7.2.

## 6.2 Aquatic Biodiversity

This section focuses on describing the baseline aquatic biodiversity of the LSA and CHAA. It summarises the findings reported in the aquatic ecology baseline reports, as presented in Appendix D.

### 6.2.1 Water Quality

The water quality characteristics, as relevant to aquatic ecology, of the near-shore environment of Lake Albert, the Masika River, the Kamansinig River and the Well Pad 2 Stream are summarised below.

#### General Parameters – Lake Albert

Generally, the water quality parameters assessed for Lake Albert fell within the accepted limits of Uganda's national drinking water standards (the Ugandan standards), as published by the National Water and Sewerage Cooperation (NEMA 1996). Generally, the water quality at all sites sampled in Lake Albert was suitable for fisheries productivity and maintenance of other aquatic biodiversity (Appendix D).

Dissolved oxygen ranged between 7.03 and 7.95 $mgL^{-1}$, levels conducive to an environment supporting a high fish biomass (Romaire 1985), and tended to be higher in the wet season.

The pH had a narrow range between 9.45 and 9.66, which, although above the Ugandan standards, is considered normal for Lake Albert. Interestingly, this pH is higher than the values for the rivers draining off the escarpment, which ranged between 8.8 and 9.2. These findings are similar to the findings from 50 years ago, when the pH ranged from 8.9 to 9.1 (Talling 1963). Typically, a pH above 9.5 can lead to ammonia toxicity to fisheries (Beveridge, 1996); however, this high level apparently has little effect on the biodiversity of the lake.

Conductivity had a narrow range of 632 to 634 $\mu S.cm^{-1}$; these values were less than those recorded by Talling (1963), which ranged from 720 to 780 $\mu S.cm^{-1}$.

Interestingly, this pH is higher than the values for the rivers draining off the escarpment, which ranged between 8.8 and 9.2.

#### General Parameters – Rivers and Wetlands

Generally, the water quality parameters assessed for the rivers and wetlands fell within the accepted limits of Uganda's national drinking water standards (the Ugandan standards), as published by the National Water and Sewerage Cooperation (NEMA 1996). Dissolved oxygen varied at all sites sampled, ranging from 1.3 $mg.L^{-1}$, near the mouth of the Masika River, to 9.2 $mg.L^{-1}$ in the Well Pad 2 River mid-stream. The pH also varied, ranging from 7.1 at the mouth of the Masika River, to 9.6 at the mid-stream of Well Pad 2 stream. Similarly, the conductivity ranged 278 µS.cm$^{-1}$ at the mouth of the Masika River, to 966 µS.cm$^{-1}$ in the middle of the Bugoma Lagoon.

### Phosphorous Compound – Lake Albert

The total phosphorus concentration ranged from 21.1 to 43.9 µg.L$^{-1}$ between the dry and wet season; these concentrations supply soluble reactive phosphorus (SRP) in the range of 0.0 to 3.4 µg.L$^{-1}$, a range which would typically lead to the lake waters off the Buhuka Flats being classed as nutrient poor and not very productive (that is, oligotrophic) (OECD 1982). However, other nutrient sources within the water column, such as soluble reactive silica (SRSi) (see below), which drives diatom biomass, counter the oligotrophic conditions. Furthermore, green and blue-green algae readily absorb the SRP, thereby increasing the biomass in the otherwise nutrient poor (that is, oligotrophic) environment.

Within such a system, as represented by Lake Albert, aquatic biodiversity can be unique, with endemic and range-restricted species encountered that are adapted to the nutrient poor conditions. Such a system is sensitive to phosphorous loading, such as that occurring from agricultural run-off and pollution, which, in turn, can adversely affect fish production.

### Phosphorous Compound – Rivers and Wetlands

The overall total phosphorus concentration ranged from 79.4 to 350.3 µg.L$^{-1}$, supplying SRP in the range of 0.2 in the middle of the lagoon, to 34.5 µg.L$^{-1}$ at the mouth of the Masika River. The influence of soap products, from local people doing their washing in the rivers, may have resulted in the high concentrations observed.

### Silica Compound – Lake Albert

The SRSi levels were relatively high in all samples from Lake Albert, and ranged from 410 to 1096 µg.L$^{-1}$ in the wet and dry season. As mentioned above, SRSi is readily absorbed by diatoms; in particular, the diatom genera *Cyclostephanodiscus* and *Nitzschia* are abundant in the lake, and form an important food source for fish.

### Silica Compound – Rivers and Wetlands

At the time of the first wet season sampling, sufficient rainfall had not yet fallen; hence, there was no water connectivity between the lake and the rivers and wetlands draining off the escarpment and the Buhuka Flats. As such, the concentration of SRSi was similar in these systems compared to the lake. The SRSi ranged from 456.7 to 929.7 µg.L$^{-1}$ in all the nine sites sampled. It is expected that, following sufficient rainfall, these systems will be flushed and the concentrations of SRSi may drop.

### Nitrogen Compound – Lake Albert

Total Nitrogen concentration decreased in the wet season, ranging from 149 to 872 µg.L$^{-1}$, compared to the dry season, which ranged from 407.8 to 729.2 µg.L$^{-1}$. These concentrations support high levels of phytoplankton, which is the major carbon producer, and food source for fish in Lake Albert. As expected, the total nitrogen concentrations in the vicinity of the confluence of the Masika River and Lake Albert were the highest, at 872 µg.L$^{-1}$.

Ammonia concentrations within the water column were similar in the wet and dry seasons, ranging from 3.1 to 28.7 µg.L$^{-1}$. The higher concentrations of 22.3 and 28.7µg.L$^{-1}$ were recorded from the sampling locations associated with Pad 2 and the confluence of the Masika River and Lake Albert. The reason as to why the concentration at the Pad 2 sampling locations is unclear; however, the high concentrations recorded at the Masika River's confluence were not unexpected. Although ammonia becomes detrimental to fish health at concentrations greater than 20 µg.L$^{-1}$, typically, within a healthy aquatic ecosystem, it is converted immediately into nitrate in the presence of oxygen (via the intermediate product nitrite) (Delince 1992). Within the samples from Lake Albert, nitrate concentrations ranged from 15.3 to 95.3 µg.L$^{-1}$ indicating efficient conversion of toxic ammonia, driven by good dissolved oxygen concentrations, which were greater than 7.0 mg.L$^{-1}$ at all sites (see above). Consequently, ammonia concentrations were observed to drop below 5 µg.L$^{-1}$ further into the lake. As such, the aquatic ecosystem offshore from the Buhuka Flats is healthy, as indicated by the efficient conversion of ammonia and good concentrations of dissolved oxygen.

### Nitrogen Compound – Rivers and Wetlands

The total nitrogen concentration ranged from 104.2 to 863. $\mu g.L^{-1}$ at all sites sampled, which presented an ammonia concentration ranging from 4.4 to 33.9 $\mu g.L^{-1}$. Nitrate concentrations ranged from 18.6 to 179.7 $\mu g.L^{-1}$. The higher concentrations were observed at the mouth of the Masika River and could be the result of an oxygen deprived environment.

### Chlorophyll a – Lake Albert

Chlorophyll a, an indirect determinant of algal biomass (Heckey 1993), ranged from 1.0 to 3.1 $\mu g.L^{-1}$ in the wet season, and 1.7 to 8.7 $\mu g.L^{-1}$ in the dry season. Similar to the observed concentrations of phosphorous, the concentrations of chlorophyll a qualifies the lake waters offshore from the Buhuka Flats as nutrient poor (that is, oligotrophic – being in the range of 0 to 8.5 $\mu g.L^{-1}$ according to OECD 1982). Within Lake Albert, this range indicates a stable food supply for the fish without visible algal blooms.

### Chlorophyll a – Rivers and Wetlands

Chlorophyll a, ranged from 0.0 to 18.3 $\mu g.L^{-1}$, which could be expected to decrease during the wet season as the algal growth is suppressed by the growth of emergent wetland plants and the shade they produce.

### Faecal Coliform – Lake Albert

The National Water and Sewerage Cooperation (NEMA 1996) identifies that zero colony forming units (CFU) per 100 mL is the recommended concentration of faecal coliform for drinking water, it is also the recommended level for the maintenance of healthy aquatic biodiversity.

Faecal coliform concentrations within Lake Albert, at the locations sampled, ranged from 2 to 8 CFU per 100 ml in the dry season, jumping to 2 to 100 CFU per 100 ml in the wet season. As expected, concentrations were higher at the inshore sampling sites, and decreased further out into the lake.

The marked difference between the wet and dry season concentrations can be attributed to the increased run-off experienced during the wet season into the lake.

### Faecal Coliform – Rivers and Wetlands

All sites within the rivers and wetlands assessed on the Buhuka Flats had faecal coliform ranging from four to 504 CFU per 100 ml. These values are well above the National Water and Sewerage Cooperation standard.

## 6.2.2 Phytoplankton

The phytoplankton communities of the near-shore environment of Lake Albert, the Masika River, the Kamansinig River and the Well Pad 2 stream are summarised below.

### Species Richness, Diversity and Abundance – Lake Albert

Thirty-five genera were identified in the phytoplankton communities of Lake Albert, offshore from the Buhuka Flats, over the wet season compared to the 26 genera identified during the dry season. These comprised: blue-green algae – 20 species comprised of eight genera; simple algae (that is, Cryptomonads, Dinoflagellates, Euglenoids) – two species each (interestingly, the Euglenoids were not recorded in the dry season); diatoms – eight species comprised of six genera; filamentous green algae – 18 species comprised of 12 genera. Generally, the species diversity increased across all groups from the dry season to the wet season.

Among the blue-green algae, six species (*Anabaenopsis tanganikae*, *Aphanocapsa incerta*, *Ap. nubilium*, *Chroococcus limneticus*, *Planktolyngbya circumcreta* and *P. limnetica*) were present at all sites sampled. Other taxa, such as *Cylindrospermopsis, Merismopedia* and *Coelosphaerium,* were rare. One species, *Microcystis aeruginosa*, recently identified as the only toxin-producing blue-green algae in Ugandan freshwater habitats (Okello et al. 2010), was conspicuously absent at all sites sampled. This is a notable observation given that this species prefers polluted environments, and its absence suggests that the waters of Lake Albert are a relatively pristine environment (Okello et al. 2010).

Of the five genera of Diatoms identified, three taxa: *Cyclostephanodiscus* species; *Nitzschia acicularis* and *N. fonticola*, were represented at all sites sampled, while *Navicula* species were found at fewer sites. The genus

*Aulacoseira* was conspicuously absent in the dry season, yet was encountered during the wet season. This difference between the seasons could be attributed to this taxon being selectively fed upon by zooplankton and fish. Interestingly, this taxon has almost disappeared from Lake Victoria, which has apparently led to the virtual total decline of some native fish species which feed almost exclusively upon it (Ogutu-Ohwayo et al, 2002).

The majority of the 18 filamentous green algae species identified were widespread across all the sampling sites. Some taxa increased during the wet season compared to the dry season, although seven genera (*viz., Closterium*, *Dictyosphaerium*, *Didymocystis*, *Gonatozygon*, *Kirchneriella*, *Oocystis* and *Pediastrum* were rare during the dry and wet seasons.

In general, there was an increase in the species composition per site from the dry season to the wet season; ranging from 15 to 23 species in the dry, to 18 to 26 species in the wet.

The composition of the phytoplankton community within Lake Albert differed between the dry and wet seasons. During the dry season, the phytoplankton communities were dominated (>50%) by diatoms (ranging from 15.46 to 85.35 $mm^3.L^{-1}$), with blue-green algae comprising between 13.92 and 70.34 $mm^3.L^{-1}$ of the biomass volume. In the wet season, blue-green algae dominated (ranging from 0.84 to 3.53 $mm^3.L^{-1}$), while the diatom communities decreased markedly to between 0.91 and 3.09 $mm^3.L^{-1}$. Both diatom and blue-green algae biomass tended to be higher in the offshore areas (~1 km) compared to the inshore areas.

It is interesting to note that the diatom biomass recorded in Lake Albert during the dry season was lower than that recorded in Lake Edward and Lake George, which ranged from 45 to 230 $mm^3.L^{-1}$ and 90 to 420 $mm^3.L^{-1}$, respectively (Okello and Kurmayer, 2011).

Single-celled algae (that is, Cryptomonads) populations increased from the dry season (~0.94 $mm^3.L^{-1}$) to the wet season (from 0.09 to 0.14 $mm^3.L^{-1}$), although they only constituted a minor proportion of the phytoplankton communities. Multi-celled algae (in particular, Dinoflagellates) were not recorded during the dry season, yet, during the wet season, their populations increased to around 0.12 $mm^3.L^{-1}$. Green algae biomass ranged between 1.38 and 37.19 $mm^3.L^{-1}$ in the dry season, and dropped to between 0.05 and 8.46 $mm^3.L^{-1}$ in the wet season.

The observed difference between the seasons could be attributed to the increase in grazing pressure from the larger zooplankton population, which increased during the wet season (see below).

### Species Richness, Diversity and Abundance – Rivers and Wetlands

Thirty-one genera, belonging to five families were identified in the phytoplankton communities of the rivers and wetlands of the LSA. These included: blue-green algae – ten species in nine genera; simple algae – one species in a single genus (which was only recorded in the lagoon); diatoms – eight species in eight genera; filamentous green algae – 13 species in 11 genera.

Among the blue-green algae, five species (*Anabaena circinalis*, *Aphanocapsa nubilium*, *Chroococcus limneticus*, *Merismopedia tenuissima* and *Planktolyngbya limnetica*) were present at all sites sampled. Like the blue-green algal community of Lake Albert, *Microcystis aeruginosa*, was conspicuously absent at all sites sampled. This is a notable observation given that this species prefers polluted environments, and its absence suggests that the waters of the rivers and wetlands of the LSA are a relatively pristine environment (Okello et al. 2010).

Ten of the identified species of diatom were recorded in the Masika River and the lagoon. Only four species were recorded in the Kamansinig River, these were: *Navicula gastrum*; *Nitzschia acicularis*; *Ni. onticola* and *Surirella* sp.). The rare *Aulacoseira* was present in the lagoon.

The 13 species of filamentous green algae were mainly present in the Bugoma Lagoon sites, being absent from the Kamansinig River, and only represented by one genus, *Actinastrum*, in the Masika River.

The Bugoma Lagoon wetland had the highest total phytoplankton biomass of ~190 $mm^3. L^{-1}$. Of this, more than 50% was contributed by the blue-green algae, while diatoms and filamentous green algae shared similar proportions. Simple algae appeared in minor quantities.

### Species of Concern

Of all the taxa of phytoplankton identified during the dry and wet season, only the genus *Aulacoseira* is a group of special interest. As mentioned above, this has almost disappeared from Lake Victoria, which has apparently led to the virtual total decline of some native fish species which feed almost exclusively upon it (Ogutu-Ohwayo et al. 2002). Its existence in Lake Albert suggests that this lake is still relatively undisturbed and unpolluted.

For further discussion and assessment of these and other species that may potentially occur in the CHAA, see Section 6.3.2.

### Habitats

The near-shore environment of Lake Albert, the watercourses and wetlands of the Buhuka Flats support a diverse assemblage of phytoplankton. These areas are naturally higher in nutrients that support higher biomasses of phytoplankton, which, in turn, drive the food web of the south-eastern shores of Lake Albert, and, potentially, contribute to the food web of the wider lake.

For further discussion and assessment of habitats, please refer to Section 6.3.1.

## 6.2.3 Zooplankton

The zooplankton communities of the near-shore environment of Lake Albert, the Masika River, the Kamansinig River and the Well Pad 2 stream are summarised below.

### Species Richness, Diversity and Abundance – Lake Albert

The zooplankton communities within Lake Albert and the Bugoma Lagoon wetland of the Buhuka Flats are dominated by three taxa: Copepod crustaceans (Order: Copepoda) (comprising three species); water fleas (Order: Cladocera) (comprising seven species), and rotifers, or wheel animals (Phylum: Rotifera) (comprising nine species). Depending on the location: Copepods comprised, on average, 56% (range: 0% to 100%) of the zooplankton biomass in the dry season samples, and 69% (range 8% to 100%) in the wet season samples; water fleas comprised, on average, 49% (range: 10% to 90%) of the biomass in the dry season samples, and 38% (range 0% to 92%) in the wet season samples; rotifers comprised, on average, 26% (range: 0% to 80%) of the biomass in the dry season samples, and 33% (range 0% to 100%) in the wet season samples.

In Lake Albert, zooplankton abundance was dominated by the Copepods *Thermocyclops neglectus* and *Mesocyclops* sp., the water fleas *Diaphanosoma excisum* and *Moina micrura*, and the rotifer *Keratella tropica*. The relative abundance was higher in the offshore environments compared to the inshore environments. In contrast, the zooplankton abundance of the Bugoma Lagoon was dominated by the rotifers *Brachionus angularis*, *B. calyciflorus*, and *B. falcatus*, with the Copepod *T. neglectus* and water fleas *M. micrura* and *D. excisum* also strongly represented.

The Bugoma Lagoon supported the highest number of rotifer species, yet also exhibited the highest decline in species richness from the dry season to the wet season. There was a marked difference in species diversity, compositions and abundance between the dry season and the wet season at all sites sampled. In the lagoon, total abundance of zooplankton decreased from an average of ~1,000,000 individuals per square metre in the dry season, to an average of ~180,000 individuals per square metre in the wet season. The dominant taxa comprising these abundances also shifted between the dry and wet seasons; as mentioned above, Copepods were more abundant in the wet season than the dry, while rotifers dominated in the dry season. The opposite trend was observed in Lake Albert. Here the zooplankton abundance increased from an average of ~350,000 individuals per square metre in the dry season, to an average of ~1,400,000 individuals per square metre in the wet season. Certainly, in Lake Albert, there was a tremendous increase in abundance of all taxa in the wet season compared to dry season.

In comparison with other lakes in the Victoria basin (for example, see Vincent et al. 2012, Mwebaza-Ndawula et al. 2003), the diversity of zooplankton in this particular part of Lake Albert is generally low. Nonetheless, key species reported to characterize zooplankton assemblages of Ugandan lakes, and which are important food species for fish (Mwebaza-Ndawula et al. 2004), occurred in relatively high abundance.

### Species of Concern

No species of concern were identified in the zooplankton communities in the LSA.

For further discussion and assessment of other species that may potentially occur in the CHAA, see Section 6.3.2.

### Habitats

The zooplankton communities of near-shore and off-shore environments of Lake Albert reflect a healthy water habitat dominated by Cyclopoid Copepods. A similar healthy environment was reported in Lake Albert over a decade ago by Lehman et al. (1998). The exception is the Bugoma Lagoon, where high numbers of rotifers were observed. Typically, a high abundance of rotifers, notably species of *Brachionus*, as observed in the lagoon, reflect elevated levels of pollution, or eutrophication, of waterbodies (Radwan and Popiolek 1989, Tasevska et al. 2010). This is possibly the current situation in the Bugoma Lagoon where *B. angularis* and *B. calyciflorus* were abundant. Another notable observation was the absence of the predatory Cyclopoid copepod, *Mesocyclops* sp., in the lagoon, yet it was recorded in >75% of the other sites sampled. The changes in the zooplankton assemblages in the Bugoma Lagoon, and the dominance of rotifers, could also be due to the lack of connectivity with the lake and the consequent stagnation of the water coupled with the increase in nutrient loads in-flowing from the Kamansinig River and the hinterland, as well as the presence of Hippopotamus adding to the nutrient loading.

Nevertheless, the dominance of Copepods in the aquatic habitats of Lake Albert is important. These taxa are keystone species in sustaining fish communities in most water bodies (Mwebaza-Ndawula et al. 2001, Mwebaza-Ndawula et al. 2003, Mwebaza-Ndawula et al. 2004). As such, the near-shore habitats, wetlands of the lower Masika River and Kamansinig River, and the large bays of the Buhuka Flats are important habitats for zooplankton.

For further discussion and assessment of habitats, please refer to Section 6.3.1.

## 6.2.4 Macro-invertebrates

The macro-invertebrate communities of the near-shore environment of Lake Albert, the Masika River, the Kamansinig River and the Well Pad 2 stream are summarised below.

### Species Richness, Diversity and Abundance – Lake Albert

Species richness of mayflies (Order: Ephemeroptera), stoneflies (Order: Plecoptera) and caddis flies (Order: Trichoptera) (EPT) in Lake Albert was low, yet similar in the dry season and both wet season samples, ranging from zero to 15.

The species diversity was equally low during the dry and both wet seasons, being dominated by a few taxa; the mayfly Povilla adusta, the molluscs *Melanoides tuberculata*, *Gabbia humerosa*, and *Bellamya unicolor*, and the freshwater clam *Corbicula africana*. In terms of abundance of individuals, mayflies comprised the largest number (0 to 1707 larvae per square metre), yet only included three species (dominated by *Povilla adusta,* with *Caenis* sp. and *Baetis* sp. also occurring); while no stoneflies were recorded during any of the seasonal surveys. Among the caddis flies, only members of the family Psychomidae were recorded in the dry season, only *Dipseudopsis* spp. (Family: Dipseudopsidae) was recorded in the first wet season, and both were recorded during the second wet season survey.

The larvae of phantom midges (Family: Chaoboridae) were common and abundant (up to 294 larvae per square metre) in the inshore and offshore sediments of Lake Albert across all sampling periods. Larvae of non-biting midges (Family: Chironomidae) and biting midges (Family: Ceratopogonidae) were also relatively abundant.

Snails (Phylum: Gastropoda), freshwater mussels (bivalves in the Order: Unionoidea), freshwater clams (*Corbicula africana*) and aquatic worms (Phylum: Annelida, Class: Oligochaeta) were the most common and abundant macro-invertebrates recovered from bottom sediments in the dry and wet seasons.

During the dry season, five snail taxa (*Melanoides tuberculata*, *Cleopatra* sp., *Gabbia* (*Gabbiella*) *humerosa*, *G. walleri* and *Bellamya unicolor*) were the most abundant and widely distributed. In contrast, during the first wet season two species (*viz.*, *M. tuberculata* and *B. unicolor*) were the most abundant and widely distributed taxa. Their densities ranged from zero to 1064 individuals per square metre in the dry season, and zero to 896 in the wet season. In the second wet season, *Gabbia humerosa* was most abundant with densities of 1401 - 1078 individuals per square metre recorded at two locations (Pad 2 and Pad 3 inshore); this species was not recorded at any other location on that occasion.

Two species of freshwater mussel (*viz.*, *Byssanodonta parasitica* and *Corbicula africana*) were common and abundant. Their densities in the dry season were markedly less than the first wet season survey (that is, zero to 294 individuals per square metre in the dry, compared to zero to 672 individuals per square metre in the first wet). In the second wet season survey, significantly higher number of individuals were recorded at the Pad 1 offshore site only (zero to 518 individuals of *B. parasitica* and zero to 140 individuals of *C. africana*) with the other sites supporting relatively low numbers.

The densities of aquatic worms (Oligochaetes) ranged from zero to 98 individuals per square metre in the dry season, up to 168 per square metre in the first wet season, and up to 42 per square metre in the second wet season; the highest densities being recorded in inshore habitats adjacent to the lagoon.

Total taxa richness scores in Lake Albert were similar in both of the wet and dry season samples, with an average of seven species (range: three to 15 species) recorded in the inshore habitats, and eight species (range: two to 15 species) recorded in the offshore habitats. Importantly, the densities of the various groups varied, sometimes significantly, between the dry and wet seasons, with higher densities observed for all groups during the first wet season.

Based on EPT and total taxa richness scores for the dry and wet season surveys, the sampling sites in Lake Albert and the wetlands of the Buhuka Flats showed varying environmental conditions. Only the inshore sampling sites in the vicinity of Pad 1 and Pad 4-2 reflected a moderate to good environmental condition. Those sampling locations in the vicinity of Pad 2 (offshore), Pad 3, Pad 4-2 (offshore), Pad 5 (offshore), and in the Bugoma Lagoon reflected fair environmental conditions. Interestingly, the remainder of the sites, namely Pad 1 (offshore), Pad 2 (inshore) and Pad 5 (inshore) reflected poor environmental conditions.

Typically, densities of benthic macro-invertebrates, especially the insect group (that is, mayflies, stoneflies, caddis flies and midges), tend to increase from the dry to wet season (Wetzel 2001). The numbers of the mayfly *Povilla adusta* and phantom midges (*Chaoboridae*) recorded across the three sampling periods reflected this trend, however, the same trend was not observed in any of the other macro-invertebrate samples from the LSA. The reasons for this are not clear based on the current data and sampling regime.

It should be noted that a dedicated search conducted in November 2014 as part of the second wet season survey did not find *Bellamya rubicunda* or *Gabiella candida* at either the Lake Albert inshore stations or the wetland streams of the Buhuka Flats (see Appendix D).

### Species Richness, Diversity and Abundance – Rivers and Wetlands

The most common macro-invertebrates in the rivers and wetlands were: mayflies (*Baetis* spp., Order: Ephemeroptera) and caddis flies (*Cheumatopsyche* spp., Order: Trichoptera), with densities ranging from 0 to 6,723 individuals/m$^2$ and 2801 individuals/m$^2$ respectively; dragonflies (Brachymesia spp., Order: Libellulidae; and) with mean density of 0 to 126 individuals/m$^2$ recorded in the River Masika at the base of the escarpment; water bugs (*Macrocoris* spp., Order: Hemiptera), with mean density of 0 to 98 individuals/m$^2$; non-biting midges (Order: Diptera, Chironomidae), with 0 to 98 individuals/m$^2$; and aquatic worms, with 0 to 385 individuals/m$^2$. Other notable groups included black flies (Order: Diptera, Simuliidae), with densities ranging from 0 to 210 individuals/m$^2$, recorded from the mouth of Well Pad 2 stream. Importantly, the densities and species composition of the various groups varied, sometimes significantly, between the dry and wet seasons, with higher densities observed for all groups during the wet seasons; particularly the dragonflies which were present in much greater densities during the second wet season survey than the previous sampling events.

Freshwater snails (*Biomphalaria* spp.) were recorded in the Kamansinig River, Masika River and Well Pad 2 stream.

Based on the EPT scores, the Kamansinig River at the foot of the escarpment reflected a moderate to good environmental condition, the remainder of the river and wetland habitats were fair to poor. Total taxa richness scores for the Kamansinig River and Well Pad 2 stream reflected a moderate to good environmental condition compared to the other sites sampled.

It is important to note that the watercourses draining off the escarpment are seasonal (Golder Associates 2014b). Therefore, low counts of macro-invertebrates would be expected in some of these sites during the dry season. This was reflected in the observed EPT diversity recorded during the second wet season; *Baetis* spp. (Ephemeroptera) and *Cheumatopsyche* spp. (Trichoptera) were abundant during this time, yet absent from the dry season surveys. Similarly, the Bugoma Lagoon appears to be isolated from the lake during the dry season. This could account for the low dissolved oxygen in the bottom sediments resulting from inadequate mixing and decomposition of plant material. These conditions in the Bugoma Lagoon support the fact that intolerant species of mayflies, stoneflies and caddis flies were absent, yet more tolerant species like non-biting midges and aquatic worms were common.

### Species of Concern

All the species recorded in the LSA were Least Concern, or not yet evaluated by the IUCN. The Critically Endangered freshwater Mud Snail (*Gabbiella candida*) has, to date, only been recorded from Butiaba, about 90 km north of the LSA (Kyambadde 2010a, GBIF 2017).

It should be noted that a dedicated search conducted in November 2014 as part of the second wet season survey did not find *Bellamya rubicunda* or *Gabiella candida* at either the Lake Albert inshore stations or the wetland streams of the Buhuka Flats (see Appendix D). Nevertheless, taking a precautionary approach, there remains a potential that these species could be found within suitable habitat in the LSA (see Section 6.3.2).

No other known macro-invertebrate species of concern were identified as occurring, or have a potential to occur, in the LSA.

### Habitats

The near-shore and inshore habitats of Lake Albert in the vicinity of the Buhuka Flats offer a diverse array of substrates (that is, clay/snail shells, sand/plant materials, soft mud, and rock/shells) that support a rich diversity of the benthic macro-invertebrates. Similarly, the wetlands associated with the Masika River, Kamansinig River, Well Pad 2 stream, and the watercourses along the pipeline route, all provide important habitat for macro-invertebrates. The Bugoma Lagoon offers a unique habitat for fish and other organisms including macro-invertebrates.

For further discussion and assessment of habitats, please refer to Section 6.3.1.

## 6.2.5 Fish

The freshwater fish communities of Lake Albert, the Masika River, the Kamansinig River and the Well Pad 2 stream are summarised below.

### Species Richness, Diversity and Abundance

Twenty-four fish species comprising 19 genera and nine families were recorded from Lake Albert in the LSA. This represents ~45% of the 53 fish species reported to occur in Lake Albert (Greenwood 1966).

Four species contributed the most biomass (% weight of catch as a surrogate for abundance – although the limitations of this are recognised) in the first wet season survey from all sampling locations in the LSA; these included: the Nile Perch (*Lates niloticus*) (42%), *Ragoge* (*Brycinus nurse*) (17%), *Ngassa* (*Hydrocynus forskahlii*) (12%) and *Angara* (*A. baremoze*) (3%). These are also some of the most commercially important species in Lake Albert (Taabu-Manyahu et al. 2012). In comparison, five species contributed the most biomass by catch in the dry season samples: Nile Perch (40%), *Ngassa* (18%), *Angara* (9%), Shield-head Catfish (*Synodontis schall*) (9%) and Black Nile Catfish (*Bagrus bajad*) (8%).

During the second wet season, *Ragoge* (*B. nurse)* dominated the catch (73%) with similar numbers being caught at Pad 1, Pad2, Pad 3 and Pad 5 sampling sites. The remainder of the catch was largely made up of Nile Perch (L. niloticus) (8%), *Ngassa* (*H. forskahlii*) (4%), Haplochromines (3%), Angara (*A. baremoze)* (1%) and *Bagrus bayad* (1%).

Other important species, in terms of abundance, included: Silver Butter Catfish (*Schilbe intermedius*) (6%), which was only recorded at two sampling locations (that is, Pad 2 and Pad 4-2) during the first wet season; a Cichlid (*Thoracochromis* (*Haplochromis*) *wingati*) (~5%) at Pad 5 during the first wet season; and another Cichlid (*T. loati*) (3%), which was recorded in sizable numbers in the vicinity of Pad 1.

Five species (*Imberi* (*Alestes macrolepidotus*), *Muziri* (*Neobola bredoi*), *Mpoi* (*Barilius* (*Distichodus*) *niloticus*, *Citharinus citharus*, *C. latus*), *Kisinja* (*Barbus* (*Labeobarbus*) *bynni*), Lake Albert Cichlid (*Thoracochromis* (*Haplochromis*) *avium*)), were not recorded during the dry season, yet were recorded in the first wet season. Conversely, the Shield-head Catfish, a Barb (*Barbus* (*Labeobarbus*) *perience*) and Mango Tilapia (*Sarotherodon galilaeus*) were recorded in the dry season, yet not in the wet season. Similarly, Senegal Bichir (*Polypterus senegalis*), *Imberi*, Barbel (*Clarius gariepinus*), *Mpoi*, *Muziri*, and Lake Albert Cichlid that were recorded in the first wet season, were not recorded in the during the second wet season. One catfish species, Sudan Squeaker (*S. frontosus*), and the African Carp (*Labeo horrie*), were recorded for the first time during the second wet season surveys. These seasonal differences seen in the community composition may be due to migratory responses to inflow of run-off into the lake.

Species composition within the Bugoma Lagoon was noticeably different compared to Lake Albert. Five species dominated the biomass of each catch; these included: Nile Tilapia (*Oreochromis niloticus*) (36%); Singidia Tilapia (*O. leucostictus*) (18%); *Imberi* (18%); Senegal Bichir (*Polypterus senegalis*) (16%); and *Angara* (8%).

In general, the fish community in the near-shore zone of the LSA is composed of a fairly uniform, multi-species mix of various ages in good condition. The diversity, age classes and condition of the species assessed is a reflection of adequate food and a healthy environment. Species distribution within the lake environment reflects that habitat requirements of each species.

The near-shore artisanal fishery is dominated by gillnets, and is mostly focused on Nile Perch, *Ragoge*, *Ngassa*, and *Angara*. *Muziri* features strongly in the seine net fishery. For more information and discussion on the fisheries, see Ecosystem Services Review.

### Species of Concern

One locally threatened species, the African Electric Catfish (*Malapterurus electricus*) may occur in the LSA. Although this species has not been recorded from LSA, it is known from the wider Lake Albert (Azeroual et al., 2010).

Eight commercially important species are known to occur within the LSA. These include the *Imberi*, *Angara*, Catfish (*Clarias lazera*), *Mpoi*, *Ngassa* (*Hydrocynus vittatus*), Nile Tilapia, Mango Tilapia, and Zill's Tilapia (*T. zillii*). The three species of *Mpoi*, the *Angara*, *Ngassa*, Butter Catfish, and Shield-head Catfish are of particular importance because these species have become very rare in Lake Albert (Wandera and Balirwa 2010). Lake Albert supports at least ten endemic, range-restricted fish species, notably the commercially important *Angara*, *Ngassa* and *Imberi* (Wandera 2000, Campbell et al. 2005, Wandera and Balirwa 2010), all of which have been recorded in the LSA.

Lake Albert has previously experienced increases in populations of *Ragoge* and *Muziri* (Wandera and Balirwa 2010). In 2012, these two species constituted 51% and 34% of commercial fish catches, and indications then were that their populations were increasing in the lake (Taabu-Manyahu et al. 2012). An increase in the populations of these species, which feed exclusively on zooplankton, could have implications for the zooplankton community structure due to increased pressure on these micro-organisms. However, recent baseline work conducted in November 2017 as part of the social baseline update indicated that fisheries are now under significant pressure in Lake Albert since the construction of the escarpment road. This new easy access to the Lake Albert shore has facilitated a large increase in fishing demand, with trucks arriving from Kampala on a near-daily basis to collect the catch. The size of fish being caught by local communities on the Flats appears to have decreased significantly, with only white bait being observed drying during 2017, compared to much larger Nile Perch observed during fieldwork conducted prior to the escarpment road being in place (see Social Impact Assessment, Ecosystem Services Review).

For further discussion and assessment of other species of concern that may potentially occur in the CHAA, see Section 6.3.2.

### Habitats

The near-shore habitats of Lake Albert and the wetlands of the lower Masika River and Kamansinig River, and the large bays of the Buhuka Flats are important habitats for zooplankton. In particular, the dominance of Copepod zooplankton is important because these taxa are keystone species in sustaining fish communities in the lake (Mwebaza-Ndawula et al. 2001, Mwebaza-Ndawula et al. 2003, Mwebaza-Ndawula et al. 2004). This is supported by the high biomass, high catch rates, and strong multispecies fishery in the near-shore waters of Lake Albert in the LSA.

For further discussion and assessment of habitats of concern, please refer to Section 6.3.1.

# 7.0 OVERALL BIODIVERSITY VALUE

Presented below are the findings of the baseline biodiversity value of the CHAA, as described based on a description of the two identified components of overall biodiversity defined in Section 3.3.3, that is, ecosystems and habitats, and species of concern. Within each of these, valued components are described.

## 7.1 Ecosystems and Habitats of Concern

Uganda falls at the confluence of a number of regional centres of endemism (White 1983): the Guinea-Congo Forest; Lake Victoria Basin; Afro-Tropical Highlands; Somali-Masai; and Sudan and Guinea Savannah. This has resulted in the region having a unique suite of biodiversity. Indeed, the Albertine Graben is an area of high endemism and threatened species (Critical, Endangered and Vulnerable); with over 50% of birds, 39% of mammals, 19% of amphibians and 14% of reptiles and plants of mainland Africa occurring in this region (Plumptre et al. 2003). Furthermore, the Albertine Graben and Lake Albert, within which the CHAA is located, is recognised as: part of the Eastern Afromontane Biodiversity Hotspot (CI 2014); an Endemic Bird Area (Stattersfield et al. 1998); a Key Biodiversity Area (IUCN 2010); and within three globally important ecoregions, notably, the Albertine Rift Montane Forests, the East Sudanian Savanna, and the Rift Valley Lakes Freshwater Ecoregion (Olson and Dinerstein 1998). As such, the Graben is recognised as an area of global importance for conservation. For further discussion and analysis of the biodiversity importance of the wider Albertine Graben and Lake Albert, see, for example, Emerton and Muramira (1999), Wandera (2000), Plumptre et al. (2003, 2005, 2007, 2010, 2011), NEMA (2010), Taabu-Munyaho et al. (2012), AECOM (2012, 2013), CI (2014). The near-shore environment of Lake Albert, and the wetlands associated with the rivers draining off the escarpment, support important populations of commercially important fish species (including important breeding areas), freshwater turtles, crocodiles, invertebrates, algae and aquatic plants, staging grounds for migratory birds, as well as biogeochemical processes that drive the ecosystem.

The Project is located within the Albertine Graben, and adjacent to Lake Albert. As such, it can be expected that the CHAA includes ecosystems and habitats that are important components of the biodiversity and biogeographical significance of the Albertine Graben and Lake Albert.

Nevertheless, the CHAA is located in an area that is heavily influenced by human activities, and currently does not support a high species richness and diversity. Historically, the Buhuka Flats was part of the Buhuka Community Wildlife Area (CWA) (UWA, pers. comm.); however, it was not maintained as a CWA, and, subsequently, the large animal populations declined (UWA, pers. comm.), and, apart from a few Hippopotamus, all the large mammals have disappeared from the area. As such, it is no longer recognised as a CWA and was degazetted in 2002 (RPS 2006). Nevertheless, as identified in Section 6.1.1.1, significant natural vegetation still on the Buhuka Flats and along the escarpment (Figure 4a), 84% of which is considered natural habitat under the IFC's definitions (Figure 15). These vegetation communities and habitats support populations of smaller mammals, mammals, reptiles, amphibians, and invertebrates, including species of concern (see Section 6.3.2).

The Buhuka Flats and the adjacent escarpment area are currently primarily used for livestock grazing, subsistence agricultural purposes, firewood collection, charcoal manufacture, and harvesting of non-timber forest products, while the near-shore environment of Lake Albert supports a strong artisanal fishing industry. These activities exert pressures on the ecosystems, and, undoubtedly have affected the ecological integrity of the ecosystems of the LSA (for example, see NEMA 2010, Wandera and Balirwa 2010). In addition, the ease of access to the Buhuka Flats has been altered with the construction of the escarpment road; this increased ease of access may facilitate increased anthropogenic demand for services such as livestock grazing and firewood harvest, exacerbating pressure on nearby ecosystems.

Similarly, the ecosystems along the pipeline route have experienced severe pressure from subsistence agricultural practices that have resulted in the transformation of a large proportion of the natural habitats in recent history (see Figure 15) (for a review, see AECOM 2012).

Regardless of the intense agricultural, fishing and subsistence pressures within the CHAA, the entire area supports ecosystems and habitats of greater or lesser value. For the intents of this impact assessment, these have been grouped into the following broad ecosystems: the near-shore environment of Lake Albert; the vegetation communities and corridors along the rift valley escarpment; wetlands of the Buhuka Flats and pipeline route; and the ecosystem services they offer (see Ecosystem Services Review) for a more detailed discussion of these ecosystems as they relate to the supply of ecosystem services); and the Bugoma Central Forest Reserve.

Information on the ecology, ecosystem functioning and processes of some of these systems are available, either in published literature (for example: Lake Albert (see, Green 1971, Wandera 2000, Campbell et al. 2005, Wandera and Balirwa 2010, Taabu-Munyaho et al. 2012); the importance of the vegetation along the escarpment as a corridor (see Plumptre et al. 2003, 2007, Ayebare et al. 2013); the Bugoma Central Forest Reserve (see Plumptre et al. 2010, 2011)), or in previous studies undertaken in the area (for example, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). As mentioned in Section 3.3.3.1.1, these available studies were supplemented by seasonal surveys of the LSA to gauge an understanding of the current integrity of the ecosystems in the CHAA (see Section 6.1, 6.2, and Appendix C and D).

As relevant to this impact assessment, a summary of those studies, and other relevant scientific literature, is provided below to provide a description of the ecological integrity of each of these ecosystems (based upon: composition and structure; linkages and corridors; key processes, including drivers of change; representativeness; resilience and stability). Therefore, as relevant to the Project, and the potential effects the Project may have on those biodiversity values, presented below is a description of the baseline of ecosystems and habitats of concern that comprise the receptors/valued components for impact assessment.

### 7.1.1 Near-Shore Habitats of Lake Albert

For the intents of this impact assessment, the near-shore environment of Lake Albert is defined as the area within 500 m of the shore of the lake, with water depths typically between 0 m to 12 m; beyond this distance the depth of the lake increases to 18 m and more (NEMA 2010). This area supports a diversity of habitats, water depths, temperature regimes and concomitant flora and fauna communities. These near-shore habitats are also recognised as sensitive ecological areas by NEMA (2010).

Lake Albert supports the most diverse commercial fisheries in Uganda, with at least 55 species (Wandera and Balirwa 2010). This diverse fish fauna supports an array of multi-species fisheries along the lake's length, and, in terms of fisheries production, Lake Albert is second only to Lake Victoria (Taabu-Munyaho et al. 2012). Although this is currently the case, Lake Albert is facing multiple environmental changes, including declining fish species diversity, over fishing and reduced catches, hyper-eutrophication in places and hypoxia (Campbell et al. 2005). Furthermore, the ecology of the lake, and the processes driving the ecosystem, remains poorly understood (for example, Lehman et al. 1998, Wandera 2000, Wandera and Balirwa 2010).

#### Composition and Structure

The south-central part of the lake, in the vicinity of the LSA, is dominated by the steep sided escarpment, and predominantly deep waters close to the shore (Taabu-Munyaho et al. 2012). In the immediate vicinity of the LSA, that is, the Buhuka Flats, the ecosystem of the lake is composed of a diversity of habitats. Indeed, all the six main habitat types in Lake Albert identified for fishes by Wandera and Balirwa (2010) (*viz.*, shallow river-associated waters, open sandy shores, lagoons, large bays, rocky escarpments, and, open-water habitats), occur within the near-shore areas of the LSA (Figure 5). Of these habitats, those workers identified river mouths, lagoons, near-shore waters of large bays, and rocky areas as priority habitats for fish breeding.

All these habitats are well represented in the CHAA (Figure 5), and constitute approximately 5.7 km (river mouths 0.3 km; lagoons 1.4 km; large bays 2 km; rocky shores 1.9 km).

Wandera and Balirwa (2010) reported that, together, throughout the lake, these habitats support 40 species of fish. River mouths contributed the highest number of species, while lagoons supported the highest number of individuals and biomass (Wandera and Balirwa 2010). Indeed, these workers specifically recognise the Bugoma Lagoon of the Buhuka Flats as one of these important habitats in the lake. The importance of the near-shore habitats within the CHAA is reflected in the diversity and abundance of fish species recorded during the aquatic ecology surveys (see Section 6.2.5, and Appendix C). Approximately 36% of the species known to inhabit Lake Albert were recorded from the LSA, and these were represented by a range of age and size classes, all in good condition. This suggests that the diversity in composition and structure of the habitats in the LSA is important for the life cycle of a range of species, including many commercial species.

Not only are the shoreline waters, and their concomitant structural diversity, important habitats for juvenile fishes (Wandera and Balirwa 2010), they are also important areas for invertebrate and algae communities that form an important food source for juvenile and adult fish. The submerged and emergent aquatic plants that are common in the shallow waters off the Buhuka Flats and the wetlands associated with the Masika River and Kamansinig River provide a diversity of structural refuge and breeding sites not only for fish, but also for many invertebrate prey species (such as, Copepod crustaceans, water fleas, rotifers, midges, mayflies, stoneflies, caddis flies). Importantly, the dominance of Copepod crustaceans in the aquatic habitats of Lake Albert is important. These taxa are keystone species in sustaining fish communities in most water bodies (Mwebaza-Ndawula et al. 2001, Mwebaza-Ndawula et al. 2003, Mwebaza-Ndawula et al. 2004). As such, the near-shore habitats, wetlands of the lower Masika River and Kamansinig River, and the large bays of the Buhuka Flats are important habitats for these components of the zooplankton community.

### Linkages and Corridors

The near-shore aquatic habitats within Lake Albert are all part of the wider lake ecosystem. In terms of size, the lake, as a contained ecosystem, is not large, being approximately 5300 $km^2$ (~150 km long by ~35 km wide) (Wandera and Balirwa 2010). And, although it is primarily fed by the Victoria Nile (which drains Lake Kyoga and Lake Victoria) and the Semliki River system, which account for 83% of inflow (Golder Associates 2014b), the biodiversity of the lake is unique. Lake Albert supports at least ten endemic fish species, notably the commercially important *Angara*, *Ngassa* and *Imberi* (Wandera 2000, Campbell et al. 2005, Wandera and Balirwa 2010), as well as numerous mollusks, crabs and seed shrimp (Crustacea: Ostracoda) (Plumptre et al. 2003).

The movement of fish and other animals within Lake Albert is currently not understood, nor is the movement of fish and other animals into and out of the lake (for example, see Campell et al. 2005, Wandera and Balirwa 2010). Nevertheless, certain species, notably *Angara*, *Ngassa*, African Butter Catfish (*Schilbe niloticus*), and African Catfish (*Clarias lazera*) do make lateral movements within the lake to shallow waters in bays and up river systems to breed (Akinyi et al. 2010a, Azeroual et al. 2010c, e, Lalèyè et al. 2010), and these breeding movements tend to be seasonally based (Kusnierz et al. 2014). How far these species travel within the lake to reach their preferred breeding areas is not known. However, given that there are only a few major river systems entering the lake that would be suitable for breeding, and the afore-mentioned species are caught throughout the lake (see Taabu-Munyaho et al. 2012), it is conceivable that individuals would travel large distances within the lake to breed. Likewise, juveniles would disperse widely within the lake.

Based on the above, and the fact the CHAA supports important breeding habitat for fish (that is, river mouths, lagoons, near-shore waters of large bays, and rocky areas (after Wandera and Balirwa 2010)), it is possible that the near-shore habitats within the vicinity of the Buhuka Flats are an important end point, or starting point, for fish.

### Key Processes and Drivers of Change

As mentioned, Lake Albert is primarily fed by the Victoria Nile and the Semliki Rivers. Certainly, in the case of the Victoria Nile, and many of the other rivers and streams feeding the lake, these flow through areas of high agricultural activity. Consequently, it can be expected that these rivers carry with them high levels of nutrients and other contaminants. Certainly, Wandera (2000) and Wandera and Balirwa (2010) identified that agricultural run-off was having real effects on increasing the nutrient levels of the lake, a process known as eutrophication.

Intense fishing pressure from commercial and artisanal fisheries has led to the decrease in populations of many of the commercially important species of the lake. Available data suggest that the overall shape of Lake Albert's food web is triangular, dominated by predatory species like the Nile Perch and *Ngassa* at the top, and the various tilapia species, *Ragoge* and *Muziri* forming the broader base (Campbell et al. 2005). As noted by Campbell et al. (2005), the Nile Perch has undergone dietary shifts suggesting that recent overfishing of it and its prey species may be changing the nature of the entire food web within the lake, and ultimately the ecosystem integrity. Another observation by Wandera and Balirwa (2010) was the shift towards increased catches of *Ragoge* and *Muziri* in recent times. These workers suspected that this shift was due to the decreased populations of larger species, and the consequent reduced catches of those species. With the increased pressure on *Ragoge* and *Muziri* populations (which are food species for the larger species, and the main predators of zooplankton, especially Cyclopoid copepods (Green 1971)), it is not unreasonable to assume that the fish community within the wider lake may change in the long-term.

The fishing activities based out of the 11 fishing villages in the CHAA and vicinity (that is, five on the Buhuka Flats, with six located to the north and south of the Buhuka Flats), undoubtedly put pressure on the local fish populations. Indeed, apart from the published accounts of the decrease in commercial fish stocks (Wandera 2000, Wandera and Balirwa 2010, Taabu-Munyahu et al. 2012), anecdotal accounts from the local fisher-folk also identify noticeable decreases in catches of fish per unit effort ( Social Impact Assessment).

Likewise, the presence of approximately 22,000 people on the Buhuka Flats and other nearby villages (Golder Associates 2014e) who do not have access to running water and sanitation, will put large pressures on the nutrient loading of the inflowing lake waters of the LSA.

Despite the current human population of the Buhuka Flats and LSA, the near-shore aquatic environment was generally healthy (as reflected by the water quality, and the phytoplankton and zooplankton communities, in particular the Copepod crustacean communities – see Section 6.2). The notable exception was the Bugoma Lagoon. Here the water quality parameters and zooplankton communities reflected an environment with a high nutrient load and stagnant water. However, this was expected given that this wetland was isolated from the lake, possibly due to the lack of significant surface water inflow (at the time of sampling) and the resident Hippopotamus population. It is expected that the water quality, and the associated zooplankton diversity, in the Bugoma Lagoon will improve as inflow increases during the rainy season (Surface Water). As such, it is plausible that the health status of this system will fluctuate between the seasons, driven by increased water flows in the rainy season, and the subsequent drying in the dry season. These seasonal effects will be observed for all the wetlands in the CHAA (see Section 6.3.1.2.3).

Current climate change models predict that Uganda is likely to experience more extreme periods of intense rainfall, an erratic onset and cessation of the rainy seasons and more frequent episodes of drought (GCCA 2012). An overall increase of approximately 180 mm per annum is predicted, which will result in a mean annual rainfall for the CHAA of 880 mm to 1580 mm for the period 2020 to 2039 (Golder Associates 2014b). Current records of the lake's water level indicate that it varies by approximately 4 m every year, as influenced by rainfall (Surface Water). How this increased rainfall could influence that water level of the lake is unknown.

Within the CHAA, the main drivers of change influencing the near-shore aquatic habitats derive from the human population exerting pressure on fish stocks, including catching breeding individuals (Golder Associates 2014e), and polluted run-off from the 11 villages in the area. There has been a substantial increase in the local population over the past 10 years, driven by a multitude of factors such as regional instability, attractive livelihood opportunities to engage in fishing on Lake Albert, and more recently, interest in capitalising from opportunities related to oil and gas developments (Social Impact Assessment).

### Representativeness

The majority of the aquatic habitats within the CHAA are represented widely around the lake. Within the southern section of the Ugandan side of the lake, from the northern end of Kaiso-Tonya Community Wildlife Area in the north, to the Uganda-Democratic Republic of Congo (DRC) border in the south (approximately 210 km of shoreline), shallow river-associated waters comprise ~14 km (7%) of shoreline, and include the mouths of, amongst others, the Wasi River, the Muzizi River, the Nkussi River, the Masika River, and a number of others. Open sandy shores account for ~68 km (32%), lagoons (including the wetland systems of the Wasi and Muzizi Rivers) account for ~54 km (26%), large bays account for ~13 km, and rocky escarpments account for ~25 km (12%).

Based on these figures, the CHAA supports 3% (0.4 km) of the shallow river-associated waters, 13% (8.5 km) of the open sandy shore habitat, 2% (1.2 km) of the lagoons, 14% (1.8 km) of large bays, and 7% (1.6 km) of rocky escarpment (Figure 14). Of particular significance is the lagoon, which, according to Wandera and Balirwa (2010), is only one of six such lagoons in the lake.

#### Resilience and Stability

Lake Albert is approximately ~5500 km$^2$. Given its size, the buffering effect of the large water body, it is expected to be reasonably resilient and stable.

#### Overall Condition

Based on the findings of the baseline studies, the condition of the near-shore habitats of Lake Albert in the CHAA are near pristine. Despite the pressures of local the local population and their associated fishing activities, these habitats are still in a natural state and support health populations of phytoplankton, zooplankton, macro-invertebrates and fish. Some localised areas, particularly around the fishing villages are slightly degraded due to polluted run-off and gross pollution.

### 7.1.2 Escarpment Vegetation Corridors

The escarpment supports natural vegetation bounded on the east by highly modified subsistence agricultural landscapes, and the Buhuka Flats and Lake Albert on the west. The vegetation communities form part of a continuous strip of vegetation to the south and to the north.

#### Composition

Within the CHAA, the vegetation communities on the escarpment are composed of a mix of the described vegetation communities of the area. Four communities dominate; comprising 66%, that is, open wooded grassland (28%), followed by dense wooded grassland (23%), dense bushland (14%), and riverine bushland (10%). The remaining communities make up the rest. These form a continuous corridor of vegetation of approximately 2443 ha within the CHAA, which is bounded on the east by agriculturally modified landscapes, and the Buhuka Flats on the west (Figure 11).

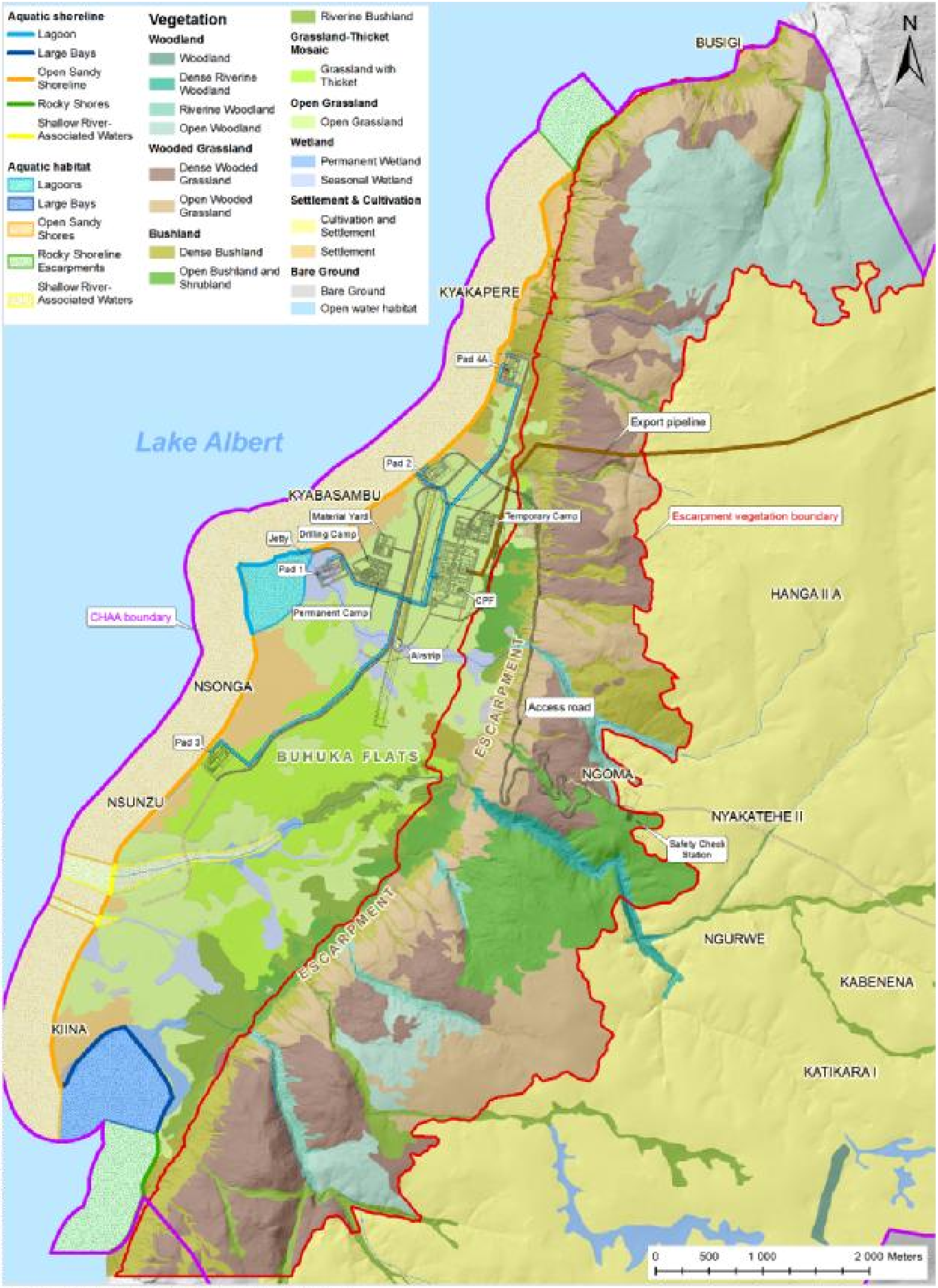


*Figure 11: Escarpment vegetation communities*

## Structure

The vegetation communities form a diverse mosaic of habitats across the escarpment, with 15 different communities represented (Table 2).

**Table 2: Extent of escarpment corridor vegetation communities within the CHAA**

| Escarpment corridor vegetation communities | Area (Ha) |
|---|---|
| Dense Bushland | 337.7 |
| Dense Riverine Woodland | 28.3 |
| Dense Wooded Grassland | 589.0 |
| Grassland with Thicket | 5.2 |
| Open Bushland and Shrubland | 71.5 |
| Open Grassland | 31.5 |
| Open Wooded Bushland | 214.0 |
| Open Wooded Grassland | 552.2 |
| Open Woodland | 85.2 |
| Open Woodland/Dense Bushland | 353.2 |
| Riverine Bushland | 89.7 |
| Riverine Woodland | 69.8 |
| Riverine Woodland and Bushland | 2.9 |
| Seasonal Wetland | 5.1 |

The vegetation communities appear to be driven by landscape and geology. For example, open wooded grassland and dense wooded grassland tend to be restricted to the crest of the escarpment; dense bushland tends to be restricted to the steep slopes; with the watercourses support riverine communities.

## Linkages and Corridors

In the regional context, these vegetation communities contribute to maintaining the continuity of the many high-priority conservation sites within the wider Albertine Graben. These corridors are also recognised as important for the maintenance of the evolutionary processes unique to the Albertine Graben (Ayebare et al. 2013).

On the local scale, within the CHAA, the escarpment is an important habitat for many species recorded in the LSA. It not only forms a continuous corridor along the length of Lake Albert, but it also offers important refugial sites for many of the small mammal species; notably the cavity and cave roosting bat species.

## Key Processes and Drivers of Change

Within the CHAA, the main drivers of change influencing the vegetation communities along the escarpment are from livestock grazing, fuel wood harvesting, charcoal manufacture and the conversion of natural vegetation for subsistence agriculture. As mentioned, this is particularly noticeable between the current vegetation on the escarpment and the Bugoma Central Forest Reserve (see Figure 4).

The keeping of livestock forms a substantial component of the local socio-economic structures in the CHAA, particularly on the Buhuka Flats (Golder Associates 2014e). Livestock numbers are large and there is strong evidence for overgrazing on the Buhuka Flats extending up onto accessible regions of the escarpment corridor.

Large trees on the escarpment are becoming rarer as these individuals are selectively harvested for the manufacture of charcoal, which is typically on-sold. Smaller woody species are regularly harvested for fuel wood used directly in the fishing villages.

The harvest of fibre and other house construction materials is common on the escarpment. For example, thatching grass is regularly harvested on the escarpment and transported to the local fishing villages (Figure 12).

*Figure 12: 'Chutes' used for transport of thatching grass harvested from the escarpment*

The occurrence of frequent fires was also evident on the escarpment. Too-frequent fire is known to detrimentally affect the functioning and processes of savanna ecosystems (Smith et al. 2013).

The condition of the vegetation communities on the escarpment suggests that all these processes are contributing to changes in their composition and structure. In particular, encroachment of bushland into the grassland and woodland communities appears to be quite frequent. Bush encroachment is a typical consequence of changed land use practices like intense livestock grazing and removal of large, ecosystem engineer species like African Elephant (Wigley et al. 2009). Nevertheless, local communities often prefer these changes because they result in increased woody resources for building and firewood and increased browse availability for goats (Wigley et al. 2009). Consequently, in the long-term, a positive feedback loop could result in these communities becoming completely transformed.

## Representativeness

The vegetation communities of the escarpment form part of a contiguous vegetation corridor, extending for approximately 70 km, from the Toro-Semliki Wildlife Reserve in the south, to the Kabwoya Wildlife Reserve in the north. This corridor is part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor (Plumptre et al. 2007). This corridor is recognised as being of regional importance for savanna species, and potential climate refugia in the future (Ayebare et al. 2013).

### Resilience and Stability

The natural vegetation along the escarpment is under increasing pressure from surrounding land uses (that is, subsistence agriculture) and increased population pressure. The condition of the vegetation communities on the escarpment suggests that all the current divers of change are contributing to changes in their composition and structure. In particular, encroachment of bushland into the grassland and woodland communities appears to be quite frequent. Bush encroachment is a typical consequence of changed land use practices like intense livestock grazing and removal of large, ecosystem engineer and keystone species like African Elephant (Wigley et al. 2009). Nevertheless, as previously mentioned, local communities often prefer these changes because they result in increased woody resources for building and firewood and increased browse availability for goats. Consequently, in the long-term, a positive feedback loop could result in the frequency of open grassland and wooded communities becoming transformed to dense bushland and shrubland.

### Overall Condition

Based on the findings of the baseline studies, and more up-to-date knowledge of the current pressures on the escarpment vegetation communities since the opening of the escarpment road, the overall condition of vegetation communities on the escarpment in the CHAA are slightly to moderately degraded. The combined pressures of livestock grazing, natural resource harvesting and frequent fire indicate that the composition of these communities are changing.

## 7.1.3 Wetlands and Riparian Habitats

The CHAA supports permanent wetlands and seasonally flooded grasslands, and riverine forest associated with riparian watercourses. These habitats form potentially important habitat for species of concern; in particular, Grey Crowned Crane, Madagascar Pond Heron and migratory birds.

### Composition

The seasonal or permanent nature of the wetland communities of CHAA tended to determine the species composition. Seasonal wetlands were comprised largely of *Cyperus articulatus* and sparse *Typha* sp., while the permanent wetlands were largely composed of *Cyperus papyrus*, *Phragmites mauritianum* and *Typha capensis* (see Section 6.1.1.1).

In the pipeline region of the CHAA, the mainly seasonal watercourses support a riverine woodland vegetation community that is dominated by Acacia species, with *Crateva* sp. *Acalypha* sp. *Tamarindus indica*, and *Rhus natalensis* also occurring in the canopy layer, and an understorey dominated by *Grewia trichocarpa* and *Azima tetracantha.*

### Structure

The seasonally flooded grassland communities had a very simple structure that, as mentioned, is largely determined by the water inundation frequency. The vegetation typically dies back during the dry season, and undergoes vigorous growth during the wet season. Consequently, the vegetation is dominated by short species that are quick growing. The underlying soils also form a determinant of these wetlands, with all the seasonally flooded areas being underlain by black cracking clays (Vertisols) (Golder Associates 2014d).

The permanent wetlands are dominated by tall growing species, such as *Phragmites* sp. and *Typha* sp. These species tend to be perennial and do not die back during the dry season. As such, the permanent wetlands maintain a dense, tall and emergent vegetation cover throughout the year.

The riverine forest associated with the riparian watercourses are characterised by an upper storey canopy layer that does not interlock and remains open, with a relatively structurally-homogenous herbaceous layer beneath.

### Linkages and Corridors

The wetlands of the CHAA are typically part of larger watercourses that drain the area. For example, the Masika River forms permanent wetlands along it lower reaches on the Buhuka Flats, while the Kamansinig River forms seasonally flooded grasslands on some of its lower reaches.

Although these wetlands are restricted to the particular watercourses of the CHAA, they do form stepping-stone habitats for wetland species moving up and down the Albertine Graben. In particular, migratory bird species. The Albertine Rift is an important stopping point for migratory birds during their annual migration, between October and March, from Europe and Asia (Byaruhanga et al. 2001).

The larger permanent wetlands along the pipeline route form part of a more extensive network of wetlands on the plateau, many of which connect to those in the Bugoma Central Forest Reserve.

### Key Processes and Drivers of Change

Currently, the wetlands of the CHAA appear to be functioning and stable. Water flows into, and through, the permanent wetlands of the CHAA appear to follow the natural wet-dry season cycles. This is reflected in the seasonal differences in the water quality data, and seasonality of particularly the insects and other animals of the wetlands (see Section 6.2.1 and 6.2.4, respectively). Seasonal water flows through these wetlands are important for flushing nutrients through the system and adding nutrients to the system. This is especially evident in the Bugoma Lagoon. The changes in the zooplankton in the lagoon, and the dominance of rotifers, could be due to the lack of flow and connectivity with the lake during the dry season.

An exception is the seasonally flooded grasslands associated with the Kamansinig River. The road leading from the foot of the escarpment and the borrow pit has noticeably influenced the flow regimes and drainage patterns of this wetland. The wetland on the western side of the road appears to have been altered and no longer fully functional (see Figure 19). This is a good example of how surface and sub-surface flows are important to maintaining a wetland's functionality and processes.

The permanent wetlands of the CHAA are important sources of fibre for house construction and container manufacture. This is especially evident in those wetlands close to human settlements, such as those along the pipeline route and the lower Masika River. Given their use as fibre sources, the frequency of human-induced fire in these wetland communities appears to be reduced.

Harvesting of large trees for the manufacture of charcoal is a noticeable driver in the riverine forest communities associated with the riparian watercourses within the CHAA, as well as trampling and grazing by cattle.

### Representativeness

The CHAA supports approximately 1157.9 ha of wetlands, of which 85.3 ha are classified as seasonal. In addition, 840 ha of riparian vegetation communities are associated with drainage lines and riparian areas. 151 ha or 12% of all wetlands within the CHAA occur on the Buhuka Flats. The representativeness of these wetlands within the wider area is unknown; however, within the CHAA, wetlands constitute approximately 1.5% of habitats. This figure may under-represent the true extent of wetlands in the CHAA, particularly in the Bugoma Central Forest Reserve. Wetlands within that forest area were not confirmed through field investigations.

### Resilience and Stability

Many factors contribute to the resilience and stability of wetlands, and those factors are dependent on the location and type of wetland (Carvalho et al. 2013). Typically, the overriding factor determining a wetland's resilience is the maintenance of the hydrological regime, and the amount of water entering and leaving the wetland. Other factors include nutrient loading, species diversity, trampling and grazing by livestock, and fire frequency (Carvalho et al. 2013).

The seasonal or permanent nature of the wetland communities of the CHAA tended to determine the species composition. Seasonal wetlands were comprised largely of *Cyperus articulatus* and sparse *Typha* sp., while the permanent wetlands were largely composed of *Cyperus papyrus*, *Phragmites mauritianum* and *Typha capensis* (see Section 6.1.1.1).

As described, the altered flow of water to the seasonally flooded grasslands on the western side of the road leading from the escarpment has noticeably affected the functioning of the portion of the wetland downstream of the road crossing (Figure 19). It is unknown whether reinstatement of those flows would resurrect those wetlands. Consequently, this scenario suggests that these seasonally flooded grasslands are not very resilient, and highly susceptible to changes in water flow patterns. Additionally, these wetlands appear to be favoured by livestock for grazing. This is possibly because the conditions within the wetlands support lush vegetation growth during the wet season, which persists well into the dry season. Consequently, this grazing pressure and trampling may be adversely influencing the species composition of these habitats.

The permanent wetlands are associated with the larger watercourses in the CHAA. Therefore, these wetlands could be reasonably resilient provided the flow volumes of those watercourses are maintained. Livestock grazing in these wetlands has intensified since the opening of the escarpment road (Figure 13); hence, trampling and overgrazing are expected to affect the resilience and stability of these systems. These permanent wetlands are dominated by *Phragmites* sp. and *Typha* sp.; these plants are known to be very resilient to pollution and increased nutrient levels. Indeed, members of these taxa are very efficient at removing pollutants from water and are used to treat polluted water in constructed wetlands (Vymazal 2011).

*Figure 13: Cattle watering at Kamansinig crossing, Buhuka Flats (Nov 2017)*

The macro-invertebrate communities within the permanent wetlands are susceptible to changes in water quality, and the composition of these communities change with the seasons (see Section 6.2.3 and 6.2.4). However, these seasonal changes in these communities appear to be part of the natural cycle of these wetlands.

#### Overall Condition

Based on the findings of the baseline studies, and more up-to-date knowledge of the current pressures on wetlands in the Buhuka Flats, the overall condition of the wetlands in the CHAA are slightly to moderately degraded due to pressures of livestock grazing and natural resource harvesting.

### 7.1.4 Bugoma Central Forest Reserve

The Bugoma Central Forest Reserve is widely recognised for its biodiversity importance. For example, it is one of a handful of forests that constitute a network and corridor of critical biodiversity sites in Uganda, and supports populations of, amongst other species, Eastern Chimpanzee (*Pan troglodytes schweinfurthii*), African Elephant (*Loxodonta africana*), Nahan's Francolin (*Ptilopachus nahani*), as well as a variety of endemic birds and butterflies (NEMA 2010). It is also: the source of numerous rivers in the region, including the Nguse and

Rutowa Rivers (NEMA 2010); and an Important Bird Area (BirdLife International 2014a). Of the 65 forested protected areas surveyed for biodiversity in Uganda, Bugoma Central Forest Reserve ranked 11 in overall biodiversity value, and 15 in terms of rarity value (BirdLife International 2014a). For a more detailed assessment and other studies on this forest's biodiversity and biogeographical importance, see, for example: Plumptre et al. (2010, 2011), and Ayebare et al. (2013). Hence, a very limited description is provided here, with only important features, as they relate to the potential effects of the Project, discussed.

### Composition and Structure

This forest is a medium altitude, moist, semi-deciduous forest with a high biodiversity. About half of the forested portion of the Bugoma Central Forest is dominated by Iron Wood (*Crynometra alexandri*); a further 38% is mixed forest (BirdLife International 2014a). Two-hundred-and-fifty-seven species of trees and shrubs have been recorded in the forest, seven of which are Albertine Rift endemics, 12 are globally threatened and 14 are listed in IUCN red list (Plumptre et al. 2003, 2010, 2011).

### Linkages and Corridors

The Bugoma Central Forest Reserve is recognised as being an important part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor (Plumptre et al. 2007). However, it is disconnected from other forest reserves, such as Budongo Central Forest Reserve, and is bordered by subsistence agricultural communities and settlements that are placing increased pressure on it (NEMA 2010, Plumptre et al. 2010, 2011).

### Key Processes and Drivers of Change

While the Bugoma Central Forest Reserve is a reserve for timber resources, and harvesting of timber is reportedly undertaken on a sustainable basis (NEMA 2010); it is not a designated *wildlife* protected area. Given the increased human population around the forest, there have been increased incidents of illegal logging, fire wood collection and charcoal manufacture, and bush meat harvesting (NEMA 2010, Plumtptre et al. 2010). Between 2011 and 2012, increased immigration into the areas surrounding the forest resulted in increased deforestation, with an estimated 5,000 ha of the forest subject to encroachment by about 1,000 families and pit-sawyers (AECOM 2013). Recent reports of illegal logging of hardwood timber, and illegal land clearance in Bugoma CFR with the intention of transformation for sugarcane plantations (ACBF, 2016) suggest that pressure on the reserve has increased substantially.

Many of the tree species within the forest require elephants or large primates to disperse their seeds. With the declining populations of these species, particularly elephants, many tree species are declining (Plumptre et al. 2010).

### Representativeness

This forest is one the last large tracts of remaining medium altitude, moist, semi-deciduous forest in western Uganda (Plumptre et al. 2010, 2011). The CHAA encompasses the entire Central Forest Reserve of approximately 401 $km^2$.

### Resilience and Stability

Given the Bugoma Central Forest Reserve's size (approximately 401 $km^2$), it should be relatively resilient and stable from disturbance. However, the forest, and the populations of species it supports, is under intense pressure from the surrounding human population. What the long-term effects of the increase in the human population around the forest (see Golder Associates 2014e, h), including the illegal settlements within the forest (see Mugerwa 2013), could have on the forest are unknown, but are expected to be damaging to the resilience and stability of the forest. This forest is isolated from other forests in the region, and is being eroded on the outer edges (see Figure 4).

### Overall Condition

Based on the findings of the studies and research conducted by others, the overall condition of the Bugoma Central Forest Reserve is slightly degraded to moderately degraded due to pressures of illegal logging, natural resource harvesting, and the current human pressures surrounding the forest.

## 7.2 Species of Concern

Appendix G provides the details of the critical habitat screening and appraisal of species of concern that could occur in the CHAA.

The information and data reviewed, together with the baseline field surveys, identified that the CHAA (Figure 2) supports a diverse and rich species assemblage, with numerous species of concern potentially occurring in the area. Based on those reports and surveys, the CHAA has the potential to support a possible 96 species of concern (excluding invasive species, which are discussed in Section 7.2.5), as per the definitions in Section 3.2.3. These include: six plant species; two macro-invertebrate species; 14 fish species; two butterfly species; one dragonfly and damselfly species; three amphibian species; nine reptile species; 44 bird species; and 14 mammal species (Appendix G). Forty-six of those species were recorded during the field surveys (Appendix C and D).

### 7.2.1 Threatened, Range-Restricted/Endemic and Statutory Species

Overall, the CHAA has a potential to support populations of seven globally recognised Critically Endangered and Endangered species (one Critically Endangered macro-invertebrate (the Mud Snail (*Gabbiella candida*), four Endangered birds (Madagascar Pond-Heron, Grey Crowned-Crane (*Balearica regulorum*), White-backed Vulture (*Gyps africanus*), Hooded Vulture (*Necrosyrtes monachus*)), one Endangered mammal (Eastern Chimpanzee (*Pan troglodytes schweinfurthii*)). The CHAA supports the range-restricted Nahan's Francolin (*Ptilopachus nahani*) which was down-listed from Endangered to Vulnerable in 2017 (IUCN 2017); and potentially supports five populations of other globally recognised Vulnerable birds and four populations of mammals; as well as one Near Threatened tree, one macro-invertebrate, 12 birds and four mammals (Appendix G).

Of these, 23 species (one Critically Endangered, three Endangered, five Vulnerable, 14 Near Threatened), could occur in the LSA, and hence potentially be affected by direct Project impacts. A further nine species (one Endangered, six Vulnerable, two Near Threatened) could occur in the CHAA, and hence potentially be affected by indirect, induced and cumulative impacts from the Project.

The CHAA also supports approximately 19 Palearctic migratory bird species that are listed under Appendix II of the Convention on Migratory Species (CMS 2014). For more details on those, and other locally important species, see Appendix G.

Of the above-mentioned species, those that have the potential to trigger critical habitat were carried forward for a more detailed and formal appraisal to determine if they could trigger critical habitat, as per the methods presented in Appendix B. That appraisal is presented in Appendix G, and the results are summarised in Section 6.3.2.2.

### 7.2.2 Species of Economic and/or Cultural Importance

Lake Albert supports a strong commercial fishing industry. As discussed in Section 6.3.1.2.1, this fishery is second in importance only to that of Lake Victoria. Within the CHAA, many of the species that form the mainstay of this fishery were recorded, or are probably present (as summarised in Appendix G, Table G1). These include: *Imberi*, *Angara*, *Mpoi*, African Catfish, *Ngassa*, Nile Tilapia, African Butter Catfish, Mango Tilapia, and Zill's Tilapia.

The off-shore habitats within Lake Albert form an important fishing ground for the 11 fishing villages in the CHAA and vicinity (that is, five on the Buhuka Flats, with six located to the north and south of the Buhuka Flats) (Golder Associates 2014e). As discussed in Section 6.3.1.1.1, the near-shore habitats supported in the CHAA are most likely important breeding habitats for many of the commercially important species supporting those 11 fishing villages.

Consequently, the near-shore environments of the CHAA also trigger critical habitat for Criterion 13 because these are seen to be important breeding areas for commercially important fish species, as well as important fishing grounds for those species. This near-shore habitat accounts for about 794 ha of the CHAA (Figure 5).

### 7.2.3 Species listed under CITES

CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments (Uganda has been a signatory since 1991 – see Section 4.0), which has the aim to ensure that international trade in species does not threaten their survival (CITES Secretariat 2017).

The CHAA supports known populations of CITES-listed Appendix II plant and animal species. These include Aloes (*Aloe* spp.), Candelabra Tree (*Euphorbia candelabrum*), Graceful Chamaeleon, Smooth Chamaeleon, Serrated Hinge-back Tortoise, Leopard Tortoise, Nile Monitor, Nile Crocodile, Grey Parrot, and Hippopotamus (see Appendix G, Table G1). Other CITES-listed Appendix II species that may occur in the CHAA, yet have not been recorded, include the Secretarybird, White-bellied Pangolin, African Golden Cat, and Giant Ground Pangolin (Appendix G, Table G1; UNEP-WCMC 2018).

Importantly, within the CHAA, and Bugoma Central Forest Reserve in particular, CITES-listed Appendix I species have a high likelihood of occurring, or have been recorded (see Plumptre et al. 2010, 2011). These species include African Elephant, Eastern Chimpanzee and Leopard (Appendix G, Table G1).

CITES-listed species are grouped in the Appendices according to how threatened they are by international trade. Appendix I lists species that are the most endangered and are threatened with extinction; CITES prohibits international trade in specimens of these species, except when the purpose of the import is not commercial (CITES Secretariat 2017). Species listed in Appendix II are not necessarily threatened with extinction now, however, unless trade in these species is controlled, they could be seriously threatened (CITES Secretariat 2014). International trade in individuals of Appendix II species may be authorized by appropriate authorities when specific conditions are met, above all, that trade will not be detrimental to the survival of the species in the wild (CITES Secretariat 2017).

The populations of the CITES-listed species potentially and actually occurring in the CHAA are not precisely known. Indications are that the certain species are relatively common, for example Aloe and Candelabra Tree (Figure 4b), while others, such as African Elephant may be very uncommon (see Plumptre et al. 2010).

### 7.2.4 Evolutionarily Distinct Species

This section identifies those species of concern that could trigger critical habitat for Criteria 5 under the IFC's definitions (IFC 2012a). As discussed in Section 3.3.3.1.2, critical habitat for key evolutionary processes does not have quantitative thresholds (for example, see IFC, 2012a). Therefore, for the purposes of this impact assessment, expert opinion was used to identify critical habitat with respect to evolutionarily distinct species as indicators of the landscape-level features that can influence key evolutionary processes.

The Albertine Rift is known as a centre of endemism driven by unique evolutionary processes; indeed, it is the most species rich region in Africa for vertebrates (Plumptre et al. 2003, 2007). It is also a recognised Endemic Bird Area (Stattersfield et al. 1998), testament to a collection of unique species derived from a set of unique evolutionary processes. Lake Albert too is a recognised centre of endemism within the Albertine Rift, and is of biogeographical significance for a number of taxa and species, in particular snails (Plam et al. 2008) and fish (Wandera and Balirwa 2010).

At the species level, Criterion 5 applies for "distinct species", which include those termed Evolutionarily Distinct and Globally Endangered (EDGE) species (GN 95 IFC 2012b, Jetz et al. 2014, ZSL 2014). Jetz et al. (2014) define evolutionary distinctness as a measure of "a species's contribution to the total evolutionary history of its clade and is expected to capture uniquely divergent genomes and functions". Based on this definition, these workers identified bird species and particular regions where birds occur, that are of enormous value for protecting evolutionary diversity. Bird species with the greatest evolutionary distinctness are often located outside of areas traditionally identified as conservation priorities (Jetz et al. 2014). Species representing the most evolutionary

Based on the works of Jetz et al. (2014), and a geographically-based search of the EDGE species database that covered the spatial extent of the CHAA (see ZSL 2017), two such EDGE species were identified as potentially occurring in the CHAA. These were the Shoebill and Secretarybird, which are discussed and assessed in Appendix G.

### 7.2.5 Invasive and Potentially Invasive Species

The CHAA has been affected to a greater or lesser extent by human activities for a very long time. These activities have altered the landscape to a greater or lesser extent, the most noticeable being the conversion of the natural vegetation on the plateau above the escarpment to agricultural crop land (AECOM 2013). The influence of people on the Buhuka Flats is also very noticeable, the majority of the flats affected by livestock grazing, small-scale agriculture, fuel wood harvest, and building material collection.

As identified in Section 6.1.1, five invasive species were recorded in the LSA, they tended to be localised, and uncommon, although within certain areas, local populations were high (Figure 14). Three of these, the Giant Sensitive Tree (*Mimosa pigra*), Lantana (*Lantana camara*) and Water Hyacinth (*Eichhornia crassipes*) were the commonest species recorded, predominantly on the Buhuka Flats and the shore of Lake Albert (Appendix D). These species are recognised as some of most noxious weeds in the world (Lowe et al. 2000).

Other species recorded include: Water Lettuce (*Pistia stratiotes*) (in a wetland community on the Buhuka Flats, where it was locally abundant); and Castor Oil Plant (*Ricinus communis*) (recorded from wetland and woodland communities).

Other potentially invasive species to note were Neem (*Azadirachta indica*), Jatropha (*Jatropha curcas*) and Parkinsonia (*Parkinsonia* sp.). It is noted that many of these species have been planted by the local communities and offer important cultural and other ecosystem services.

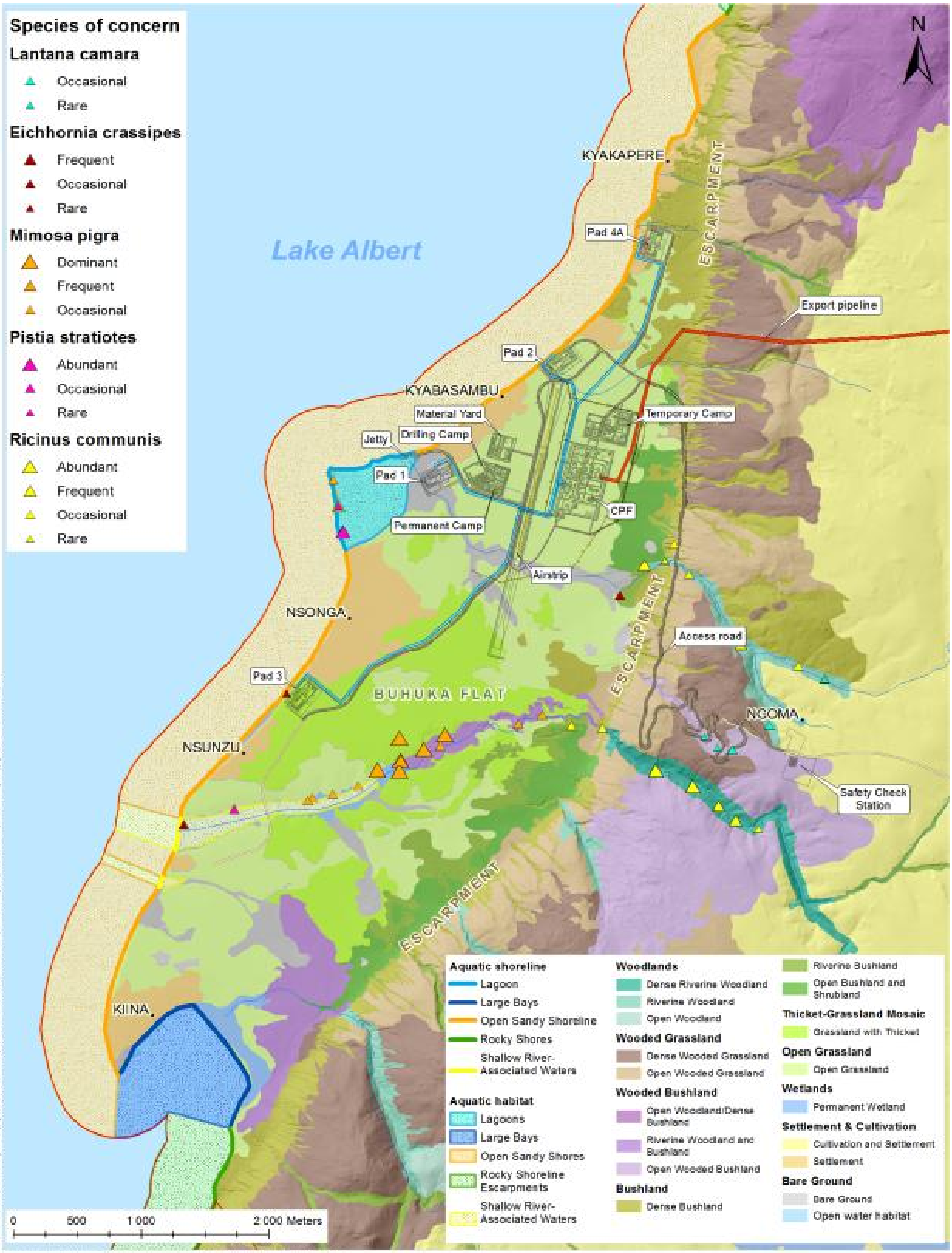


*Figure 14: Invasive species recorded on the Buhuka Flats*

# 8.0 NATURAL AND MODIFIED HABITAT WITHIN THE CHAA

An assessment and identification of the natural and modified habitats was restricted to the CHAA (Figure 2). The results of the assessment are summarised in Table 2.

**Table 3: Natural and modified habitat in the CHAA**

| Habitat | Area (ha) | Area (km$^2$) | Proportion of CHAA |
|---|---|---|---|
| Modified | 12,944 | 129.4 | 16% |
| Natural | 68,303 | 683.0 | 84% |

The majority of the Buhuka Flats and the escarpment is natural habitat, while the pipeline route is dominated by modified habitat (Figure 15). In the case of the Buhuka Flats, although this area is inhabited (including the villages of Kiina, Nsunzu, Nsonga Kyabasambu, Kyakapere) and under pressure from subsistence agriculture and livestock grazing, a large proportion of the flats is dominated by natural vegetation communities. These include, amongst others: thicket-grassland mosaic, open grassland, bushed grassland, and Wetlands (see Section 6.1.1.1, and Figure 4a and b). Of interest is the connectivity of the natural habitat that occurs on the Buhuka Flats and the escarpment. These habitats form part of the wider Murchison Falls National park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor (Plumptre et al. 2003) (see Section 6.3.1.2.1).

The plateau above the escarpment is markedly different. Here the area has been largely transformed into cropland and plantations, interspersed with settlements and patches of natural habitat, comprised largely of wetlands (see Figure 6).

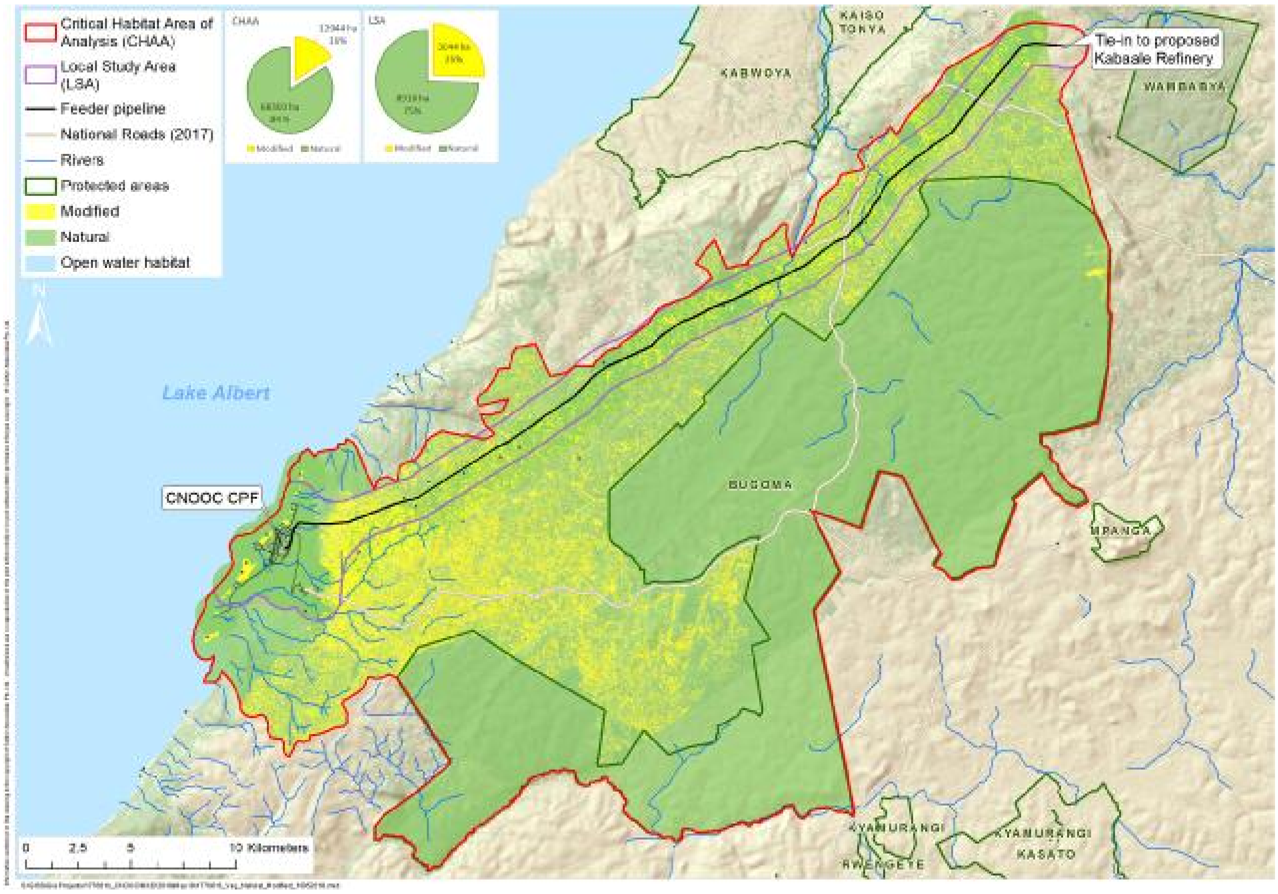


*Figure 15: Natural and Modified habitat in the CHAA*

# 9.0 CRITICAL HABITAT WITHIN THE CHAA

Appendix G presents the screening and assessment of all species of concern that could trigger Criterion 1, 2, 3 and 5 critical habitat within the CHAA, as per the methods presented in Appendix B. Ecosystems that could trigger Criterion 4 critical habitat are discussed in Section 9.1.2.

As discussed, quantitative thresholds for critical habitat are available for Criteria 1 to 3. No such thresholds exist for the other criteria. Therefore, a qualitative assessment of the remaining criteria for valued components of the CHAA was undertaken.

## 9.1 Assessment of Potential Triggers of Critical Habitat

The short-list of possible triggers of critical habitat that are likely to occur in the CHAA, derived from the critical habitat screening exercise (see Appendix G) are discussed in detail in the sections that follow.

### 9.1.1 Species Potentially Triggering Criterion 1, 2 and 3 Critical Habitat

As discussed in Section 3.2.3.3 and Appendix B, quantitative thresholds for distinguishing the tiers of critical habitat have been developed by the IFC for Criteria 1 to 3. Part of these thresholds require the need to have a reasonable understanding or knowledge of the global populations of species that could trigger those criteria, as well as knowledge of their global distributions (EOO) and occupancy (AOO).

Very few of the species assessed against the screening criteria (see Table G1) had detailed population-level information available or detailed distribution records. Nevertheless, some did have the required information. Where spatial data for EOO and AOO were available (as derived from the IUCN (2017) and other references), these were used as the species' distribution owing to a need to quantify the amount of overlap of these distributions with the CHAA, and, in some instances, were used as a proxy for population level data to assess the values against the Tier 1 and Tier 2 triggers (Appendix B).

#### *9.1.1.1 Mud Snail (Gabbiella candida)*

i Potential Critical Habitat triggered – Criterion 1 and 2

This Mud Snail is a globally listed Critically Endangered species (Table G2). It's known AOO is less than 10 km$^2$, around the port of Butiaba on Lake Albert, and is presumed to be endemic to this area (Kyambadde 2010a). Further surveys to understand this species's EOO have not been undertaken, yet it is possible that it could occur in a much wider area, within suitable habitat.

Two sister species (Bithyniidae: *G. humerosa* and *G. walleri*) were recorded in the LSA (see Section 3.3.2.4 of the main report, Appendix D). These two species have been recorded in the same locality and habitat that *G. candida* was recorded (GBIF 2017). Therefore, it is conceivable that it could occur within the CHAA within suitable habitat.

Major threats to this species include declining habitat quality due to erosion and silting from agriculture and water pollution (Kyambadde 2010a).

Although this species has not been recorded in the CHAA, and its known AOO (that is Butiaba, about 90 km north of the Buhuka Flats) is not within the CHAA, this species may occur in the near-shore habitats off the Buhuka Flats. Suitable, near-shore aquatic habitat within the CHAA (see Section 6.3.1.1.1) for this species includes the Bugoma Lagoon (33.2 ha), large bays (73.7 ha), open sandy shores (554.8 ha) and shallow river-associated water (37.2 ha), totalling approximately 699 ha (Figure 5).

**Table G2: Population details for the Mud Snail**

| | |
|---|---|
| Global listing* | Critically Endangered |
| National listing | Not listed |
| Restricted range* | Yes |
| Migratory or congregatory | No |
| Discrete Management Unit | CHAA (814 km$^2$) |

| | |
|---|---|
| Global population* | Unknown |
| Global EOO* | 10 km$^2$ |
| Global AOO* | 10 km$^2$ |
| Regional/national population* | Unknown |
| Regional/national EOO* | 10 km$^2$ |
| Regional/national AOO** | 10 km$^2$ |
| Number of global discrete management units | 1 (Butiaba Port) |

* Kyambadde (2010a)

Although the Mud Snail has not been recorded in the CHAA, there is a potential that it could occur, due to the presence of potentially suitable habitat. Assuming it potentially could occur in the wider Lake Albert, within suitable habitat, and knowing that it is endemic to Lake Albert, its EOO and AOO could be less than 5000 km², based on the total area of Lake Albert (5,335 km²) and the availability of suitable habitat (that is, less than 18 m water depth) (after Kyambadde 2010b). Within the CHAA, suitable habitat for this species only occurs in the near-shore aquatic habitats, which total about 8.5 km$^2$. Using the EOO (that is, 5000 km$^2$) as a proxy for the global population for this species (see reasoning above), then the 8.5 km$^2$ of potential habitat within the CHAA equates to 0.2% of this species population potentially occurring in the CHAA.

Hence, applying the quantitative and qualitative triggers for Criterion 1 and 2 critical habitat (Appendix B, Table B1) to these derived population details for this species identifies that it does not trigger Criterion 2. However, there is a potential that it could occur in the CHAA, hence, because it is a Critically Endangered species, and taking a precautionary approach, this species has been assessed as triggering Criterion 1 Tier 2 critical habitat within the CHAA.

### 9.1.1.2 Snail (Bellamya rubicunda)

Potential critical habitat – Criterion 2

This Snail is globally listed as Near Threatened (Table G3). It is an endemic, range restricted species, known only from Lake Albert (Kyambadde 2010b). Given that it is endemic to Lake Albert, its EOO and AOO is less than 5000 km², based on the total area of Lake Albert (5,335 km²) and the fact the species only occurs down to a maximum of 18 m depth (Kyambadde 2010b). Accordingly, it is also close to meeting the IUCN's Endangered category (IUCN 2014); however, current known locations and threats appear to be localised and dispersed (Kyambadde 2010b).

A sister species (Viviparidae: *B. unicolor*) was recorded in the CHAA (see Section 3.3.2.4 of the main report, and Appendix D). This species has been recorded in the same locality and habitat that *B. rubicunda* was recorded (GBIF 2014). Therefore, it is conceivable that it could occur within the CHAA within suitable habitat.

Major threats to this species include declining habitat quality due to erosion and silting from agriculture and water pollution (Kyambadde 2010b).

Although this species has not been recorded in the CHAA, its EOO and AOO (that is Lake Albert) overlaps with the CHAA. Therefore, it is conceivable that this species may occur in the near-shore habitats off the Buhuka Flats. Suitable, near-shore aquatic habitat (see Section 5.3.1.1.1 of the main report) within the CHAA for this species includes: the Bugoma Lagoon (33.2 ha); large bays (73.7 ha); open sandy shores (554.8 ha); and shallow river-associated water (37.2 ha); totalling approximately 699 ha, or ~7 km$^2$ (Figure 12 of the main report).

**Table G3: Population details for the Snail**

| | |
|---|---|
| Global listing* | Near Threatened |
| National listing | Not listed |
| Restricted range* | Yes |
| Migratory or congregatory | No |
| Discrete Management Unit | CHAA (814 km$^2$) |

| | |
|---|---|
| Global population* | Unknown |
| Global EOO* | 5000 km$^2$ |
| Global AOO* | Unknown |
| Regional/national population* | Unknown |
| Regional/national EOO* | 5000 km$^2$ (Lake Albert)<br>~7 km$^2$ of 814 km$^2$ (CHAA) |
| Regional/national AOO** | Unknown |
| Number of global discrete management units | Unknown |

* Kyambadde (2010b)

Although the Snail has not been recorded in the CHAA, there is a potential that it could occur, for the above reasons. Within the CHAA, suitable habitat for this species only occurs in the near-share aquatic habitats, which total about 7 km$^2$. Using the EOO (that is, 5000 km$^2$) as a proxy for the global population for this species (see reasoning above), then the 7 km$^2$ of potential habitat within the CHAA equates to 0.1% of this species population potentially occurring in the CHAA.

Hence, applying the quantitative and qualitative triggers for Criterion 2 critical habitat (Appendix B, Table B1) to these derived population details for this species identifies that it does not trigger Criterion 2. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

### 9.1.1.3 Madagascar Pond Heron (*Ardeola idae*)

Potential critical habitat – Criterion 1 and 3

The Madagascar Pond Heron is a globally listed Endangered species (Table G4), because of a very small breeding population limited to Madagascar that is undergoing continuing decline (BirdLife International 2017). It has a very large non-breeding range, which includes central and east Africa, including the Albertine Rift (BirdLife International 2017). Anecdotal evidence suggests that this species exhibits site fidelity and residence in suitable habitat throughout its non-breeding migratory habitat (Ndang'ang'a and Sande 2008).

Non-breeding habitat for this species includes shallow waterbodies fringed with vegetation and trees, the banks of small streams, including those inside forest (BirdLife International 2017). Its diet is broad and typical of a heron this size, that is, fish, insects, small invertebrates and vertebrates (Ndang'ang'a and Sande 2008).

Major threats to this species have primarily been noted in their breeding range, and include habitat loss from clearing, draining and converting wetland habitats to rice fields (BirdLife International, 2017).

Although this species has not been recorded in the CHAA, its non-breeding EOO overlaps the CHAA (IUCN 2017). Nevertheless, based on the presence of suitable, non-breeding habitat within the CHAA (see Table G1, Figure G1), this species may occur in the wetlands and riparian habitats of Buhuka Flats (primarily the Masika River), Bugoma Central Forest Reserve, and along the pipeline corridor.

**Table G4: Population details for Madagascar Pond Heron**

| | |
|---|---|
| Global listing* | Endangered |
| National listing** | Vulnerable |
| Restricted range | No |
| Migratory or congregatory** | Yes - CMS Appendix II, Categories 1b and 1c of the AEWA |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population** | 2000 – 6000 (1,300-4,000 mature individuals) |
| Global EOO# (non-breeding) | 3,322,293 km$^2$ |
| Global AOO# | Unknown |
| Regional/national population** | Unknown |
| Regional/national EOO** | Unknown |

| | |
|---|---|
| Regional/national AOO** | Unknown |
| Number of global discrete management units | Unknown |

* IUCN (2017)

** Ndang'ang'a and Sande (2008)

*** BirdLife International (2017)

# IUCN (2014)

Although the Madagascar Pond Heron has not been recorded in the CHAA, with the nearest records around Lake Edward (~180 km south-west of the CHAA, Ndang'ang'a and Sande 2008), there is a potential that it could occur in the CHAA. Suitable non-breeding habitat for this species occurs across the CHAA, and it may not necessarily be limited to those habitats mentioned above. As such, the whole CHAA was considered to be a DMU that could support a non-breeding sub-population of this species. Furthermore, the global population of this species is estimated to be between 2000 and 6000 individuals (Ndang'ang'a and Sande 2008). The precise distribution of these individuals across the non-breeding EOO is unknown; however, Kenya and Tanzania are believed to be the core areas for its non-breeding EOO (Martínez-Vilalta et al. 2014). Therefore, a disproportionate distribution of this species across its non-breeding EOO can reasonably be assumed, with concentrations in Kenya and Tanzania (after Ndang'ang'a and Sande 2008, Martínez-Vilalta et al. 2014).

Given these uncertainties, and the lack of data, regardless of the apparent disproportionate distribution of this species across its non-breeding EOO, a conservative approach to the application of the critical habitat triggers was used. It was assumed that individuals were evenly distributed across the global (non-breeding) EOO (that is, 3,322,293 km$^2$), which was then used as a proxy for the global non-breeding population of this species. Hence, the 814 km$^2$ of the CHAA equates to <0.01% of this species' non-breeding population.

Hence, applying the quantitative and qualitative triggers for Criterion 1 and 3 critical habitat (Appendix B, Table B1) to the derived population details for this species, identifies that it does not trigger Criterion 1 or 3. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

#### 9.1.1.4 Grey Crowned Crane (*Balearica regulorum*)

i Potential critical habitat – Criterion 1

The Grey Crowned-crane is a globally listed Endangered species (Table G5) (IUCN, 2017). It has a very large range that includes central, east and southern Africa, including the Albertine Rift (BirdLife International 2017).

The largest remaining populations of this species are concentrated in the northern part of their range, where approximately 30,000 to 55,000 individuals remain; with between 4000 and 5000 birds in the southern part (BirdLife International, 2017).

In East Africa, the populations tend to have peak breeding during the dry season (BirdLife International 2017). Typically, this species nests in solitary, territorial pairs at the edges of wetlands and in marshes with water at least 1 m deep and tall, emergent vegetation (Morrison and Bothma 1998, BirdLife International 2017).

The Grey Crowned-crane's diet is broad, consisting of seed heads, growing tips of grasses, pulses, nuts and grain, and small invertebrates and vertebrates (BirdLife International, 2017).

Major threats to this species are mainly from the loss of suitable breeding wetlands, pesticide use, frequent fires, changes to hydrological regimes, egg collecting and live trade/domestication of chicks (BirdLife International 2017). In Uganda, for example, indications are that that the illegal captive trade is particularly significant (Morrison 2008, 2009 in BirdLife International 2017). Additionally, electrocution and collision with overhead power lines has been identified as a serious threat in Uganda (K. Morrison in litt. 2011, J. Harris in litt. 2012).

This species' EOO substantially overlaps with the CHAA, and it has been recorded in the CHAA, on the Buhuka Flats and along the proposed pipeline route, with 14 individuals seen during the wet season surveys (see Section 6.3.2, Appendix C). Suitable breeding habitat for this species (that is, permanent wetlands (Morrison and Bothma 1998, Archibald et al. 2013)), occurs on the Buhuka Flats (~84 ha) and ~83 ha occurs in the remainder of the CHAA (Appendix G, Figure G2). Suitable foraging habitat also occurs in the CHAA in the form of seasonally flooded grassland (73.1 ha in the Buhuka Flats and 0.6 ha along the pipeline route corridor), and open grassland (568 ha (Buhuka Flats)) (Appendix G, Figure G2). It is noted that In East Africa this species is most commonly found in human-modified habitats (Archibald et al. 2013). However, a model of habitat suitability for Grey Crowned Crane in Uganda (Stabach et al., 2009) indicates that the CHAA lies within an area of relatively low suitability for this species, more or less in between two key areas of habitat suitability – the southwestern portion of Uganda, and the area just north of Lake Albert along the Albert Nile river. Interestingly, these areas were correlated with having both the highest and lowest values of temperature seasonality in the country, as well as having suitable wetland habitat (Stabach et al., 2009). The importance of temperature variation in defining Grey Crowned Crane habitat suitability is further underlined by the reported threat of the loss of large tree roosting sites used by cranes for sheltering from the midday sun, a factor that may be crucial to crane conservation in warmer areas and during dry periods (Olupot, 2014).

**Table G5: Population details for Grey Crowned Crane**

| | |
|---|---|
| Global listing* | Endangered, CITES Appendix II |
| National listing | Protected (Uganda Wildlife Bill 2017) |
| Restricted range | No |
| Migratory or congregatory* | No |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population** | 50,000 – 64,000 |
| Global EOO# | 3,561,114 km$^2$ |
| Global AOO# | Unknown |
| Regional/national population* | 13,000 – 20,000 |
| Regional/national EOO* | Unknown |
| Regional/national AOO* | Unknown |
| Number of global discrete management units | Unknown |

* IUCN (2017)

** BirdLife International (2017)

# IUCN (2014)

Grey Crowned Crane has been recorded in the CHAA, with up to 14 individuals identified on the Buhuka Flats during the wet season surveys (Appendix C). It is possible that other individuals could occur within the wider CHAA, with a conservative estimate of between 15 and 20 individuals potentially occurring in this area at any one time, based on the relatively low habitat suitability of the CHAA modelled by Stabach et al. (2009), the transformation of the majority of the CHAA beyond the Buhuka Flats for agriculture, and the expected likely lack of suitable tree roosting sites in proximity to wetlands within the CHAA beyond the Buhuka Flats. As such, the whole CHAA was considered to be a DMU for this species that supports a sub-population of this species in the region. It could support 0.1% of the regional population (15 to 20 individuals of the Ugandan population of 13,000 to 20,000 individuals).

Hence, applying the quantitative and qualitative triggers for Criterion 1 critical habitat (Appendix B, Table B1) to this population identifies that it does not trigger Criterion 1. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

### 9.1.1.5 *White-backed Vulture (Gyps africanus)*

i Potential critical habitat – Criterion 1

The White-backed Vulture is a globally listed Critically Endangered species (Table G6) (IUCN, 2017). It has a very large range from Senegal, Gambia and Mali in the west, throughout the Sahel region to Ethiopia and Somalia in the east, through East Africa into Mozambique, Zimbabwe, Botswana, Namibia and South Africa in the south (BirdLife International 2017). It is commonest and most widespread vulture in Africa, however, it is suffering rapid declines across much of this range (BirdLife International 2017, Kemp et al. 2014).

The White-backed Vulture is a gregarious species congregating at carcasses, in thermals and at roost sites. Indications are that this species migrates down the Rift Valley in Uganda in July (Kemp et al. 2014). Indeed, observations of this species made during the wet season survey of the CHAA (in May 2014, Appendix B), indicate that a group was moving down the valley.

As with most of the world's vultures, major threats to this species are mainly from the loss of wild ungulate populations, which has led to a loss in the availability of sufficient carrion, hunting for trade, persecution and poisoning, and collisions with power lines (BirdLife International 2017). In East Africa, poisoning (especially from the highly toxic pesticide carbofuran) appears to be the main problem; although this occurs mainly outside protected areas (Kemp et al. 2014). Recent research has indicated that the use of the veterinary anti-inflammatory drug, diclofenac, has resulted in dramatic declines in vulture numbers, particularly across Asia (for example, see Green et al. 2006, Harris 2013). If this situation has affected the vultures of Africa, in particular East Africa, it is unclear at this time.

This species' EOO substantially overlaps with the CHAA, and 20 individuals have been recorded in the CHAA (see Section 5.1.4 of the main report, Appendix C). This species prefers open wooded savannah, where it requires tall trees for nesting (BirdLife International 2017). Nests are typically located in the crown of large trees or, less often, in an open fork, frequently along a watercourse; they can be frequently clumped in loose colonies of two to 13 nests (Kemp et al. 2014). Suitable breeding and foraging habitat for this species occurs across the CHAA (Figure G3), and includes open woodland (161.7 ha), woodland (190.4 ha), riverine woodland (69.8 ha), dense wooded grassland (554.7 ha), open wooded grassland (468.9 ha), wooded grassland (184.3 ha), open woodland/dense bushland (147.9 ha), and open wooded bushland (214.0 ha).

**Table G6: Population details for White-backed Vulture**

| | |
|---|---|
| Global listing* | Endangered |
| National listing* | Not listed |
| Restricted range | No |
| Migratory or congregatory* | No |
| Discrete management unit | CHAA (814 $km^2$) |
| Global population* | 270,000 |
| Global EOO# | 12,348,146 $km^2$ |
| Global AOO# | Unknown |
| Regional/national population*** | ~40,000 |
| Regional/national EOO* | Unknown |
| Regional/national AOO* | Unknown |
| Number of global discrete management units | Unknown |

* BirdLife International (2017)

*** Kemp et al. (2014)

# IUCN (2014)

The White-backed Vulture has been recorded in the CHAA, with up to 20 individuals identified soaring along the escarpment (Appendix C). It is possible that other individuals could occur within the wider CHAA. However, individuals of this species are very wide ranging, and are known to move up and down the Albertine Rift (Kemp et al. 2014). Therefore, it is difficult to put a precise number on the population utilising the CHAA. Regardless, the whole CHAA was considered to be a DMU for this species that supports a sub-population of this species in the region. It could support <0.05% of the regional population (20 individuals of the regional population of ~40,000 individuals).

Hence, applying the quantitative and qualitative triggers for Criterion 1 critical habitat (Appendix B, Table B1) to this population identifies that it does not trigger Criterion 1. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

### 9.1.1.6 Hooded Vulture (*Necrosyrtes monachus*)

i Potential critical habitat – Criterion 1

The Hooded Vulture is a globally listed Endangered species (Table G7) (IUCN, 2017). It has a very large range, tending to be confined to sub-Saharan Africa, from Senegal and southern Mauritania, through south Niger and Chad to South Sudan, Ethiopia and Somalia, to Namibia and Botswana, Zimbabwe, Mozambique and north-east South Africa (Kemp and Christie 2013).

As with most of the world's vultures, major threats to this species are mainly from hunting for trade, persecution and poisoning (Kemp and Christie 2013, BirdLife International 2017). In Kampala, where scavenging birds were very conspicuous between the 1970s and mid-2000s, they have since noticeably decreased in numbers (Kemp and Christie 2013). Declines could also be attributed to land-use change through development, and improvements of abattoir hygiene and refuse disposal in some areas. Hooded Vultures also appear to suffer some mortality from avian influenza (H5N1), probably acquired from feeding on dead poultry (Kemp and Christie 2013). In East Africa, poisoning (especially from the highly toxic pesticide carbofuran) appears to be the main problem; although this occurs mainly outside protected areas (Kemp and Christie 2013). Recent research has indicated that the use of the veterinary anti-inflammatory drug, diclofenac, has resulted in dramatic declines in vulture numbers, particularly across Asia (for example, see Green et al. 2006, Harris 2013). If this situation has affected the vultures of Africa, in particular East Africa is unclear at this time.

This species's EOO substantially overlaps with the CHAA; although it has not yet been recorded in the CHAA. This species prefers open woodland and savanna, also forest edge, and is generally absent from desert and dense forest, although it has been known to utilise secondary forest, clearings, settlements and urban areas (Kemp and Christie 2013). This species builds a small stick nest from April to July in the upper fork of large trees, usually deep within foliage and not on the crown (unlike other vulture species) (Kemp and Christie 2013).

Suitable breeding and foraging habitat for this species occurs across the CHAA (Figure G4), and includes open woodland (161.7 ha), woodland (190.4 ha), riverine woodland (69.8 ha), dense wooded grassland (554.7 ha), open wooded grassland (468.9 ha), wooded grassland (184.3 ha), open woodland/dense bushland (147.9 ha), and open wooded bushland (214.0 ha).

**Table G7: Population details for Hooded Vulture**

| | |
|---|---|
| Global listing* | Endangered |
| National listing | Protected (Uganda Wildlife Bill, 2017) |
| Restricted range | No |
| Migratory or congregatory* | No |
| Discrete management unit | CHAA (814 $km^2$) |
| Global population* | 197,000 |
| Global EOO# | 12,369,089 $km^2$ |
| Global AOO# | Unknown |
| Regional/national population* | Unknown |
| Regional/national EOO* | Unknown |
| Regional/national AOO* | Unknown |
| Number of global discrete management units | Unknown |

* BirdLife International (2017)

\# IUCN (2017)

The Hooded Vulture has not yet been recorded in the CHAA (Appendix C), although it is likely that it could occur. Individuals are probably sedentary in most areas, but may range over 200 km when not breeding (Kemp and Christie 2013). Therefore, it is difficult to put a precise number on the population utilising the CHAA, or even the region. Regardless, the whole CHAA was considered to be a DMU for this species that could support a sub-population of this species in the region. Therefore, the CHAA and EOO were used as a proxy for the population. Based on that assessment, the CHAA could support <0.01% of the global population of this species.

Hence, applying the quantitative and qualitative triggers for Criterion 1 critical habitat (Appendix B, Table B1) to this population identifies that it does not trigger Criterion 1. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

#### *9.1.1.7 Nahan's Francolin (Ptilopachus nahani)*

i Potential critical habitat – Criterion 1, 2 and 5

The Nahan's Francolin is a globally listed Vulnerable species (Table G8) (IUCN, 2017). It has a very restricted distribution, being found only in north-east DRC (within the area bordered by the Aruwimi River, the Nepoko River and the Semliki River) and western and south-central Uganda (in particular the forests of Budongo, Bugoma and Mabira) (McGowan and de Juana 1994).

This species is confined to dense, mature, moist, sometimes swampy medium-altitude forest below 1,500 m (McGowan and de Juana 1994, BirdLife International 2017); and is reasonably common in Budongo Central Forest Reserve (Plumptre et al. 2010, 2011). Large trees with appropriate buttress formation are important for breeding sites for this species (Sande et al. 2009a). Forest disturbance appears to reduce the home range of this species (Sande et al. 2009b).

The population trend of this species appears to be decreasing, with the primary threats thought to be habitat loss through logging and clearance of forest for charcoal burning and agriculture, particularly within Bugoma Central Forest Reserve (BirdLife International 2017). Fragmentation alone probably does not appear to adversely affect the species, but it does appear to be affected by habitat changes associated with human-induced fragmentation, such as the extensive removal of large trees (BirdLife International 2012ad, 2014i).

It appears to have a very restricted EOO, although populations in the wider DRC are unknown, hence its distribution may be larger than thought (BirdLife International 2017). This species's EOO overlaps with the CHAA; and has been recorded in the CHAA within Bugoma Central Forest Reserve (Plumptre et al. 2010, 2011). Suitable habitat for this species occurs only in Bugoma Central Forest Reserve (40,243 ha), within the CHAA (Figure G5).

**Table G8: Population details for Nahan's Francolin**

| | |
|---|---|
| Global listing* | Vulnerable |
| National listing | Not listed |
| Restricted range | Yes |
| Migratory or congregatory* | No |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | 50,000 - 99,999 |
| Global EOO# | 100,339 km$^2$ |
| Global AOO# | Unknown |
| Regional/national population* | 44,038 (95% CI: 32,827-59,079) |
| Regional/national EOO | 1046 km$^2$<br>(Budongo (435 km$^2$), Bugoma Forest (401 km$^2$) and Mabira Forest (210 km$^2$)) |
| Regional/national AOO | 1046 km$^2$<br>(Budongo (435 km$^2$), Bugoma Forest (401 km$^2$) and Mabira Forest (210 km$^2$)) |
| Number of global discrete management units | 3<br>(Budongo (435 km$^2$), Bugoma Forest (401 km$^2$) and Mabira Forest (210 km$^2$)) |

* IUCN (2017) ** BirdLife International (2017) # IUCN (2014)

The Nahan's Francolin has been recorded in the CHAA (Plumptre et al. 2010, 2011). Although the precise number of individuals occurring within the CHAA is unknown, the CHAA does support approximately 38% of this species's known regional AOO (Table G8). Therefore, it is conceivable that the CHAA could support ~16,700 individuals (38% of 44,038).

Hence, applying the quantitative and qualitative triggers for Criterion 1 critical habitat (Appendix B, Table B1) to this population identifies that it triggers only Criterion 1 Tier 1. Therefore, this species has been assessed as triggering critical habitat within the CHAA.

#### *9.1.1.8 Eastern Chimpanzee (Pan troglodytes schweinfurthii)*

i Potential critical habitat – Criterion 1

The Eastern Chimpanzee is a globally listed Endangered species (IUCN, 2017; Wilson et al. 2008) (Wilson et al. 2008). Generally, Chimpanzees have a wide, but discontinuous distribution, across Africa, yet tend to be confined to the equatorial belt (Oates et al. 2008). The Eastern Chimpanzee ranges from the Ubangi River/Congo River in Central African Republic and the DRC, to western Uganda, Rwanda and western Tanzania (Wilson et al. 2008).

They prefer mature moist and dry forests, either evergreen or semi-deciduous, and forest galleries extending into savanna woodlands (Wilson et al. 2008). They are omnivorous, and their diet is highly variable according to individual populations and seasons. Chimpanzees form social communities with home ranges larger in woodland forest mosaics than in mixed forest, averaging 12.5 km² (range 5 to 400 km²) (Wilson et al. 2008).

Due to high levels of exploitation, loss of habitat and habitat quality due to expanding human activities, this species is estimated to have experienced a significant population reduction in the past 20 to 30 years (Wilson et al. 2008). Major threats include habitat destruction and degradation (slash and burn agriculture, deforestation, logging), poaching (bush meat, pet trade, traditional medicine, crop protection), and disease (Oates et al. 2008).

This species's EOO overlaps with the CHAA; and it has been recorded in the CHAA, in particular, Bugoma Central Forest Reserve (Plumptre et al. 2010, 2011). Suitable habitat for this species occurs only in Bugoma Central Forest Reserve (401 km²), within the CHAA (Figure G6).

**Table G9: Population details for Eastern Chimpanzee**

| | |
|---|---|
| Global listing* | Endangered, CITES Appendix I |
| National listing* | VU, Protected (Uganda Wildlife Bill, 2017) |
| Restricted range | No |
| Migratory or congregatory | No |
| Discrete management unit | CHAA (814 km²) |
| Global population* | 172,700 - 299,700 |
| Global EOO# | 5,759,594 km² |
| Global AOO# | Unknown |
| Regional/national population** | 4000 - 5700 |
| Regional/national EOO | 1046 km² (Budongo (435 km²), Bugoma Forest (401 km²) and Mabira Forest (210 km²)) |
| Regional/national EOO | 1046 km² (Budongo (435 km²), Bugoma Forest (401 km²) and Mabira Forest (210 km²)) |
| Number of global discrete management units | Unknown |

* Oates et al. (2008) ** Thompson and Wrangham (2013) # IUCN (2014)

The Eastern Chimpanzee has been recorded in the CHAA (Plumptre et al. 2010, 2011). Although the precise number of individuals occurring within the CHAA is unknown, the CHAA does support approximately 38% of this species known regional EOO (Table G9). Therefore, it is conceivable that the CHAA could support between 1520 and 2160 individuals (38% of 4000 to 5700).

Eastern Chimpanzees are great apes, therefore, under the quantitative and qualitative triggers for Criterion 1 critical habitat (Appendix B, Table B1) they trigger Criterion 1 Tier 1. Therefore, this species has been assessed as triggering critical habitat within the CHAA.

#### *9.1.1.9 Migratory and Congregatory Species*

##### *Migratory Birds*

i Potential critical habitat – Criterion 3

The CHAA supports a diversity of migratory and congregatory species as listed under the Convention on Migratory Species (CMS), to which Uganda is a signatory (see Section 4.0 of the main report). All of these species are listed under Appendix II of the CMS. Species listed under Appendix II are identified as having an unfavourable conservation statues, that is, they may be threatened or near threatened, and, therefore, need international agreements for their conservation and management within the countries within which they are known to range (CMS 2014).

At least 12 Palearctic migratory birds could occur in the CHAA (see Section 5.1.4 of the main report, Appendix C, Table G1). These include, amongst others, Common Ringed Plover, Kittlitz's Plover, White-winged Tern, Great Snipe, Black-winged Pratincole, Collared Pratincole, Black-tailed Godwit, Eurasian Curlew, African Skimmer, Common Sandpiper, African Wattled Lapwing, and Spur-winged Lapwing. Although individual numbers of these species were low during the surveys conducted (see Section 5.1.4 of the main report), it could be expected that the CHAA may support substantial numbers of these species during peak migration times. In particular, around September and October; a survey for migratory species is planned for that time to gauge the importance of the CHAA for migratory birds. Nevertheless, the CHAA supports suitable habitat for all of the aforementioned species. In particular, the Buhuka Flats supports ~12 km of shoreline (Figure G7), which is favourable to wading and shore birds like the Common Ringed Plover, Kittlitz's Plover, White-winged Tern, Great Snipe, Black-tailed Godwit, Eurasian Curlew, African Skimmer, and Common Sandpiper. The flats also support ~850 ha of grassland and ~77 ha of seasonally flooded grassland (Figure 4a and b of the main report), that is favoured habitat of Black-winged Pratincole, Collared Pratincole, African Wattled Lapwing, and Spur-winged Lapwing.

**Table G10: Population details for Common Ringed Plover**

| | |
|---|---|
| Global listing* | Least Concern |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | 360,000 - 1,300,000 |
| Global EOO# | NA |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | NA |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G11: Population details for Kittlitz's Plover**

| | |
|---|---|
| Global listing* | Least Concern |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 $km^2$) |
| Global population* | Unknown |
| Global EOO# | NA |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | NA |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G12: Population details for White-winged Tern**

| | |
|---|---|
| Global listing* | Least Concern |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 $km^2$) |
| Global population* | 2,500,000 - 4,500,000 |
| Global EOO# | NA |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | NA |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G13: Population details for Great Snipe**

| | |
|---|---|
| Global listing* | Least Concern |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 $km^2$) |
| Global population* | 465,000 - 1,040,000 |
| Global EOO# | NA |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | NA |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G14: Population details for Black-winged Pratincole**

| | |
|---|---|
| Global listing* | Near Threatened |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | 220,000 - 290,000 |
| Global EOO# | 9,354,763 km$^2$ |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | 4,498,364 km$^2$ |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G15: Population details for Collared Pratincole**

| | |
|---|---|
| Global listing* | Least Concern |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | Unknown |
| Global EOO# | NA |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | NA |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G16: Population details for Black-tailed Godwit**

| | |
|---|---|
| Global listing* | Near Threatened |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | 427,000 – 805,000 |
| Global EOO# | 45,772,340 km$^2$ |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | 11,050,681 km$^2$ |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G17: Population details for Eurasian Curlew**

| | |
|---|---|
| Global listing* | Near Threatened |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | 77,000 - 1,065,000 |
| Global EOO# | 31,500,728 km$^2$ |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | 9,201,510 km$^2$ |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G18: Population details for African Skimmer**

| | |
|---|---|
| Global listing* | Near Threatened |
| National listing* | Protected (Uganda Wildlife Bill 2017) |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | 15,000 - 25,000 |
| Global EOO# | 10,384,709 km$^2$ |
| Global AOO# | NA |
| Regional/national population* | 8,000 - 12,000 |
| Regional/national EOO# | 10,384,709 km$^2$ |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G19: Population details for Common Sandpiper**

| | |
|---|---|
| Global listing* | Least Concern |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | 2,600,000 - 3,200,000 |
| Global EOO# | NA |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | NA |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017) # IUCN (2014)

**Table G20: Population details for African Wattled Lapwing**

| | |
|---|---|
| Global listing* | Least Concern |
| National listing* | Protected (Uganda Wildlife Bill, 2017) |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | Unknown |
| Global EOO# | NA |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | NA |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017)  # IUCN (2014)

**Table G21: Population details for Spur-winged Lapwing**

| | |
|---|---|
| Global listing* | Least Concern |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population* | Unknown |
| Global EOO# | NA |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | NA |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* IUCN (2017)  # IUCN (2014)

Applying the quantitative and qualitative triggers for Criterion 3 critical habitat (Appendix B, Table B1) to the population details of each of these species in relation to the CHAA (see Table G10 to G21) and the known baseline (see Appendix C), identifies that none of them triggers Criterion 3. Therefore, these species have been assessed as not triggering critical habitat within the CHAA.

### *Congregatory Bats*

i Potential critical habitat – Criterion 3

The CHAA potentially supports populations of the migratory and congregatory African Straw-coloured Fruit-bat (*Eidolon helvum*), a Bent-wing Bat (*Miniopterus* sp.) and Large-eared Free-tailed Bat (*Otomops martiensseni*). Although these species do not migrate across vast distances and continents like birds, they can migrate hundreds of kilometres from hibernacula to breeding roosts (Monadjem et al. 2010). No roosting colonies of African Straw-coloured Bat were recorded in the CHAA, and it is more likely that individuals or small colonies of this gregarious species may occur in the CHAA. Certainly, it is doubtful that roosts would occur in the LSA. The Bent-wing Bats and the Large-eared Free-tailed Bat are obligate cavity or cave roosters (Dietz et al. 2009, Monadjem et al. 2010, Happold 2013b, Yalden and Happold 2013). Although the Large-eared Free-tailed Bat has not yet been recorded in the CHAA, a Bent-wing Bat has been recorded. This is interesting because Bent-wing Bats, being a obligate cave roosting species, which can form roosting colonies numbering thousands of individuals (Monadjem et al. 2010), are also known to share its roosting colonies with other species of bats, such as the Large-eared Free-tailed Bat (Large-eared Free-tailed Bat). As such, it is conceivable that one or more caves occur in the CHAA where-in these species may roost. The precise locality of these caves is not known; however, these could, more than likely occur somewhere along the escarpment.

**Table G22: Population details for African Straw-coloured Fruit-bat**

| | |
|---|---|
| Global listing* | Near Threatened |
| National listing | Protected (Uganda Wildlife Bill, 2017) |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 $km^2$) |
| Global population* | Unknown, suspected to be millions |
| Global EOO# | 12,945,414 $km^2$ |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | Unknown |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* Mickleburgh et al. (2008a)

# IUCN (2014)

The African Straw-coloured Fruit-bat has not yet been recorded in the CHAA, and the global population of this species is unknown; therefore, the global EOO and the CHAA were used as proxies for the global and local populations, respectively. The CHAA potentially supports <0.01% of the global population.

Hence, applying the quantitative and qualitative triggers for Criterion 3 critical habitat (Appendix B, Table B1) to the population details of African Straw-coloured Fruit-bat in relation to the CHAA (see Table G22) identifies that it does not trigger Criterion 3. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

**Table G23: Population details for Large-eared Free-tailed Bat**

| | |
|---|---|
| Global listing* | Near Threatened |
| National listing* | - |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 $km^2$) |
| Global population* | Unknown |
| Global EOO# | 7,649,368 $km^2$ |
| Global AOO# | NA |
| Regional/national population* | Unknown |
| Regional/national EOO# | Unknown |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* Mickleburgh et al. (2008c)

# IUCN (2014)

The Large-eared Free-tailed Bat has not yet been recorded in the CHAA, and the global population of this species is unknown; therefore, the global EOO and the CHAA were used as proxies for the global and local populations, respectively. The CHAA potentially supports 0.01% of the global population.

Hence, applying the quantitative and qualitative triggers for Criterion 3 critical habitat (Appendix B, Table B1) to the population details of Large-eared Free-tailed Bat in relation to the CHAA (see Table G23) identifies that it does not trigger Criterion 3. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

### *African Elephant (Loxodonta africana)*

i Potential critical habitat – Criterion 3

The African Elephant is also identified by the CMS as a migratory species (Table G1). This species occurs in the CHAA, and individuals have been recorded in the Bugoma Central Forest Reserve (Plumptre et al. 2010, 2011). However, the records suggest that the individuals occurring in the Bugoma Central Forest Reserve are lone, or single individuals (see Plumptre et al 2010, 2011), and certainly not large breeding herd that would migrate.

**Table G24: Population details for African Elephant**

| | |
|---|---|
| Global listing* | Vulnerable, CMS Appendix II, CITES Appendix I |
| National listing* | Vulnerable; Protected (Uganda Wildlife Bill, 2017) |
| Restricted range | No |
| Migratory or congregatory | Yes |
| Discrete management unit | CHAA (814 $km^2$) |
| Global population* | Unknown |
| Global EOO# | 3,543,323 $km^2$ |
| Global AOO# | Unknown |
| Regional/national population* | 2000 - 3000 |
| Regional/national EOO# | 103,983 $km^2$ |
| Regional/national AOO# | NA |
| Number of global discrete management units | unknown |

* Blanc (2008)

# IUCN (2014)

The African Elephant has been recorded in the CHAA, although it appears that those were lone individuals. The precise population within the CHAA is unknown, as is the global population; although the population within Uganda is estimated to be between 2000 and 3000 individuals (Table G24). Therefore, the regional EOO and the CHAA were used as proxies to estimate the regional and local populations, respectively. The CHAA potentially supports 0.8% of the regional population.

Hence, applying the quantitative and qualitative triggers for Criterion 3 critical habitat (Appendix B, Table B1) to the population details of African Elephant in relation to the CHAA (see Table G24) identifies that it does not trigger Criterion 3. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

### 9.1.2 Ecosystems Potentially Triggering Criterion 4 Critical Habitat: Highly Threatened and/or Unique Ecosystems

Highly threatened or unique ecosystems are those (i) that are at risk of significantly decreasing in area or quality; (ii) with a small spatial extent; and/or (iii) containing unique assemblages of species including assemblages or concentrations of biome-restricted species (IFC, 2012).

In addition, areas determined to be irreplaceable or of high priority/significance based on systematic conservation planning techniques carried out at the landscape and/or regional scale by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally-recognized NGOs) or that are recognized as such in existing regional or national plans, such as the NBSAP, would qualify as critical habitat per Criterion 4 (IFC, 2012).

#### *9.1.2.1 Bugoma Central Forest Reserve*

Bugoma Central Forest Reserve therefore triggers Critical Habitat on the basis of the following qualifying factors:

i) It is at risk of significantly decreasing in area and quality as a result of human encroachment as a result of demand for ecosystem services by the local communities, as well as recent illegal land-grabbing activity - in 2016, the Muhangaizima Block was reportedly leased for sugar cane cultivation, with subsequent transformation activities affecting approximately 8000 ha of the CFR (ACBF, 2016);

ii) It is conservatively assessed as Vulnerable (after Rodriguez et al. 2011) – suspected of undergoing a ≥30% decline in extent of occurrence over the last 50 years in the region (based on Plumptre 2002, Plumptre et al. 2003, 2007, 2010, 2011);

iii) It supports a relatively unique assemblage of species including Uganda's only population of the range-restricted Nahan's Francolin (*Ptilopachus nahani*), as well as Endangered Eastern Chimpanzee (*Pan troglodytes schweinfurthii*), and Vulnerable African Elephant (*Loxodonta africana*) for which it is also of recognised importance as a climate change refugium; is a a recognised chimpanzee conservation unit (Plumptre et al. 2010), and is a recognised area of old growth forest (Plumptre et al. 2010, 2011); and

iv) It is recognised as an Important Bird Area by the internationally-recognised NGO BirdLife International.

### 9.1.3 Species Potentially Triggering Criterion 5 Critical Habitat (Evolutionarily Distinct Species)

As discussed in Section 3.2.3.3 and Appendix B, quantitative thresholds for distinguishing the tiers of critical habitat have been developed by the IFC for Criteria 1 to 3, and the thresholds for Criterion 5 are purely qualitative.

This criterion therefore is defined by the presence within the CHAA of subpopulations of species that are phylogenetically or morphogenetically distinct and may be of special conservation concern given their distinct evolutionary history, including 'Evolutionarily Distinct and Globally Endangered' (EDGE) species (ZSL, 2017).

#### *9.1.3.1 Shoebill (Balaeniceps rex)*

The Shoebill is a globally listed Vulnerable species (Table G25) (IUCN, 2017). It has a very wide distribution, from South Sudan to Zambia, but is very locally distributed within that range and prefers large swamps (BirdLife International 2017).

This species is a true wetland specialist that is sedentary as an adult. It breeds and forages in seasonally flooded marshes where vegetation is dominated by a mixture of Papyrus (*Cyperus papyrus*), reeds (*Phragmites* spp.), cattails (*Typha* spp.) and grasses, particularly *Miscanthidium*, although it tends to avoid areas where the vegetation is taller than itself (BirdLife International 2017). Suitable habitat for breeding is very limited within the CHAA; however, it is conceivable that non-breeding individuals may occur in suitable habitat (seasonally-flooded marshes) within the CHAA.

In Uganda, this species shows a preference for feeding on Lungfish (*Protopterus aethiopicus*), although it does take a variety of species including Senegal Bichir, catfish (*Clarias* spp.) and tilapia (*Tilapia* spp.) (BirdLife International 2017), all species common in the CHAA (Appendix C).

Major threats to this species are mainly from the loss of suitable breeding wetlands, general habitat destruction and degradation, disturbance, hunting, and capture for the bird trade (BirdLife International 2017).

This species' EOO does not overlap with the CHAA, and it has not been recorded in the CHAA (see Table G1).

**Table G25: Population details for Shoebill**

| | |
|---|---|
| Global listing* | Vulnerable, CITES Appendix II |
| National listing* | Vulnerable; Protected (Uganda Wildlife Bill, 2017) |
| Restricted range | No |
| Migratory or congregatory* | No |
| Discrete management unit | CHAA (814 km$^2$) |
| Global population** | <10,000 |
| Global EOO# | Unavailable at time of writing |
| Global AOO# | Unknown |
| Regional/national population** | 100 – 150 |
| Regional/national EOO# | Unknown |
| Regional/national AOO# | Unknown |
| Number of global discrete management units | Unknown |

* IUCN (2017)

** BirdLife International (2017)

# IUCN (2014)

Hence, applying the qualitative triggers for Criterion 5 critical habitat (Appendix B) to the population details of Shoebills in relation to the CHAA (see Table G25) identifies that it does not trigger Criterion 5. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

### 9.1.3.2 Secretarybird (*Sagittarius serpentarius*)

The Secretarybird is a globally listed Vulnerable species (Table G26) (IUCN, 2017). It has a very wide distribution, from West Africa (Senegal and the Gambia) across to Ethiopia and Somalia, and south to South Africa (Kemp et al. 2014).

It prefers grassland or tree and grass savanna, favouring short grass with scattered *Acacia* thorn trees to provide sites for roosting and nesting; it is also found in large-scale agricultural areas and sub-desert areas; it rarely visits clearings in woodland or forest (BirdLife International 2017, Kemp et al. 2014). They tend to be sedentary (with regular seasonal breeding) in some areas, but nomadic in most areas in response to changes in rainfall, grazing and fires (Kemp et al. 2014).

Secretarybirds breed at any time of year, whenever food is abundant; build large nests on top of low trees, often flat-topped Acacias (Kemp et al. 2014).

This species can be common to rare and localised across its range, with recent evidence suggesting rapid decline; within Uganda it is never common, and is now largely confined to national parks (Kemp et al. 2014). Major threats coming from the excessive burning of grasslands, which may suppress populations of prey species, intensive grazing of livestock is also probably degrading otherwise suitable habitat (BirdLife International 2017). Disturbance by humans could affect breeding, while live trade of individuals has also been reported, along with indiscriminate poisoning at waterholes as possible threats (BirdLife International 2017).

This species' EOO overlaps substantially with the CHAA, yet it has not yet been recorded in the CHAA (see Appendix G). Suitable breeding and foraging habitat for this species occurs across the wider CHAA, and the CHAA, and includes open woodland, woodland, open wooded grassland, wooded grassland, and open grassland (Table 6).

**Table G26: Population details for Secretarybird**

| | |
|---|---|
| Global listing* | Vulnerable, CITES Appendix II |
| National listing* | Protected (Uganda Wildlife Bill, 2017) |
| Restricted range | No |
| Migratory or congregatory* | No |

| | |
|---|---|
| Discrete management unit | CHAA (814 km$^2$) |
| Global population** | Unknown |
| Global EOO# | 15,137,802 km$^2$ |
| Global AOO# | Unknown |
| Regional/national population** | 100 – 150 |
| Regional/national EOO# | Unknown |
| Regional/national AOO# | Unknown |
| Global number of discrete management units | |

* BirdLife International (2013h)

** BirdLife International (2014j)

# IUCN (2014b)

Hence, applying the qualitative triggers for Criterion 5 critical habitat (Appendix B) to the population details of Secretarybirds in relation to the CHAA (see Table G26) identifies that it does not trigger Criterion 5. Therefore, this species has been assessed as not triggering critical habitat within the CHAA.

### 9.1.4 Species/Ecosystems triggering other Qualitative Critical Habitat Criteria

The near-shore habitats are both important fishing grounds and nursery habitat for fisheries, that support 11 fishing villages on the Buhuka Flats and surrounds (see Ecosystem Services Review). This triggers the qualitative Criterion 13 as described in Appendix G.

Furthermore, the near-shore habitats of Lake Albert within the CHAA could potentially constitute critical habitat under Criterion 1 if the mud snail *G. candida* is confirmed present in this area.

## 9.2 Confirmed Triggers of Critical Habitat in the CHAA

Table 4 presents a summary of the confirmed triggers of critical habitat in the CHAA. The spatial representation of critical habitat within the CHAA is presented in Figure 16

**Table 4: Triggers of critical habitat in the CHAA**

| Valued Component | Potential triggering criteria* | Critical Habitat Designation** | Habitat and reasoning |
|---|---|---|---|
| Mud Snail (*Gabbiella candida*) | 1 and 2 | Criterion 1<br>Tier 1 | • Could occur on near-shore aquatic habitats (Bugoma Lagoon, large bays, open sandy shores, shallow river-associated water)<br>• See Appendix G for precise reasoning |
| Nahan's Francolin (*Ptilopachus nahani*) | 2 | Criterion 2<br>Tier 2 | • Occurs in Bugoma Central Forest Reserve, possibly one of less than 10 DMUs globally (including DRC)<br>• Potential for CHAA to support >10% of this species' known global population<br>• See Appendix G for precise reasoning |
| Eastern Chimpanzee (*Pan troglodytes schweinfurthii)* | 1 | Criterion 1<br>Tier 1 | • Occurs in Bugoma Central Forest Reserve<br>• Great apes are an iconic species (see GN 74 and footnotes in PS6, IFC 2012a and b)<br>• See Appendix G for precise reasoning |
| Bugoma Central Forest Reserve | 4, 6, 7, 9, 11, 12, 13, 15, 16 | Criterion 4 | • Threatened ecosystem – over 110 km$^2$ of forest surrounding the Bugoma CFR boundary has been cleared since the mid-1980s (Plumptre 2002); and in 2016, the Muhangaizima Block was reportedly leased for sugar cane cultivation, with subsequent transformation activities affecting approximately 8000 ha of the CFR (ACBF, 2016).<br>• Therefore, conservatively assessed as Vulnerable (after Rodriguez et al. 2011) – suspected of undergoing a ≥30% decline in extent of occurrence over the last 50 years in the region (based on Plumptre 2002, Plumptre et al. 2003, 2007, 2010, 2011)<br>• Of recognised importance as a climate change refugium for Vulnerable Nahan's Francolin and Endangered Eastern Chimpanzee (Ayebare et al. 2013), and a recognised chimpanzee conservation unit (Plumptre et al. 2010)<br>• Recognised area of old growth forest (Plumptre et al. 2010, 2011)<br>• Supports a population of Eastern Chimpanzee (McLennan 2008, Plumptre et al. 2003, 2010, 2011) that is recognised as being one for the four largest in the region (Plumptre et al. 2010); apart from being an Endangered species, chimpanzees are |

| | | | |
|---|---|---|---|
| | | | also recognised as key stone species and ecosystem engineers (Chapman et al. 2013)<br>• The forest is recognised for its unique biodiversity values, including biome restricted species (Plumptre et al. 2011)<br>• Local people harvest timber, fibre, fuel wood and charcoal, and non-timber forest products from the forest (Plumptre 2002)<br>• Bugoma Central Forest Reserve is recognised as an Important Bird Area (BirdLife International 1998, IUCN 2010, 2014b)<br>• Recognised as a high conservation priority area (NEMA 2010) |
| Near-shore habitats of Lake Albert | 13 | Criterion 13 | • The near-shore habitats are important fishing grounds that support 11 fishing villages on the Buhuka Flats and surrounds (see Ecosystem Services Review) |

* IFC (2012b)

** In instances where more than one potential criterion could be triggered, only the highest-level designation is presented

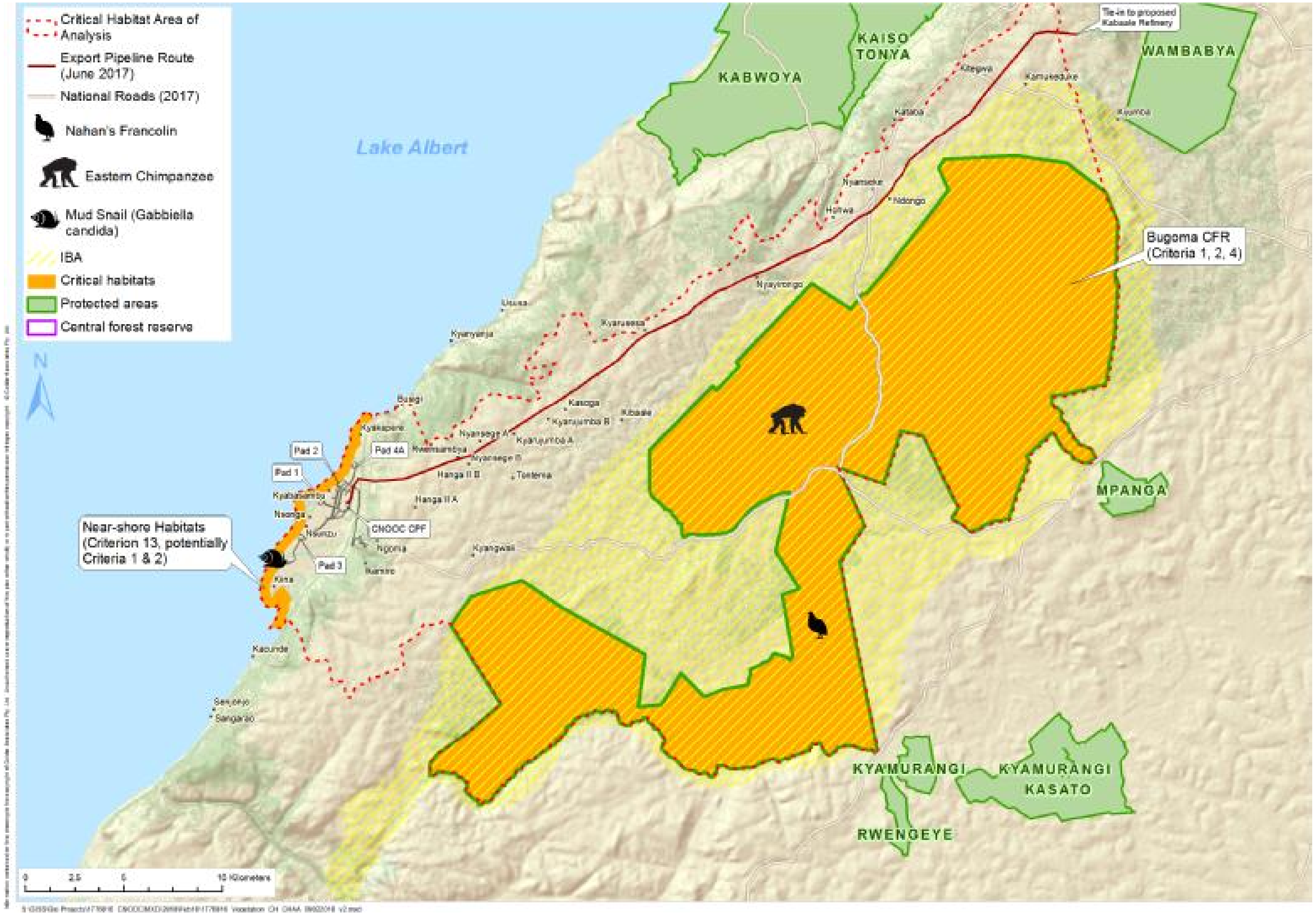


*Figure 16: Potential critical habitat in the CHAA*

# 10.0 IMPACT ASSESSMENT – PRODUCTION FACILITY

This section presents an assessment of the possible interactions of biodiversity valued components with the production facility infrastructure and activities, and the resulting impacts during the construction, operation and decommissioning phases of the Project.

The biodiversity valued components for the Production Facility impact assessment are listed in Table 5 below. They include all of the species and habitats that trigger critical habitat designation within the CHAA. In addition, ecosystems of concern that will be potentially affected by the Project, and Grey Crowned Crane, were also included as valued components for impact assessment, for reasons outlined in the Table below. As mentioned in Section 10.1.2, potential impacts to other species of concern are assessed at the habitat level (ecosystems of concern).

**Table 5: Biodiversity Valued Components for Impact Assessment**

| Valued Component | Confirmed CH Trigger? (see Table 4) | Reasoning (see Table 4) |
|---|---|---|
| Near-shore aquatic habitats of Lake Albert | • Yes – Criterion 13<br>• Possibly Criterion 1 and Criterion 2 (G. candida) | • The near-shore habitats are important fishing grounds that support 11 fishing villages on the Buhuka Flats and surrounds (see Ecosystem Services Review)<br>• May support the CR and range-restricted species *Gabbiella candida* |
| Wetlands | • No | • Natural habitat – priority habitat according to IFC (2012)<br>• Supports Endangered Grey Crowned Crane<br>• Important in supply of ecosystem services to local communities (see Ecosystem Services Review) |
| Escarpment vegetation corridor | • No | • Natural habitat – priority habitat according to IFC (2012)<br>• Forms part of a contiguous vegetation corridor that is part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor<br>• The location of caves and cavities along the escarpment that could be important for cavity-roosting bats |
| Bugoma Central Forest Reserve | • Yes –<br>• Criterion 4<br>• Criterion 1<br>• Criterion 2 | • Triggers CH on the basis of being a highly threatened and unique ecosystem (Criterion 4)<br>• Triggers Criterion 1 Tier 1 CH on the basis of support of a population of Eastern Chimpanzee, that is recognised as being one for the four largest in the region; apart from being an Endangered species, chimpanzees are also recognised as key stone species and ecosystem engineers<br>• Triggers Criterion 2 Tier 2 CH on the basis of support of range-restricted Nahan's Francolin<br>• Recognised area of old growth forest |

| Valued Component | Confirmed CH Trigger? (see Table 4) | Reasoning (see Table 4) |
|---|---|---|
| | | • The forest is recognised for its unique biodiversity values, including biome restricted species<br>• Is an important ecosystem service supply area for local people who harvest timber, fibre, fuel wood and charcoal, and non-timber forest products from the forest<br>• Bugoma Central Forest Reserve is recognised as an Important Bird Area<br>• Nationally recognised as a high conservation priority area (NEMA 2010) |
| Mud Snail (*Gabbiella candida*) | • Possibly Criterion 1 and Criterion 2 | • Could occur on near-shore aquatic habitats (Bugoma Lagoon, large bays, open sandy shores, shallow river-associated water)<br>• Has not been confirmed in LSA to date and is included on basis of precautionary principle |
| Grey Crowned Crane | • No | • Although Grey Crowned Crane is not present in numbers that would trigger CH designation, it is an Endangered species and has been confirmed present on the Buhuka Flats during baseline fieldwork in 2014 and 2017<br>• Any potential Project impacts on a globally-recognised and nationally-protected Endangered species are unacceptable and warrant addressing via the impact assessment process |
| Nahan's Francolin (*Ptilopachus nahani*) | • Yes – Criterion 2 | • Occurs in Bugoma Central Forest Reserve, possibly one of less than 10 DMUs globally (including DRC)<br>• Potential for CHAA to support >10% of this species' known global population |
| Eastern Chimpanzee (*Pan troglodytes schweinfurthii)* | • Yes – Criterion 1 | • Occurs in Bugoma Central Forest Reserve<br>• Great apes are an iconic species of anthropological and evolutionary significance<br>• They generally immediately trigger CH designation (see GN 74 and footnotes in PS6, IFC 2012a and b) |

## 10.1 Construction and Decommissioning Phase Impacts

The anticipated impacts are expected to be similar for the construction and decommissioning phases, and will occur over a similar duration for both phases (that is, ~2 years). Therefore, for the intents of this impact assessment, the decommissioning phase impacts have been included with the construction phase impacts in their assessment.

The predicted impacts to valued components include: direct loss of habitat due to land take for the Project infrastructure (Table 6); sensory disturbances (from noise, vibration, light, and odour); changes to surface water quality and flows, air emissions and the associated potential for pollution; erosion and sedimentation; and direct mortality of species of concern from vehicle movements and site preparation.

The predicted impacts are assessed in two broad categories:

- Impacts on habitat and ecosystem integrity; including the near-shore environment of Lake Albert, the vegetation corridors along the escarpment, and wetlands in the LSA and CHAA.
- Impacts on species of concern, specifically the Mud Snail *Gabbiella candida*.

For the assessment of impacts during the construction and decommissioning phase, the key questions were divided into sub-questions that focused on individual valued components within the CHAA and LSA. In answering each question, the individual components of the Project were considered with regards to their potential to affect a valued component. These questions are presented below.

### 10.1.1 What impact could the construction/decommissioning of the Project have on habitats and ecosystem integrity?

This section presents the assessment of impacts that the construction and decommissioning of the Project could have on the habitat and ecosystem integrity within the CHAA and the LSA. These habitats either do, or could, support populations of species of concern. Therefore, the assessment of potential impacts to those species, and others, occurring in the CHAA has been assessed in this section through the determination of the impacts to potential habitat (Table 6) for those species.

The impacts of the Project on critical habitat, as triggered by species of concern, are covered under the individual assessment of those species in Section 9.1.2. Other triggers of critical habitat are discussed, as relevant, in the appropriate sections.

**Table 6: Area of vegetation communities at baseline, disturbance and loss due to Production Facility, and net change (% loss) in CHAA**

| Vegetation Community | Baseline CHAA (ha)* | Baseline Buhuka Flats (ha) | Loss to already permitted/ constructed infrastructure | Loss to proposed infrastructure (ha) | % Loss CHAA | % Loss Buhuka Flats |
|---|---|---|---|---|---|---|
| Bare Ground | 24.0 | 5.0 | 1.9 | 0.3 | 9.0% | 43.3% |
| Dense Bushland | 1097.6 | 53.3 | - | 0.6 | 0.1% | 1.1% |
| Dense Wooded Grassland | 613.2 | 2.2 | - | - | - | - |
| Grassland with Thicket | 1101.1 | 255.6 | 4.2 | 6.7 | 1.0% | 4.3% |
| Lagoons | 33.2 | 32.5 | - | 0.1 | 0.6% | 0.6% |
| Large Bays | 73.7 | 2.7 | - | - | - | - |
| Open Bushland and Shrubland | 2896.3 | 27.5 | 0.1 | 0.2 | 0.0% | 1.2% |
| Open Grassland | 568.5 | 518.2 | 30.3 | 50.8 | 14.3% | 15.6% |
| Open Sandy Shores | 554.8 | 3.3 | - | - | - | - |
| Permanent Wetland | 83.8 | 83.7 | - | - | - | - |
| Riverine Bushland | 640.3 | 35.6 | - | - | - | - |
| Riverine Woodland and Bushland | 76.8 | 73.9 | - | - | - | - |
| Rocky Escarpments | 101.1 | 0.2 | - | - | - | - |
| Seasonal Wetland | 85.3 | 67.8 | 0.8 | 2.8 | 4.2% | 5.3% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Settlement | 207.9 | 142.2 | 0.3 | 2.8 | 1.5% | 2.1% |
| Shallow River-Associated Waters | 37.2 | 21.2 | - | - | - | - |

#### 10.1.1.1 What impact could the construction/decommissioning of the Project have on the near-shore aquatic habitats of Lake Albert?

##### Impact Indicators

Indicators used to assess impacts of the Project on the habitat and ecosystem integrity of the near-shore environment of Lake Albert were changes in: regional representativeness; topography (geomorphology) and sediments; water quality; ecosystem composition; ecosystem configuration.

Loss of habitat due to direct disturbance and clearing associated with the Project was quantified by overlaying the current, baseline extent of the habitat with the Project footprint.

Additional, indirect impacts to habitat were estimated by applying a 1 km buffer to the Project footprint, forming the LSA. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by sensory disturbance, changes in water quality, and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential succession changes in species composition that could occur. This was accomplished by examining available literature about the ecology of Lake Albert, and scientific literature about the impacts of human activities on aquatic environments.

##### Impact Assessment

- Representativeness

The CHAA supports 16.2 km of near-shore aquatic habitats, equating to about 810 ha (based on the near-shore habitat extending 0.50 km into the lake, see Section 7.1.1). Loss and degradation of these communities as a result of the Project has already occurred through the upgrade of the jetty area. Approximately 0.12 km of open sandy shoreline, extending 20 m into the lake, has been physically lost or severely disturbed by the construction of the jetty. This represents ~1% of the near-shore habitat within the CHAA, which is, consequently, a very localised impact, which is considered to be within the expected range of natural disturbance perturbations for the shoreline of Lake Albert. For example, through extreme weather events, lake level rise and fall, and longshore drift. The loss of this proportion of sandy shoreline community is, therefore, considered negligible in relation to the regional representativeness of this community; that is, a loss of 0.12 km of ~68 km (or 0.2%) of regional community.

The impact will be long-term, but largely reversible after decommissioning. Taking all factors into account, the magnitude of loss and disturbance will be low. However, this must be weighed against the very high sensitivity of the lake ecosystem, being a fresh water body that supports a high diversity of endemic and commercially important species of fish, threatened snails (the Critically Endangered mud snail, *Gabbiella candida*, and the Near Threatened Snail *Bellamya rubicunda*), threatened reptiles (the Vulnerable African Soft-shelled Turtle *Trionyx triunguis*) and threatened birds (the Endangered Grey-crowned Crane *Balearica regulorum*), as well as a shoreline important for many species of migratory birds.

- Topography (geomorphology) and sediment transport

During construction, the existing jetty - consisting of a solid concrete structure extending some 20 m into the lake to provide sufficient draught during low water periods – will be upgraded; however, no material changes in the dimensions of the structure are anticipated. Approximately 1 km north along the shoreline beside Well Pad 2, a water intake and water extraction pump station that also extends ~20 m into the lake is proposed for construction, which will see the alteration of ~0.12 km of open sandy shoreline.

The existing jetty's influence on the physical structure of the adjacent shoreline, and subsequent effects on the local geomorphology and longshore drift that maintain the shoreline, are not well understood; however, examination of recent aerial imagery suggests that some accretion of sediment on the eastern side of the jetty, and some erosion on the western side, is evident. Sediment drift is recognised as an important driver in shoreline ecosystems, contributing to the nutrient input that drives phytoplankton, zooplankton and fish communities (Parks et al. 2013). Various studies have shown that structures constructed on shorelines may disrupt hydrodynamic flow patterns, creating a barrier for sediment movement along the shore that can have a number of effects on faunal communities such as altered patterns of larval supply and food availability, and subsequent indirect effects on distribution and abundance of fish, turtles and birds through habitat modification and loss (in Walker et al. 2008). However, the zone of influence of structures constructed on shorelines is likely to be variable, depending on factors such as prevailing current direction, wave strength, and underlying substrate as well as the physical properties of the structure itself.

Given that there are not expected to be material changes in the dimensions of the jetty following upgrade works; it is not expected that its proposed upgrade will alter, in a substantial way, the geomorphological processes and sediment drift that currently govern the shoreline ecosystem of the Buhuka Flats, additional to the sediment deposition and erosion either side of the jetty that has already taken place. However, there is potential for the construction of the new water intake and water extraction pump station to affect geomorphological processes and sediment drift down-shore of Well Pad 2; which in combination with the existing jetty structure, could potentially affect the sediment drift or shoreline morphodynamics between Well Pad 2 and Bugoma Lagoon.

i Water Quality

*Sediment Loads*

The construction of the jetty upgrade and water intake station has the potential to alter the water quality within the immediate surrounds of the construction activities through disturbance of the lake bed, and introduction of sediment into the water column during the works. It is expected that these increased sediment loads will dissipate reasonably quickly following completion of the jetty upgrade. The sediment loads in the vicinity of the jetty are not expected to exceed those that would normally be expected during windy periods on the lake and the consequent turbid conditions caused by those winds. Furthermore, these works are not expected to permanently alter the water chemistry in the vicinity of the jetty given the large buffering capacity of the lake compared to the scale of the works (see Surface Water). Therefore, it can be expected that the upgrade of the jetty will not significantly affect the sediment loads and water quality of the near-shore habitats during construction.

The construction of the Kingfisher camps/parking lots/materials yards, airstrip extension, CPF, new in-field roads, crusher plant/spoil area A and development of existing well pads and associated infrastructure could cause increased sedimentation of near-shore habitats on the Buhuka Flats. Sediment generated during construction of the CPF itself, and other onshore infrastructure, could enter the lake during storm flows over the three-year construction period, peaking during site establishment when vegetation is being cleared and civil earthworks are ongoing. The soils of the Buhuka Flats are dispersive (Golder Associates 2014d), and active soil erosion is evident in the LSA. With the construction of the Project's components, and the consequent exposed areas of soil, there is a potential that, without adequate erosion and sediment control measures in place, sediment loads within the watercourses draining the Project footprint could increase. Cleared areas will be prone to sheet flow and scour, and high sediment loads could be expected, particularly in River 1, which will receive the drainage from the CPF earthworks and temporary camp (Figure 17). Additional sediment loads will also be contributed from the construction of the permanent camp. These sediment-laden watercourses report to Lake Albert and the Bugoma Lagoon, and, hence, there is a potential for increased sediment loads in the near-shore environments. Near-shore habitats particularly at risk include the lagoon, and to a lesser extent, the shallow river-associated habitats. Nevertheless, the watercourses draining the CHAA support dense emergent vegetation (see Section 7.1.1). Such vegetation forms an impactive filter for most sediment (IECA 2008), therefore, it can be expected that sediment loads reporting to the near-shore habitats, at least via the Kamansinig River, River 1 and Masika River, could be minimal. Sediment loads from overland (stormwater) flows may not be retarded by vegetation, and hence may report to the near-shore habitats, contributing to measurable increased turbidity during and after storms, where River 1 discharges to the Lake.

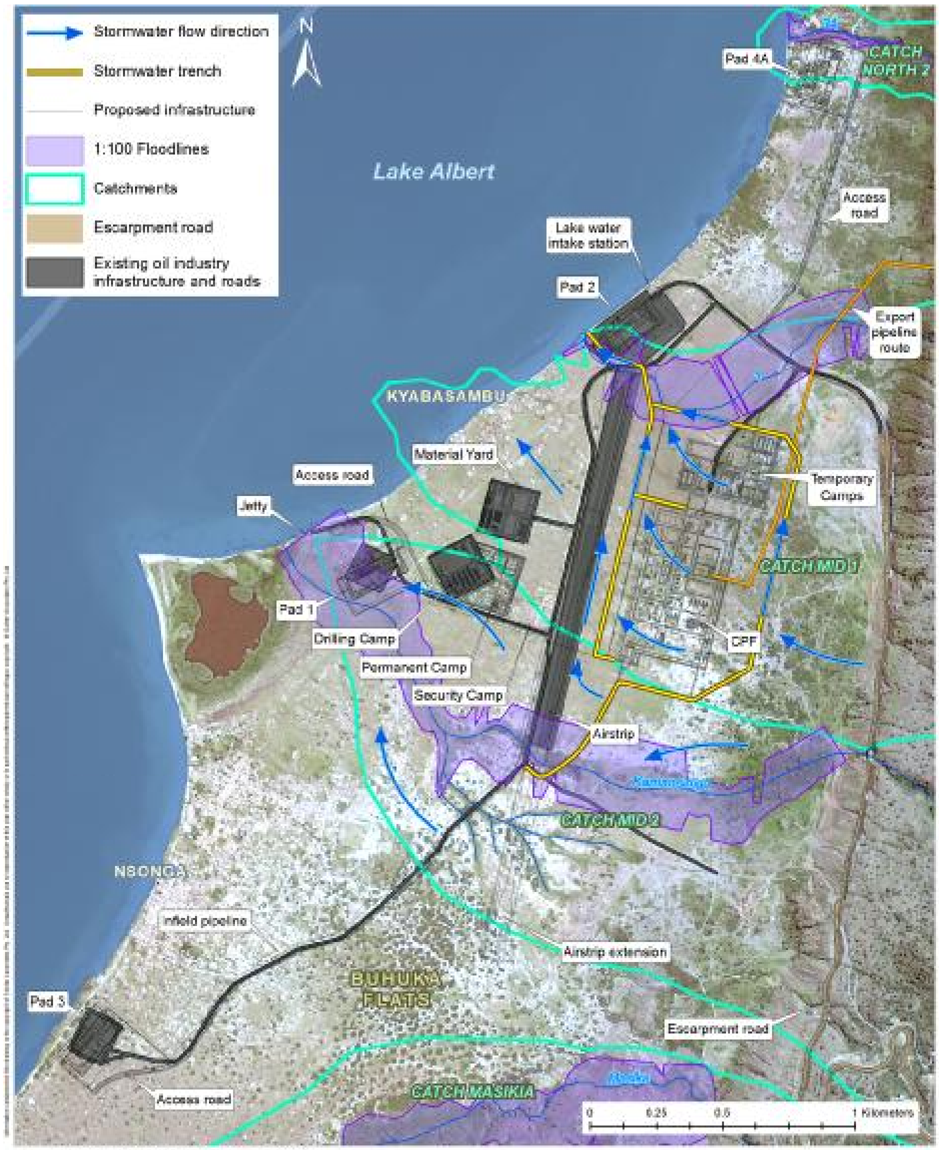

Figure 17: Rivers and catchments on Buhuka Flats

## Oil and Chemical Pollution

Accidental spillages of small quantities of fuels and chemicals, and rain wash from oily construction equipment working on the jetty and water intake station during construction could report to the near-shore habitats of the CHAA, via stormwater drainage into River 1, and subsequently Lake Albert, south west of Well Pad 2. There is a real potential for this to occur as part of the jetty upgrade, expansion of Well Pad 1, and construction of new Well Pads. Both the jetty and the proposed expansion of Well Pad 1 are located on the lake shore, with no meaningful buffer between the facilitates and the lake; in these areas, the impact of this contamination would be more obvious than on land, and would also be harder to contain and clean up.

A further risk could result from the construction and drilling of the wells. While control systems such as bunding are proposed to manage contaminated stormwater and wash-water from the well pads, the presence of drilling crews on site for over a year, using potentially hazardous drilling fluid and other hazardous materials; and the absence of a buffer between the well pads and the lake (or, in the case of Well Pad 1, the seasonal wetland); makes it likely that occasionally-contaminated drainage could reach the lake, unless there is a very high level of control of day-to-day activities.

These risks should be assessed in the context of the sensitivity of the near-shore environment to oil and chemical spills. Certain invertebrate species (for example, aquatic snails (Araujo et al. 2012), mayflies (Savić et al. 2011)) and juvenile fish (for example, Agamy 2013) are highly sensitive to chemical pollutants, particularly hydrocarbons. Currently, the concentrations of hydrocarbons and other pollutants in the lake water are below levels that could cause harm to the environment ( Surface Water); this is supported by the healthy aquatic communities observed in the lake's near-shore habitats (see Section 6.2). Therefore, impacts arising from potential changes to the water quality are predicted to be beyond the expected range of natural disturbance perturbations.

As such, without adequate spill prevention and clean-up measures in place, the entrainment of chemical and oil pollution to Lake Albert could have a detrimental impact on the near-shore habitats of the CHAA through the introduction of toxic compounds and pollutants. Such a spill could also have a detrimental impact on the aquatic invertebrate community and juvenile fish occurring in these habitats; this includes the Critically Endangered Mud Snail (*Gabbiella candida*) (if it does occur in the area).

*Discharge of treated sewerage*

The only continuous discharge into the lake during the construction phase will be from the sewage treatment plants. The effluent will be treated to meet the Ugandan effluent quality discharge standards (see Surface Water). At peak construction, the discharge will be around 300 $m^3$/day at the EPC contractor plant, and 50 $m^3$/day at the drilling camp plant. Both of these discharges will enter the lake via River 1, just south of Well Pad 2. The currents in the near-shore area of the LSA are not well known, so dispersion of nutrients in the sewage effluent have not been modelled. However, given the point source discharge, and the quantity of effluent involved, there is a risk of localised eutrophication, causing algal growth and possibly even fish kills around the discharge point. Impacts on water quality as a result of this potential eutrophication are predicted to be beyond the expected range of natural disturbance perturbations.

- Ecosystem composition

All six of the main habitat types in Lake Albert, as identified for fishes by Wandera and Balirwa (2010) (that is, shallow river-associated waters, open sandy shores, lagoons, large bays, rocky escarpments, and, open-water habitats), occur within the near-shore areas of the CHAA (see Section 7.1.1, Figure 5). Similarly, the species guilds associated with the near-shore habitats of the CHAA, in particular fish, are well represented throughout those regions of the lake that have been investigated (for example, see Wandera and Balirwa 2010, Taabu-Munyaho et al. 2012). Consequently, at baseline, the composition of these ecosystems can be said to be in good condition and reflective of the aquatic diversity of Lake Albert. Similarly, these aquatic habitats have a well-developed structure, that is, well-defined aquatic plant layers associated with underwater features and substrates.

Tthe construction of the Project is likely to result in localised alteration of the ecosystem composition of the aquatic communities; particularly the open sandy shoreline habitat in the vicinity of the proposed water intake and water extraction pump station, and the sewage effluent discharge outfall. Although the upgrade of the existing jetty is not expected to substantially alter that section of open sandy shoreline within which it is located; a degree of sediment deposition and erosion has already taken place on either side of the structure; therefore similar effects are anticipated up-current and down-current of the proposed water intake and water extraction pump station near Well Pad 2, which would be beyond the expected range of natural disturbance.

The point source effluent discharge, and the quantity of effluent involved, presents a risk of localised eutrophication, which could cause changes in algal growth rates, and aquatic vegetation community composition, thereby changing diversity and complexity of the aquatic habitats and their ability to support associated aquatic faunal communities. Impacts from the changes to ecosystem composition as a result of this eutrophication are predicted to be beyond the expected range of natural disturbance perturbations.

Although the open sandy shoreline habitat of itself is not very complex, consisting of a gently sloping lake bed comprised of fine and medium-grained sediments (Wandera and Balirwa 2010), with occasional aquatic plants; it could support species that trigger critical habitat including the Critically Endangered mud snail (*G. candida*) and African Soft-shelled Turtle (*T. triunguis*); therefore, any negative impacts on this habitat have the potential to be of major significance, and residual impacts will likely require offsetting.

- Ecosystem configuration

The construction of the CPF is expected to last for three years, and drilling will continue on individual well pads for a period of seven years. Although the upgrading of the jetty is not expected to substantially alter the configuration of the aquatic ecosystems and habitats in the CHAA, the construction of the new water intake and pump station could interrupt the connectivity amongst the near-shore aquatic habitats in its vicinity, to an extent beyond the range of natural perturbances.

### *Impact Classification*

The near-shore aquatic habitat's sensitivity is high because these habitats potentially support populations of the Critically Endangered Mud Snail (*G. candida*), the Vulnerable African Soft-shelled Turtle (*T. triunguis*), and the range-restricted and Near Threatened Snail (*Bellamya rubicunda*). Near-shore aquatic habitat constitutes Tier 2 Critical Habitat for the Mud Snail (*G. candida)* (Table 4). Impacts on this habitat are therefore classified on the basis of high sensitivity to potential effects of the proposed development.

- Representativeness

Impacts to the representativeness of the habitat will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA, and will only constitute approximately 0.2% loss of sandy shore habitat in the wider area. Impact duration will be into the far future (that is, ~25 years) because the jetty will remain in place even after the project is decommissioned. The changes to the representativeness of the near-shore habitats are expected to be reversible over time as naturalised geomorphological processes re-establish in the vicinity of the jetty and water intake station following construction, and re-establish following decommissioning. The magnitude of the impacts of construction/decommissioning on representativeness of the near-shore aquatic habitats is low; however, this must be weighed against the high sensitivity of these habitats. Therefore, the magnitude and sensitivity combine to produce an overall impact of moderate significance to representativeness prior to the application of project-specific mitigation measures (Table 7).

Following the application of appropriate mitigation measures, the impact significance is expected to remain the same, that is, moderate, primarily because the magnitude will still remain the same due to the loss of habitat, and the sensitivity of the receptor will remain the same.

- Topography (geomorphology), sediment load, and water quality

Impacts to the topography (geomorphology), sediment, and water quality will be adverse. The geographical extent of impacts will be regional because impacts are restricted to the CHAA. Impact duration will be short-term (that is, ~2 years) because impacts are expected to be limited to the construction phase.

The magnitude of the impact of the upgrade of the jetty and construction of the water intake pump station on topography (geomorphology) and sediment transport is medium, as although there will be no material change to the jetty's current dimensions, the water intake pump station will be constructed at a new location; and to date, the jetty appears to have caused some observable impact on the movement of sediment along the lake shore (build-up of sediment on the eastern side, and erosion on the western side). The geographical extent of any impacts will be restricted to the LSA, and the duration of impacts will be short-term (that is, ~3 years) because impacts are expected to be limited to the construction/decommissioning phase. Therefore, the significance of impact of the jetty upgrade and the construction of the new water intake pump station is considered to be **major.** Following the application of appropriate mitigation measures, the impact significance on topography (geomorphology) and sediment transport is expected to be reduced to moderate, primarily because the magnitude will become low, and the sensitivity of the receptor will remain the same.

The magnitude of the impact of construction/decommissioning of the production facility and subsequent increased sediment load on water quality is medium, because, prior to any mitigation, there is potential for pollution to alter the quality of near-shore habitats. The geographical extent of impacts will be regional, being restricted to the CHAA, because, for example, possible effects on nursery areas for fish could eventually be felt across the entire Lake. The duration will be short-term (that is, ~3 years), that is, limited to the construction/decommissioning phase. Therefore, the medium magnitude of the impact and high sensitivity of the near-shore habitats combine to produce a major overall impact level to water quality as a result of increased sediment load during the construction/decommissioning of the production facility, pre-mitigation

(Table 7). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, primarily because the magnitude will become low, and the sensitivity of the receptor will remain the same.

In the context of the absence of a meaningful buffer between the well pads and the lake, the magnitude of the impact of the potential entrainment of small quantities of oil, chemicals and potentially hazardous drilling fluid into stormwater and wash water from the well pads on water quality is medium. This is because prior to the application of site-specific mitigation measures, the potential for pollution to alter water quality and affect highly sensitive aquatic species is substantial. As was the case for sediment load, the geographical extent of impacts could be regional. The duration will be short-term (that is, ~3 years) i.e. limited to the construction phase. As mentioned previously, the near-shore aquatic habitat's sensitivity is high, therefore, the magnitude and sensitivity combine to produce a major overall impact level to water quality as a result of potential contamination with oil and potentially hazardous chemicals during the construction/decommissioning of the production facility and drilling of the wells, pre-mitigation (Table 7). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, primarily because the magnitude will become very low.

The magnitude of the impact of construction/decommissioning of the production facility and subsequent discharge of treated sewage effluent prior to mitigation is medium; given the quantity of effluent involved, the extent of changes to ecosystem composition brought about by increased algal growth (above that normally occurring) and eutrophication in the vicinity of the point source discharge could be significant. Therefore, the medium magnitude and high sensitivity combine to produce a major overall impact level to ecosystem composition during the construction/decommissioning phase of the Project, pre-mitigation (Table 7). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, primarily because the magnitude will become negligible, and the sensitivity of the receptor will remain the same.

- Ecosystem composition

Impacts to the ecosystem composition of near-shore habitats will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA, in the vicinity of the jetty and proposed water intake pump station. Impact duration will be short-term (that is, ~3 years) because impacts are expected to be limited to the construction/decommissioning phase, and impacts would be largely reversible following construction, and later following decommissioning. The magnitude of the impact on ecosystem composition is low because, prior to mitigation, the potential for localised changes to ecosystem composition potentially brought about by changes in sediment erosion/deposition patterns, spread of invasive species, and changes in aquatic invertebrate, fish and plant communities around the treated sewage discharge point is possible. Therefore, the low magnitude and high sensitivity combine to produce a moderate overall impact level to ecosystem composition during the construction/decommissioning phase of the Project, pre-mitigation (Table 7).

Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, primarily because the magnitude will become negligible, and the sensitivity of the receptor will remain the same.

- Ecosystem configuration

Adverse construction/decommissioning impacts on ecosystem configuration are predicted to occur with the construction of the new water intake pump station. The magnitude of the resultant impacts to the ecosystem configuration of near-shore habitats is predicted to be low, as the geographical extent of impacts will be local - restricted to the LSA, in the vicinity proposed water intake pump station, although impact duration will be long-term because impacts are expected to be continue beyond the construction phase and into the operation phase.

Therefore, the low magnitude and high sensitivity combine to produce a moderate overall impact level to ecosystem composition during the construction/decommissioning phase of the Project, pre-mitigation (Table 7). Following the application of the recommended mitigation measures, the impact significance is expected to remain moderate, as impacts of a low magnitude will continue for the operational lifetime of the pump station, and the sensitivity of the receptor will remain the same.

**Table 7: Potential impacts in the construction phase to near-shore habitats**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Representativeness | Low - 2 | High - 4 | Moderate – 8 | Low - 2 | High - 4 | Moderate – 8 |
| Topography (geomorphology) and sediment transport | Medium - 3 | High - 4 | Major – 12 | Low - 2 | High - 4 | Moderate – 8 |
| Water quality – sediment loads | Medium - 3 | High - 4 | Major – 12 | Negligible - 1 | High - 4 | Minor – 4 |
| Water quality –oil and chemical pollution | Medium - 3 | High - 4 | Major – 12 | Negligible - 1 | High - 4 | Minor – 4 |
| Water quality - sewerage | Medium - 3 | High - 4 | Major – 12 | Negligible - 1 | High - 4 | Minor – 4 |
| Ecosystem composition | Low - 2 | High - 4 | Moderate – 8 | Negligible - 1 | High - 4 | Minor – 4 |
| Ecosystem configuration | Low - 2 | High - 4 | Moderate – 8 | Low - 2 | High - 4 | Moderate – 8 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the near-shore habitats of the CHAA. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios with the level of Lake Albert, which has, in the recent and not so recent past, varied quite dramatically (Talbot et al. 2006), it is conceivable that level of the lake may increase or decrease thereby altering near-shore habitats.

The spatial extent of the near-shore habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 7.1.1). The actual extent of possible habitat may have been over-estimated.

## *10.1.1.2 What impact could the construction/decommissioning of the Project have on the wetlands in the Buhuka Flats region of the CHAA?*

### *Impact Indicators*

Indicators used to assess impacts of the Project on the habitat and ecosystem integrity of the wetlands of the CHAA were changes in: regional representativeness; ecosystem composition; and ecosystem configuration.

Loss of habitat due to direct disturbance and clearing associated with the Project (including existing, permitted infrastructure, and proposed infrastructure not yet built) was quantified by overlaying the current, baseline extent of the vegetation communities with the current and proposed Project footprint.

Additional, indirect impacts to habitat were estimated by applying a 0.50 km buffer to the Project infrastructure. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by edge effects, fragmentation, sensory disturbance, changes in water quantity and quality (drivers of ecosystem processes and functions), and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential changes in species composition that could occur, and the disruption of known corridors. This was accomplished by examining available scientific literature about the ecology of wetlands (permanent and seasonally flooded grasslands).

### *Impact Assessment*

i Representativeness

In the Buhuka Flats, the CHAA supports approximately 151 ha of wetlands (see Table 6). These are comprised of permanent wetlands (83 ha, or 55% of wetlands in the Buhuka Flats) and seasonally flooded grasslands (69 ha, or 45%).

Wetlands in the LSA are associated with drainage off the escarpment, which is seasonal to varying degrees. The shallow gradients across the Buhuka Flats encourage wetland formation, and most of the stream channels are associated with fringing wetland vegetation and seasonally flooded grasslands. The Kamansinig River is hydrologically linked to the Bugoma Lagoon, the large papyrus-fringed wetland south-west of well pad 1.

Construction/decommissioning of the Project infrastructure will affect both the permanent wetlands and the seasonally flooded grasslands of the LSA. Figure 18 shows the main areas of direct impact. Table 8 quantifies the impact, based on the area of physical disturbance during construction and the expected long-term (or permanent) impact after construction and decommissioning. It should be noted that the infield access roads have already been licensed and built (see Table 8), but are included in this discussion of impacts for completeness. The construction right-of-way for both roads and flow lines is 20 m wide.

The road and flow line to well-pad 3 cut across the permanent wetlands of the lower Masika River; the in-field road and flow line from well-pad 3 to well-pad 2 cut across seasonally flooded grassland; the extension of the airstrip has resulted in the loss of approximately 1 ha of seasonally flooded grassland; and the extension of well pad 1 will result in the direct loss of an additional 4.8 ha of seasonally flooded grassland. This loss equates to approximately 4.7 ha (3.11%) of wetlands in the CHAA.

**Table 8: Wetland areas directly affected by the construction of the production facility**

| **Project Infrastructure Name** | **Wetland Area Affected (ha)*** | **Propoprtionate loss (%)** |
|---|---|---|
| | Kamansinig River | |
| Infield Access Road** | 1.5 | 0.99% |
| Infield Flowline | 0.5 | 0.33% |
| Well Pad 1 | 2.7 | 1.78% |
| Total | 4.7 | 3.11% |

* *Blue cells show temporary construction impact. White cells show long term / permanent impact*
*** Licensed and built*

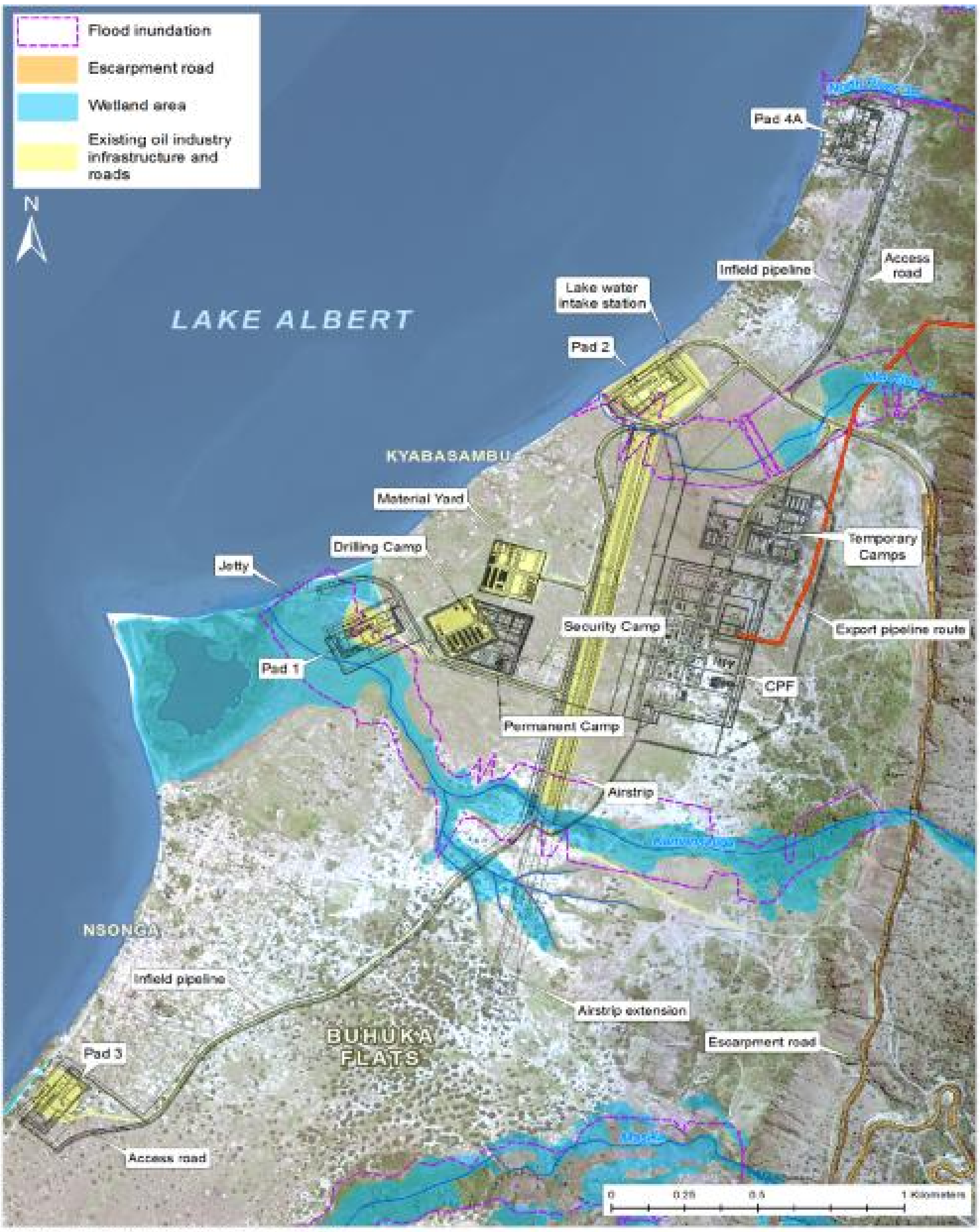


*Figure 18: Wetlands in the Buhuka Flats directly impacted by construction/decommissioning of the Production Facility*

The loss of this quantity of wetlands in relation to their representation in the wider CHAA and the Buhuka Flats is not insubstantial (~4% - 5%); furthermore, because this loss is brought about by the construction of linear features, there is a potential for the downstream wetland habitat to be affected if proper management controls are not implemented.

Impacts from the changes to representation of the wetlands in the CHAA are predicted to be beyond the expected range of natural disturbance perturbations.

i Wetland Structure and Ecosystem Composition

Roads

The construction of linear infrastructure, such as roads through wetland communities is known to have detrimental impacts on the functioning, processes and species composition of these communities (Roise et al. 2004). Road construction may result in significant loss of biodiversity at both local and regional scales due to restricted movement between populations, increased mortality, habitat fragmentation and edge effects, invasion by exotic species, or increased human access to wildlife habitats, all of which are expected to increase local extinction rates or decrease local recolonisation rates (Findlay and Bourdages 2000). Consequently, it could be expected that, particularly the construction of the airstrip and in-field roads through the seasonally flooded grassland would have already altered the ecosystem processes and functions driving these wetlands, especially downstream. This could have occurred if flow paths for water, both surface and sub-surface, were not maintained (see Chapter X.0 Surface Water). If these flow paths are not maintained on an ongoing basis, there is a potential that the wetland community downstream of the obstruction could become altered – typically via redirection of flows, and/or flow concentration and channel incision in downstream wetlands that were previously supplied by diffuse, dispersed flows. In an environment like the Buhuka Flats, where soils are clayey and dispersive, the risk of incised drainage and associated loss of wetland function due to concentration of water flows is high. The vegetation within these seasonally flooded grasslands is adapted to seasonal inundation, and, therefore, is dependent upon that cycle of wet and dry for survival. Additional, associated impacts that could occur in tandem with channel incision and subsequent wetland desiccation include exotic species invasion.

As part of standard construction methods, wetland/drainage line crossings have been installed as part of the in-field road and airstrip construction. Nevertheless, even with such measures in place, there is still a potential for changes to the wetland character to occur. For example, there is the potential for erosion downstream of the crossings, backwater upstream of the crossings, and erosion at the entrance to the crossing structures. The airstrip is one area in particular where construction across a drainage line might lead to decreased flows and erosion downstream of the airstrip (Golder Associates 2014b). This could lead to changes in the ecosystem functions and processes in the downstream wetlands.

There is an existing example of this on the Kamansinig River, where a road crossing upstream of the airfield leads to a quarry near the base of the escarpment (Figure 19). The damage was done by inappropriate culvert design (size, numbers and spacing), mostly in the wrong place, which has resulted in an altered flow regime, and subsequent desiccation of the wetland downstream of the impeding feature (the road), and increased wetness upstream of the road. The long-term impacts of the flow impediment created by the road include encroachment of terrestrial and exotic plant species to areas of the wetland that have become desiccated, and changes in vegetation community upstream – from seasonally flooded grassland communities to plants more characteristic of permanently saturated conditions, such as *Phragmites* sp. and *Typha* sp. During times of peak rainfall, outflow to the downstream areas is likely to be concentrated at a single spill point, and could contribute to channel erosion and further desiccation of the downstream wetland areas over time.

In addition, these wetland communities are already under pressure from livestock grazing, and harvesting of fibre for house construction. It is possible that these communities may change in the long-term as grazing pressure increases, and the human population of the Buhuka Flats increases (Golder Associates 2014e). These changes could alter the habitat structure and composition, which, in turn, could affect the utilisation of these wetlands by the currently resident species guilds.

Impacts to ecosystem composition of the wetlands in the CHAA are predicted to be beyond the expected range of natural disturbance perturbations.

*Figure 19: Impact of a poorly-designed road crossing on wetland in Buhuka flats*

Flowlines

Buried pipelines crossing rivers and wetlands will not (of themselves) obstruct surface water flow. The backfill into the trench is not normally cemented or compacted, which, for small diameter pipelines, minimises the risk of impact on subsurface flow. The risk to wetland function is mainly due to the disruption of wetland vegetation and soils by heavy machinery, particularly when tracked vehicles are used that have greater impact on soil structure and the soil profile is overturned due to careless construction management. Disruption of flows and ecosystem composition may also occur if fill material is imported into the wetland to provide stability for excavators and pipe layers, and is not completely removed and replaced with the natural soils after construction. This may result in long-term changes in vegetation composition and changes in flow patterns, with similar downstream consequences to those described under ‘roads’.

Impacts on wetland fauna will depend on the changes in wetland vegetation as a result of construction; in addition, the noise and sensory disturbances created by the construction equipment could alter the behaviour of species frequenting the wetlands during construction/decommissioning. For example, wading birds and Grey Crowned Cranes are unlikely to tolerate construction nuisance within 500 m and could avoid these areas entirely during the construction period. If construction occurs during the breeding season of the Grey Crowned Crane (that is, the dry season (Archibald et al. 2013)), which could be breeding in the permanent wetland associated with the Masika River, then disturbance from the construction activities could cause nest abandonment (Strasser et al. 2013).

Wellpad 1 expansion

The extension of well pad 1 will impact directly on wetland functioning in the seasonally-flooded grassland associated with the lower reaches of the Kamansinig River. The existing well pad is within the northern edge of these seasonally flooded grasslands. The expanded well pad will extend the impact on the wetland into the centre of the floodplain. The darker colour of the wetland in the satellite image in Figure 20 shows its position in relation to the well pad. The magnitude of this impact is considered to be high from legal and functional perspectives – the location is prohibited by Ugandan legislation (Uganda Wildlife Act, 2000), and contrary to the natural habitat conservation guidelines of IFC PS6 - and the impact on wetland function could be material, interfering with subsurface flow and surface flow during peak flow events. The vegetation within these seasonally flooded grasslands is adapted to seasonal inundation, and, therefore, is dependent upon that cycle of wet and dry for survival. The noise and sensory disturbances created by the construction equipment could alter the behaviour of species frequenting the wetlands, particularly Grey Crowned Crane. Coupled with the very high sensitivity of this system, with its hydrological interconnectivity to the Bugoma lagoon, the impact significance will be high**.**

Increased runoff from construction areas

The majority of the area affected by construction of the CPF will drain north into River 1 (Figure 20). Perimeter drains upslope of the CPF will divert clean stormwater flow around the platform and discharge directly to River 1. The first 15 minutes of stormwater draining from potentially contaminated areas such as the platforms will be diverted to a testing and treatment tank, before being discharged to River 1 once acceptable standards have been reached. After the first 15 minutes, stormwater from potentially contaminated areas will be discharged directly to River 1 via the perimeter drains. Stormwater from the construction of most of the permanent camp, the extension of well pad 1 and the southern section of the flow line linking well pad 1 to the CPF will drain southward into the Kamansinig River, and will follow the same standard clean and dirty water practises. Figure 20 shows the most likely direction of flow from the construction sites.

Drainage volumes during storm events are expected to be larger (due to the removal of vegetation and the compaction of ground surfaces, and hardstand areas), and, consequently, peak-flow volumes will be larger. Additionally, concentration of stormwater flows into the drainage lines will significantly increase the risk of channel incision, which in the flat environment between the escarpment and the lake, may result in drying out of the associated wetlands due to more rapid drainage of the area. The magnitude of this impact will be exacerbated by the soils, which are dispersive (see Soils and Landuse), prone to gully erosion, and, therefore, highly likely to form incised channels.

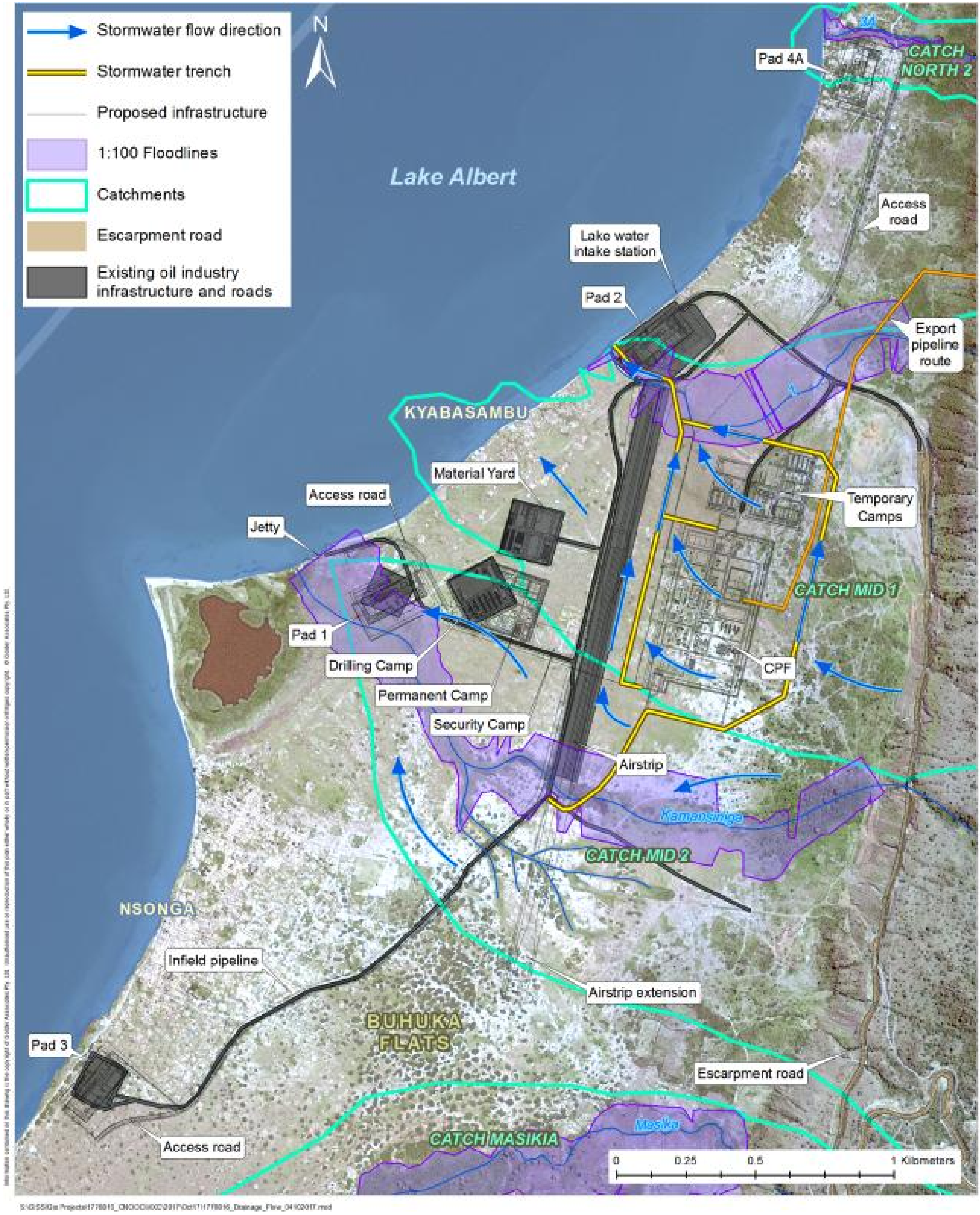


*Figure 20: Direction of storm flows from construction sites*

i Water Quality and Ecosystem Composition

Impacts to ecosystem composition of the wetlands in the CHAA are predicted to be well beyond the expected range of natural disturbance perturbations; factors affecting wetland water quality that could impact ecosystem composition, including erosion and sedimentation, fuel and chemical spills, discharge of hydrotest water, disposal of treated effluent, overturning of acid sulphate soils and population increases are discussed below.

**Erosion and Sedimentation**

The construction of the Kingfisher camps/parking lots/materials yards, airstrip extension, CPF, new in-field roads, crusher plant/spoil area A, , and associated infrastructure could cause increased erosion and sediment-laden run-off to report to the wetlands surrounding the Project footprint. The soils of the Buhuka Flats are dispersive (Golder Associates 2014d), and active soil erosion is evident in the LSA. With the construction of the Project's components, and the consequent exposed areas of soil, there is a potential that, without adequate erosion and sediment control measures in place, sediment loads within the watercourses draining the Project footprint could increase. Hence, there is a potential for increased sediment loads in the wetland habitats. The watercourses and associated wetlands draining the LSA support dense emergent vegetation (see Section 6.1.1.1). Such vegetation can form an impactive filter for most sediment (IECA 2008); therefore, it can be expected that sediment loads reporting to downstream wetland habitats could be minimal. Nevertheless, if sediment loads are substantial, there is a potential for that sediment to smother wetland vegetation and interfere with aquatic invertebrates. If this occurs, it could detrimentally affect the wetland processes and functions, which, in turn, could alter wetland composition, albeit on a localised scale.

As part of standard construction methods, appropriate drainage line crossings will be installed as part of the in-field road and airstrip construction. Nevertheless, even with such measures in place, there is still a potential for changes to the wetland character to occur. For example, there is the potential for erosion downstream of the crossings, backwater upstream of the crossings, and erosion at the entrance to the crossing structures. The airstrip is one area in particular where construction across a drainage line might lead to decreased flows and erosion downstream of the airstrip (Golder Associates 2014b). This could lead to changes in the ecosystem functions and processes in the downstream wetlands.

**Hydrocarbon and Chemical Spills**

Accidental spillage of fuels and chemicals during the construction/decommissioning of the CPF are possible, where the most complex construction activities will take place over a period of 3 years, involving a wide range of potentially toxic materials (refer to Waste). On the well pads, the presence of drilling crews for around a year, using large quantities of potentially hazardous drilling fluid and other hazardous materials, increases the risk of escape of contaminated water into watercourses and subsequently the wetlands of the LSA. The highest risk is most likely at Well Pad 1, most of which is being extended into the seasonally-flooded grassland wetland associated with the Kamansinig River.

Certain invertebrate species (for example, aquatic snails (Araujo et al. 2012), mayflies (Savić et al. 2011)) and juvenile fish (for example, Agamy 2013) are highly sensitive to chemical pollutants, particularly hydrocarbons. Currently, the concentrations of hydrocarbons and other pollutants in the water of the Bugoma Lagoon are below levels that could cause harm to the environment (Golder Associates 2014b); this is supported by the healthy aquatic communities observed in the lagoon's and Masika River wetland habitats (see Section 6.2). The proximity of the main areas of construction to wetlands on the Flats provides little buffer in the event that minor day-to-day spillages escape from the work areas, which increases the risk of impact.

**Discharge of Hydrotest Water**

The commissioning of pressure vessels and flow lines involves hydrotesting, in which the vessels are filled with water and pressurised to verify their integrity. On occasions, biocides and corrosion inhibitors are added to the water, depending on the residence time, before it is discharged. Details are not presently available, but is it is assumed that this water will be discharged into the nearest drainage lines. Without management, its release can present a severe risk to the aquatic environment, resulting in possible mortality and degradation of downstream ecosystems and species.

**Disposal of Treated Sewage Effluent**

Treated sewage effluent in excess of 300 m$^3$/day will be discharged for much of the construction phase. The effluent will be treated to meet the Ugandan effluent quality discharge standard (see  Surface Water). It is proposed that the effluent from the temporary camp will be discharged into River 1, north of the camp. The effluent from the drilling camp will be discharged into River 1.

Wetlands are efficient nutrient sinks and have been used in both controlled and uncontrolled conditions to polish sewage effluent. Depending on the point of discharge, River 1 is likely to be tolerant of the additional daily flow and the addition of nutrients, which will promote the growth of emergent wetland vegetation.

**Overturning of Acid Sulphate Soils**

The potential for the occurrence of acid sulphate soils in the permanent wetland associated with the Masika River should not be discounted. Typically, submerged sediments in inland aquatic ecosystems have very little oxygen below the first few millimetres, and can, therefore, be sites where sulphur compounds are formed, which can lead to potential acid sulphate soils (EPHC 2011). When these soils are disturbed and exposed to oxygen, such as through the construction of a trench through a wetland, the sulphur compounds react with the oxygen in the air and the water to produce sulphuric acid. If the amount of acidity produced by this process is greater than the system's ability to absorb, or neutralise that acidity, then the acidity, or pH, of the system falls (EPHC 2011). The formation and release of this acid can lead to adverse impacts to aquatic habitats. Assuming the wetland does not have a high capacity to neutralise the acid, the process of forming the acid can consume oxygen, and, in extreme cases, can remove all of the oxygen from the water column, resulting in the death of aquatic organisms. The acid formed by this process may also lead to the mobilisation and availability of heavy metals (such as, cadmium and lead), aluminium, iron, and arsenic into the environment. These elements can be toxic to aquatic life (EPHC 2011).

Within Uganda, these soils are typically associated with papyrus peats and other permanent wetlands (Golder Associates 2014d). The permanent wetland associated with the lower reaches of the Masika River, has a potential to harbor potential acid sulphate soils. Therefore, if these soils are disturbed, for example, during the construction of trenches for flowlines, there is a potential for acid formation and the consequent toxic impacts to the ecosystem. If severe enough, such toxic impacts can cause the permanent dieback of wetland vegetation and alter wetland functioning and processes (EPHC 2011).

However, while acid sulphate soils may be present in the permanent wetlands along the Masika River to the south and in the Buhuka Lagoon, they are not expected in the seasonal wetlands that will be affected by construction of the production facility and the toxic effect of acid generation associated with their disturbance should not arise.

**Increase in Population on Buhuka Flats**

Indirect impacts on wetlands as a result of water quality impacts could occur as a result of the migration of people onto the Buhuka Flats in search of work. Existing sanitary conditions on the Flats are poor, with all of the streams that drain across the Flats being contaminated with faecal waste from both animals and humans ( Social Impact Assessment). Increasing population pressures on the flats will exacerbate these conditions. Increased grazing pressure and erosion from denuded areas around expanding settlements will increase erosion and sedimentation in the wetlands.

i Ecosystem configuration

Roads are known to be significant barriers to, or can alter behaviours of, a range of wetland wildlife, from: amphibians (for example, Pontoppidan et al. 2013); to turtles (for example, Langen et al. 2012). Depending on the species, the presence of the existing in-field roads may affect individuals in many direct and indirect ways. For example, roads may inhibit seasonal migration and may cause an impactive loss of habitat due to avoidance. The presence of the in-field roads through the wetlands of the Buhuka Flats are not expected to be major barriers to movement for those species inhabiting them. These roads are only expected to be 5 m wide and unsealed, and, once construction is complete, they will convey limited traffic volumes. Therefore, they are not expected to be major barriers.

The construction of the existing and proposed in-field roads and airstrip has/will cut currently contiguous wetlands in the LSA. If not managed correctly during the construction process, that is, the installation of appropriate drainage connections, these Project components could cause permanent barriers between the two newly separated wetland habitats – as has already been demonstrated at the road crossing adjacent to the airstrip (Figure 19). The process of clearing the wetlands for the construction of the roads and airstrip will create edge impacts, and result in the fragmentation of the wetland habitats. As already discussed, vegetation clearing creates edges or boundaries where habitat meets a disturbance. These edges open up habitat in areas where it was previously continuous, and this generally changes the abiotic conditions (for example, temperature, light, and moisture regimes) (Porensky and Young 2013). Edges also often result in changes in species composition along the edge, with the edges typically becoming dominated by pioneer and weedy species adapted to the particular microclimate experienced on the edge (Porensky and Young 2013). Fragmentation of wetland habitat is known to reduce the viability of many species and the wetland as a whole, with the viability of the particular fragment dependent on its size, proximity and, hence, connectivity to other wetland habitats (Uzarski et al. 2009).

What long-term impacts the construction of these roads and the airstrip could have on the wetland communities' configuration are unknown; in particular their resilience. What is known is that these wetland communities are already under pressure from livestock grazing, and harvesting of fibre for house construction.

Impacts to ecosystem configuration of the wetlands in the CHAA are predicted to be beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The wetland's sensitivity is high because these habitats, particularly the permanent wetlands, are potential breeding habitat for Grey Crowned Cranes (a species of concern). The wetlands are also already under stress from livestock grazing and harvesting of fibre. This high sensitivity is weighed against the magnitude of each of the impacted indicators as described in the paragraphs below, in order to derive the overall impact level for each indicator.

- Representativeness

Impacts to the representativeness of the habitat will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA on the Buhuka Flats, and will constitute loss of approximately 4.2% of seasonally flooded grassland communities in relation to the CHAA. The flowline construction impacts will be generally short-term (subject to appropriate construction management); and while permanent wetland habitat loss will be caused by well pad 1 and its proposed expansion, and by the access roads, the relatively small area covered results in an overall impact of low magnitude. In the context of high wetland sensitivity, this results in impacts of moderate significance.

Following the application of appropriate mitigation measures, the impact significance is expected to remain minor, as some permanent wetland loss to the roads and expansion of well pad 1 will remain in place even after the project is decommissioned. The changes to the representativeness of the wetland communities, although probably irreversible, are expected to be amendable via offsetting (see Section 13.0).

- Wetland Structure and Ecosystem Composition

Impacts to the ecosystem composition will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be into the far future (that is, ~25 years) because impacts are expected last as long as the in-field roads and airstrip are in place. The magnitude of the impact on ecosystem composition is medium because, prior to the implementation of the recommended site-specific mitigation, the potential for changes to wetland structure and ecosystem composition potentially brought about by the roads, flowlines, well pad 1 extension, potentially contaminated runoff from construction areas and population/livestock head increases are likely, which could result in edge effects, changed flow regimes, and erosion and sedimentation of affected wetlands. Therefore, the magnitude and high sensitivity of the wetlands combine to produce a major overall impact level to ecosystem composition during construction/decommissioning of the Project, pre-mitigation (Table 9).

Following the application of appropriate mitigation measures, including appropriate construction management methods, the impact significance is expected to remain moderate, because although the magnitude will become low, the sensitivity of the receptor will remain the same.

- Water Quality and Ecosystem Composition

Impacts to the ecosystem composition will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be for the duration of construction, which is expected to take approximately 3 years. The magnitude of the different project-specific impacts on ecosystem composition varies, as discussed under each of the subheadings below.

**Erosion and Sedimentation**

Clearing of vegetation will result in increased sediment loads in stormwater flows. These impacts will be of short duration, most likely occurring as a result of significant rain events, and will be most frequent in the early stages of construction when bulk earthworks are in progress and large areas of exposed earth are available. Impacts will be local (mainly in the catchment of River 1 and, to a lesser degree, in the Kamansinig River catchment). They will generally be reversible, and, consequently, have a medium magnitude. Wetland plant species are generally tolerant of occasional increases in sediment load in stormwater flows, and can serve as an effective sediment filter. In cases of severe and/or ongoing sediment loading, detrimental impacts on wetland vegetation and macro-invertebrates could be likely, which could detrimentally affect wetland processes and functions and, in turn, wetland composition at a localised scale. Overall wetland sensitivity to sediment increase is considered to be high; therefore the overall significance of this impact is moderate**.**

Following the application of appropriate mitigation measures, the impact significance is expected to reduce to minor, because the majority of sediment would not reach the rivers, lagoon or lake in one flush.

**Hydrocarbon and Chemical Spills**

The concentrations of hydrocarbons and other industrial pollutants in the wetlands of the LSA are presently below levels that cause harm in the aquatic environment (Golder Associates 2014b). Some invertebrate species (such as aquatic snails, described in Araujo et al. 2012), mayflies (Savić et al. 2011)) and juvenile fish (Agamy 2013) are particularly sensitive to these pollutants. The proximity of the main areas of construction to wetlands on the flats provides little buffer in the event that spillages escape from the work areas, which increases both the risk of impact, and the potential magnitude of such an event. In the absence of daily monitoring and management of site activities by competent personnel, the potential impact magnitude could be high, resulting in an overall impact of major significance.

Following the application of appropriate mitigation measures, the impact magnitude is expected to reduce to medium, which in combination with the high sensitivity of the wetland habitat, results in an overall impact of moderate significance.

**Discharge of Hydrotest Water**

Details on the use of biocides and corrosion inhibitors in the hydrotest water are not presently available, but for the purposes of the assessment it is assumed that they are present, and the hydrotest water will be discharged into the nearest drainage lines. Without management, this one-off release can present a severe risk to the aquatic environment, resulting in possible mortality and/or degradation of downstream species and ecosystems. Unmitigated impacts will be long term, only partly reversible, local in geographic extent, and, therefore, of low magnitude. Combined with high receptor sensitivity, this will result in impacts of major significance, prior to mitigation.

Following the application of appropriate mitigation measures, the impact magnitude is expected to reduce to low, which in combination with the high sensitivity of the wetland habitat, results in an overall impact of moderate significance.

**Disposal of Treated Sewage Effluent**

Assuming that the point of discharge is located further upstream where the permanent wetland vegetation is established in that area and has the capacity to act as a buffer, River 1 is likely to be tolerant of the additional daily flow and the addition of nutrients, a change in species composition due to the promotion of the growth of emergent wetland vegetation could occur, with some species that adapt well to nutrient-enrichment (persistent emergent plants such as sedges (eg. *Scirpus sp.)*, rushes (*Juncus sp.)*, common reed (*Phragmites sp.)* and cattails (*Typha sp.*) could proliferate. The magnitude of this impact is considered low, which, combined with high receptor sensitivity, will result in impacts of moderate significance.

**Overturning of Acid Sulphate Soils**

Acid sulphate soils are not expected in the seasonally-flooded grassland wetlands that will be affected by construction of the production facility; therefore, the toxic effect of acid generation associated with their disturbance should not arise.

The permanent wetland associated with the lower reaches of the Masika River, has a potential to harbor potential acid sulphate soils. Therefore, if these soils are disturbed during the construction of the flowlines between the well pads, there is a potential for acid formation and the consequent toxic effects to the ecosystem.

It is assumed that the potential acid sulphate soils in the permanent wetlands in the CHAA will be adequately managed during construction, and no lasting effects will occur. The magnitude of this impact is thus considered neglible, which, combined with high receptor sensitivity, will result in impacts of minor significance

**Increase in Population on Buhuka Flats**

In the absence of project interventions, the impact of increased population density (and associated increases in grazing livestock) on the Buhuka Flats is expected to be long-term, and to have a material effect on water quality in the wetlands across the Flats through reductions in sanitary water quality, exacerbation of wetland erosion, increased harvest of plant species used for traditional home construction, increased fire frequency and increased grazing pressure. The effects will be irreversible, and of high magnitude. In the context of the high wetland sensitivity, the predicted impact significance is major, prior to mitigation.

Following the application of appropriate mitigation measures, including appropriate construction management methods, the impact significance is expected to remain moderate, as although the magnitude will become low, the sensitivity of the receptor will remain the same.

**i Ecosystem Configuration**

Impacts to the ecosystem configuration will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will extend into the far future (that is, ~25 years) because impacts are expected to continue as long as the in-field roads and airstrip are in place. The magnitude of the impact on ecosystem configuration is medium because, prior to the application of the site-specific mitigation measures (Section 9.0), the potential for changes to ecosystem configuration is possible, especially from fragmentation.

As mentioned, the wetland's sensitivity is high because these habitats, particularly the permanent wetlands, are potential breeding habitat for Grey Crowned Cranes. The wetlands are also already under stress from increased fire frequency, livestock grazing and harvesting of fibre. Therefore, the magnitude and sensitivity combine to produce a major overall impact level to ecosystem configuration during the construction phase of the Project, pre-mitigation (Table 11).

Following the application of site-specific mitigation measures (Section 12.2), the impact significance is expected to remain moderate, although the magnitude will become low, yet the sensitivity of the receptor will remain the same.

### *Impact Significance Rating*

**Table 9: Potential impacts in the construction phase to the wetlands of the CHAA**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Representativeness | Medium – 3 | High – 4 | Major – 12 | Low – 2 | High – 4 | Moderate – 8 |
| Ecosystem composition – wetland structure | Medium – 3 | High – 4 | Major – 12 | Low – 2 | High – 4 | Moderate – 8 |
| Ecosystem composition – water quality | | | | | | |
| Erosion and sedimentation | Medium – 3 | High – 4 | Major – 12 | Low - 2 | High – 4 | Moderate - 6 |
| Hydrocarbon and chemical spills | High – 4 | High – 4 | Major – 16 | Low - 2 | High – 4 | Moderate - 8 |
| Discharge of hydrotest water | Medium – 3 | High – 4 | Major – 12 | Low - 2 | High – 4 | Moderate - 8 |
| Disposal of treated sewage effluent | Low - 2 | High – 4 | Moderate – 8 | Negligible - 1 | High – 4 | Minor – 4 |
| Overturning of acid sulphate soils | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor - 4 |
| Population increase | High – 4 | High – 4 | Major – 16 | Low – 2 | High – 4 | Moderate – 8 |
| Ecosystem configuration | Medium – 3 | High – 4 | Major – 12 | Low – 2 | High – 4 | Moderate – 8 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the wetlands of the Buhuka Flats region of the CHAA. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future is uncertain.

The spatial extent of habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.1). The actual extent of possible habitat may have been over-estimated.

## *10.1.1.3 What impact could the construction/decommissioning of the Escarpment Road have on the escarpment vegetation corridors?*

While the escarpment road has been licensed and built on the basis of an earlier impact assessment (AWE, 2014c), the loss of escarpment habitat is considered and included here for completeness, and because more accurate post-construction information is now available about the area disturbed.

### *Impact Indicators*

Indicators used to assess impacts of the Project on the habitat and ecosystem integrity of the vegetation corridors on the escarpment were changes in: regional representativeness; ecosystem composition; and ecosystem configuration.

Loss of habitat due to direct disturbance and clearing associated with the Project was quantified by overlaying the current, baseline extent of the vegetation communities with the Project footprint. This included the escarpment road (which, it is recognised, is covered by a separate ESIA process, see AWE (2014c); however, the inclusion of this road in this assessment is important because of its cumulative impacts on the vegetation of the escarpment) (ref. Cumulative Impact Assessment).

Additional, indirect affects to habitat were estimated by applying a 0.50 km buffer to the temporary camp and quarry at the top of the escarpment, and the footprint of the escarpment road. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by edge effects, fragmentation, sensory disturbance, barriers to movement, changes in water quantity and quality, and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential changes in species composition that could occur, and the disruption of known movement corridors. This was accomplished by examining available literature about the ecology of the vegetation communities on the escarpment, and scientific literature about the impacts of human activities on corridors, and consultation with experts.

### *Impact Assessment*

- Representativeness

The CHAA supports approximately 2443 ha of escarpment corridor vegetation communities (see Section 6.3.1.1.2), which are bounded on the east by agriculturally modified landscapes, and the Buhuka Flats on the west (Figure 11). As mentioned, these vegetation communities form part of a contiguous vegetation corridor that is part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor (Plumptre et al. 2003) (see Section 7.1.2). Therefore, their continuous extent represents an important landscape feature in the CHAA.

The escarpment road traverses for approximately 5.5 km through the escarpment vegetation communities before it arrives on the Buhuka Flats. The total area of escarpment habitat that has been permanently lost as a result of the road's construction is 12.8 ha; this comprises: 1.9 ha of open wooded bushland; 4.6 ha of open wooded grassland; 2.9 ha of dense bushland; 3.1 ha of dense wooded grassland; 0.1 ha of riverine woodland; and 0.1 ha of open grassland (Table 10). A further 3.6 ha has been temporarily disturbed along the edges of the road. Approximately 4.5 ha of open wooded bushland was lost to the temporary camp on top of the escarpment, this area has since been rehabilitated. All these vegetation communities are widely represented on the escarpment, and the CHAA.

The total loss within the CHAA equates to: 1% of open wooded bushland; 0.6% of open wooded grassland; 0.4% of dense bushland; 0.2% of dense wooded grassland; 0.1% of riverine woodland; and 0.02% of open grassland.

**Table 10: Permanent loss of escarpment vegetation due to construction of escarpment road**

| Vegetation Type | Total area in the CHAA (ha) | Total area in Escarpment corridor (ha) | Area lost to Road (ha) | % loss in CHAA | % loss in escarpment corridor |
|---|---|---|---|---|---|
| Cultivation and settlement | 31860.9 | 0.1 | 0.1 | 0.0% | 100.0% |
| Dense bushland | 1097.6 | 337.7 | 2.9 | 0.3% | 0.9% |
| Dense wooded grassland | 613.2 | 589.0 | 3.1 | 0.5% | 0.5% |
| Open grassland | 568.5 | 31.5 | 0.1 | 0.0% | 0.3% |
| Open wooded bushland | 523.0 | 214.0 | 1.9 | 0.4% | 0.9% |
| Open wooded grassland | 1900.9 | 552.2 | 4.6 | 0.2% | 0.8% |
| Riverine woodland | 74.8 | 69.8 | 0.1 | 0.2% | 0.2% |

The loss of this quantity of vegetation in relation to the total amount in the CHAA is not substantial. Nevertheless, the loss of this vegetation does open up and cut a previously contiguous tract of vegetation with a linear corridor that introduces edge effects and the concomitant aspects associated with those, as discussed below.

Impacts from the changes to representativeness are predicted to be beyond the expected range of natural disturbance perturbations.

- Ecosystem composition

The construction of the road is expected to have contributed to losses of biodiversity at both local and regional scales due to it restricting movement between populations, increasing mortality, habitat fragmentation and edge effects, facilitating invasion by exotic species, or increased human access to wildlife habitats, all of which are expected to increase local extinction rates or decrease local recolonisation rates (Findlay and Bourdages 2000). Indeed, the construction of any linear corridor (such as the road) through an area of relatively intact vegetation, like that on the escarpment, creates edge effects that could, in the long-term, alter the composition of the ecosystem through which the road traverses. Vegetation clearing creates edges or boundaries where habitat (for example, riverine woodland) meets a disturbance (for example, the road). Edges associated with disturbance are different than transition areas, or ecotones, amongst vegetation communities, because disturbance edges tend to be abrupt with a high degree of contrast between two areas (for example, road and open wooded grassland). Edges open up habitat in areas where it was previously continuous, and this generally changes the abiotic conditions (for example, temperature, light, and moisture regimes) (Porensky and Young 2013). Edges often result in changes in species composition along the edge, with the edges typically becoming dominated by pioneer species adapted to the particular microclimate experienced on the edge (Porensky and Young 2013). Often, these microclimates are favoured by weed species. However, certainly for fauna species, and depending on the species, edges can have either a positive or negative impact on habitat quality and quantity (Prevedello et al. 2013, Wellicome et al. 2014). Given the length of the escarpment road (approximately 5.8 km) traversing the escarpment vegetation communities, this equates to approximately 11.6 km of edges in the escarpment vegetation corridor, which would have otherwise not existed.

The escarpment road is sealed for its length down the escarpment. Sealing of the road presents other aspects that may affect the ecosystem composition of the communities on either side of the road. For example, concentrating water run-off from the sealed surface, which could carry contaminants, such as fuel, heavy metals and poly-aromatic hydrocarbons, to watercourses not otherwise influenced by such run-off. This could possibly lead to changes in water quality of local watercourses and erosion regimes.

The construction of the Kingfisher camps/parking lots/materials yards, airstrip extension, CPF, pipeline, new in-field roads, crusher plant/spoil area A, new well pads, and associated infrastructure will not directly lead to changes in the composition of vegetation communities on the escarpment; however, indirect impacts from the changes to ecosystem composition are predicted to be well beyond the expected range of natural disturbance perturbations.

- Ecosystem configuration

Roads, and especially sealed roads are known to be significant barriers, or alter behaviours, of a range of wildlife, from: small ground-dwelling mammals, insects, reptiles and amphibians (for example, Brehme et al. 2013, Pontoppidan et al. 2013, Rotholz and Mandelik 2013); to bats (for example, Berthinussen and Altringham 2012); to birds (for example, Kociolek et al. 2011); to primates (for example, Mammides et al. 2009); to large ungulates (for example, Leblond et al. 2013, Meisingset et al. 2013). Depending on the species, the presence of roads may affect individuals in many direct and indirect ways. For example, roads may inhibit seasonal migration and may cause an impactive loss of habitat due to avoidance.

The construction of the Kingfisher camps/parking lots/materials yards, airstrip extension, CPF, pipeline, new in-field roads, crusher plant/spoil area A, new well pads, and associated infrastructure will not directly lead to changes in the configuration of vegetation communities on the escarpment. The construction of the escarpment road is also unlikely to have had any direct impact on the configuration of vegetation communities on the escarpment. As in the case of ecosystem composition, the most significant changes in ecosystem configuration on the escarpment are already occurring as a result of increased migration into the area facilitated by the new ease of access, and associated degradation of escarpment vegetation, creating barriers to species movement. Ecosystem configuration impacts being caused by ongoing habitat degradation due to increased population and road traffic during operation are discussed in Section 10.2.1.

Direct impacts from the changes to ecosystem configuration on the escarpment as a result of the road are beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The vegetation community of the escarpment's sensitivity is medium because these habitats are already under stress from livestock grazing and harvesting of fuel wood and non-timber forest products. They also form part of a wider wildlife corridor, which is recognised for its regional importance.

Impacts to the representativeness of the habitat will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA, and will only constitute approximately 0.02 % loss of vegetation communities in relation to the CHAA. Impact duration will be into the far future (that is, ~25 years) because the road down the escarpment will remain in place even after the project is decommissioned. The changes to the representativeness of the vegetation communities, although possibly irreversible, are expected to be amendable via offsetting (see Section 13.0). The magnitude of the impacts of the road on representativeness of the vegetation communities of the escarpment is medium. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to representativeness during the construction phase of the Project, pre-mitigation (Table 11). Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, as the magnitude will become low, while the sensitivity of the receptor will remain the same.

Impacts to the ecosystem composition will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be into the far future (that is, ~25 years) because impacts are expected last as long as the road is in place. The magnitude of the impact on ecosystem composition is medium because, prior to any mitigation, the potential for changes to ecosystem composition potentially brought about by edge impacts is possible. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to ecosystem composition during the construction phase of the Project, pre-mitigation (Table 11). Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, as although the magnitude will become low, the sensitivity of the receptor will remain the same.

Impacts to the ecosystem configuration will be adverse. The geographical extent of impacts will be regional because impacts are restricted to the CHAA. Impact duration will extend into the far future (that is, ~25 years) because impacts are expected to continue as long as the road is in place. The magnitude of the impact on ecosystem configuration is medium because, prior to mitigation, the potential for changes to ecosystem configuration is possible, especially inference with wildlife movement corridors. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to ecosystem composition during the construction phase of the Project, pre-mitigation (Table 11).

Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, as although the magnitude will become low, the sensitivity of the receptor will remain the same.

**Table 11: Potential impacts in the construction phase to the vegetation communities of the escarpment**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | **Magnitude** | **Sensitivity of the Receptor** | **Significance** | **Magnitude** | **Sensitivity of the Receptor** | **Significance** |
| Representativeness | Medium – 3 | Medium – 3 | Moderate – 9 | Low – 2 | Medium – 3 | Moderate – 6 |
| Ecosystem composition | Medium – 3 | Medium – 3 | Moderate – 9 | Low – 2 | Medium – 3 | Moderate – 6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ecosystem configuration | Medium – 3 | Medium – 3 | Moderate – 9 | Low – 2 | Medium – 3 | Moderate – 6 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the vegetation communities of the escarpment, and the wildlife corridors of which they form part. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future is uncertain. Indications are that they will increase in importance (Ayebare et al. 2013), provided human pressures do not overwhelm them.

The spatial extent of habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 7.1.2). The actual extent of possible habitat may have been over-estimated.

## *10.1.1.4 What impact could the construction/decommissioning of the Project have on the Bugoma Central Forest Reserve?*

### *Impact Indicators*

The Ugandan Government will be responsible for upgrading the roads that the oil industry will need for access. Scheduled 'oil industry' road upgrades to support the Kingfisher development include those shown in Figure 21. Although it is recognised that CNOOC will not be upgrading the roads, and the Ugandan Government will be responsible for the upgrades; any effects associated with, and stemming from the proposed road upgrades can be seen to be induced impacts arising as a consequence of the Project's development.

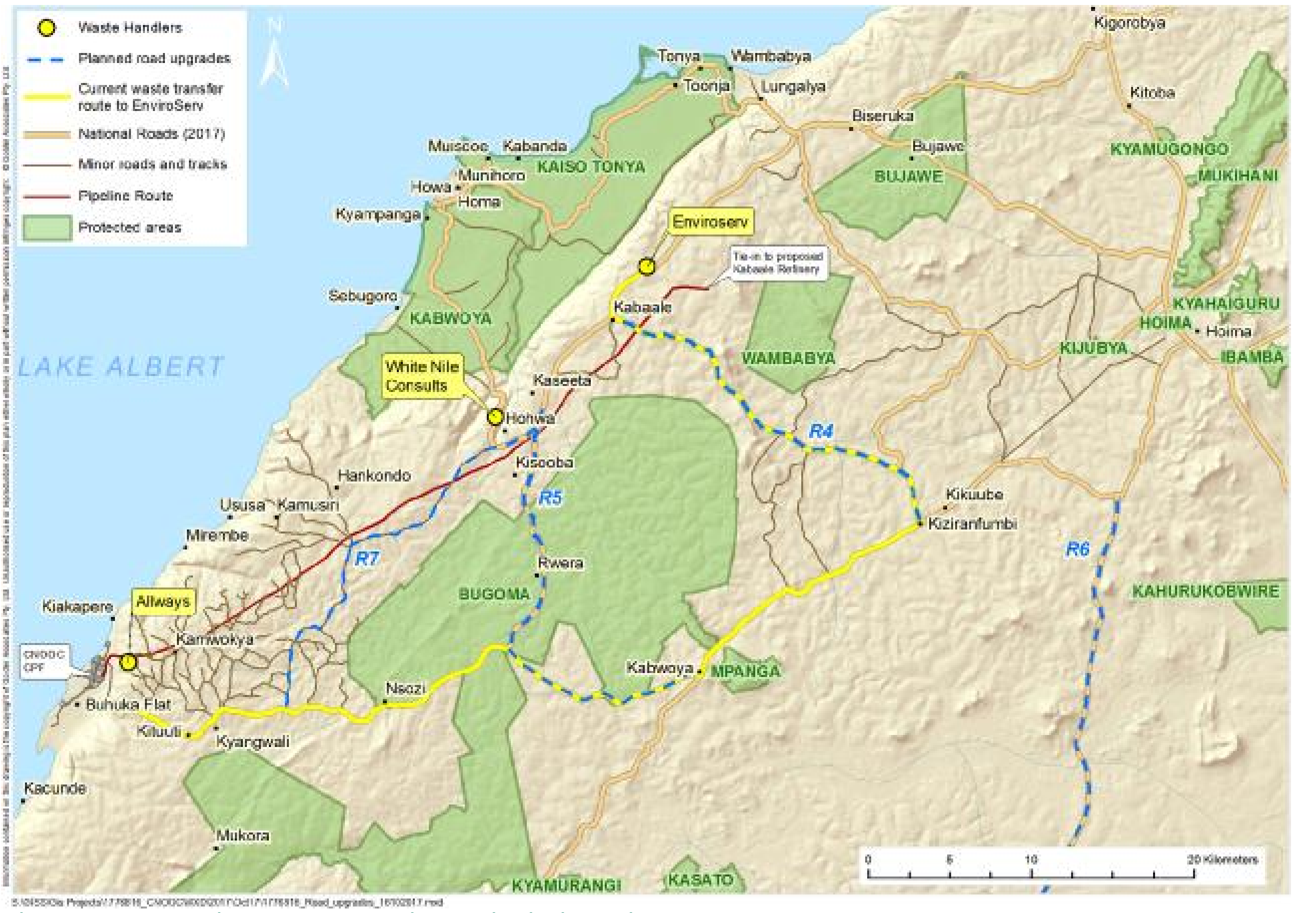

*Figure 21: Proposed Government road upgrades in the region*

A formal impact classification based on indicators was developed for induced and cumulative impacts to the Bugoma Central Forest Reserve; the impacts are discussed, and their significance assessed through a **reasoned narrative**. An overall impact significance classification is then developed. This was accomplished by examining available literature about the ecology of the Bugoma Central Forest Reserve (BCFR), and scientific literature regarding the effects of migration and human population pressure on forests in Africa.

The impacts were assessed in light of the guidance provided by IFC (2013), and in consideration of other known projects being developed in the wider area. In particular, the development of the oil processing facility at Kabaale, the oil developments around the Kaiso-Tonya area (AECOM 2012), the Hoima-Mputa-Fort Portal-Nkenda power line, and the potential for regional population increases in the wider area.

### *Impact Assessment*

The Bugoma Central Forest Reserve (Bugoma CFR) is identified as a valued component for this impact assessment, certainly in terms of biodiversity (see Section 6.3.1.1.4). As identified in that section, apart from being one of the last stands of tropical semi-deciduous forests in the region, it also supports known populations of the Endangered Eastern Chimpanzee and range-restricted Nahan's Francolin (Plumptre et al. 2011), potential non-breeding habitat for the Endangered Madagascar Pond Heron (see Section 6.3.3.1), as well as elephants and a host of other threatened and irreplaceable species.

The R5 passes through the centre of Bugoma CFR in a north-south direction for approximately 9.7 km, and the P1 road runs along part of the main south-western and south-eastern boundaries of the Bugoma CFR, passing through the reserve in an east-west direction for approximately 3.5 km near Kisaru. Both roads are currently unsealed and relatively narrow, and become impassable from time to time in the wet season. No data traffic data are available for the roads.

The construction of the roads will cause the direct loss of forest species in the area of the road widening. Depending on the final road width (assuming a width of 10 m), the construction methodologies used and the need to accommodate traffic, this could result in the permanent removal of around 9.7 ha of forest habitat along the R5 section of road, and 3.5 ha along the P1 section of road from Kiziranfumbi and Nsozi.

The Bugoma Central Forest Reserve is home to populations of threatened species and an array of other species (see Plumptre et al. 2010, 2011). Many of these species will move within the forest and between sections of the forest. Although the negative effects of roads on wildlife in tropical rainforests, like Bugoma Central Forest Reserve, are poorly understood, indications are that: (1) many species avoid roads altogether (especially, medium-sized mammals, diurnal, solitary and group living animals, and ungulates); and (2) high vegetation cover on the road verges (Figure 22) increases crossing probability substantially (van der Hoeven et al. 2010). Currently, the road side vegetation on the R5 and P1 roads would encourage wildlife to cross (Figure 22). This could place them in the direct paths of traffic.

During construction, Project-generated traffic will consist of 65 trucks per day over a 2.5 year period, amounting to approximately one truck every 10 minutes during daylight hours. This, combined with a general increase in vehicular traffic to the area facilitated by the improving road surfaces, is predicted to cause increased disturbance to faunal species within the Bugoma CFR, as well as increase the risk of direct mortality of wildlife due to traffic collisions. Impacts to species of concern associated with Bugoma CFR (Eastern Chimpanzee and Nahan's Francolin) due to increased risk of traffic collisions during the construction phase are addressed in Section 9.1.2.

*Figure 22: The P1 road through Bugoma Central Forest Reserve*

## *Impact Classification*

Impacts from the upgrade of the R5 and the P1 roads and the resultant increased traffic (reducing adjacent habitat integrity as a result of noise, vibration etc) along that road during the construction of the Project will be adverse. The geographical extent of impacts will be regional because effects are restricted to the R5 and the P1 road corridors in the CHAA. Impact duration will be short-term (that is, limited to the road upgrade construction, and the construction phase of the Project, that is, ~2 years). The magnitude of the effects of construction, in the context of habitat loss, on the Bugoma Central Forest Reserve is low.

The sensitivity of the Bugoma Central Forest Reserve is high because it is a threatened ecosystem that is already under pressure. Therefore, the intensity and sensitivity combine to produce a moderate overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 12).

The mitigation hierarchy is an important process that has been used to minimise impacts to the Bugoma Forest Reserve. The focus for the continued use of the mitigation hierarchy during the road upgrade and construction will be continued development and implementation of mitigation measures through monitoring and adaptive management; including suggested measures for the Ugandan Government to apply in the management of the upgrade of the P1 Road (see Section 11.0).

Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, primarily because the intensity could become negligible, although the sensitivity of the receptor will remain the same (Table 12).

**Table 12: Potential impacts in the construction phase to the Bugoma Central Forest Reserve**

| | **Pre-mitigation** | | | **Post-mitigation (pre-offsets)** | | |
|---|---|---|---|---|---|---|
| | **Magnitude (the expected size of the impact)** | **Sensitivity of the Receptor** | **significance** | **Magnitude (the expected size of the impact)** | **Sensitivity of the Receptor** | **significance** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Habitat and ecosystem integrity | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |

As noted above, the focus for reducing impacts to the Bugoma Central Forest Reserve is mitigation to lessen various types of disturbance that may occur (Section 11.0). Optimising mitigation will reduce the need for offsetting. However, offsetting options to compensate for residual impacts to the forest have been identified and are discussed in Section 10.0.

### 10.1.2 What impact could the construction/decommissioning of the Project have on species of concern?

This section presents the assessment of the impacts that the Project construction/decommissioning could have only on those species of concern that potentially trigger critical habitat, as identified in Section 6.3.3; that is, the Mud Snail (*Gabbiella candida*), Grey Crowned Crane (*Balearica regulorum*), Nahan's Francolin (*Ptilopachus nahani*) and Eastern Chimpanzee (*Pan troglodytes*). Potential impacts to other species of concern are assessed at the habitat level (see Section 7.3.1.1).

#### *10.1.2.1 What impact could the construction/decommissioning of the Production Facility have on the Mud Snail (Gabbiella candida)?*

The Mud Snail (*Gabbiella candida*) is a Critically Endangered and range-restricted species. Currently, the only known populations occur around Butiaba (see Section 6.3.3.1), which is on the eastern shore of Lake Albert approximately 90 km north of the LSA. Although this species was not confirmed within the CHAA during the course of baseline studies, there is a potential that this species could occur in the near-shore habitats of the CHAA, based on its known habitat preferences, and those of other Mud Snail species (*Gabbiella* spp.), which have previously been recorded in both the same locality as this species at Butiaba, as well as in the LSA. Hence, a precautionary approach has been adopted, and *G. candida* is assumed to occur in the near-shore habitats of the CHAA.

*Impact Indicators*

Indicators used to assess impacts of the construction of the Project on the Mud Snail were: habitat quantity and quality; and habitat connectivity, because no individuals were recorded, yet potential habitat is present.

Habitat loss due to direct disturbance and clearing of habitat was assessed by calculating the loss of suitable habitat from the CHAA as a result of the construction of the Project. Changes to habitat quality were assessed by the prediction of sediment loads and changes to water quality in the water column from construction activities.

Changes in habitat connectivity were assessed by identifying potential barriers to genetic movement, and source populations. This was accomplished by visually examining the spatial distribution of critical habitat in relation to the Project footprint, to qualitatively identify areas where critical habitat becomes fragmented.

*Impact Assessment*

- Habitat Quality and Quantity

Very little information is available for this species. Information about the genus *Gabbiella* indicates that this group is generally found in lakes, rivers and, less commonly, in small water bodies, and rarely in habitats that dry out (Kristensen and Stensgaard 2010). Two sister species (*G. humerosa* and *G. walleri*) were recorded in the LSA (see Section 3.3.2.4, Appendix D). These two species have also been recorded in the same locality and habitat as *G. candida* (GBIF, 2014). Therefore, the habitat preferences of those two species were used as a model to predict the potential impacts of changes to habitat quantity and quality for this species.

The two sister Mud Snail species recorded from the CHAA were collected from bottom substrates in the open sandy shore habitats in the LSA. These habitats are characterised by a gently sloping lake bed extending from the shore line to deeper water. The substrate is typically comprised of sand and finer sediments (Wandera and Balirwa 2010). This habitat constitutes approximately linear (lake shore) 10.5 km of the CHAA, most of which is located within the LSA.

The jetty will be upgraded, although there are not expected to be material changes in its dimensions. Currently, it consists of a solid concrete structure extending some 20 m into the lake to provide sufficient draught during low water periods. Although the existing jetty structure appears to have caused some accretion of sediment on the eastern side of the jetty, and some erosion on the western side, the proposed jetty upgrade is not expected to alter the geomorphological processes and sediment drift that currently govern the shoreline ecosystem of the Buhuka Flats, additional to the sediment deposition and erosion either side of the jetty that has already taken place.

The new water intake and pump station will extend a similar distance (~20 m) into the lake. The construction works will affect, through direct disturbance, approximately 0.04 ha or 0.005% of potential habitat (810 ha of near-shore aquatic habitats) for the Mud Snail in the CHAA. Additionally, there is potential for this proposed structure to affect geomorphological processes and sediment drift down-shore of Well Pad 2; which in combination with the existing jetty structure, could potentially affect the sediment drift or shoreline morphodynamics between Well Pad 2 and Bugoma Lagoon. Since sediment drift is recognised as an important driver in shoreline ecosystems, contributing to the nutrient input that drives phytoplankton, zooplankton and fish communities (Parks et al. 2013); there is potential for the Mud Snail habitat to be affected, beyond the area of primary disturbance.

The new water intake and pump station also has the potential to alter the water quality within the immediate surrounds of the construction activities through disturbance of the lake bed, and introduction of sediment into the water column over the short-term during the works. It is expected that these increased sediment loads will dissipate reasonably quickly following completion of the construction works. The sediment loads in the vicinity of the new water intake and pump station are not expected to exceed those that would normally be expected during windy periods on the lake (see Golder Associates 2014g), and the consequent turbid conditions caused by those winds. Furthermore, these construction works are not expected to permanently alter the water chemistry in the vicinity of the new water intake and pump station given the large buffering capacity of the lake compared to the scale of the works, and the short-term duration of the works. Therefore, it can be expected that the construction of the new water intake and pump station will not affect the sediment loads and water quality of the near-shore habitats following completion of works.

Accidental spillages of small quantities of fuels and chemicals during the construction of the Production Facility components (not including significant/catastrophic spillages, which are described in Volume 2, Chapter 2.0) could end up in River 1 and, ultimately report to the near-shore habitats of the CHAA south-west of well pad 2. There is also a real potential for accidental spillages to occur as part of the jetty upgrade works, and during the construction of the new water intake and pump station. A further risk will result from the construction and drilling of the wells. While control systems are proposed to manage contaminated stormwater and wash-water from the well pads, the presence of drilling crews on site for approximately a year, using potentially hazardous drilling fluid and other hazardous materials; and the absence of a buffer between the well pads and the lake (in the case of well pad 1, the seasonal wetland); makes it likely that occasionally contaminated drainage will reach the lake unless there is a very high level of control of day-to-day activities. Aquatic snails are highly sensitive to chemical pollutants, particularly hydrocarbons (Araujo et al. 2012). Currently, the concentrations of hydrocarbons and other pollutants in the lake waters of the near-shore habitats are below levels that could cause harm to the environment (Golder Associates 2014b); this is supported by the healthy aquatic communities observed in the lake's near-shore habitats (see Section 6.2). As such, without a very high level of control of day-to-day activities and adequate spill prevention and clean-up measures in place during construction, accidental spillages of fuels and chemicals could, depending on the volume spilt, have a detrimental impact on the near-shore habitats of the LSA through the introduction of toxic compounds and pollutants. Such a spill could have a detrimental impact on the Mud Snail.

Discharge of treated sewerage during construction could affect water quality and algal growth rates, potentially affecting the quality of the Mud Snail's preferred habitat. However, *Gabbiella* sp. are detritivores/omnivore living on muddy lake bottoms and plants, and *Gabbiella humerosa*, the sister species of *Gabbiella candida*, appears to benefit from increased eutrophication (Van Damme & Lange, 2017). Therefore, the discharge of treated sewerage during construction may not have a detrimental impact on the Mud Snail.

The construction of the Kingfisher permanent and temporary camps/parking lots/materials yards, airstrip extension, CPF, new in-field roads, crusher plant/spoil area A, expansion of exploration well pads to production well pads (particularly the expansion of well pad 2 to its full size), and associated infrastructure could cause increased sedimentation of near-shore habitats on the Buhuka Flats. The soils of the Buhuka Flats are dispersive (Golder Associates 2014d), and active soil erosion is evident in the LSA. With the construction of the Project's components, and the consequent exposed areas of soil, there is a potential that, without adequate erosion and sediment control measures in place during construction, sediment loads within the watercourses (particularly River 1, which will receive the drainage from the CPF earthworks and temporary camp) draining the Project footprint could increase. These sediment-laden watercourses report to Lake Albert, and, hence, there is a potential for increased sediment loads in the near-shore habitats. Near-shore habitats particularly at risk include the lagoon, and to a lesser extent, the shallow river-associated habitats, both potential habitat for the Mud Snail. Nevertheless, the watercourses draining the LSA support dense emergent vegetation (see Section 6.1.1.1). Such vegetation forms an impactive filter for most sediment (IECA 2008), therefore, it can be expected that sediment loads reporting to the near-shore habitats, at least, via the Kamansinig River, River 1 and Masika River, could be minimal. Sediment loads from overland flows may not be as retarded by vegetation, and hence may report to the near-shore habitats and affect them detrimentally. However, little construction storm water will flow into the Kamansinig River and the seasonal wetlands upstream of the Bugoma Lagoon, since only the expansion of Well Pad 1 and roughly half of the construction area of the permanent camp fall within its catchment (Figure 20). The seasonal wetland will provide efficient attenuation of sediment, and a significant increase in sediment concentrations in the lake or in Bugoma lagoon are unlikely.

Impacts on habitat quality and quantity for *G. candida* arising from direct disturbance, changes in sediment dynamics and potential accidental spillages of small quantities of fuels and chemicals during construction are predicted to be beyond the expected range of natural disturbance perturbations. Potential loss of critical habitat for the Mud Snail requires the consideration of offsets to meet IFC requirements.

- Habitat Connectivity

The construction of the Project is expected to last for three years (the jetty upgrade has already been completed). Besides the upgrading of the jetty, it is unlikely that construction activities could substantially alter the habitat connectivity of the near-shore habitats in the CHAA. No structures are being put in place that will alter the natural connectivity of the aquatic habitats of the lake. It is expected that the connectivity amongst the aquatic habitats will remain the same during construction as they were during baseline.

### *Impact Classification*

The Mud Snail's sensitivity is high because this species is Critically Endangered, and potentially triggers a Tier 1 critical habitat designation.

Impacts to the Mud Snail's habitat quantity and quality will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA, with approximately 0.04 ha or 0.005% of potential habitat affected. Impact duration will be short-term (that is, limited to the construction phase of ~3 years) because disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities. Although the jetty structure will remain in place into the far future (that is, ~25 years) after the project is decommissioned, the changes to the open sandy shore habitat in the vicinity of the jetty are expected to be reversible over time as natural geomorphological processes re-establish the open sandy shoreline. The magnitude of the physical impacts of construction on the habitat quantity and quality of the Mud Snail is expected to be low. Following the application of appropriate mitigation measures, the impact significance for physical impacts on habitat quality and quantity is expected to remain the same, that is, moderate, primarily because the magnitude will still remain the same due to habitat disturbance during construction (Table 13).

Adverse impacts on habitat quality are expected as a result of accidental spillages of small quantities of fuels and chemicals (including potentially hazardous drilling fluid) during the construction of the Project components and installation of the wells, ultimately reporting to the near-shore habitats of the Lake. Although the impact duration will be short-term, and should be reversible with time as the Lake waters dilute and disperse the contaminants, the magnitude of the impacts of accidental entrainment of contaminants to *G. candida's* habitat could be high. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact on physical habitat quality and quantity during the construction phase of the Project, and a major overall impact on habitat quality and quantity as a result of contamination, pre-mitigation (Table 13). The strict application of the recommended mitigation measures (Section 11.2.1) will reduce the risk, and thus the likely magnitude, of potential habitat contamination for the Mud Snail, reducing the overall impact significance to moderate.

Impacts to the Mud Snail's habitat connectivity will be neutral. The geographical extent of impacts will be local because impacts are restricted to the LSA, with approximately 0.04 ha or 0.005% of potential habitat affected. Impact duration will be short-term (that is, limited to the construction phase of ~3 years) because disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities, and no barrier to habitat connectivity will be constructed. Although the existing jetty structure will remain in place into the far future after the project is decommissioned (that is, ~25 years), the proposed upgrade works will not result in changes to current jetty footprint and subsequently the open sandy shore habitat in the vicinity of the jetty. The application of the recommended site-specific mitigation measures in the construction of the new water intake and pump station (Section 11.0) are expected to minimise any detrimental effects on longshore sediment drift and morphodynamics, and any subsequent negative effects on the habitat connectivity of the Mud Snail, to a point where the magnitude of the potential impact is negligible. Therefore, the magnitude and sensitivity combine to produce a minor overall impact on habitat connectivity for *G. candida* during the construction phase of the Project, pre-mitigation (Table 13.

**Table 13: Potential impacts in the construction phase to the Mud Snail**

| **Indicator of potential impact** | **Pre-mitigation** | | | **Post-mitigation (pre-offsets)** | | |
|---|---|---|---|---|---|---|
| | **Magnitude (the expected size of the impact)** | **Sensitivity of the Receptor** | **Significance** | **Magnitude (the expected size of the impact)** | **Sensitivity of the Receptor** | **Significance** |
| Habitat quality and quantity (physical impacts) | Low – 2 | High – 4 | Moderate – 8 | Low – 2 | High – 4 | Moderate – 8 |
| Habitat quality and quantity (contamination) | High – 4 | High – 4 | Major - 16 | Low – 2 | High - 4 | Moderate – 8 |
| Habitat connectivity | Negligible – 1 | High – 4 | Minor – 4 | Negligible – 1 | High – 4 | Minor – 4 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the near-shore habitats of the CHAA, and hence potential local populations of Mud Snail. However, there is some uncertainty with regard to this species actually occurring in the CHAA. As such, the above assessment has been undertaken based on a precautionary approach.

The spatial extent of the near-shore habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1.1). The actual extent of possible habitat may have been over-estimated.

### *10.1.2.2 What impact could the construction/decommissioning of the Production Facility have on Grey Crowned Crane?*

The Grey Crowned Crane is an Endangered species. Up to 14 individuals were regularly recorded on the Buhuka flats during baseline surveys, and a pair of Grey Crowned Crane was observed on the Flats during social baseline survey work conducted in November 2017. More than three-quarters of the world's Grey Crowned Cranes occur in Uganda and Kenya in East Africa, leading Uganda to develop a species action plan for their conservation in-country. The population of Grey Crowned Crane using the Buhuka flats is thus regarded as highly sensitive, and the wetlands of the Flats are considered an important conservation unit for the species.

The construction of the Production Facility could directly impact Grey Crowned Crane breeding and foraging habitat on, given that construction impacts on wetlands in the Buhuka Flats are expected (Section 9.1.1.2). In addition, although it is recognised that the escarpment road has already been licensed and built on the basis of an earlier impact assessment (AWE, 2014c), the induced effects of its operation on the Buhuka Flats wetland habitats used by Grey Crowned Crane are expected to exacerbate predicted construction phase impacts on this species in the Buhuka Flats locality, and this is included for completeness.

The potential direct, indirect and induced impacts of the construction of the Production Facility to the Grey Crowned Crane are presented below.

### *Impact Indicators*

Indicators used to assess effects of the construction of the Production Facility on Grey Crowned Crane were: habitat quantity and quality, habitat connectivity, abundance and distribution, and survival and reproduction.

Habitat loss due to direct disturbance and clearing of habitat was assessed by calculating the loss of suitable habitat from the CHAA as a result of the construction of the various Project components and infrastructure. Changes to habitat quality due to indirect disturbance were estimated by applying a 200m buffer to the infrastructure footprint. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality caused by indirect disturbance arising from light, noise, vibration, and edge effects.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and loss of corridors. This was accomplished by visually examining the spatial distribution of critical habitat for Grey Crowned Crane in relation to the infrastructure to qualitatively identify areas where habitat becomes fragmented.

Potential changes in abundance and distribution, and survival and reproduction were assessed qualitatively by considering changes in disturbances (that is, vehicle traffic, light, noise, vibration) and site clearing activities. These disturbances were considered in light of known or inferred effects to the survival and reproduction of Grey Crowned Crane, where data on these types of effects are available.

### *Impact Assessment*

- Habitat Quality and Quantity

Grey Crowned Crane is distributed across eastern and southern Africa. Populations in many areas including Uganda have experienced rapid declines during the past 45 years (BirdLife International, 2018) for reasons including habitat loss to farming, human presence causing disturbance, collection of chicks for domestication, disruption of breeding activity, loss of roosting sites (large trees located remotely from areas frequented by humans) and dry-season fires in wetland habitats (Olupot, 2014). Its habitat preferences are diverse, including wetlands with tall emergent vegetation, open riverine woodland, shallowly flooded plains and temporary pools with adjacent grasslands, open savannas, croplands, pastures, fallow fields and irrigated areas (Archibald et al, 2018). It prefers short to medium height open grasslands adjacent to wetlands for foraging, which is consistent with the seasonally flooded grassland wetlands in the Buhuka Flats. For breeding, it prefers marshes with water 1 m deep and emergent vegetation 1 m above the water (Archibald et al, 2018); habitat which corresponds to the permanent wetlands of the Buhuka Flats.

Direct loss of suitable foraging habitat (seasonally flooded grassland) to the Project footprint will consist of 5.8 ha or 8.4% of a total of 69 ha of seasonally flooded grassland in the Buhuka Flats area. No direct losses of permanent wetlands are anticipated on the Flats. Some large trees with cultural importance have reportedly been removed from the Buhuka Flats during construction activities. Such trees are important roosting resources for Grey Crowned Crane and their loss could influence their presence in/use of the area for foraging and breeding (Olupot, 2014).

Although Grey Crowned Crane can tolerate a low degree of anthropogenic disturbance in foraging habitat (e.g. subsistence and commercial farming practises), in Ugandan wetlands it has been observed to be intolerant of human proximity within 100-200m (Olupot, 2014), flying away on approach; a factor which also affects breeding success as breeding birds flush from nests on approach, causing increased rates of predation, reduced time at the nest (either incubating or feeding), and ultimately nest abandonment. How tolerant foraging/roosting/breeding Grey Crowned Crane may be to indirect disturbances, such as noise, light, vibration and edge effects, is not known. The application of a 200m buffer around the Project infrastructure footprint indicates that approximately 4.64 ha of seasonally flooded wetland habitat will be reduced in quality as a result of sensory disturbance.

This equates to a total potential habitat loss in the Buhuka Flats region of the CHAA from direct losses from vegetation clearing, and indirect losses from sensory disturbances and edge effects associated with the Production Facility of up to 10.44 ha (0.09% of 11,579 ha of wetlands in CHAA; 15% of 69 ha seasonally flooded grassland in the Buhuka Flats).

Effects from loss of habitat are predicted to be beyond the expected range of natural disturbance perturbations (for example, fire), although not beyond the human-induced rate of degradation via cattle grazing pressure etc.

- Habitat Connectivity

The effect of the Project construction as a barrier to the movement of Grey Crowned Crane is likely to be adverse. The construction activity will create sensory disturbances in the short-term, which can elicit reduced use or complete avoidance of affected areas, thereby creating movement barriers (for example, see Kolowski and Alonso 2009, Gleeson and Gleeson 2012). It is noted that the construction of power lines between the CPF and development wells will present a significant barrier to movement for Grey Crowned Crane, as this species is susceptible to in-flight collisions with overhead powerlines (BirdLife International, 2018); however, the construction of powerlines does not form part of this impact assessment and is instead discussed in the cumulative impact assessment (ref. Cumulative Impact Assessment). Construction of linear infrastructure (roads and flowlines) through wetlands has the potential to create temporary barriers to movement as a result of the associated disturbance due to human presence in the area.

Effects from loss of habitat are predicted to be well beyond the expected range of natural disturbance perturbations.

- Abundance and Distribution

Up to 14 individuals of Grey Crowned Crane were frequently observed on the Flats during the baseline fieldwork conducted in 2014. Given the extent of their tolerance of human presence (approx. 100m – 200m), the large-scale changes in the human population on the Flats that have occurred since the construction of the escarpment road are likely to have affected Grey Crowned Crane occurrence on the Buhuka Flats.

For the purposes of this assessment, it is assumed that Grey Crowned Crane remains present in suitable habitat (permanent and seasonal wetlands) in the Buhuka Flats. The construction of the Production Facility is likely to exacerbate existing levels of sensory disturbance in the locality, with resultant effects on habitat quality and the distribution of the species. The loss of foraging habitat to the Project footprint is also likely to affect the abundance and distribution of Grey Crowned Crane in the CHAA.

Effects on the abundance and distribution of Grey Crowned Crane are predicted to be well beyond the expected range of natural disturbance perturbations.

- Survival and Reproduction

During the baseline fieldwork conducted in May 2014, the formation of breeding pairs of observed Grey Crowned Crane was indicated. Grey Crowned Crane nests are typically constructed within or on the edges of marshes with water of 1m depth and emergent vegetation 1m high (BirdLife International, 2018). Loss and degradation of wetland habitat on the Buhuka Flats is expected to decrease the likelihood of Grey Crowned Crane selecting these areas for breeding.

As mentioned above, direct disturbance via human proximity within 100-200m causes breeding birds to flush from nests on approach (Olupot, 2014), which may result in increased rates of predation, reduced time at the nest, either incubating or feeding, and ultimately nest abandonment, affecting reproductive success. It is assumed for this assessment that indirect disturbances arising from noise, light, vibration and edge effects are also likely to affect the breeding success of Grey Crowned Crane on the Buhuka Flats.

Removal of large trees which have importance as night-time roosts and day-time shelter from the midday sun has been indicated in localised declines in Grey Crowned Crane in Uganda (Olupot, 2014); the loss of such trees is therefore expected to have implications for the survival of flocks and individuals in the area.

The installation of powerlines as part of the Project infrastructure presents a serious risk of in-flight collisions, resulting in mortalities of individual birds – these impacts are addressed in the cumulative impact assessment (ref  Cumulative Impact Assessment).

These effects to the survival and reproductive success of Grey Crowned Crane are predicted to be well beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The Grey Crowned Crane sensitivity is high because it is Endangered, and triggers Tier 2 critical habitat.

Impacts to Grey Crowned Crane habitat quantity and quality will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas within 200 m of the Production Facility infrastructure footprint, with approximately 5.8 ha (8.4%) of potential habitat in the Buhuka Flats being permanently lost, and 10.44 ha (6.6 %) of potential habitat in the Buhuka Flats indirectly affected. Impact duration will be short-term (that is, limited to the construction phase of the Project, that is, ~3 years). Changes to the habitat quality and quantity from sensory disturbances arising from construction activities are expected to be reversible after completion of the works. The magnitude of the effects of construction on Grey Crowned Crane habitat quantity and quality is considered medium. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to decrease to moderate, because the magnitude of effects could be reduced to low, and the sensitivity of the receptor will remain the same (Table 14).

Impacts to Grey Crowned Crane habitat connectivity will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas where wetlands will be crossed by linear infrastructure i.e. access roads. Impact duration will be long-term, as the presence of access roads will commence during construction and remain in place throughout the operational lifetime of the Project, although sensory disturbances arising from construction activities are expected to dissipate within a short time after completion of the construction phase. The magnitude of the effects of construction on Grey Crowned Crane habitat connectivity is low, as the species is mobile and capable of flight to preferred areas. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the road upgrade and construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, primarily because the magnitude will remain low as long as the roads are present, and the sensitivity of the receptor will remain the same (Table 14).

Impacts to Grey Crowned Crane abundance and distribution will be adverse. The geographical extent of impacts will be local because effects are restricted to wetlands within 200m of the proposed Production Facility infrastructure on the Buhuka Flats. Impact duration will be short-term (that is, limited to the construction phase of ~3 years) because physical and sensory disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities. There is a possibility that individuals could be killed or severely disturbed during the construction phase; however, in the context of overall species abundance, these losses or disturbances are expected to be reversible after completion of the works. The magnitude of the effects of construction on Grey Crowned Crane abundance and distribution is thus considered medium. Therefore, the magnitude and sensitivity combine to produce an impact of major significance during the construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to decrease to moderate, because the magnitude of effects could be reduced to low, and the sensitivity of the receptor will remain the same (Table 14).

Impacts to the survival and reproduction of Grey Crowned Crane will be adverse. The geographical extent of impacts will be local because effects are restricted to wetlands within 200m of the proposed Production Facility infrastructure on the Buhuka Flats. Impact duration will be short-term (that is, limited to the construction phase of ~3 years) because physical and sensory disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is considered probable that at least this number of individuals in the local population within the Buhuka Flats will be affected. The magnitude of the effects of construction on the survival and reproduction of the Grey Crowned Crane is therefore medium. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to decrease to moderate, primarily because the intensity could become low, although the sensitivity of the receptor will remain the same (Table 14).

**Table 14: Potential construction phase impacts to Grey Crowned Crane**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude (the expected size of the impact) | Sensitivity of the Receptor | Significance | Magnitude (the expected size of the impact) | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Medium - 3 | High – 4 | Major - 12 | Low – 2 | High – 4 | Moderate - 8 |
| Habitat connectivity | Low – 2 | High – 4 | Moderate - 8 | Low – 2 | High – 4 | Moderate - 8 |
| Abundance and distribution | Medium - 3 | High – 4 | Major - 12 | Low – 2 | High – 4 | Moderate - 8 |
| Survival and reproduction | Medium - 3 | High – 4 | Major - 12 | Low – 2 | High – 4 | Moderate - 8 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts on the Grey Crowned Crane and its habitat in the CHAA.

The spatial extent of the wetland habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1.1). The actual extent of possible habitat may have been over-estimated.

### *10.1.2.3 What impact could the construction/decommissioning of the Production Facility have on Nahan's Francolin?*

Nahan's Francolin is a Vulnerable and range-restricted species. It has a very restricted distribution, being found only in north-east DRC and western and south-central Uganda; in particular, the forests of Budongo, Bugoma and Mabira (McGowan and de Juana 1994). It has been recorded within Bugoma Central Forest Reserve within the CHAA.

This species triggers Tier 2 critical habitat (Section 6.3.2.2, Appendix G) under Criterion 2. Tier 2 habitats are considered to be sensitive, and, therefore, if a project is located in such a habitat, the IFC considers that compliance with the provisions of paragraph 17 of PS 6 (IFC 2012a) would be difficult. In summary, a project will not be developed in Tier 2 habitat unless: no other viable alternatives exist; and, the project does not lead to measurable and irreversible adverse impacts to the valued component that triggered critical habitat; and, the project does not lead to a net reduction in the global and/or national/regional population of the triggering species (such as Nahan's Francolin) over a reasonable period of time; and, a robust, appropriately designed, and long-term biodiversity monitoring and evaluation programme is part of the project's Environmental and

Social Management System (ESMS). A Biodiversity Action Plan (BAP) will then be developed to achieve net gain for the affected species.

Although it is expected that the construction of the Production Facility will not have direct impacts to Nahan's Francolin, the proposed upgrade of the R5 and P1 roads by the Ugandan Government for the benefit of the Project (Figure 21) could have induced and cumulative impacts to this species and Bugoma Central Forest Reserve (see also Section 7.3.1.1.4). The IFC's PS1, paragraph 2, recognises that certain effects and impacts arising from a Project may be "the responsibility of the government or other third-parties over which the client does not have control or influence" (IFC 2012c). Nevertheless, although CNOOC cannot control the actions of the government, the ESMS for the Project must identify the Ugandan Government's role, and the corresponding risks they present to CNOOC and the Project (IFC 2012c). Furthermore, the ESMS must identify opportunities for CNOOC to collaborate with the Ugandan Government in order to achieve outcomes that are consistent with PS6.

The proposed Government upgrade of R5 and P1 roads is one such opportunity. The potential induced and cumulative effects of that proposed development to this species are presented below.

### *Impact Indicators*

Indicators used to assess effects of the upgrade of the R5 and P1 on Nahan's Francolin were: habitat quantity and quality, habitat connectivity, abundance and distribution, and survival and reproduction.

Habitat loss due to direct disturbance and clearing of habitat was assessed by calculating the loss of suitable habitat from the CHAA as a result of the upgrade of the R5 and P1 roads, approximately 9.7 km and 3.5 km respectively of which passes through Bugoma CFR. Direct habitat loss due to vegetation clearance for road widening was estimated using a footprint of 10 m width. Habitat loss due to indirect disturbance and edge effects was estimated by applying a 200 m buffer to the road corridor. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality caused by indirect disturbance like light, noise, vibration, and edge effects.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and loss of corridors. This was accomplished by visually examining the spatial distribution of critical habitat in relation to the road corridor to qualitatively identify areas where habitat becomes fragmented.

Potential changes in abundance and distribution, and survival and reproduction were assessed qualitatively by considering changes in disturbances (that is, vehicle traffic, light, noise, vibration) and site clearing activities. These disturbances were considered in light of known or inferred effects to the survival and reproduction of other francolin/buttonquail species for which data on these types of effects are available.

### *Impact Assessment*

i Habitat Quality and Quantity

This species is confined to dense, mature, moist, sometimes swampy medium-altitude forest below 1,500 m (McGowan and de Juana 1994, BirdLife International 2014i); and is reasonably common in Budongo Central Forest Reserve (Plumptre et al. 2010, 2011). Suitable habitat was predicted to cover an area of ~35,201 ha (352 km$^2$) in the CHAA, principally in the Bugoma Central Forest Reserve. Direct habitat loss of suitable habitat as a result of clearing to widen the road corridor will be 9.7 ha of forest habitat along the R5 section of road, and 3.5 ha along the P1 section of road (based on approximately 9.7 km of the R5 and 3.5 km of the P1 traversing dense forest habitat (Figure 21), and a conservative clearing width of 10 m either side of the current road), representing 13.2 ha or 0.03% of suitable habitat present at baseline.

The Nahan's Francolin's degree of vulnerability to disturbance is unknown. Birds are known to be sensitive to land use and habitat alteration (Lussier et al. 2006). The behavioural response of species to disturbance will depend on species-specific tolerance levels, disturbance type and frequency, group size for socially-foraging animals, and local conditions such as the availability of alternative foraging sites (Madsen 1998). Many studies have reported a reduction in breeding success attributable to human disturbance (for a review, see Hill et al. 1992). Mechanisms include: increased rates of predation, nest abandonment and reduced time at the nest, either incubating or feeding. Clearly, a reduction in breeding output may have conservation implications and consequences for the population. How tolerant the Nahan's Francolin may be to indirect disturbances, such as noise, light, vibration and edge effects, is not known. However, assuming it is sensitive to such disturbance because it is a shy, forest-dependent species (Sande et al. 2009a), then with a 200 m buffer applied to the road upgrade's footprint, approximately 264 ha of potential Nahan's Francolin habitat will be lost or reduced in quality as a result of edge effects, and possibly sensory disturbance. This equates to a potential habitat loss in the CHAA from vegetation clearing, sensory disturbances and edge effects of up to 277 ha (0.8%).

Effects from loss of habitat are predicted to be well beyond the expected range of natural disturbance perturbations (for example, fire), although not beyond the human induced deforestation rate.

- Habitat Connectivity

The effect of the road upgrade as a barrier to the movement of Nahan's Francolin is unknown. Roads are recognised as creating sensory disturbances, which can elicit reduced use or complete avoidance of affected areas, thereby creating movement barriers (for example, see Kolowski and Alonso 2009, Gleeson and Gleeson 2012). However, given that the R5 and P1 already exist, if the Nahan's Francolin is sensitive to such effects, then it is reasonable to assume the existing roads are already a barrier to a greater or lesser degree. The upgrade of the road will bring increased sensory disturbance in the short-term, during upgrade construction, and then a potential for long-term effects as traffic along the road increases. Certainly, for the duration of the construction of the Project and the movement of components to the Buhuka Flats, traffic volumes on the road are expected to increase significantly (ref. Section 9.1.1.4).

Effects from loss of habitat connectivity are predicted to be well beyond the expected range of natural disturbance perturbations (for example, fire), although not beyond the human induced deforestation rate.

- Abundance and Distribution

Nahan's Francolin is reported to be relatively common in the Bugoma Central Forest Reserve (Plumptre et al. 2011). What effects the upgrade of the road, and the predicted increased traffic levels along the road during the construction of the Project, could have on the abundance and distribution of this species is unknown. Although this species within the forest is reported to be relatively common (*viz.*, Plumptre et al. 2011), the distribution of individuals within this habitat is unknown.

It is conceivable that the current road could act as a barrier and sensory disturbance to this species, and, as such, its distribution and abundance around the road corridor could be affected. That is, the local population along the road could be less than the surrounding forest. However, the actuality of this scenario is unknown.

Consequently, it is assumed that the current distribution of this species is evenly spread within suitable habitat in the Bugoma Central Forest Reserve, including along the current road. With the construction of the road upgrade, and the increased traffic along the road during the construction of the Project, it is reasonable to assume that the distribution of this species may be altered. Individuals may avoid the resultant sub-optimal habitat brought about by the upgrade construction activities and increased traffic volumes. Additionally, the increased traffic on the road could lead to an increase in direct mortality of individuals, with individuals potentially being killed by that traffic.

Effects from the upgrade construction and increased traffic volumes during construction of the production facility are predicted to be well beyond the expected range of natural disturbance perturbations, although not beyond the disturbance from the human-induced deforestation rate.

- Survival and Reproduction

The Nahan's Francolin's degree of vulnerability to direct disturbance, particularly during the breeding season, is not well understood. Nahan's Francolin is reliant upon large trees, with appropriate buttress formation, for breeding sites (Sande et al. 2009a). The reduction of the number of suitable breeding sites, through the removal of such large trees, can, therefore, be expected to reduce the breeding success of this species. Generally, for birds, the behavioural response of species to disturbance will depend on species-specific tolerance levels, disturbance type and frequency, group size for socially-foraging animals, and local conditions such as the availability of alternative breeding sites (Madsen 1998). Many studies have reported a reduction in breeding success attributable to human disturbance (for a review, see Hill et al. 1992). Mechanisms include: increased rates of predation, nest abandonment and reduced time at the nest, either incubating or feeding. Clearly, a reduction in breeding output may have conservation implications and consequences for the local population of Nahan's Francolin.

How tolerant the Nahan's Francolin may be to indirect disturbances, such as noise, light, vibration and edge effects, during the breeding season, are also not completely understood. What is known is that disturbance of mature forest generally appears to reduce the home range of this species (Sande et al. 2009b), and hence its potential to find suitable mates. Assuming it is sensitive to sensory disturbance because it is a shy, forest-dependent species (Sande et al. 2009a), the construction of the road upgrade, and the disturbance arising from the increased traffic levels on the road during the construction of the Project could affect the breeding success of those individuals living in close proximity to the road. In addition, if the birds attempt to cross the upgraded road in order to forage within their usual range, they will risk collision with Production Facility construction-related traffic, resulting in mortality.

These effects to the survival and reproductive success of Nahan's Francolin are predicted to be well beyond the expected range of natural disturbance perturbations, although not beyond the human induced deforestation rate.

### *Impact Classification*

The Nahan's Francolin's sensitivity is high because it triggers Tier 2 critical habitat.

Impacts to the Nahan's Francolin's habitat quantity and quality will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas within 200 m of the R5 and P1 road corridors in the CHAA, with approximately 277 ha (0.8%) of potential habitat affected. Impact duration will be short-term (that is, limited to the road upgrade construction, and the construction phase of the Project, that is, ~2 years). Changes to the habitat quality and quantity from sensory disturbances arising from construction activities are expected to be reversible after completion of the works. The magnitude of the effects of construction on the habitat quantity and quality of the Nahan's Francolin is low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 15). Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (Table 15).

Impacts to the Nahan's Francolin's habitat connectivity will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas within the 10 m R5 and P1 road clearance footprint in the CHAA, with approximately 13.2 ha or 0.03% of potential habitat affected. Impact duration will be short-term (that is, limited to the road upgrade and construction phase of ~2 years) because physical and sensory disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities. Changes to the habitat connectivity from sensory disturbances arising from construction activities are expected to be reversible after completion of the works. The magnitude of the effects of construction on the habitat connectivity of the Nahan's Francolin is Low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 15).

Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (Table 15).

Impacts to the Nahan's Francolin's abundance and distribution could be adverse. The geographical extent of impacts will be local because effects are restricted to those within 200 m of the R5 and P1 road corridors in the CHAA, with approximately 277 ha (0.8%) of potential habitat affected. Impact duration will be short-term (that is, limited to the road upgrade and construction phase of ~2 years) because physical and sensory disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities. There is a possibility that individuals could be killed or severely disturbed during the construction phase; however, these losses or disturbances are expected to be reversible after completion of the works. The magnitude of the effects of construction on the abundance and distribution of the Nahan's Francolin is

Low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 15).

Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (Table 15).

Impacts to the survival and reproduction of Nahan's Francolin could be adverse. The geographical extent of impacts will be local because effects are restricted to those areas within the 10 m R5 and P1 road clearance footprint in the CHAA, with approximately 13.2 ha or 0.03% of potential habitat affected. Impact duration will be short-term (that is, limited to the road upgrade and construction phase of ~2 years) because physical and sensory disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities. No large, buttressed trees, utilised as breeding sites, are expected to be removed during the road upgrade. There is a possibility that individuals could be killed or severely disturbed during the construction phase; however, those losses or disturbances are expected to be reversible after completion of the works. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is expected that this number of individuals in the local population within Bugoma Central Forest Reserve will not be affected. The magnitude of the effects of construction on the survival and reproduction of the Nahan's Francolin is therefore low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 15).

Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (Table 15).

**Table 15: Potential impacts in the construction phase to the Nahan's Francolin**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |
| Habitat connectivity | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |
| Abundance and distribution | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |
| Survival and reproduction | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |

### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential effects that the upgrade works associated with the R5 and P1 roads, and traffic associated with the construction of the Project, could have on the Nahan's Francolin and its habitat in the CHAA.

The spatial extent of the dense forest habitat in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1.1). The actual extent of possible habitat may have been over-estimated.

### *10.1.2.4 What impact could the construction/decommissioning of the Production Facility have on Eastern Chimpanzee?*

The Eastern Chimpanzee is an Endangered species. The population of Eastern Chimpanzees in the Bugoma Central Forest Reserve is recognised as being one for the four largest in the region (Plumptre et al. 2010).

Hence, the forest is recognised as an important chimpanzee conservation unit by the IUCN (Plumptre et al. 2010).

This species triggers Tier 1 critical habitat (Section 6.3.2.2, Appendix G). Tier 1 habitats are considered to be very sensitive, and, therefore, if a project is located in such a habitat, the IFC considers it unlikely that the client will be able to comply with the provision of PS 6, in particular paragraphs 17, 18 and 19 (IFC 2012a, as presented in Appendix C). In summary, a project will not be developed in Tier 1 habitat unless: no other viable alternatives exist; and, the project does not lead to measurable and irreversible adverse impacts to the valued component that triggered critical habitat; and, the project does not lead to a net reduction in the global and/or national/regional population of the triggering species (i.e. Eastern Chimpanzee) over a reasonable period of time; and, a robust, appropriately designed, and long-term biodiversity monitoring and evaluation programme is part of the project's Environmental and Social Management System (ESMS). A Biodiversity Action Plan (BAP) will be developed to achieve net gain for the affected species.

Although it is expected that the construction of the Production Facility will not have direct impacts to Eastern Chimpanzees, the proposed upgrade of the R5 by the Ugandan Government (Figure 21) for the benefit of the Project could have induced and cumulative impacts to this species and Bugoma Central Forest Reserve (also see Section 6.1.1.4). The IFC's PS1, paragraph 2, recognises that certain effects and impacts arising from a Project may be "the responsibility of the government or other third-parties over which the client does not have control or influence" (IFC 2012c). Nevertheless, although CNOOC cannot control the actions of the government, the ESMS for the Project must identify the Ugandan Government's role, and the corresponding risks they present to CNOOC and the Project (IFC 2012c). Furthermore, the ESMS must identify opportunities for CNOOC to collaborate with the Ugandan Government in order to achieve outcomes that are consistent with PS6.

The proposed Government upgrade of the R5 is one such opportunity. The potential induced and cumulative effects to from this upgrade to the Eastern Chimpanzee are presented below.

### *Impact Indicators*

Indicators used to assess effects of the upgrade of the R5 on Eastern Chimpanzee were: habitat quantity and quality, habitat connectivity, abundance and distribution, and survival and reproduction.

Habitat loss due to direct disturbance and clearing of habitat was assessed by calculating the loss of suitable habitat from the CHAA as a result of the upgrade of the road. Habitat loss due to indirect disturbance and edge effects was estimated by applying a 500 m buffer to the road corridor. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality caused by indirect disturbance like noise, vibration and traffic. The buffer width was determined based known chimpanzee sensitivities to noise disturbance (Parren and Byler 2003, Rabanal et al. 2010). The amount of loss or degradation of habitats within the buffer was evaluated across a range of possibilities, including that habitats become completely unavailable to chimpanzees during the construction phase. Evaluating the potential for complete avoidance of the buffer area is a conservative approach, which addresses uncertainty about the attenuation distance of sensory disturbances for chimpanzees, even though the likelihood of strict avoidance throughout the entire buffer may be low.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and loss of corridors. This was accomplished by visually examining the spatial distribution of critical habitat in relation to the road corridor to qualitatively identify areas where habitat becomes fragmented.

Potential changes in abundance and distribution were assessed qualitatively by considering changes in disturbances (that is, vehicle traffic, light, noise, vibration) and site clearing activities. These disturbances were considered in light of known or inferred effects to the survival and reproduction of other populations of chimpanzees for which data on these types of effects are available.

To assess effects to survival and reproduction as a result of in-migration and potential associated increases in poaching and disease spread, in-migration rates were predicted based on the predictions in Golder Associates (2014h). A literature review of the impact of contact with humans was also conducted

### *Impact Assessment*

i Habitat Quality and Quantity

Eastern Chimpanzees appear to range throughout the Bugoma Central Forest Reserve, both on the northern southern sides of the existing P1 road (Plumptre et al. 2010). Chimpanzees build nests to sleep in each night (Thompson and Wrangham 2013). Based on the data presented in Plumptre et al. (2010), the distribution of nesting sites appears to be widely distributed through the forest; the exception being within the vicinity of the existing Nsozi-Kabwoya road. Here the frequency of nest encountered by those workers was a lot lower than elsewhere in the forest. This suggests that the Eastern Chimpanzees within the Bugoma Central Forest Reserve are actively avoiding the road, preferring to sleep some distance away from the disturbances arising from the road. The observation supports the findings of Parren and Byler (2003) that chimpanzees actively avoid environments where they will be disturbed at night.

Based on the above, the habitat along the current P1 and R5 roads could be considered foraging, or non-core, habitat (after Parren and Byler 2003). The entire Bugoma Central Forest Reserve is considered suitable habitat for Eastern Chimpanzees, as well as the areas beyond the boundaries of the forest reserve (see McLennan 2008). However, for the intents of this impact assessment, the habitat within and immediately surrounding the Bugoma Central Forest Reserve was only considered.

Suitable habitat was predicted to cover an area of ~40,200 ha (402 $km^2$) in the CHAA, principally in the Bugoma Central Forest Reserve. Direct loss of suitable habitat as a result of clearing to widen the road corridor will be approximately 26.4 ha (based on ~9.7 km of the proposed R5 upgrade, and 3.5 km of the proposed P1 upgrade, traversing suitable habitat (Figure 21), and a conservative clearing width of 10 m either side of the current road for upgrade purposes), representing 0.07% of critical habitat present at baseline.

The degree of vulnerability to disturbance experienced by chimpanzees is reasonably well known (for example, see Parren and Byler 2003, Rabanal et al. 2010, Thompson and Wrangham 2013). The chimpanzees living in and around the Bugoma Central Forest Reserve most likely experience sensory disturbances at present from human activities, given the high human populations living around the reserve. Indeed, groups are known to forage in the agricultural fields surrounding the forest, and hence, would more than likely be used to human noises and disturbances (McLennan 2008). As such, the potential sensory disturbances arising from the road upgrade construction and increased traffic during the Project's construction are likely to be minimal. Nevertheless, the magnitude of noise may not be the most important determinant of chimpanzee response. Instead, chimpanzees may respond to 'new' noises or may associate particular noises with other occurrences (for example, machine noise may be associated with human presence, which chimpanzees may, in turn, associate with the presence of danger). Where humans pose a threat, chimpanzees generally avoid them (Hockings and Humle 2009, Parren and Byler 2003). Therefore, the degree of avoidance may depend on the behaviour of people, highlighting the importance of managing contractor activity.

Avoidance of industrial activity, like earth moving, by chimpanzees also varies. Chimpanzees have been recorded to leave their range as a result of logging activities heard from a distance of 5 to 10 km, and there are suggestions that this could cause lasting avoidance of disturbed areas (Parren and Byler 2003). Such avoidance may explain why chimpanzee densities were consistently lower in logged areas in Kibale National Park, compared to unlogged areas, although avoidance of hunting as a result of logging activity may also have been a factor (Chapman and Lambert 2000). However, Rabanal et al. (2010) did not find large-scale spatial responses to oil and gas related noise disturbance, in Loango National Park, Gabon; although chimpanzees avoided sites where explosions were used for exploration for a period of four months after the activity had ceased (Rabanal et al. 2010). The chimpanzees within the Bugoma Central Forest Reserve are, therefore, likely to show localised patterns of avoidance, particularly near the immediate road corridor during upgrade construction phase when noise and human activity will be most intense.

The introduction and spread of invasive species during the road upgrade is not expected to cause a change in habitat quality and quantity for the Eastern Chimpanzees. Populations of invasive species currently occur along the road corridor. The construction activities could create new sites for the colonisation of invasive species present in the area, although it is doubtful that the current populations of these species will increase dramatically.

With the above in mind, then with a 500 m buffer applied to the road upgrade's footprint, approximately 660 ha of Eastern Chimpanzee habitat will be reduced in quality as a result of sensory disturbance. This equates to a total potential habitat loss in the CHAA from vegetation clearing, sensory disturbances and edge effects of up to 686.4 ha (1.7%). The reality of this quantity is doubtful given that upgrade construction works may not occur along the entire length at once; however, there is a potential that the sensory disturbance arising from the increased traffic associated with the Project's construction may affect the habitat quality along the length of the road through the forest, as there is presently very little traffic on the roads through the centre of the reserve.

Although the effects on habitat quantity are probably not beyond the human induced deforestation rate, the disturbance arising from the Project construction traffic and subsequent effects on habitat quality is predicted to be well beyond the expected range of natural disturbance perturbations.

- Habitat Connectivity

The upgrade of the R5 and P1 Roads will directly remove suitable habitat for the Eastern Chimpanzees. It may also affect that habitat within the 500 m buffer through indirect impacts like edge effects and sensory disturbance. However, the chimpanzees within Bugoma Central Forest Reserve are assumed to be accustomed to human activity, and they may, more than likely, regularly cross roads within their range. Therefore, it is possible that they will not avoid the road corridor when construction activity is not occurring. However, during upgrade construction works, they may avoid those sections where construction activity is occurring.

While the Bugoma Central Forest Reserve chimpanzees are accustomed to some human activity, including occasional road traffic, and they are known to regularly cross roads within their range, the magnitude of the impact caused by construction activities (both road building and particularly, the CNOOC production facility construction traffic) is likely to be significantly greater than is currently experienced. The probable split between construction traffic on the R5 and the P1 is not known, nor is the extent of avoidance behaviour by the chimpanzees to increasing degrees of nuisance and perceived threat. However, it is reasonable to assume that the order of magnitude increase in traffic will materially affect the behaviour of the animals, and will discourage regular road crossings. As such, the impact of the increased Project construction traffic as a barrier to chimpanzee movements is predicted to be of moderate magnitude.

- Abundance and Distribution

The Bugoma Central Forest Reserve supports one of the top four Eastern Chimpanzee populations in Uganda, with a population of between 450 and 850 individuals (Plumptre et al. 2010). The construction works associated with the upgrade of the R5 Road are not expected to detrimentally affect the abundance of chimpanzees in the forest. Their localised distribution may be altered temporarily as they avoid sensory disturbances associated with the construction works. However, these distributions are expected to return to baseline conditions when the works cease.

Construction traffic will increase to frequencies where interaction between vehicles and animals crossing the road could be likely on occasions. How the chimpanzees would behave in the face of an oncoming vehicle is unknown. The probability of collisions and the potential magnitude of this impact on abundance and distribution is still thought to be low, but it is no longer negligible, as is the case at present where traffic volumes are limited.

Effects from the increased traffic volumes arising from the construction of the Production facility are predicted to be well beyond the expected range of natural disturbance perturbations, although not beyond the disturbance from the human-induced deforestation rate and habitat loss, and bush meat hunting in Bugoma Central Forest Reserve.

- Survival and Reproduction

As mentioned, the chimpanzees within the forest appear to currently avoid the road corridor for night-time nesting and other activities (after Plumptre et al. 2011). Furthermore, given that the chimpanzees within the forest are more than likely used to human activities in and around the forest, they are predicted to adapt to most of the sensory disturbance arising from the construction activities. The survival and reproduction of the

Eastern Chimpanzees within the Bugoma Central Forest Reserve are not expected to be affected as a result of the road upgrade construction works; however, the increased traffic associated with the Project's construction presents an increased collision risk and risk of injuries and mortalities.

The increased traffic on the upgraded road, associated with the Project construction, has the potential to cause direct mortality of individuals, should such individuals cross the road. What effect the loss of individuals from the population could have is unknown. It is doubtful that the population could be reduced by 10% and, hence, reach that critical population threshold due to road mortalities alone; however, any mortality or injury to individuals of Eastern Chimpanzee as a result of collisions with Project construction vehicles is considered unacceptable.

These effects to the survival and reproductive success of Eastern Chimpanzees are predicted to be beyond the expected range of natural disturbance perturbations, although not beyond the human induced deforestation rate, habitat degradation and bush meat hunting. In the short-term, the survival and reproduction of individual chimpanzees within the forest could be detrimentally affected by the significant increase in construction traffic associated with the construction of the Production Facility.

### *Impact Classification*

The Eastern Chimpanzee's sensitivity is high because it is Endangered.

Impacts to the Eastern Chimpanzee's habitat quantity and quality will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to the R5 and P1 Road corridor in the CHAA, with approximately 504 ha (1.2%) of potential habitat affected. Impact duration will be short-term (that is, limited to the road upgrade construction, and the construction phase of the Project, that is, ~3 years). Changes to the habitat quality and quantity from sensory disturbances arising from construction activities are expected to be reversible after completion of the works. The magnitude of the effects of construction on the habitat quantity and quality of the Eastern Chimpanzee is low. Therefore, the intensity and sensitivity combine to produce a moderate overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 16). Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (Table 16).

Impacts to the Eastern Chimpanzee's habitat connectivity are expected, primarily as a result of the significant increase in traffic associated with the trucks being used during construction of the Production Facility. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to road corridor in the CHAA, with approximately 504 ha, or 1.2%, of potential habitat affected. Impact duration will be short-term (that is, limited to the construction phase of ~3 years) because physical and sensory disturbances arising from the road upgrade works, and the physical barrier to movement presented by the Production Facility construction traffic are expected to dissipate within a short time after cessation of upgrade activities, and so are expected to be reversible after completion of the works. The magnitude of the effects of construction of the Production Facility on the habitat connectivity of the Eastern Chimpanzee is thus considered medium. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 16). Following the application of recommended mitigation measures, the impact significance is expected to be reduced to minor, primarily because the magnitude would become negligible, although the sensitivity of the receptor will remain the same (Table 16).

Impacts to the Eastern Chimpanzee's abundance and distribution, primarily as a result of the increased traffic volumes during construction of the Production Facility, could be adverse. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to the R5 Road corridor within the Bugoma CFR. Impact duration will be short-term (that is, limited to the road upgrade and Production Facility construction phase of ~3 years) because physical and sensory disturbances arising from construction activities and traffic are expected to dissipate within a short time after cessation of activities. Although there is a possibility that individuals could be killed or severely disturbed during the construction phase, this is unlikely to have a material effect on the species abundance or distribution of Eastern Chimpanzee. The magnitude of the potential construction impacts on the abundance and distribution of the Eastern Chimpanzee is low.

Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 16). Following the application of the recommended mitigation measures (Section 11.0), the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (Table 16).

Impacts to the survival and reproduction of population of Eastern Chimpanzee in Bugoma Central Forest Reserve could be adverse. The geographical extent of physical and sensory disturbances will be local because effects are restricted to those areas immediately adjacent to the R5 Road corridor in the CHAA, with approximately 504 ha, or 1.2%, of potential habitat affected. Impact duration will be short-term (that is, limited to the road upgrade and construction phase of ~3 years) because physical and sensory disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities. Indications are that the chimpanzees in Bugoma Central Forest Reserve nest away from the current road, and therefore, it can be expected that effects to their survival and reproduction due to physical and sensory disturbances will be minimal.

However, in the event that the chimpanzees do need to cross the upgraded road, the increased traffic associated with the Project's construction could present an unacceptable collision risk and subsequent injuries/mortality of chimpanzees. Therefore, in the short-term, the survival and reproduction of chimpanzees within the forest could be detrimentally affected by the increased vehicular traffic that will be present during the construction phase of the Project. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is expected that this number of individuals in the local population within Bugoma Central Forest Reserve will not be affected through direct mortality or severe sensory disturbance; nevertheless, a single incidence of mortality or injury to any individual of this Endangered species is considered unacceptable. The magnitude of the impact of increased traffic on the P1 associated with the construction of the Project on the survival and reproduction of the Eastern Chimpanzee is medium. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 16). Following the successful application of the recommended mitigation measures for control of Project-related traffic, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same.

**Table 16: Potential impacts in the construction phase to the Eastern Chimpanzee**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |
| Habitat connectivity | Medium - 3 | High – 4 | Major – 12 | Negligible – 1 | High – 4 | Minor – 4 |
| Abundance and distribution | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |
| Survival and reproduction | Medium - 3 | High – 4 | Major – 12 | Negligible – 1 | High – 4 | Minor – 4 |

## Prediction Confidence

Given the information available, there is a reasonable understanding of the potential effects that the upgrade works associated with the R5 and P1 Roads, and traffic associated with the construction of the Project, could have on the Eastern Chimpanzees and their habitat in the CHAA.

The spatial extent of the dense forest habitat in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.1). The actual extent of possible habitat may have been over-estimated.

## 10.2 Operation Phase Impacts

For the assessment of impacts during the operations phase, the key questions were divided into sub-questions that focused on individual valued components within the CHAA and LSA. In answering each question, the individual components of the Project were considered with regards to their potential to affect a valued component. These questions are presented below.

### 10.2.1 What impact could the operation of the Project have on habitats and ecosystem integrity?

This section presents the assessment of impacts that the operation of the Project could have on the habitat and ecosystem integrity within the CHAA and the LSA. These habitats either do, or could, support populations of species of concern. Therefore, the assessment of potential impacts to those species, and others, occurring in the CHAA has been assessed in this section through the determination of the impacts to potential habitat for those species.

The impacts of the Project on critical habitat, as triggered by species of concern, are covered under the individual assessment of those species in Section 7.2. Other triggers of critical habitat are discussed as relevant in the appropriate sections, and in Appendix G.

#### *10.2.1.1 What impact could the operation of the Project have on the near-shore environment of Lake Albert?*

***Impact Indicators***

Indicators used to assess impacts of the Project on the habitat and ecosystem integrity of the near-shore environment of Lake Albert were changes in: regional representativeness; topography (geomorphology), sediments, water quality; ecosystem composition; ecosystem configuration.

Additional, indirect impacts to habitat were estimated by applying a 1 km buffer to the Project footprint, forming the LSA. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by sensory disturbance, changes in water quality, and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential succession changes in species composition that could occur. This was accomplished by examining available literature about the ecology of Lake Albert, and scientific literature about the impacts of human activities on aquatic environments.

***Impact Assessment***

- Representativeness

The operation of the Kingfisher camps/parking lots/materials yards, airstrip, CPF, pipeline, in-field roads, crusher plant/spoil area A, new well pads, and associated infrastructure will not cause the loss of additional near-shore aquatic habitat beyond that already removed during the construction phase.

The potential for influx and in-migration of people onto the Buhuka Flats seeking opportunities from the Project, and because of the easier access provided by the escarpment road, could place increased pressure on the near-shore habitats. This increased pressure could arise from increased fishing activities and pollution (such as, fuels, human and livestock waste, fish waste, and litter). The resultant increased pressures could lead to a change in the current drivers of change to the near-shore aquatic habitats, although it is doubtful that these changes would lead to a change in the representativeness of habitats.

Impacts from the changes to representativeness are predicted to be within the expected range of natural disturbance perturbations.

- Topography (geomorphology) and sediment transport

The operation of the Kingfisher camps/parking lots/materials yards, airstrip, CPF, pipeline, in-field roads, crusher plant/spoil area A, new well pads, and associated infrastructure could cause increased sedimentation of near-shore habitats on the Buhuka Flats. The soils of the Buhuka Flats are dispersive (Golder Associates 2014d), and active soil erosion is evident in the LSA; which could be exacerbated by increased areas of bare ground and deterioration of land capability (due to overgrazing and more extensive presence of hardstanding areas) in the LSA. Erosion around cleared areas around the site could lead to the accumulation of sediment upstream of the points where the infrastructure crosses the drainage paths (ref. Surface Water). It is expected that most areas that were cleared of vegetation during the construction phase and where no infrastructure is located, will have been revegetated by the operations phase (see Section 10.1.1). Dust generation, erosion and sedimentation is, therefore, likely to be limited to the drainage associated with the main access road. Sediment-laden stormwater runoff from this road will enter the near-shore environment of the Lake via the Kamansinig River, to the north of the lagoon.

If adequate erosion and sediment control structures are not maintained as part of the prescribed stormwater management system during the operation of the Project, there is a potential that sediment loads within the watercourses draining the Project footprint could increase. These sediment-laden watercourses report to Lake Albert, and, hence, there is a potential for increased sediment loads in the near-shore environments. Near-shore habitats particularly at risk include the lagoon, and to a lesser extent, the shallow river-associated habitats. Nevertheless, the watercourses draining the LSA support dense emergent vegetation (see Section 6.2). Such vegetation forms an impactive filter for most sediment (IECA 2008), therefore, it can be expected that sediment loads reporting to the near-shore habitats, at least, via the Kamansinig River, River 1 and Masika River, could be minimal. Sediment loads from overland flows may not be retarded by vegetation, and hence may report to the near-shore habitats, contributing to measurable increased turbidity during and after storms, where River 1 discharges to the Lake.

Impacts from the changes to topography (geomorphology) and sediment are predicted to be beyond the expected range of natural disturbance perturbations if the mitigation measures fail or are inadequate.

i Water quality

Impacts from the changes to water quality are predicted to be beyond the expected range of natural disturbance perturbations, if the mitigation measures fail or are inadequate. Contributing factors to potential changes in water quality are discussed below:

***Discharge of poor quality sewerage effluent***

The discharge of treated sewerage effluent from the plant to Lake Albert presents an increased risk of eutrophication of the near-shore habitats on the Buhuka Flats. Sewage from the CPF will be routed via conservancy tanks to a regulating tank at the permanent camp, from where it will be treated in a Membrane Bioreactor sewage treatment works (Project Description). Options for final disposal of treated sewage effluent include the base case (discharge into perimeter drains around the CPF, which discharge into small drainage lines leading to Lake Albert), irrigation onto land in the buffer area around the CPF and at the personnel camp lawns and gardens, and/or discharge into an artificial wetland or sustainably managed plantation.

***Oil and Chemical Pollution***

Accidental, minor spillage of fuels and chemicals during the day-to-day operation of the Project components (other than catastrophic spillages, which are addressed in the chapter on unplanned events) could report to the near-shore habitats of the CHAA, via stormwater drainage into River 1, and subsequently Lake Albert, south west of Well Pad 2. In this way, minor spillages during operation could ultimately report to the near-shore habitats of the CHAA. Further sources of contamination could occur around the jetty when barges are being loaded and unloaded. This Project component is located right on the lake shore, and the impact of an accidental spill would be more obvious than a land-based spill; it would also be harder to contain and clean up.

These risks must be assessed in the context of the high sensitivity of the near-shore environment to oil and chemical spills. Certain invertebrate species (for example, aquatic snails (Araujo et al. 2012), mayflies (Savić et al. 2011)) and juvenile fish (for example, Agamy 2013) are highly sensitive to chemical pollutants, particularly hydrocarbons. Currently, the concentrations of hydrocarbons and other pollutants in the lake water are below levels that could cause harm to the environment (Golder Associates 2014b); this is supported by the healthy aquatic communities observed in the lake's near-shore habitats (see Section 6.2). As such, without adequate spill prevention and clean-up measures in place, a chemical spill could, depending on the volume spilt, have a detrimental impact on the near-shore habitats of the CHAA through the introduction of toxic compounds and pollutants. Such a spill could have a detrimental impact on the aquatic invertebrate community and juvenile fish occurring in these habitats; including the Critically Endangered Mud Snail (*G. candida*) (if it does occur in the area).

***Discharge of poor quality storm water***

Potentially Oil Contaminated (POC) stormwater generated in the defined hazardous areas of the plant will be collected in the open drain system for delivery to an API oil separator. These API separators are designed to separate gross amounts of oil and suspended solids from the water. The first 15 minutes of any storm will be captured and routed through the API separator, before being delivered to the secondary treatment section of the produced water treatment system for further treatment and disposal with produced water. A maximum 15-minute stormwater runoff value of 120 $m^3$ (equivalent to runoff of 478 $m^3$/hr) is provided for. The balance of any stormwater will be captured in a stormwater pond, tested and released into the environment, if it meets the discharge specification. All stormwater from designated non-hazardous areas of the plant will be released directly from the open drains, without testing.

While control systems are proposed to manage contaminated stormwater and wash water from the well pads, the absence of a buffer between the well pads and the lake (or, in the case of well pad 1, the seasonally-flooded grassland wetland); makes it likely that occasionally-contaminated drainage could reach the near-shore habitats of the lake, unless there is a very high level of control of day-to-day activities.

***Population increases***

The potential for influx and in-migration of people onto the Buhuka Flats seeking opportunities from the Project, and because of the easier access provided by the escarpment road, could place increased pressure on the near-shore habitats. This increased pressure could arise from increased pollution (such as fuels, human and livestock waste, fish waste, and litter), particularly nutrient enrichment from sewerage and livestock. The resultant increase in pollution levels could lead to a dramatic change in the current drivers of change to the near-shore aquatic habitats, especially the Bugoma Lagoon which is already nutrient-enriched to a degree.

- Ecosystem composition

The operation of the jetty, Kingfisher camps/parking lots/materials yards, airstrip, CPF, pipeline, in-field roads, crusher plant/spoil area A, new well pads, and associated infrastructure is not expected to result any noticeable alternation of the ecosystem composition of the aquatic communities.

As mentioned above, pollution and erosion and sedimentation derived from the Project's footprint could alter the composition of the communities if that pollution is toxic to aquatic life, or sediment loads smother aquatic organisms if mitigation measures fail. This notwithstanding (with the exception of catastrophic pollution events) it is considered unlikely that operation activities would alter the ecosystem composition of the near-shore aquatic communities during the expected ~25-year operation period for the Project.

The potential for influx and in-migration of people onto the Buhuka Flats seeking opportunities from the Project, and because of the easier access provided by the escarpment road, could place increased pressure on the near-shore habitats. This increased pressure could arise from increased fishing activities, as well as additional sources of pollution (such as, fuels, human and livestock waste, fish waste, and litter). The resultant increase in the population on the Buhuka Flats could lead to a dramatic change in the current drivers of change to the near-shore aquatic habitats. These pressures could alter the ecosystem composition of these habitats.

Provided that the appropriate management measures are in place, in line with CNOOC's in-house alien invasive species management policy, increases in populations of invasive and exotic species are not expected to result directly from the operation of the project. The increased population of people on the Buhuka Flats could alter ecosystem processes and functions and lead to an increased susceptibility of the natural ecosystems to invasion by exotic species. However, certainly for the near-shore aquatic environment, this is not expected.

Impacts from the changes to ecosystem composition are predicted to be beyond the expected range of natural disturbance perturbations, if the mitigation measures fail or are inadequate.

- Ecosystem configuration

The operation of the Project is expected to last for 25 years. The operation of the jetty, Kingfisher camps/parking lots/materials yards, airstrip, CPF, pipeline, in-field roads, crusher plant/spoil area A, new well pads, and associated infrastructure is not expected to result any noticeable alteration of the ecosystem configuration of the aquatic ecosystems and habitats in the CHAA. It is expected that the connectivity amongst the aquatic habitats will remain the same during operation as they were during baseline.

The potential for influx and in-migration of people onto the Buhuka Flats seeking opportunities from the Project, and because of the easier access provided by the escarpment road, could place increased pressure on the near-shore habitats. This increased pressure could arise from increased fishing activities, as well as additional sources of pollution (such as, fuels, human and livestock waste, fish waste, and litter), and introduction/spread of invasive plant species. The resultant increase in the population on the Buhuka Flats could lead to a dramatic change in the current drivers of change to the near-shore aquatic habitats. These pressures could alter the ecosystem composition of these habitats.

Impacts from the changes to ecosystem configuration are predicted to be within the expected range of natural disturbance perturbations.

### *Impact Classification*

The near-shore aquatic habitat's sensitivity is high because these habitats potentially support populations of the Critically Endangered Mud Snail (*Gabbiella candida*), and the range restricted and Near Threatened Snail (*Bellamya rubicunda*).

Impacts to the representativeness of near-shore habitats will be neutral. The geographical extent of impacts will still be local because impacts are restricted to the LSA. Impact duration will be into the far future (that is, ~25 years) because the jetty and water intake and pump station will remain in place for the duration of the operation phase, and natural ecosystem processes (i.e. longshore sediment drift) are expected to become re-established in the vicinity of the water intake and pump station (assuming that the recommended construction-phase mitigation measures were successfully applied). Although increased human populations and activity (fishing activity – wastes, fuels, litter; increased cattle grazing) on the Buhuka Flats could contribute to increased pressure on Lake Albert, no changes to the representativeness of the near-shore habitats during operations are expected. The magnitude of operation phase impacts of on representativeness of the near-shore aquatic habitats is therefore considered negligible. Therefore, the negligible magnitude of impact and high sensitivity of the receptor combine to produce a minor overall impact level to representativeness during the operations phase of the Project, pre-mitigation (Table 17). Following the application of appropriate mitigation measures (Section 11.0), the impact significance is expected to remain the same, that is, minor, primarily because the magnitude will remain negligible, and the sensitivity of the receptor will remain the same.

Impacts to the topography (geomorphology) and sediment transport in the near-shore habitats during operation will be adverse. The geographical extent of impacts will be local, because impacts are restricted to the LSA. Impact duration will be medium-term (that is, ~25 years operation duration). The magnitude of the impact on topography (geomorphology) and sediment transport is expected to be low prior to mitigation, because wetland vegetation within the Kamansinig River, Masika River and River 1 are expected to provide efficient attenuation of sediment, and a significant increase in sediment concentrations in the lake or in Bugoma Lagoon as a result of Project operations are unlikely. However, sediment loads from overland (stormwater) flows may not be retarded by vegetation (particularly in a scenario where human-induced pressures such as cattle overgrazing and land deterioration occurs over the lifetime of the Project), and hence may report to the near-shore habitats, contributing to measurable increased turbidity during and after storms, where River 1 discharges to the Lake; potentially resulting in impacts of low magnitude. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact significance to topography (geomorphology), sediment, and water quality during the operational phase of the Project, pre-mitigation (Table 17). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, primarily because the magnitude will become minor, and the sensitivity of the receptor will remain the same.

Impacts to the water quality as a result of discharge of treated sewerage effluent, and stormwater that could contain oil and chemical pollution will be adverse. The geographical extent of impacts will be local, because impacts are restricted to the LSA, in the immediate vicinity of the discharge points to the Lake. Impact duration will be medium-term (that is, ~25 years). The baseline concentration of hydrocarbons and other pollutants in the lake water is currently below levels that could cause harm in the lake environment (ref. Surface Water). The magnitude of the potential impacts on water quality varies; with high magnitude assigned to any impacts associated with stormwater contaminated with oil and potentially-hazardous/toxic chemicals, and medium magnitude impacts predicted for potential discharge of treated sewerage. Combined with the high sensitivity of the near-shore habitats, both impacts on water quality could be of major significance, prior to mitigation (Table 17). Following the application of appropriate mitigation measures, the impact significance associated with contaminated stormwater reaching the Lake is expected to be reduced to moderate, primarily because the magnitude will become low, and the sensitivity of the receptor will remain the same. Consideration of other options for final disposal of treated sewage effluent, such as irrigation onto land in the buffer area around the CPF and at the personnel camp lawns and gardens, or discharge into an artificial wetland or sustainably managed plantation (ref. Section 11.0), could further reduce the magnitude of effects on water quality associated with disposal of treated sewerage effluence to negligible, resulting in overall impacts of minor significance on water quality.

Impacts to the water quality as a result of increased numbers of people and livestock on the Buhuka Flats are likely, and will be adverse. The geographical extent of impacts will be local, because impacts will be restricted to the LSA. Impact duration will be medium-term (that is, ~25 years). In the context of existing nutrient enrichment in the Bugoma Lagoon, the magnitude of additional nutrient input is predicted to be medium, which combined with the high sensitivity of the habitat, results in an overall impact of major significance, prior to mitigation. Following the application of appropriate mitigation measures, the impact significance could be reduced to moderate, primarily because the magnitude will become low, but the sensitivity of the receptor will remain the same (Table 17).

Impacts to the ecosystem composition will be adverse. The geographical extent of any impacts will be local because impacts are restricted to the LSA. Impact duration will be long-term (that is, ~25 years). The magnitude of the impact on ecosystem composition is low because, prior to any mitigation, the potential for changes to ecosystem composition potentially brought about by increased fishing intensity, pollution and smothering is possible. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to ecosystem composition during the operational phase of the Project, pre-mitigation (Table 17). Following the application of appropriate mitigation measures, the impact significance is expected to remain minor, because the magnitude will remain negligible, and the sensitivity of the receptor will remain the same.

Impacts to the ecosystem configuration will be neutral. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be long-term (that is, ~25 years). The magnitude of the impact on ecosystem configuration is negligible because, prior to any mitigation, the potential for changes to ecosystem configuration is very remote. Consequently, even post-mitigation, the significance of the impact will remain minor (Table 17).

**Table 17: Potential impacts in the operation phase to near-shore habitats**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude (the expected size of the impact) | Sensitivity of the Receptor | Significance | Magnitude (the expected size of the impact) | Sensitivity of the Receptor | Significance |
| Representativeness | Negligible – 1 | High - 4 | Minor – 4 | Negligible – 1 | High - 4 | Minor – 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Topography (geomorphology) and sediment | Low – 2 | High - 4 | Moderate – 8 | Negligible – 1 | High - 4 | Minor – 4 |
| Water quality – sewerage effluent | Medium - 3 | High - 4 | Major - 12 | Negligible – 1 | High – 4 | Minor - 4 |
| Water quality – contaminated stormwater | High - 4 | High - 4 | Major - 16 | Low – 2 | High - 4 | Moderate – 8 |
| Water quality – increased population and livestock | Medium - 3 | High - 4 | Major - 12 | Low – 2 | High - 4 | Moderate – 8 |
| Ecosystem composition | Low – 2 | High - 4 | Moderate – 8 | Negligible – 1 | High - 4 | Minor – 4 |
| Ecosystem configuration | Negligible – 1 | High - 4 | Minor – 4 | Negligible – 1 | High - 4 | Minor – 4 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the near-shore habitats of the CHAA. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios with the level of Lake Albert, which has, in the recent and not so recent past varied quite dramatically (Talbot et al. 2006), it is conceivable that level of the lake may increase or decrease thereby altering near-shore habitats.

The extent of influx and in-migration of people onto the Buhuka Flats specifically seeking opportunities is uncertain. Indications are that additional large numbers of people have moved onto the flats, or are present daily in large numbers, primarily because access is now easier ( Social Impact Assessment). This increase in population is expected to exacerbate existing anthropogenic pressures on the Buhuka Flats and the near-shore habitats of Lake Albert.

The spatial extent of the near-shore habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.0). The actual extent of possible habitat may have been over-estimated.

## *10.2.1.2 What impact could the operation of the Project have on the wetlands in the Buhuka Flats region of the CHAA?*

### *Impact Indicators*

Indicators used to assess impacts of the Project on the habitat and ecosystem integrity of the wetlands of the CHAA were changes in: regional representativeness; ecosystem composition; and ecosystem configuration.

Indirect affects to habitat were estimated by applying a 0.50 km buffer to the Project infrastructure. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by edge impacts, fragmentation, sensory disturbance, changes in water quantity and quality, air emissions and dust, and population increases.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential changes in species composition that could occur, and the disruption of known corridors. This was accomplished by examining available scientific literature about the ecology of wetlands (permanent and seasonally flooded grasslands).

### *Impact Assessment*

- Representativeness

Operation of the Project infrastructure is unlikely to cause ongoing loss of representativeness of wetlands in the CHAA, or ongoing impacts to the permanent wetlands and the seasonally flooded grasslands of the CHAA, assuming the mitigation measures devised for the construction phase are impactive.

Impacts to representativeness of wetlands during the operation of the Project are predicted to be within the expected range of natural disturbance perturbations.

i Ecosystem composition

The operation of the Project infrastructure is unlikely to cause changes to the composition of wetlands in the CHAA, or ongoing impacts to the permanent wetlands and the seasonally flooded grasslands of the CHAA, assuming the mitigation measures devised for the construction phase are impactive. Similarly, during the operation phase, noise and sensory disturbances created by the equipment is not expected to alter the behaviour of species frequenting the wetlands. For example, wading birds and Grey Crowned Cranes could become accustomed to the ongoing operational noises.

It is assumed, as part of standard operational methods, that appropriate drainage-line crossings will be maintained as part of the in-field road and airstrip management. Nevertheless, even with such measures in place, there is still a potential for long-term changes to the wetland character to occur. For example, there is the potential for erosion downstream of the crossings, backwater upstream of the crossings, and erosion at the entrance to the crossing structures. The airstrip is one area in particular where construction across a drainage line might lead to decreased flows and erosion downstream of the airstrip in the long-term (Golder Associates 2014b). This could lead to changes in the ecosystem functions and processes in the downstream wetlands, if not maintained during the operational phase.

The operation of the Kingfisher camps/parking lots/materials yards, airstrip extension, CPF, in-field roads, crusher plant/spoil area A, well pads, and associated infrastructure could cause increased erosion and sediment-laden run-off to report to the wetlands surrounding the Project footprint. The soils of the Buhuka Flats are dispersive (Golder Associates 2014d), and active soil erosion is evident in the LSA. There is a potential that, without adequate erosion and sediment control measures in place during operations, sediment loads within the watercourses draining the Project footprint could increase. Hence, there is a potential for increased sediment loads in the wetland habitats. The watercourses and associated wetlands draining the LSA support dense emergent vegetation (see Section 6.1.1). Such vegetation can form an impactive filter for most sediment (IECA 2008); therefore, it can be expected that sediment loads reporting to downstream wetland habitats could be minimal. Nevertheless, if sediment loads are substantial, there is a potential for that sediment to smother wetland vegetation and interfere with aquatic invertebrates. If this occurs, it could detrimentally affect the wetland processes and functions, which, in turn, could alter wetland composition, albeit on a localised scale.

It is assumed that the potential acid sulphate soils in the permanent wetlands in the CHAA were adequately managed during construction, and no lasting impacts occur.

All of the above direct impacts to ecosystem composition of the wetlands in the CHAA are predicted to be within the expected range of natural disturbance perturbations during operations.

However, indirect impacts on wetlands will occur as a result of the migration of people into the CHAA both as a result of easier access provided by the operation of the newly constructed escarpment road, and in search of work opportunities, and associated increase in head of livestock grazing in the Buhuka Flats. Increased stocking is likely to result in greater pressure on vegetation communities supplying wood and fibre resources, overgrazing, and expansion of subsistence crops, causing greater runoff, channel incision, heightened fire risk and the loss of wetland function over large areas. In the dispersive soils of the Buhuka Flats, the risk of catastrophic soil loss and subsequent effects on wetland ecosystem composition will be high.

Indirect effects on the ecosystem composition of wetland communities are also likely, as a result of ongoing discharge of treated sewage effluent and stormwater in excess of the first 15 minutes of rainfall, to the receiving surface water systems (primarily River 1 and the Kamansinig River). Long-term discharges of this nature are likely to affect the vegetation species composition as a result of nutrient enrichment from the sewerage discharge, as well as the fluctuations in wetness regimes brought about by both the sewerage discharge and occasional (seasonal) stormwater peak flow inputs.

In addition, minor spillages of fuels and chemicals during the day-to-day operation of the Project components (other than catastrophic spillages, which are addressed in Surface Water) could end up in the wetlands of the LSA; potentially affecting some invertebrate species (for example, aquatic snails (Araujo et al. 2012), mayflies (Savić et al. 2011)) and juvenile fish (for example, Agamy 2013) which are highly sensitive to chemical pollutants, particularly hydrocarbons. Currently, the concentrations of hydrocarbons and other pollutants in the water of the Bugoma Lagoon are below levels that could cause harm to the environment (Golder Associates 2014b); this is supported by the healthy aquatic communities observed in the lagoon's and Masika River wetland habitats (see Section 5.2). The entrainment of small quantities of oil and potentially hazardous chemicals in stormwater runoff from the Project infrastructure and subsequent entry to wetlands (particularly the seasonally flooded grassland adjacent to well pad 1) is considered possible as the proximity of well pad 1 to the wetlands provides little buffer for potential contamination.

- Ecosystem configuration

The long-term impacts of the construction of roads, the airstrip and the flowlines through the wetlands of the CHAA are unknown. Although the roads could potentially act as barriers to certain wetland species, they are only expected to be 5 m wide and unsealed, and, during operations, they will convey reduced Project-related traffic volumes; however, they are likely to be preferentially used by members of the increased local communities of the Buhuka Flats. Therefore, they could become barriers to species movement, particularly for species such as Grey Crowned Crane, should that species become accustomed to the increased human disturbance brought about by the population influx to the Buhuka Flats during operation.

The operation and management of the in-field roads and airstrip should not affect ecosystem processes driving the wetlands, assuming the installation of appropriate drainage connections was successful during construction. What the long-term impact of the edge impacts, and fragmentation of the wetland habitats, in the CHAA caused by the construction of roads, is unknown. As already discussed, vegetation clearing creates edges or boundaries where habitat meets a disturbance. These edges open up habitat in areas where it was previously continuous, and this generally changes the abiotic conditions (for example, temperature, light, and moisture regimes) (Porensky and Young 2013). Edges also often result in changes in species composition along the edge, with the edges typically becoming dominated by pioneer and weedy species adapted to the particular microclimate experienced on the edge (Porensky and Young 2013). Fragmentation of wetland habitat is known to reduce the viability of many species and the wetland as a whole, with the viability of the particular fragment dependent on its size, proximity and, hence, connectivity to other wetland habitats (Uzarski et al. 2009).

What long-term impacts that the operation these roads and the airstrip could have on the wetland communities' configuration are unknown; in particular their resilience. What is known is that these wetland communities are already under pressure from livestock grazing, and harvesting of fibre for house construction.

The operation of the Kingfisher camps/parking lots/materials yards, CPF, crusher plant/spoil area A, well pads, and associated infrastructure will not directly lead to changes in the ecosystem configuration of wetlands in the CHAA.

The long-term impacts to ecosystem configuration of the wetlands in the CHAA are predicted to be beyond the expected range of natural disturbance perturbations during operations, if mitigation measures are inadequate or fail.

### *Impact Classification*

Wetland sensitivity is high because these habitats, particularly the permanent wetlands, are potential breeding habitat for Grey Crowned Cranes (a species of concern). The wetlands are also already under stress from fires, livestock grazing and harvesting of fibre.

Impacts to the representativeness of the habitat may be adverse during operations. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be into the far future (that is, ~25 years) because the roads (which may affect the hydrological character of the wetlands, and subsequently wetland extent and condition) will be permanent features, and will remain in place even after the project is decommissioned. The magnitude of the impacts of operation of the Project on representativeness of the wetland communities is low. Therefore, the magnitude and high sensitivity of the wetlands combine to produce a moderate overall impact level to representativeness during the operations phase of the Project, prioir to the implementation of site-specific mitigation measures (Section 11.2). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced minor because the magnitude will be negligible, while the sensitivity of the receptor will remain the same.

Impacts to the ecosystem composition as a result of the operation of Project infrastructure, and presence of wetlands crossings, will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be into the far future (that is, ~25 years) because impacts are expected last as long as the in-field roads and airstrip are in place, and the potential changes to ecosystem composition are unknown. The magnitude of the impact on ecosystem composition is high because, prior to any mitigation, the potential for changes to ecosystem composition potentially brought about by edge impacts, changed flow regimes, and sedimentation, is possible, as evidenced by desiccation occurring downstream of existing crossings (Figure 19). Therefore, the magnitude and sensitivity combine to produce a major overall impact level to ecosystem composition during the operation phase of the Project, pre-mitigation (Table 18). Following the application of appropriate mitigation measures, the impact significance is expected to become minor because the magnitude will become negligible, yet the sensitivity of the receptor will remain the same.

Impacts to the ecosystem composition as a result of the increased human population living on the flats, and the associated increase in head of livestock grazing in the Buhuka Flats, will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be into the far future (that is, ~25 years) because impacts are expected to be permanent, and the potential changes to ecosystem composition are unknown. The magnitude of the impact on ecosystem composition is medium because, prior to mitigation, changes to ecosystem composition potentially brought about by overgrazing, cattle trampling and subsequent effects on wetlands soils could be near the limits of wetland capacity to adapt. Therefore, the magnitude and sensitivity combine to produce a major overall impact level to ecosystem composition during the operation phase of the Project, pre-mitigation (Table 18). Following the application of appropriate mitigation measures, the impact significance is expected to become moderate because the magnitude will become low, yet the sensitivity of the receptor will remain the same.

The entrainment of small quantities of oil and potentially hazardous chemicals in stormwater runoff from the Project infrastructure and subsequent entry to wetlands (particularly the seasonally flooded grassland adjacent to well pad 1) will result in adverse impacts of local extent, that could occur intermittently throughout the lifetime of the Project. The magnitude of the potential impacts on wetland water quality is high, as pollution events could significantly alter aquatic species communities, and therefore ecosystem composition. Combined with the high sensitivity of the wetland habitats, impacts on wetland water quality could be of major significance prior to mitigation (Table 18). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, primarily because the magnitude will become negligible, and the sensitivity of the receptor will remain the same.

Impacts to the ecosystem configuration will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will extend into the far future (that is, ~25 years) because impacts are expected to continue as long as the in-field roads, flowlines and airstrip are in place. The magnitude of the impact on ecosystem configuration is low because, prior to any mitigation, the potential for changes to ecosystem configuration is possible, especially from fragmentation. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to ecosystem configuration during the operation phase of the Project, pre-mitigation (Table 18). Following the application of appropriate mitigation measures, the impact significance is expected to become minor because the magnitude will become negligible, yet the sensitivity of the receptor will remain the same.

**Table 18: Potential impacts in the operation phase to the wetlands of the CHAA**

| | Pre-mitigation | Post-mitigation |
|---|---|---|

| Indicator of potential impact | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
|---|---|---|---|---|---|---|
| Representativeness | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |
| Ecosystem composition – project infrastructure, wetland crossings | Medium - 3 | High – 4 | Major – 12 | Negligible – 1 | High – 4 | Minor – 4 |
| Ecosystem composition – increased population | Medium - 3 | High – 4 | Major – 12 | Low - 2 | High – 4 | Moderate – 8 |
| Ecosystem composition – contaminated stormwater | High – 4 | High – 4 | Major - 16 | Negligible – 1 | High – 4 | Minor – 4 |
| Ecosystem configuration | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the wetlands of the CHAA. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future is uncertain.

The spatial extent of habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.0). The actual extent of possible habitat may have been over-estimated.

## *10.2.1.3 What impact could the operation of the Project have on the escarpment vegetation corridors?*

### *Impact Indicators*

Indicators used to assess impacts of the Project on the habitat and ecosystem integrity of the vegetation corridors on the escarpment were changes in: regional representativeness; ecosystem composition; and ecosystem configuration.

It is recognised that the escarpment road has already been permitted and is currently operational, and was covered by a separate ESIA process, see AWE (2014c); however, the inclusion of this road in this assessment is important because of its induced (and cumulative – Cumulative Impact Assessment) impacts on the vegetation of the escarpment. Literature was reviewed to understand the long-term impacts of roads through natural habitats, during operation.

Additional, indirect affects to habitat were estimated by applying a 0.50 km buffer to the temporary camp and quarry at the top of the escarpment, and the footprint of the escarpment road. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by edge impacts, fragmentation, sensory disturbance, changes in water quantity and quality, and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential changes in species composition that could occur over the life of the Project, and the disruption of known corridors. This was accomplished by examining available literature about the ecology of the vegetation communities on the escarpment, and scientific literature about the impacts of human activities on corridors in the long-term.

### *Impact Assessment*

- Representativeness

The CHAA supports approximately 2443 ha of vegetation communities on the escarpment (see Section 7.1.2), which are bounded on the east by agriculturally modified landscapes, and the Buhuka Flats on the west. As mentioned, these vegetation communities form part of a contiguous vegetation corridor that is part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor (Plumptre et al. 2003). Therefore, their continuous extent represents an important landscape feature in the CHAA.

The initial loss of habitat from the construction of the temporary camp on top of the escarpment is expected to be reverted during operation, because the camp site will have been rehabilitated. Rehabilitation measures should return the site to a vegetation cover similar to that that was there before the camp was constructed, that is, open wooded bushland. The loss of approximately 12.8 ha of vegetation communities, because of the construction of the escarpment road, will persist during the operational phase.

The operation of the Kingfisher camps/parking lots/materials yards, airstrip extension, CPF, pipeline, new in-field roads, crusher plant/spoil area A, new well pads, and associated infrastructure will not directly lead to the loss of vegetation communities on the escarpment.

Impacts from the changes to representativeness are predicted to be the less than those experienced during the construction phase because temporary construction areas should have been rehabilitated. Nevertheless, the loss of vegetation to the escarpment road footprint will remain for operation, representing a change in representativeness is predicted to be beyond the expected range of natural disturbance perturbations.

- Ecosystem composition

What the long-term impact of the escarpment road on the ecosystem composition of the escarpment in the CHAA is unknown. The long-term consequences of a linear corridor through an area of relatively intact vegetation, like that on the escarpment, create edge impacts that could, in the long-term, alter the composition of the ecosystem through which the road traverses (Findlay and Bourdages 2000). Edges associated with roads tend to be abrupt, with a high degree of contrast between the two areas (for example, road and open wooded grassland). The edges open up habitat in areas where it was previously continuous, and this generally changes the abiotic conditions (for example, temperature, light, and moisture regimes) (Porensky and Young 2013). Edges often result in changes in plant species composition along the edge, with the edges typically becoming dominated by pioneer species adapted to the particular microclimate experienced on the edge (Porensky and Young 2013). Often, these microclimates are favoured by weed species. However, certainly for fauna species, and depending on the species, edges can have either a positive or negative impact on habitat quality and quantity (Prevedello et al. 2013, Wellicome et al. 2014).

Apart from the possible changes brought about by the edge impacts, the road may also: restrict movement of certain less mobile faunal species between populations; increase mortality of individuals due to collision with vehicles; fragment habitat; present a possible path for invasive species to enter the area; or increase human and livestock access to otherwise less accessible habitats (Findlay and Bourdages 2000). All these predicted impacts, combined, could be expected to increase the potential for local extinction rates or decrease local recolonisation rates.

The escarpment road is sealed for its length down the escarpment. Sealing of the road presents other aspects that may affect the ecosystem composition of the communities on either side of the road in the long-term. For example, concentrating water run-off from the sealed surface, which could carry contaminants such as fuel, heavy metals and polycyclic-aromatic hydrocarbons, to watercourses not otherwise influenced by such run-off, and possibly lead to changes in water quality and erosion regimes. Polluted run-off could lead to detrimental impacts on aquatic species downstream from the escarpment road.

What long-term effects that these edge impacts could have on the vegetation communities' composition throughout the lifetime of the road operation are unknown; in particular their resilience[4]. The most significant project-related impact on the ecosystem composition of the escarpment is likely to be the indirect effect of migration into the area, facilitated by the escarpment road. Without mitigation, it is likely that both the project and the new ease of access to the Flats will cause significant additional in-migration (refer to Social Impact Assessment for detail), with people settling both on the Flats and in the villages above the escarpment. The escarpment vegetation communities are already under pressure from harvesting of fuel wood and charcoal manufacture, and livestock grazing. Cattle have been shown to substantially increase the edge impacts in savannah habitats (Porensky et al. 2013). It is conceivable that the road could afford people, cattle and other livestock easier access to resources and grazing on the escarpment, and facilitate the spread of weed and invasive plant species, which could place increased pressure on these communities in the long-term. It is likely that these communities may change in the long-term as grazing pressure increases, and large trees are removed for charcoal manufacture. These changes could substantially alter the habitat structure and composition, which, in turn, could affect its utilisation by the current species guild. To some extent, this may already be occurring. For example, very few medium sized mammals were recorded in the CHAA, and those that were recorded tended to be thicket and dense bushland specialists, such as bushbuck and duiker. The low populations and diversity of these species could also be a reflection of increased pressure for bush meat from the local human population, which has increased markedly over the last ten years (AECOM 2012).

The operation of the Kingfisher camps/parking lots/materials yards, airstrip extension, CPF, pipeline, new in-field roads, crusher plant/spoil area A, new well pads, and associated infrastructure will not directly lead to changes in the composition of vegetation communities on the escarpment.

Impacts from the long-term changes to ecosystem composition are predicted to be well beyond the expected range of natural disturbance perturbations if mitigation measures fail or are inadequate.

- Ecosystem configuration

Roads, and especially sealed roads are known to be significant barriers, or alter behaviours, of a range of wildlife, from: small ground-dwelling mammals, insects, reptiles and amphibians (for example, Brehme et al. 2013, Pontoppidan et al. 2013, Rotholz and Mandelik 2013); to bats (for example, Berthinussen and Altringham 2012); to birds (for example, Kociolek et al. 2011); to primates (for example, Mammides et al. 2009); to large ungulates (for example, Leblond et al. 2013, Meisingset et al. 2013). Depending on the species, the presence of roads may affect individuals in many direct and indirect ways. For example, roads may inhibit seasonal migration and may cause an impactive loss of habitat due to avoidance.

The wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor is recognised as being important for threatened species in the face of climate change adaptation (Ayebare et al. 2013), and as part of a much broader set of corridors running the length of the Albertine Rift. This corridor in the southern portion of the eastern shores of Lake Albert, in the vicinity of the Project, is very narrow compared to its extent elsewhere, and is recognised as being important for savannah species (Plumptre et al. 2010). The escarpment road to the Buhuka Flats is the only major road on the south-eastern portion of Lake Albert from the southern end of the lake to the Kabwoya Wildlife Reserve, that is, the only major road within the identified wildlife corridor. This area is otherwise devoid of notable roads and tracks, adding to its value as a wildlife movement corridor.

Indications are that populations of highly mobile wildlife within the area, which may depend on the corridor, are not substantial, and potentially severely depleted (see Section 7.1.2). In particular, most of those species that could utilise this corridor, such as large ungulates, predators, and primates are very rare in the escarpment area surrounding the Buhuka Flats, with the exception of birds. However, the road is not expected to be a barrier for birds; for example, White-backed Vultures were seen moving south down the escarpment corridor during the surveys (see Section 6.1.4). What impact the road could have on the movement on those terrestrial individuals and species that may utilise this corridor in the long-term is unknown. The corridor is recognised

[4] For this study, indirect effects, such as increased harvesting pressures due to migration into the area, either because of better access to existing resources or because of opportunities provided by the oil industry, are considered to be operational impacts which are driven by the access provided by the road

as an important climate change refugium for a range of threatened species, which may become increasingly important for those species in the future (Ayebare et al. 2013), that is, within the life time of the Project.

Impacts from the changes to ecosystem configuration on the escarpment as a result of the long-term operation of the road are predicted to be beyond the expected range of natural disturbance perturbations, if mitigation measures fail or are inadequate.

### *Impact Classification*

The vegetation community of the escarpment's sensitivity is medium because, although the integrity of these habitats is already under stress from livestock grazing and harvesting of fuel wood and non-timber forest products, they do form part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor.

During operation, the impacts to the representativeness of the habitat will be neutral, because areas used temporarily during construction will be rehabilitated and the vegetation on those areas will be establishing. The geographical extent of impacts will be local because impacts are still restricted to the LSA, and the loss of vegetation communities because of the road's construction will persist. Impact duration will be into the far future (that is, ~25 years) because the road down the escarpment will remain in place even after the project is decommissioned. The magnitude of the impacts of operation on representativeness of the vegetation communities of the escarpment is negligible. Therefore, the magnitude and sensitivity combine to produce a minor overall impact level to representativeness during the operational phase of the Project, pre-mitigation (Table 19). Following the application of appropriate mitigation measures during operation, including the assumption that offset mechanisms for the initial losses during construction of the escarpment road are in place and working, the impact significance is expected to remain minor, primarily because it is assumed that offsets will be achievable, while the sensitivity of the receptor will remain the same.

Impacts to the ecosystem composition will be adverse in the long-term. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be into the far future (that is, ~25 years) because impacts are expected last as long as the road is in place. The magnitude of the impact on ecosystem composition is medium because, prior to any mitigation, the potential for changes to ecosystem composition potentially brought about by edge impacts, and the consequences of easier access to the adjacent escarpment areas for livestock grazing and natural resource harvest, is possible. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to ecosystem composition during the operational phase of the Project, pre-mitigation (Table 19). Following the application of appropriate mitigation measures, including the assumption that offset mechanisms for the losses suffered during construction are in place and working, the impact significance is expected to remain moderate, although the magnitude will become low, yet the sensitivity of the receptor will remain the same.

Impacts to the ecosystem configuration will be adverse. The geographical extent of impacts will be regional because impacts are restricted to the CHAA. Impact duration will extend into the far future (that is, ~25 years) because impacts are expected to continue as long as the road is in place. The magnitude of the impact on ecosystem configuration is medium because, prior to any mitigation, the potential for changes to ecosystem configuration is possible, especially inference with wildlife movement corridors. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to ecosystem composition during the operational phase of the Project, pre-mitigation (Table 19).

Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate; although the magnitude will become low, the sensitivity of the receptor will remain the same.

**Table 19: Potential impacts in the operation phase to the vegetation communities of the escarpment**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |

| | | | | | | |
|---|---|---|---|---|---|---|
| Representativeness | Negligible - 1 | Medium – 3 | Minor - 4 | Negligible - 1 | Medium – 3 | Minor - 4 |
| Ecosystem composition | Medium – 3 | Medium – 3 | Moderate – 9 | Low – 2 | Medium – 3 | Moderate – 6 |
| Ecosystem configuration | Medium – 3 | Medium – 3 | Moderate – 9 | Low – 2 | Medium – 3 | Moderate – 6 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the vegetation communities of the escarpment, and the wildlife corridors of which they form part. However, there is some uncertainty with regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future is uncertain. Indications are that they will increase in importance (Ayebare et al. 2013), provided human pressures associated with the presence of the escarpment road do not overwhelm them.

The spatial extent of habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.0). The actual extent of possible habitat may have been over-estimated.

## *10.2.1.4 What impact could the operation of the Project have on the Bugoma Central Forest Reserve?*

### *Impact Analysis – Methods*

As discussed in Section 6.1.6, it is recognised that CNOOC will not be responsible for the management of the R5 and P1 Roads during the operation of the Project. It is expected that the Ugandan Government will be responsible for that management and upkeep. Nevertheless, as discussed, the road will have been upgraded during the construction phase, and will remain in place throughout the operational phase and beyond. Therefore, any effects associated with, and stemming from the existence of the upgraded road can be seen to be induced impacts arising as a result of the Project's development.

A formal impact classification based on indicators was developed for induced and cumulative impacts to the Bugoma Central Forest Reserve; the impacts are discussed, and their significance assessed through a **reasoned narrative**. An overall impact significance classification is then developed. This was accomplished by examining available literature about the ecology of the Bugoma Central Forest Reserve, and scientific literature regarding the effects of migration and human population pressure on forests in Africa.

The impacts were assessed in light of the guidance provided by IFC (2013), and in consideration of other known projects being developed in the wider area. In particular, the development of the oil processing facility at Kabaale, the oil developments around the Kaiso-Tonya area (AECOM 2012), the Hoima-Mputa-Fort Portal-Nkenda power line, and the potential for regional population increases in the wider area.

### *Impact Analysis Results*

As discussed, the Bugoma Central Forest Reserve is identified as a valued component for this impact assessment, in terms of biodiversity (see Section 6.3.1.1.4). As identified in that section, apart from being one of the last stands of tropical semi-deciduous forests in the region, it also supports known populations of the range-restricted Nahan's Francolin and Endangered Eastern Chimpanzee (Plumptre et al. 2011), potential non-breeding habitat for the Endangered Madagascar Pond Heron (see Section 6.3.3.1), as well as elephants and a host of other threatened and irreplaceable species.

The Bugoma Central Forest Reserve is under severe pressure from the human population surrounding it. Only recently were more than 1,500 people evicted illegally after settling within the forest (Mugerwa 2013). The land cover study (see Appendix D and Figure 14) clearly shows that the areas surrounding the forest have largely been transformed for agricultural and subsistence purposes. This trend of encroachment of protected areas, like the Bugoma Central Forest Reserve, is not unique. Protected areas are known to be particularly vulnerable to changes in human demographics and deforestation; and Wittemyer et al. (2008) identified that human population growth and encroachment around protected areas is significantly higher than the average population growth in rural areas. This difference was largely due to the immigration of people into these areas because of the perceived increased availability of opportunities, natural resources and potential jobs (Wittemyer et al. 2008). This is supported by research conducted in the forests of the Albertine Graben, and the wider CHAA. For example, in a study of Budongo Central Forest Reserve, Zommers and MacDonald (2012), identified that of the local communities that hunted bush meat in the forest, nearly 73% were immigrants to the area. Furthermore, these workers identified that the households of immigrants were also more likely to be involved with deforestation.

The upgrade and improvement of roads in rural areas can influence immigration rates into those areas (Wennergren and Whitaker 1976, Godar et al. 2012). It is highly likely that the upgraded R5 and P1 roads could induce population influx into the Bugoma Central Forest Reserve, as well as areas adjacent to the road itself throughout its operational lifetime, because access would be made easier. Furthermore, the proximity of the Bugoma Central Forest Reserve in the area could also make the area more attractive to immigrants seeking opportunities (*viz.*, Wittemyer et al. 2008). The current influx of refugees into the CHAA is also not expected to dissipate with the continued instability in the DRC (UNHCR 2014). Therefore, there is a potential that the upgrade of the road could place increased pressure on the Bugoma Central Forest Reserve, the natural resources it offers (such as, timber, non-timber forest products), and bush meat.

An Influx Management Strategy and Framework Plan (Golder Associates 2014) has been developed to manage the potential influx of people into the LSA. However, this plan can only focus on those measures over which CNOOC has control, and to support the range of government and donor projects in Uganda aimed at socio-economic development and environmental conservation. How this translates to the potential influx of people along the improved R5 and P1 roads is unknown.

The improved road could also allow for an increase in vehicular traffic into the area, and faster speeds associated with those vehicles. Therefore, there is also the potential that direct mortality of wildlife along the road could increase. The Bugoma Central Forest Reserve is home to populations of threatened species and an array of other species (see Plumptre et al. 2010, 2011). Many of these species will move within the forest and between sections of the forest. Although the negative effects of roads on wildlife in tropical rainforests, like Bugoma Central Forest Reserve, are poorly understood, indications are that: (1) many species avoid roads altogether (especially, medium-sized mammals, diurnal, solitary and group living animals, and ungulates); and (2) high vegetation cover on the road verges (see Figure 20) increases crossing probability substantially (van der Hoeven et al. 2010). Currently, the roadside vegetation on the P1 road would encourage wildlife to cross (Figure 22); presumably this is also the case for the R5 road. This could place them in the direct paths of traffic during the operational phase of the Project.

### *Impact Classification*

Impacts from the presence of the R5 and P1 roads, and the resultant increased traffic and ease of forest access along that road during the operation of the Project will be adverse. The geographical extent of impacts will be regional because effects are restricted to the R5 and P1 Road corridor in the CHAA. Impact duration will be long-term (extending for the lifetime of the Project, and beyond, as the roads are government-managed and will remain in place). The magnitude of the effects of operation on the Bugoma Central Forest Reserve is low.

The sensitivity of the Bugoma Central Forest Reserve is high because it is a threatened ecosystem that is already under pressure. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operation phase of the Project, pre-mitigation (Table 20).

The mitigation hierarchy is an important process that has been used to minimise impacts to the Bugoma Forest Reserve. The focus for the continued use of the mitigation hierarchy during the road upgrade and construction will be continued development and implementation of mitigation measures through monitoring and adaptive management; including suggested measures for the Ugandan Government to apply in the management of the upgrade of the P1 Road, and recommendations regarding the intended use of the R5 road running north to south through Bugoma CFR (see Section 11.0).

Following the application of appropriate mitigation measures, including management support of the forest to limit influx of people, the impact significance is expected to remain major, although the intensity could become medium, yet the sensitivity of the receptor will remain the same (Table 20).

**Table 20: Potential impacts in the operation phase to the Bugoma Central Forest Reserve**

| | **Pre-mitigation** | | | **Post-mitigation (pre-offsets)** | | |
|---|---|---|---|---|---|---|
| | **Magnitude (the expected size of the impact)** | **Sensitivity of the Receptor** | **Significance** | **Magnitude (the expected size of the impact)** | **Sensitivity of the Receptor** | **Significanc e** |
| Habitat and ecosystem integrity | High – 4 | High – 4 | Major – 16 | Medium – 3 | High – 4 | Major – 12 |

As noted above, the focus for reducing impacts to the Bugoma Central Forest Reserve is mitigation to lessen various types of disturbance that may occur (Section 12.0). Optimising mitigation will reduce the need for offsetting. However, offsetting options to compensate for impacts to the forest have been identified and are discussed in Section 13.0.

### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential effects that the operation of the upgraded R5 and P1 roads, could have on the Bugoma Central Forest Reserve.

The spatial extent of the forest reserve in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.0). The actual extent of possible habitat may have been over-estimated.

## 10.2.2 What impact could the operation of the Project have on species of concern?

This section presents the assessment of the impacts that the operation of the Project could have only on those species of concern that trigger critical habitat, as identified in Section 9.2, and other species of concern that were included as valued components for the impact assessment (Table 5). Potential impacts to other species of concern are assessed at the habitat level (see Section 3.3.2).

### *10.2.2.1 What impact could the operation of the Project have on the Mud Snail?*

As previously discussed, the Mud Snail (*Gabbiella candida*) is a Critically Endangered and range restricted species, which could occur in the CHAA.

### *Impact Indicators*

Indicators used to assess impacts of the operation of the Project on the Mud Snail were: habitat quantity and quality, and habitat connectivity.

Habitat loss due to indirect disturbance was assessed by calculating the area of disturbance of suitable habitat from the CHAA as a result of the operation of the Project. Changes to habitat quality were assessed by the prediction of sediment loads and changes to water quality in the water column from operational activities.

Changes in habitat connectivity were assessed by identifying potential barriers to genetic movement, and source populations. This was accomplished by visually examining the spatial distribution of critical habitat in relation to the Project footprint to qualitatively identify areas where critical habitat becomes fragmented.

### *Impact Assessment*

- Habitat Quality and Quantity

Very little information is available for this species. The two Mud Snail species recorded from the CHAA were collected from bottom substrates in the open sandy shore habitats. These habitats are characterised by a gently sloping lake bed extending from the shore line to deeper water.

The operation of the Project, and, in particular, the jetty, could affect the open sandy shoreline habitat within the vicinity of this infrastructure. However, the operation of the jetty itself is unlikely to change the physical structure of the open sandy shoreline habitat. Rather, the wash created by berthing and departing barges could affect the habitat quality through the disturbance of bed sediments. It is expected that these increased sediment loads will dissipate reasonably quickly. The sediment loads in the vicinity of the jetty are not expected to exceed those that would normally be expected during windy periods on the lake (see Golder Associates 2014g), and the consequent turbid conditions caused by those winds. In addition, with the opening of the escarpment road, the use of the jetty is expected to be minimised.

Accidental spillages of small quantities of fuels and chemicals during the operation of the Project components, such as loading and unloading barges, or refuelling vehicles, and drilling fluids, could end up directly in the lake, or in a watercourse, which, ultimately, report to the near-shore habitats of the CHAA. There is a real potential for this to occur as part of the jetty operation, and as a component of stormwater discharge beyond the first 15 minute rainfall events. The jetty and stormwater discharge points are located right on the lake shore, and the impact of an accidental spill would be more obvious than a land-based spill; it would also be harder to contain and clean up. Aquatic snails like *G. candida* are highly sensitive to chemical pollutants, particularly hydrocarbons (Araujo et al. 2012). Currently, the concentrations of hydrocarbons and other pollutants in the lake waters of the near-shore habitats are below levels that could cause harm to the environment (Golder Associates 2014b); this is supported by the healthy aquatic communities observed in the lake's near-shore habitats (see Section 6.2). As such, without adequate spill prevention and clean-up measures in place during operation, a chemical spill could, depending on the volume spilt, have a detrimental impact on the near-shore habitats of the CHAA through the introduction of toxic compounds and pollutants. Such a spill could have a detrimental impact on the Mud Snail *G. candida*.

The operation of the Kingfisher camps/parking lots/materials yards, airstrip extension, CPF, in-field roads, crusher plant/spoil area A, well pads, and associated infrastructure could cause increased sedimentation of near-shore habitats on the Buhuka Flats. The soils of the Buhuka Flats are dispersive (Golder Associates 2014d), and active soil erosion is evident in the LSA. With the operation of the Project's components, there is a potential that, without adequate and maintained erosion and sediment control measures in place, sediment loads within the watercourses draining the Project footprint could increase. These sediment-laden watercourses report to Lake Albert (particularly River 1, which will receive stormwater runoff from the CPF and the airstrip; and the Kamansinig, which will receive stormwater runoff from the escarpment road, part of the airstrip and Well Pad 1), and, hence, there is a potential for increased sediment loads in near-shore habitats in the vicinity of the drainage discharge points south of Well Pad 2 and north of Bugoma Lagoon. Near-shore habitats particularly at risk include the Bugoma Lagoon, and to a lesser extent, the shallow river-associated habitats of the Kamansinig and River 1, both potential habitat for the Mud Snail. Nevertheless, the watercourses draining the CHAA support dense emergent vegetation (see Section 6.1.1.1). Such vegetation forms an impactive filter for most sediment (IECA 2008), therefore, it can be expected that sediment loads reporting to the near-shore habitats, at least, via the Kamansinig River, River 1 and Masika River, could be minimal. Sediment loads from overland flows may not be retarded by vegetation, and hence may report to the near-shore habitats and affect them detrimentally.

The potential for influx and in-migration of people onto the Buhuka Flats seeking opportunities from the Project, and because of the easier access provided by the escarpment road, could place increased pressure on the near-shore habitats. This increased pressure could arise from increased pollution (such as, fuels, human and livestock waste, fish waste, and litter), as well as physical disturbance from drinking cattle. The resultant increase in pollution levels could lead to a dramatic change in the current drivers of change to the near-shore aquatic habitats, and, ultimately affect the Mud Snail.

Impacts from the alteration quality of, or loss of, habitat are predicted to be beyond the expected range of natural disturbance perturbations.

- Habitat Connectivity

The operation of the Project is expected to last for ~25 years. Besides the operation of the jetty, it is unlikely that operational activities could substantially alter the habitat connectivity of the near-shore habitats in the CHAA. No structures are being put in place that will alter the natural connectivity of the aquatic habitats of the lake. It is expected that the connectivity amongst the aquatic habitats will remain the same during operations as they were during baseline.

### *Impact Classification*

The Mud Snail's sensitivity is high because this species is Critically Endangered.

Impacts to the Mud Snail's habitat quantity and quality could be adverse during operations. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be long-term (that is, 25 years). The magnitude of the impacts during operation - particularly long-term effects of trampling by drinking cattle and changes influenced by the jetty - on the habitat quantity and quality of the Mud Snail is predicted to be moderate. Therefore, the moderate magnitude and high sensitivity combine to produce a major overall impact level during the operation phase of the Project, pre-mitigation (Table 24). Following the application of appropriate mitigation measures, the impact significance is may be reduced to moderate, primarily because the magnitude of habitat disturbance arising from human and livestock will at best be reduced to low during operation, and the sensitivity of the receptor will remain the same (Table 21).

Impacts to the Mud Snail's habitat connectivity will be neutral. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be long-term, and no barrier to habitat connectivity will be constructed. The magnitude of the impacts of operation on the habitat connectivity of the Mud Snail is negligible, therefore the magnitude and sensitivity combine to produce a minor overall impact level during the operation phase of the Project, pre-mitigation (Table 21). Following the application of appropriate mitigation measures, the impact significance is expected to remain the same, that is, minor, primarily because the magnitude will still remain the same during operation, and the sensitivity of the receptor will remain the same (Table 21).

**Table 21: Potential impacts in the operation phase to the Mud Snail**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | **Magnitude (the expected size of the impact)** | **Sensitivity of the Receptor** | **Significance** | **Magnitude (the expected size of the impact)** | **Sensitivity of the Receptor** | **Significance** |
| Habitat quality and quantity | Medium - 3 | High – 4 | Major - 12 | Low – 2 | High – 4 | Moderate – 8 |
| Habitat connectivity | Negligible – 1 | High – 4 | Minor – 4 | Negligible – 1 | High – 4 | Minor – 4 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the near-shore habitats of the CHAA, and hence potential local populations of Mud Snail. However, there is some uncertainty in regard to this species actually occurring in the CHAA. As such, the above assessment has been undertaken based on a precautionary approach.

The spatial extent of the near-shore habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.0). The actual extent of possible habitat may have been over-estimated.

#### 10.2.2.2 What impact could the operation of the Project have on Grey Crowned Crane?

Grey Crowned Crane is an Endangered species. In the CHAA, it is associated with permanent and seasonal wetlands habitats.

The operation of the Production Facility could indirectly impact Grey Crowned Crane breeding and foraging habitat, given that operational impacts on wetlands in the Buhuka Flats are expected (Section 9.1.1.2); largely as a result of the induced impacts brought about by the escarpment road on the Buhuka Flats wetland habitats used by this species.

The potential direct, indirect and induced impacts to this species due to the operation of the Production Facility are presented below.

*Impact Indicators*

Indicators used to assess effects of the operation of the Production Facility on Grey Crowned Crane were: habitat quantity and quality, habitat connectivity, abundance and distribution, and survival and reproduction.

Habitat loss due to indirect disturbance and edge effects was estimated by applying a 200 m buffer to the Project infrastructure. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality caused by indirect disturbance like light, noise, vibration, and edge effects.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and loss of corridors. This was accomplished by visually examining the spatial distribution of critical habitat for Grey Crowned Crane (permanent and seasonal wetlands) in relation to the Project infrastructure to qualitatively identify areas where habitat remains fragmented during operation.

Potential changes in abundance and distribution, and survival and reproduction were assessed qualitatively by considering changes in disturbances (that is, vehicle traffic, light, noise, vibration). These disturbances were considered in light of known or inferred effects to the survival and reproduction of Grey Crowned Crane for which data on these types of effects are available.

*Impact Assessment*

- Habitat Quality and Quantity

No direct losses of wetland habitat are expected during the Production Facility's operation, however, additional indirect losses of suitable foraging habitat (seasonally flooded grassland) may occur in the event that wetlands being crossed or encroached by Project infrastructure incur changes in hydrological flow patterns if construction design mitigation is not successful, potentially resulting in desiccated or permanently flooded habitats.

Although Grey Crowned Crane can tolerate a low degree of anthropogenic disturbance (e.g. agricultural cultivation), in Ugandan wetlands it has been observed to be intolerant of human proximity within 100-200m (Olupot, 2014), flying away on approach; a factor which also affects breeding success as breeding birds flush from nests on approach, causing increased rates of predation, reduced time at the nest, either incubating or feeding, and ultimately nest abandonment. How tolerant foraging/roosting/breeding Grey Crowned Crane may be to indirect disturbances, such as noise, light, vibration and edge effects, is not known. The application of a 200m buffer around the Project infrastructure footprint indicates that approximately 4.64 ha of seasonally flooded wetland habitat will be reduced in quality as a result of sensory disturbance, throughout the operational lifetime of the Project.

The escarpment road to the Project is expected to facilitate an influx of people into the area, seeking opportunities. It can reasonably be expected that the increased human population in the Buhuka Flats will exacerbate existing pressures on the wetlands of the area. These pressures are likely to manifest in increased rates of habitat loss and degradation, resulting in long-term reduction of habitat quality and quantity for Grey Crowned Crane.

Impacts from loss of habitat and reduction of habitat quality are predicted to be beyond the expected range of natural disturbance perturbations.

- Habitat Connectivity

The effect of the Project operation as a barrier to the movement of Grey Crowned Crane is likely to be adverse. The operation activity is likely to create noise and visual sensory disturbances, which could elicit reduced use or complete avoidance of affected areas, thereby creating movement barriers. The presence of power lines between the CPF and development wells will present a significant barrier to movement for Grey Crowned Crane, as this species is susceptible to in-flight collisions with overhead powerlines (BirdLife International, 2018). The presence of roads crossing the wetlands has the potential to create barriers to movement as a result of the associated disturbance due to human presence and traffic in the area. The increased human population, and the associated increase in head of livestock grazing in the Buhuka Flats, is expected to further degrade wetland habitats and reduce habitat connectivity for Grey Crowned Crane.

Effects from disruption of habitat connectivity are predicted to be well beyond the expected range of natural disturbance perturbations.

- Abundance and Distribution

Grey Crowned Crane was relatively common in the Buhuka Flats during baseline surveys, with up to 14 individuals frequently observed. Given the extent to which they reportedly tolerate human presence (approx. 100m – 200m; Olupot, 2014), the large-scale changes in the human population on the Flats that have occurred with the operation of the escarpment road are likely to have affected Grey Crowned Crane occurrence on the Buhuka Flats. The ongoing population influx to the Flats following development of the escarpment road is likely to exacerbate existing levels of sensory disturbance in the locality, which in combination with anthropogenic degradation of suitable foraging, roosting and breeding habitat is expected to adversely affect the abundance and distribution of the species.

Effects on the abundance and distribution of Grey Crowned Crane are predicted to be well beyond the expected range of natural disturbance perturbations.

- Survival and Reproduction

Although Grey Crowned Crane were observed forming breeding pairs during the baseline fieldwork, the widespread degradation of suitable breeding habitat (permanent wetlands) is expected to become exacerbated throughout the operational lifetime of the Project, largely due to the population increase on the Buhuka Flats. This habitat degradation and increased human presence is expected to significantly reduce the likelihood of Grey Crowned Crane continuing to select these areas for breeding.

As mentioned above, direct disturbance via human proximity within 100-200m causes breeding birds to flush from nests on approach (Olupot, 2014), which may result in increased rates of predation, reduced time at the nest, either incubating or feeding, and ultimately nest abandonment, affecting reproductive success. The increased human population on the flats is also expected to result in increased hunting of cranes for bush meat and capture for domestication, and taking of eggs for food.

It is assumed that indirect disturbances arising from noise, light, and vibration would continue to affect the breeding success of Grey Crowned Crane on the Buhuka Flats, should they nest there during operation.

Removal of large trees which have importance as night-time roosts and day-time shelter from the midday sun has been indicated in localised declines in Grey Crowned Crane in Uganda (Olupot, 2014); the absence of such trees during the operational phase is therefore expected to have implications for the survival of flocks and individuals in the area.

These effects to the survival and reproductive success of Grey Crowned Crane are predicted to be well beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The Grey Crowned Crane's sensitivity is high because it is an Endangered species and it triggers Tier 2 critical habitat.

Impacts to Grey Crowned Crane habitat quantity and quality may be adverse during operation. The geographical extent of impacts will be local because effects will be restricted to the LSA, with approximately 4.64 ha (6.72 %) of potential habitat on the Buhuka Flats indirectly affected. Impact duration will be into the far future (that is, ~25 years) because changes to the habitat quality and quantity from sensory disturbances are expected to continue throughout the operational lifetime of the Production Facility. The magnitude of the effects of operation on Grey Crowned Crane habitat quantity and quality is considered high (ref. Section 9.2.1.2). Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the operation phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to remain major, because the magnitude of effects can at best be reduced to medium as the pressures on wetland integrity associated with human influx are expected to be difficult to mitigate, and the sensitivity of the receptor will remain the same (Table 22).

Impacts to Grey Crowned Crane habitat connectivity will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas where wetlands will be crossed by access roads. Impact duration will be long-term, as the presence of the access roads will remain in place throughout the operational lifetime of the Project, with ongoing sensory disturbances arising from traffic and the increased human population using the access roads continuing into the far-future; the increased human population living on the flats, and the associated increase in head of livestock grazing in the Buhuka Flats is likely to further compromise habitat connectivity for Grey Crowned Crane. The magnitude of the effects of operation on Grey Crowned Crane habitat connectivity is considered high. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the operation phase of the Project, pre-mitigation. Following the application of mitigation measures, the impact significance is expected to remain major, because the magnitude of effects is likely to remain medium as the pressures on wetland integrity associated with human influx are expected to be difficult to mitigate, and the sensitivity of the receptor will remain the same (Table 22).

Impacts to Grey Crowned Crane abundance and distribution will be adverse. The geographical extent of impacts will be local, as impacts will be restricted to wetlands in the Buhuka Flats. Impact duration will be will be into the far future (that is, ~25 years) as the sensory disturbance and habitat degradation associated with the ongoing population influx to the Flats is likely to remain ongoing throughout the lifetime of the Production Facility. The magnitude of the effects of operation on Grey Crowned Crane abundance and distribution is thus considered high. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to remain major, because the magnitude of effects can at best be reduced to moderate as the pressures on Grey Crowned Crane (wetland) habitat integrity associated with human influx are expected to be difficult to mitigate. The sensitivity of the receptor will remain the same (Table 22).

Impacts to the survival and reproduction of Grey Crowned Crane will be adverse. The geographical extent of impacts will be local because effects are restricted to wetlands on the Buhuka Flats. Impact duration will be will be into the far future (that is, ~25 years) as the sensory disturbance and habitat degradation associated with the ongoing population influx to the Flats is likely to remain ongoing throughout the lifetime of the Production Facility. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is considered probable that at least this percentage of individuals in the local population within the Buhuka Flats will be affected. The magnitude of the effects of construction on the survival and reproduction of the Grey Crowned Crane is therefore high. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to remain major, because the magnitude of effects can at best be reduced to moderate as the pressures on Grey Crowned Crane habitat integrity associated with human influx are expected to be difficult to mitigate. The sensitivity of the receptor will remain the same (Table 22).

**Table 22: Potential Production Facility operation phase impacts to Grey Crowned Crane**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quantity and quality | High – 4 | High – 4 | Major - 16 | Medium - 3 | High – 4 | Major – 12 |
| Habitat connectivity | Medium - 3 | High – 4 | Major – 12 | Medium - 3 | High – 4 | Major – 12 |
| Abundance and distribution | High – 4 | High – 4 | Major – 16 | Medium - 3 | High – 4 | Major – 12 |
| Survival and reproduction | High – 4 | High – 4 | Major - 16 | Medium - 3 | High – 4 | Major – 12 |

### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential direct, indirect and induced (the upgraded R5 and P1 roads) impacts that the operation of the Production Facility could have on Grey Crowned Crane and its habitat in the CHAA.

The spatial extent of the wetland habitat in the CHAA was broadly mapped based on knowledge of the study area, baseline studies, literature and reports (see Section 6.0). The actual extent of possible habitat may have been over-estimated.

### *10.2.2.3 What impact could the operation of the Project have on Nahan's Francolin?*

Nahan's Francolin is a Vulnerable and range-restricted species. In the CHAA, it is restricted to the Bugoma Central Forest Reserve. It triggers Tier 2 critical habitat under Criterion 2 (Section 6.3.2.2, Appendix G).

The potential induced and cumulative effects to this species due to the operation of the upgraded R5 and P1 roads are presented below.

#### *Impact Indicators*

Indicators used to assess effects of the operation of the upgrade of the R5 and P1 roads on Nahan's Francolin were: habitat quantity and quality, habitat connectivity, abundance and distribution, and survival and reproduction.

Habitat loss due to indirect disturbance and edge effects was estimated by applying a 200 m buffer to the road corridors. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality caused by indirect disturbance like light, noise, vibration, and edge effects.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and loss of corridors. This was accomplished by visually examining the spatial distribution of critical habitat in relation to the road corridor to qualitatively identify areas where habitat becomes fragmented.

Potential changes in abundance and distribution, and survival and reproduction were assessed qualitatively by considering changes in disturbances (that is, vehicle traffic, light, noise, vibration). These disturbances were considered in light of known or inferred effects to the survival and reproduction of buttonquail species for which data on these types of effects are available.

### *Impact Assessment*

- Habitat Quality and Quantity

The Nahan's Francolin's degree of vulnerability to disturbance is unknown. Birds are known to be sensitive to land use and habitat alteration (Lussier et al. 2006). The behavioural response of species to disturbance will depend on species-specific tolerance levels, disturbance type and frequency, group size for socially-foraging animals, and local conditions, such as the availability of alternative foraging sites (Madsen 1998). Many studies have reported a reduction in breeding success attributable to human disturbance (for a review, see Hill et al. 1992). Mechanisms include: increased rates of predation, nest abandonment and reduced time at the nest, either incubating or feeding. Clearly, a reduction in breeding output may have conservation implications and consequences for the population of this species in Bugoma CFR.

How tolerant the Nahan's Francolin may be to indirect disturbances, such as noise, light, vibration and edge effects, is not known. However, assuming it is sensitive to such disturbance because it is a shy, forest-dependent species (Sande et al. 2009a), then potential Nahan's Francolin habitat will be lost or reduced in quality as a result of edge effects, and possibly sensory disturbance.

The improved R5 and P1 roads could result in an influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma Central Forest Reserve will put pressure on the forest. These pressures could manifest in increased rates of habitat alteration and deforestation, as well as increased bush meat hunting. These factors could combine to reduce the habitat quality and quantity for Nahan's Francolin.

Effects from loss of habitat are predicted to be well beyond the expected range of natural disturbance perturbations.

- Habitat Connectivity

The upgraded R5 and P1 roads will not directly remove suitable habitat for the Nahan's Francolin. However, may affect that habitat within the 200 m buffer through indirect impacts like edge effects and sensory disturbance. As such, the road may become and effective barrier to the movement of Nahan's Francolin if the levels of traffic on the road substantially increase over the life of the Project. Roads are recognised as creating sensory disturbances, which can elicit reduced use or complete avoidance of affected areas, thereby creating movement barriers (for example, see Kolowski and Alonso 2009, Gleeson and Gleeson 2012). However, given that the Hoima-to-Ikamiro Road already exists, if the Nahan's Francolin is sensitive to such effects, then it is reasonable to assume the existing road is already a barrier to a greater or lesser degree.

The improved R5 and P1 roads could result in an influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma Central Forest Reserve will put pressure on the forest. These pressures could manifest in increased rates of habitat alteration and deforestation. These factors could reduce the habitat connectivity for Nahan's Francolin.

Effects from loss of habitat connectivity are predicted to be well beyond the expected range of natural disturbance perturbations.

- Abundance and Distribution

Nahan's Francolin is reported to be relatively common in the Bugoma Central Forest Reserve (Plumptre et al. 2011). What effects the upgrade of the road, and the predicted increased traffic levels along the road during the operation of the Project, could have on the abundance and distribution of this species is unknown.

With the operation of the upgraded road, and the increased traffic along the road, it is reasonable to assume that the local abundance and distribution of this species may be altered. Individuals may avoid the resultant sub-optimal habitat brought about by the upgraded road and increased traffic volumes. Additionally, the increased traffic on the road could lead to an increase in direct mortality of individuals.

The improved R5 and P1 roads could result in an influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma Central Forest Reserve will put pressure on the forest. These pressures could manifest in increased rates of bush meat hunting and habitat alteration. These factors could reduce the abundance and distribution of Nahan's Francolin.

Effects from the upgraded road are predicted to be well beyond the expected range of natural disturbance perturbations.

- Survival and Reproduction

The Nahan's Francolin's degree of vulnerability to direct disturbance, particularly during the breeding season, is not well understood. Generally, for birds, the behavioural response of species to disturbance will depend on species-specific tolerance levels, disturbance type and frequency, group size for socially-foraging animals, and local conditions such as the availability of alternative breeding sites (Madsen 1998). Many studies have reported a reduction in breeding success attributable to human disturbance (for a review, see Hill et al. 1992). Mechanisms include: increased rates of predation, nest abandonment and reduced time at the nest, either incubating or feeding. Clearly, a reduction in breeding output may have conservation implications and consequences for the local population of Nahan's Francolin.

How tolerant the Nahan's Francolin may be to indirect disturbances, such as noise, light, vibration and edge effects, during the breeding season, are also not completely understood. What is known is that disturbance of mature forest generally appears to reduce the home range of this species (Sande et al. 2009b), and hence its potential to find suitable mates. Assuming it is sensitive to sensory disturbance because it is a shy, forest-dependent species (Sande et al. 2009a), the operation of the upgraded roads, and the increased traffic levels on the road could affect the breeding success of those individuals living in close proximity to the road.

The improved R5 and P1 roads could result in an influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma Central Forest Reserve will put pressure on the forest. These pressures could manifest in increased rates of bush meat hunting and habitat alteration. These factors could reduce the survival and reproduction of Nahan's Francolin.

These effects to the survival and reproductive success of Nahan's Francolin are predicted to be well beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The Nahan's Francolin's sensitivity is high because it is range-restricted, and triggers Tier 2 critical habitat.

Impacts to the Nahan's Francolin's habitat quantity and quality will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to the R5 and P1 road corridors in the CHAA. Impact duration will be long-term. The magnitude of the effects of operation on the habitat quantity and quality of the Nahan's Francolin is low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operational phase of the Project, pre-mitigation (Table 25).

Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, primarily because the effectiveness of mitigation measures in the long-term are unknown and beyond the control of CNOOC, although the sensitivity of the receptor will remain the same (Table 23).

Impacts to the Nahan's Francolin's habitat connectivity will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to the R5 and P1 road corridors in the CHAA. Impact duration will be long-term. The magnitude of the effects of operation on the habitat connectivity of the Nahan's Francolin is Low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operational phase of the Project, pre-mitigation.

Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, primarily because the effectiveness of mitigation measures in the long-term are unknown and beyond the control of CNOOC, although the sensitivity of the receptor will remain the same (Table 23).

Impacts to the Nahan's Francolin's abundance and distribution could be adverse. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to the R5 and P1 road corridors in the CHAA. Impact duration will be long-term. There is a possibility that individuals could be killed or severely disturbed during the operation phase. The magnitude of the effects of operation on the abundance and distribution of the Nahan's Francolin is Low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operation phase of the Project, pre-mitigation.

Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, primarily because the effectiveness of mitigation measures in the long-term are unknown and beyond the control of CNOOC, although the sensitivity of the receptor will remain the same (Table 23).

Impacts to the survival and reproduction of Nahan's Francolin could be adverse. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to the R5 and P1 road corridors in the CHAA. Impact duration will be long-term. There is a possibility that individuals could be killed or severely disturbed during the operation phase. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is expected that this number of individuals in the local population within Bugoma Central Forest Reserve will not be affected. The magnitude of the effects of operation on the survival and reproduction of the Nahan's Francolin is therefore low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operational phase of the Project, pre-mitigation (Table 23).

Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, primarily because the effectiveness of mitigation measures in the long-term are unknown and beyond the control of CNOOC, and the sensitivity of the receptor will remain the same (Table 23).

**Table 23: Potential impacts in the operational phase to the Nahan's Francolin**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Low – 2 | High – 4 | Moderate – 8 | Low – 2 | High – 4 | Moderate – 8 |
| Habitat connectivity | Low – 2 | High – 4 | Moderate – 8 | Low – 2 | High – 4 | Moderate – 8 |
| Abundance and distribution | Low – 2 | High – 4 | Moderate – 8 | Low – 2 | High – 4 | Moderate – 8 |
| Survival and reproduction | Low – 2 | High – 4 | Moderate – 8 | Low – 2 | High – 4 | Moderate – 8 |

### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential direct, indirect and induced (the upgraded R5 and P1 roads) impacts that the operation of the Project could have on the Nahan's Francolin and its habitat in the CHAA.

The spatial extent of the dense forest habitat in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.0). The actual extent of possible habitat may have been over-estimated.

#### *10.2.2.4 What impact could the operation of the Project have on Eastern Chimpanzee?*

Eastern Chimpanzee is an Endangered species. A population occurs in the Bugoma Central Forest Reserve. This species triggers Tier 1 critical habitat.

The potential induced effects of the upgraded R5 and P1 roads on Eastern Chimpanzee are presented below.

### *Impact Indicators*

Indicators used to assess effects of the upgraded R5 and P1 roads on Eastern Chimpanzee were: habitat quantity and quality, habitat connectivity, abundance and distribution, and survival and reproduction.

Habitat loss due to indirect disturbance and edge effects during operation was estimated by applying a 500 m buffer to the road corridor. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality caused by indirect disturbance like noise, vibration and traffic. The buffer width was determined based known chimpanzee sensitivities to noise disturbance (Parren and Byler 2003, Rabanal et al. 2010). The amount of loss or degradation of habitats within the buffer was evaluated across a range of possibilities, including that habitats become completely unavailable to chimpanzees during the operation phase. Evaluating the potential for complete avoidance of the buffer area is a conservative approach, which addresses uncertainty about the attenuation distance of sensory disturbances for chimpanzees, even though the likelihood of strict avoidance throughout the entire buffer may be low.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and loss of corridors. This was accomplished by visually examining the spatial distribution of critical habitat in relation to the road corridor to qualitatively identify areas where habitat becomes fragmented.

Potential changes in abundance and distribution were assessed qualitatively by considering changes in disturbances (that is, vehicle traffic, light, noise, vibration). These disturbances were considered in light of known or inferred effects to the survival and reproduction of other populations of chimpanzees for which data on these types of effects are available.

To assess effects to survival and reproduction as a result of in-migration and potential associated increases in poaching and disease spread, in-migration rates were predicted based on the predictions in Golder Associates (2014h). A literature review of the impact of contact with humans was also conducted

### *Impact Assessment*

- Habitat Quality and Quantity

Based on the data presented in Plumptre et al. (2010), the distribution of nesting sites appears to be widely distributed through the forest; the exception being within the vicinity of the Hoima-to-Ikamiro Road. Here the frequency of nests encountered by those workers was a lot lower than elsewhere in the forest. This suggests that the Eastern Chimpanzees within the Bugoma Central Forest Reserve are actively avoiding the road, preferring to sleep some distance away from the disturbances arising from the road. The observation supports the findings of Parren and Byler (2003) that chimpanzees actively avoid environments where they will be disturbed at night.

The degree of vulnerability to disturbance experienced by chimpanzees is reasonably well known (for example, see Parren and Byler 2003, Rabanal et al. 2010, Thompson and Wrangham 2013). The chimpanzees living in and around the Bugoma Central Forest Reserve most likely experience sensory disturbances at present from human activities, given the high human populations living around the reserve. Indeed, groups are known to forage in the agricultural fields surrounding the forest, and hence, would more than likely be used to human noises and disturbances (McLennan 2008). As such, the potential sensory disturbances arising from the operation of the upgraded road are likely to be minimal. Nevertheless, the magnitude of noise may not be the most important determinant of chimpanzee response. Instead, chimpanzees may respond to ‘new’ noises or may associate particular noises with other occurrences (for example, machine noise may be associated with human presence, which chimpanzees may, in turn, associate with the presence of danger). Where humans pose a threat, chimpanzees generally avoid them (Hockings and Humle 2009, Parren and Byler 2003). Therefore, the degree of avoidance may depend on the behaviour of people, highlighting the importance of managing contractor activity.

The improved R5 and P1 roads could result in an influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma Central Forest Reserve will put pressure on the forest. These pressures could manifest in increased rates of bush meat hunting and habitat alteration. These factors could reduce the survival and reproduction of Eastern Chimpanzee.

Effects from the loss of habitat are predicted to be well beyond the expected range of natural disturbance perturbations.

- Habitat Connectivity

Although the operation of the upgraded R5 and P1 roads will not cause direct losses of suitable habitat for the Eastern Chimpanzees; it may affect suitable habitat within the 500 m buffer through indirect impacts like edge effects and sensory disturbance.

However, the chimpanzees within Bugoma Central Forest Reserve are assumed to be accustomed to human activity, and they may, more than likely, regularly cross roads within their range. Therefore, it is possible that they will not completely avoid the road corridor when the road is operational.

As such, the effect of the operation of the upgraded roads and associated traffic volumes within Bugoma CFR as a barrier to chimpanzee movements is predicted to be negligible – assuming that the mitigation recommendation of restricted access on the R5 intersecting the reserve has been applied.

Effects from loss of habitat connectivity are predicted to be beyond the expected range of natural disturbance perturbations.

- Abundance and Distribution

The Bugoma Central Forest Reserve supports one of the top four Eastern Chimpanzee populations in Uganda, with a population of between 450 and 850 individuals (Plumptre et al. 2010). Although the increased traffic volumes expected on these roads during operation has the potential to cause direct mortality of individuals, should such individuals cross the road, the operation of the upgraded roads is not expected to detrimentally affect the abundance of chimpanzees in the forest directly. What effect the loss of individuals from the population could have is unknown. It is doubtful though that the population could be reduced by 10% and hence, reach that critical population threshold due to road mortalities alone.

The long-term presence of the improved R5 and P1 roads could continue to facilitate influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma Central Forest Reserve will put pressure on the forest. These pressures could manifest in increased rates of bush meat hunting and habitat alteration. These factors could reduce the abundance and distribution of Eastern Chimpanzee.

Effects from the upgraded road are predicted to be well beyond the expected range of natural disturbance perturbations, although not beyond the disturbance from the human-induced deforestation rate and habitat loss, and bush meat hunting in Bugoma Central Forest Reserve.

- Survival and Reproduction

In-migration associated with upgrade of the R5 and P1 roads may adversely affect survival and reproduction of chimpanzees through poaching and disease transfer. Hunting and poaching is a recognised threat to chimpanzees in Bugoma Central Forest Reserve (Plumptre et al. 2003), and this pressure could increase as in-migration of people from other areas occurs. Mitigation and management of in-migration (see Golder Associates 2014h) will be very important to minimise potential effects on chimpanzees and other fauna species.

Disease is one of the major threats to Eastern Chimpanzees (Oates et al. 2008); increased abundance of people and competition for land and food resources between humans and chimpanzees could lead to higher rates of disease spread from humans to chimpanzees. Chimpanzees are closely related to humans; therefore, many diseases are transferrable between chimpanzees and humans (Formenty et al. 2003; Isabirye-Basulta and Lwanga 2008). Either direct or indirect contact with humans can spread disease. For example, there is evidence to suggest that respiratory illnesses have been transferred directly to chimpanzees from humans as a result of researcher and tourist contacts, often leading to outbreaks and death (Formenty et al. 2003). Human defecation in forest undergrowth can indirectly lead to spread of intestinal diseases, such as *Clostridium perfringens*, which can be fatal to chimpanzees (Fujita 2011). As forest fragments decrease in size, risks of contact with, and transmission of, disease from humans increases (Isabirye-Basulta and Lwanga 2008). Factors that lead to increased crop raiding or sharing of water resources can also increase the risk of disease spread (Hockings and Hulme 2009). As identified in Golder Associates (2014e), communicable respiratory diseases are a significant concern in the LSA.

An increasing human population, facilitated by an improved road, could lead to an increase in the demand for agricultural resources, which, in turn could further fragment, change, and degrade the Bugoma Central Forest Reserve and surrounding habitat. With the upgrade of the road, and the potential for the Project to be attractive for people seeking opportunities, could see a substantial increase the current population around the Bugoma Central Forest Reserve.

Effects from the upgraded road are predicted to be well beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The Eastern Chimpanzee's sensitivity is high because it is Endangered.

Impacts to the Eastern Chimpanzee's habitat quantity and quality will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to the Hoima-to-Ikamiro Road corridor in the CHAA. Impact duration will be long-term. The magnitude of the effects of construction on the habitat quantity and quality of the Eastern Chimpanzee is low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operation phase of the Project, pre-mitigation (Table 20). Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, primarily because the effectiveness of mitigation measures in the long-term are unknown and beyond the control of CNOOC, although the sensitivity of the receptor will remain the same (Table 24).

Impacts to the Eastern Chimpanzee's habitat connectivity will be neutral. The geographical extent of impacts will be local because effects are restricted to those areas immediately adjacent to the Hoima-to-Ikamiro Road corridor in the CHAA. Impact duration will be long-term. The magnitude of the effects of construction on the habitat connectivity of the Eastern Chimpanzee is negligible. Therefore, the magnitude and sensitivity combine to produce a minor overall impact level during the operational phase of the Project (Table 24).

Impacts to the Eastern Chimpanzee's abundance and distribution could be adverse. The geographical extent of impacts will be regional because, although effects are restricted to those areas immediately adjacent to the Hoima-to-Ikamiro Road corridor in the CHAA, there is the potential to extend beyond that area. Impact duration will be long-term. There is a possibility that individuals could be killed or severely disturbed during the operational phase. The magnitude of the effects of operation on the abundance and distribution of the Eastern Chimpanzee is medium. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the operation phase of the Project, pre-mitigation (Table 24). Following the application of appropriate mitigation measures, the impact significance is expected to become moderate, primarily because the effectiveness of mitigation measures in the long-term are unknown and beyond the control of CNOOC, although the sensitivity of the receptor will remain the same (Table 24).

Impacts to the survival and reproduction of the population of Eastern Chimpanzee in Bugoma Central Forest Reserve could be adverse. The geographical extent of impacts will be national because effects could extend well beyond the CHAA. Impact duration will be long-term. There is a possibility that individuals could be killed or severely disturbed during the operation phase. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is expected that this number of individuals in the local population within Bugoma Central Forest Reserve could be affected through direct mortality from bush meat hunting or other disturbance. Therefore, the magnitude of the effects of operations on the survival and reproduction of the Eastern Chimpanzee high. Therefore, the magnitude and sensitivity combine to produce a major overall impact level during the road upgrade and construction phase of the Project, pre-mitigation (Table 24).

Following the application of appropriate mitigation measures, the impact significance is expected to become moderate, primarily because the effectiveness of mitigation measures in the long-term are unknown and beyond the control of CNOOC, although the sensitivity of the receptor will remain the same (Table 24).

**Table 24: Potential impacts in the operation phase to the Eastern Chimpanzee**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude (the expected size of the impact) | Sensitivity of the Receptor | Significance | Magnitude (the expected size of the impact) | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Low – 2 | High – 4 | Moderate – 8 | Low – 2 | High – 4 | Moderate – 8 |
| Habitat connectivity | Negligible – 1 | High – 4 | Minor – 4 | Negligible – 1 | High – 4 | Minor – 4 |
| Abundance and distribution | Medium – 3 | High – 4 | Major – 12 | Low – 2 | High – 4 | Moderate – 8 |
| Survival and reproduction | High – 4 | High – 4 | Major – 12 | Low – 2 | High – 4 | Moderate – 8 |

### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential direct, indirect and induced (the upgraded R5 and P1 roads) impacts that the operation of the Project could have on the Eastern Chimpanzees and their habitat in the CHAA.

The spatial extent of the dense forest habitat in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.0). The actual extent of possible habitat may have been over-estimated.

# 11.0 IMPACT ASSESSMENT – FEEDER LINE

This section presents an assessment of the possible interactions of biodiversity valued components with the feeder line infrastructure and activities, and the resulting impacts during the construction and operation phases.

The biodiversity valued components for the feeder line impact assessment are listed in Table 5 below. They include all of the species and habitats that trigger critical habitat designation within the CHAA. In addition, ecosystems of concern that will be potentially affected by the Project, and Grey Crowned Crane, were also included as valued components for impact assessment, for reasons outlined in the Table below. As mentioned in Section 10.1.2, potential impacts to other species of concern are assessed at the habitat level (ecosystems of concern).

**Table 25: Biodiversity Valued Components for Feeder line Impact Assessment**

| Valued Component | Confirmed CH Trigger? (see Table 4) | Reasoning (see Table 4) |
|---|---|---|
| Near-shore aquatic habitats of Lake Albert | • Yes – Criterion 13<br>• Possibly Criterion 1 and Criterion 2 (G. candida) | • The near-shore habitats are important fishing grounds that support 11 fishing villages on the Buhuka Flats and surrounds (see Ecosystem Services Review)<br>• May support the CR and range-restricted species Gabbiella candida |

| Valued Component | Confirmed CH Trigger? (see Table 4) | Reasoning (see Table 4) |
|---|---|---|
| Wetlands | • No | • Natural habitat – priority habitat according to IFC (2012)<br>• Supports Endangered Grey Crowned Crane<br>• Important in supply of ecosystem services to local communities (see Ecosystem Services Review) |
| Escarpment vegetation corridor | • No | • Natural habitat – priority habitat according to IFC (2012)<br>• Forms part of a contiguous vegetation corridor that is part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor<br>• The location of caves and cavities along the escarpment that could be important for cavity-roosting bats |
| Bugoma Central Forest Reserve | • Yes –<br>• Criterion 4<br>• Criterion 1<br>• Criterion 2 | • Triggers CH on the basis of being a highly threatened and unique ecosystem (Criterion 4)<br>• Triggers Criterion 1 Tier 1 CH on the basis of support of a population of Eastern Chimpanzee, that is recognised as being one for the four largest in the region; apart from being an Endangered species, chimpanzees are also recognised as key stone species and ecosystem engineers<br>• Triggers Criterion 2 Tier 2 CH on the basis of support of range-restricted Nahan's Francolin<br>• Recognised area of old growth forest<br>• The forest is recognised for its unique biodiversity values, including biome restricted species<br>• Is an important ecosystem service supply area for local people who harvest timber, fibre, fuel wood and charcoal, and non-timber forest products from the forest<br>• Bugoma Central Forest Reserve is recognised as an Important Bird Area<br>• Nationally recognised as a high conservation priority area (NEMA 2010) |
| Mud Snail (*Gabbiella candida*) | • Possibly Criterion 1 and Criterion 2 | • Could occur on near-shore aquatic habitats (Bugoma Lagoon, large bays, open sandy shores, shallow river-associated water)<br>• Has not been confirmed in LSA to date and is included on basis of precautionary principle |
| Grey Crowned Crane | • No | • Although Grey Crowned Crane is not present in numbers that would trigger CH designation, it is an Endangered species and has been confirmed present on the Buhuka Flats during baseline fieldwork in 2014 and 2017 |

| Valued Component | Confirmed CH Trigger? (see Table 4) | Reasoning (see Table 4) |
|---|---|---|
| | | - Any potential Project impacts on a globally-recognised and nationally-protected Endangered species are unacceptable and warrant addressing via the impact assessment process |
| Nahan's Francolin (*Ptilopachus nahani*) | - Yes – Criterion 2 | - Occurs in Bugoma Central Forest Reserve, possibly one of less than 10 DMUs globally (including DRC)<br>- Potential for CHAA to support >10% of this species' known global population |
| Eastern Chimpanzee (*Pan troglodytes schweinfurthii)* | - Yes – Criterion 1 | - Occurs in Bugoma Central Forest Reserve<br>- Great apes are an iconic species of anthropological and evolutionary significance<br>- They generally immediately trigger CH designation (see GN 74 and footnotes in PS6, IFC 2012a and b) |

It should be noted that there is limited potential for decommissioning phase impacts for the feeder line, as typically pipelines are left in situ following decommissioning. In any case, the decommissioning activity will be the subject of a separate ESIA process, to be conducted towards the end of the operational phase.

## 11.1 Construction Phase Impacts

The construction of the feeder line will occur over 10-12 months, and is expected to present direct impacts to valued components including sensory disturbances, the potential for pollution and erosion and sedimentation, and direct mortality from vehicle movements and entrapment in open trenches. Indirect impacts on valued components are also anticipated as a result of population influx, due to expectations of work on the construction contract.

For the assessment of impacts during the construction phase, the key questions were divided into sub-questions that focused on individual valued components within the CHAA and LSA. In answering each question, the individual components of the pipeline were considered with regards to their potential to affect a valued component. These questions are presented below.

### 11.1.1 What impact could the construction of the Feeder line have on habitats and ecosystem integrity?

This section presents the assessment of impacts that the construction and decommissioning of the Feeder line could have on the habitat and ecosystem integrity within the CHAA and the LSA. These habitats either do, or could, support populations of species of concern. Therefore, the assessment of potential impacts to those species, and others, occurring in the CHAA has been assessed in this section through the determination of the impacts to potential habitat for those species.

The impacts of the Feeder line on critical habitat, as triggered by species of concern, are covered under the individual assessment of those species in Section 11.1.2. Other triggers of critical habitat are discussed, as relevant, in the appropriate sections.

#### 11.1.1.1 What impact could the construction of the Feeder line have on the near-shore aquatic habitats of Lake Albert?

*Impact Indicators*

The feeder line will not be constructed in the vicinity of the near-shore aquatic habitats of Lake Albert and thus is not expected to directly impact these habitats in terms of direct or indirect habitat loss as a result of disturbances and clearing during construction. However, changes in water quality as a result of the proposed discharge of hydrotest water to Lake Albert could affect the habitat and ecosystem integrity of the near-shore environment of Lake Albert.

Indicators used to assess impacts of the Project on the habitat and ecosystem integrity of the near-shore environment of Lake Albert were changes in: regional representativeness; topography (geomorphology) and sediments; water quality; ecosystem composition; ecosystem configuration.

Potential losses of habitat due to direct disturbance and clearing associated with the Project was quantified by overlaying the current, baseline extent of the habitat with the Project footprint.

Additional, indirect impacts to habitat were estimated by applying a 1 km buffer to the Project footprint, forming the LSA. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by sensory disturbance, changes in water quality, and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential succession changes in species composition that could occur. This was accomplished by examining available literature about the ecology of Lake Albert, and scientific literature about the impacts of human activities on aquatic environments.

*Impact Assessment*

- Representativeness

The CHAA supports 16.2 km of near-shore aquatic habitats, equating to about 810 ha (based on the near-shore habitat extending 0.50 km into the lake, see Section 7.1.1).

The feeder line will not be constructed in the vicinity of the near-shore aquatic habitats of Lake Albert and thus is not expected to directly impact these habitats in terms of direct or indirect habitat loss as a result of disturbances and clearing during construction. Therefore, no effects on regional representativeness are predicted.

- Topography (geomorphology) and sediment transport

The feeder line will not be constructed in the vicinity of the near-shore aquatic habitats of Lake Albert and thus is not expected to directly impact these habitats in terms of direct or indirect habitat loss as a result of disturbances and clearing during construction. Therefore, no pipeline-related impacts on the topography (geomorphology) and/or sediment transport in the near-shore habitats are predicted.

- Water Quality

The commissioning of the feeder line will involve hydrotesting, in which the vessels are filled with water and pressurised to verify their integrity. On occasions, chemical additives such as biocides, oxygen scavengers, dyes and/or corrosion inhibitors are added to the water, depending on the residence time, before it is discharged. This water is proposed to be discharged directly to Lake Albert. Without management, its release can present a severe risk to the aquatic environment, resulting in possible mortality and degradation of downstream ecosystems and species.

- Ecosystem composition

All six of the main habitat types in Lake Albert, as identified for fishes by Wandera and Balirwa (2010) (that is, shallow river-associated waters, open sandy shores, lagoons, large bays, rocky escarpments, and, open-water habitats), occur within the near-shore areas of the CHAA (see Section 7.1.1, Figure 5). Similarly, the species guilds associated with the near-shore habitats of the CHAA, in particular fish, are well represented throughout those regions of the lake that have been investigated (for example, see Wandera and Balirwa 2010, Taabu-Munyaho et al. 2012). Consequently, at baseline, the composition of these ecosystems can be said to be in good condition and reflective of the aquatic diversity of Lake Albert. Similarly, these aquatic habitats have a well-developed structure, that is, well-defined aquatic plant layers associated with underwater features and substrates.

If not correctly treated, the discharge of hydrotest fluids directly to Lake Albert during pipeline construction is likely to result in high-intensity, temporary and localised alteration of the ecosystem composition of the aquatic communities; particularly those inhabiting the near-shore habitats in the vicinity of the discharge outfall.

The point source discharge, and the quantity of hydrotest fluid involved, presents a risk of localised toxicity, which could cause mortality of fish and aquatic invertebrates, algae and plants, thereby changing diversity and complexity of the aquatic habitats and their ability to support associated aquatic faunal communities. Impacts from the changes to ecosystem composition as a result of this contamination are predicted to be beyond the expected range of natural disturbance perturbations.

Since the near-shore habitats of Lake Albert within the CHAA potentially support species that trigger critical habitat including the Critically Endangered mud snail (*G. candida*); any negative impacts on the ecosystem composition of this habitat have the potential to be of major significance.

- Ecosystem configuration

The feeder line will not be constructed in the vicinity of the near-shore aquatic habitats of Lake Albert and thus is not expected to directly impact these habitats in terms of direct or indirect habitat loss as a result of disturbances and clearing during construction. Therefore, no pipeline-related impacts on the connectivity, or ecosystem configuration of the near-shore habitats are predicted.

### *Impact Classification*

The near-shore aquatic habitat's sensitivity is high because these habitats potentially support populations of the Critically Endangered Mud Snail (*G. candida*), the Vulnerable African Soft-shelled Turtle (*T. triunguis*), and the range-restricted and Near Threatened Snail (*Bellamya rubicunda*). Near-shore aquatic habitat within the CHAA potentially constitutes Tier 1 Critical Habitat for the Mud Snail (*G. candida)* (Table 4). Impacts on this habitat are therefore classified on the basis of high sensitivity to potential effects of the proposed development.

- Representativeness

Impacts to the representativeness of the habitat will be neutral, as the feeder line will not be constructed in the vicinity of the near-shore aquatic habitats of Lake Albert, and thus is not expected to directly impact these habitats in terms of direct or indirect habitat loss as a result of disturbances and clearing during construction. Therefore, no effects on regional representativeness are predicted.

- Topography (geomorphology) and sediment transport

Impacts to the topography (geomorphology) and sediment transport in the near-shore aquatic habitats of Lake Albert will be neutral, as the feeder line will not be constructed in the vicinity of these habitats, and thus is not expected to directly impact them in terms of direct or indirect habitat loss as a result of disturbances and clearing during construction. Therefore, no pipeline-related impacts on the topography (geomorphology) and/or sediment transport in the near-shore habitats are predicted

- Ecosystem composition – water quality

Impacts to the water quality, and subsequently the ecosystem composition of near-shore habitats will be adverse. The geographical extent of impacts is expected to be localised, around the Lake Albert discharge point. The duration will be temporary (that is, over the course of several weeks), and will only occur once the construction of the full pipeline has been completed i.e. at the end of the construction phase.

The magnitude of the potential impacts of the direct discharge of hydrotest effluent from the pipeline on the water quality is medium. This is because, prior to mitigation, the potential for hydrotest discharge to alter the baseline water quality is substantial, resulting localised changes to ecosystem composition as a result of toxic effects on aquatic invertebrate, fish and plant communities (i.e. the diversity and complexity of the habitat) around the discharge point. As mentioned previously, the near-shore aquatic habitat's sensitivity is high, therefore, the magnitude and sensitivity combine to produce a major overall impact level to water quality as a result of potential contamination with potentially toxic chemicals during the hydrotesting of the feeder line, prior to the application of the recommended mitigation (Table 7). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, primarily because the magnitude will become negligible.

Following the application of the mitigation measures (Section 12.2), the impact significance is expected to be reduced to minor, primarily because the magnitude will become negligible, and the sensitivity of the receptor will remain the same.

- Ecosystem configuration

Impacts to the ecosystem configuration of the near-shore aquatic habitats of Lake Albert will be neutral, as the feeder line will not be constructed in the vicinity of these habitats, and thus is not expected to directly impact them in terms of direct or indirect habitat loss as a result of disturbances and clearing during construction. Therefore, no pipeline-related impacts on the ecosystem configuration of the near-shore habitats are predicted.

**Table 26: Potential impacts in the construction phase to near-shore habitats**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Ecosystem composition - Water quality | Medium - 3 | High - 4 | Major – 12 | Negligible - 1 | High - 4 | Minor – 4 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the near-shore habitats of the CHAA. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios with the level of Lake Albert, which has, in the recent and not so recent past, varied quite dramatically (Talbot et al. 2006), it is conceivable that level of the lake may increase or decrease thereby altering near-shore habitats.

The spatial extent of the near-shore habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 7.1.1). The actual extent of possible habitat may have been over-estimated.

## *11.1.1.2 What impact could the construction of the Feeder line have on the escarpment vegetation corridors?*

### *Impact Indicators*

Indicators used to assess impacts of the Project on the habitat and ecosystem integrity of the vegetation corridors on the escarpment were changes in: regional representativeness; ecosystem composition; and ecosystem configuration.

Loss of habitat due to direct disturbance and clearing associated with the feeder line was quantified by overlaying the current, baseline extent of the escarpment vegetation communities with the feeder line footprint.

Additional, indirect affects to habitat were estimated by applying a 0.50 km buffer to the footprint of the feeder line. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by edge effects, fragmentation, sensory disturbance, changes in water quantity and quality, and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential changes in species composition that could occur, and the disruption of known corridors. This was accomplished by examining available literature about the ecology of the vegetation communities on the escarpment, and scientific literature about the impacts of human activities on corridors.

### *Impact Assessment*

- Representativeness

The CHAA supports approximately 2443 ha of escarpment corridor vegetation communities (see Section 6.3.1.1.2), which are bounded on the east by agriculturally modified landscapes, and the Buhuka Flats on the west. As mentioned, these vegetation communities form part of a contiguous vegetation corridor that is part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor (Plumptre et al. 2003) (see Section 7.1.2). Therefore, their continuous extent represents an important landscape feature in the CHAA.

The proposed feeder line will traverse approximately 0.8 km through escarpment vegetation communities before it enters agriculturally-modified habitats on the plateau above the escarpment. The total area of escarpment habitat that will be lost and disturbed as a result of the construction of the feeder line is 4.1 ha. All these vegetation communities are widely represented on the escarpment, and the CHAA.

The total loss of escarpment vegetation communities within the CHAA due to the construction of the feeder line is outlined in Table 27).

**Table 27: Permanent loss of escarpment corridor vegetation due to construction of feeder line**

| Vegetation Type | Total area in the CHAA (ha) | Total area in Escarpment vegetation corridor (ha) | Area of escarpment vegetation corridor affected by the pipeline (ha) | % loss of vegetation corridor within CHAA |
|---|---|---|---|---|
| Cultivation and settlement | 31860.9 | 0.1 | - | - |
| Dense bushland | 1097.6 | 337.7 | 1.6 | 0.5% |
| Dense wooded grassland | 613.2 | 589.0 | 1.7 | 0.3% |
| Open grassland | 568.5 | 31.5 | - | - |
| Open wooded bushland | 523.0 | 214.0 | 0.8 | 0.4% |
| Open wooded grassland | 1900.9 | 552.2 | - | - |
| Riverine woodland | 74.8 | 69.8 | - | - |

The loss of this quantity of vegetation in relation to the amount in the CHAA is not substantial. Nevertheless, the loss of this vegetation does open up a previously contiguous tract of vegetation with a linear corridor that introduces edge effects and the concomitant aspects associated with those, as discussed below.

Impacts from the changes to representativeness are predicted to be beyond the expected range of natural disturbance perturbations.

- Ecosystem composition

The construction of the feeder line may result in loss of biodiversity at both local and regional scales due to restricting movement between populations, increased mortality, habitat fragmentation and edge effects, invasion by exotic species, or increased human access to wildlife habitats, all of which are expected to increase local extinction rates or decrease local recolonisation rates (Findlay and Bourdages 2000). Indeed, the construction of a linear corridor (such as the feeder line) through an area of relatively intact vegetation, like that on the escarpment, creates edge effects that could, in the long-term, alter the composition of the ecosystem through which the pipeline traverses. Vegetation clearing creates edges or boundaries where habitat (for example, riverine woodland) meets a disturbance (for example, the pipeline corridor). Edges associated with disturbance are different than transition areas, or ecotones, amongst vegetation communities, because disturbance edges tend to be abrupt with a high degree of contrast between two areas (for example, pipeline corridor and open wooded grassland). Edges open up habitat in areas where it was previously continuous, and this generally changes the abiotic conditions (for example, temperature, light, and moisture regimes) (Porensky and Young 2013). Edges often result in changes in species composition along the edge, with the edges typically becoming dominated by pioneer species adapted to the particular microclimate experienced on the edge (Porensky and Young 2013). Often, these microclimates are favoured by weed and/or invasive plant species. However, certainly for fauna species, and depending on the species, edges can have either a positive or negative impact on habitat quality and quantity (Prevedello et al. 2013, Wellicome et al. 2014). Given the length of the feeder line (approximately 0.8 km) traversing the escarpment vegetation communities, this equates to approximately 1.6 km of edges in the escarpment vegetation corridor, which would have otherwise not existed.

What long-term impacts that these edge impacts could have on the vegetation communities' composition are unknown; in particular their resilience. The escarpment vegetation communities are already under pressure from harvesting of fuel wood and charcoal manufacture, and livestock grazing. Cattle have been shown to substantially increase the edge impacts in savannah habitats (Porensky et al. 2013). Vegetation clearing for the feeder line could facilitate the introduction and spread of invasive plant species throughout the escarpment vegetation communities, as well as create a nick point for erosion and subsequent degradation of adjacent vegetation. These changes could substantially alter the habitat structure and composition, which, in turn, could affect its utilisation by the current species guild. To some extent this may already be occurring. For example, very few medium sized mammals were recorded in the CHAA, and those that were recorded tended to be thicket and dense bushland specialists, such as bushbuck and duiker. The low populations and diversity of these species could also be a reflection of increased pressure for bush meat from the local human population, which has increased markedly over the last ten years (AECOM 2012). It is expected that the existing trends in this regard will increase markedly once people become aware that project construction is imminent.

The 800 m section of the feeder line that will intercept the escarpment vegetation corridor will be routed straight up a 76% (40º) slope. The trench for the pipeline will probably need to be drilled and blasted to achieve the minimum 0.8m depth of cover for rocky ground. During construction, the trenches present a risk of injury and mortality to fauna, in particular smaller mammal and reptile species, which could affect ecosystem composition, albeit in a temporary and localised manner.

If properly managed during construction, including rolling rehabilitation of the buried pipeline once construction is complete, impacts on the ecosystem composition could be minor, nevertheless the potential construction impacts are predicted to be beyond the expected range of natural disturbance perturbations.

i Ecosystem configuration

The wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor is recognised as being important for threatened species in the face of climate change adaptation (Ayebare et al. 2013), and as part of a much broader set of corridors running the length of the Albertine Rift. This corridor in the southern portion of the eastern shores of Lake Albert, in the vicinity of the Project, is very narrow compared to its extent elsewhere, and is recognised as being important for savannah species (Plumptre et al. 2010).

The construction of the pipeline generally requires a 30 m wide construction right-of-way[5] and will involve digging/blasting of a trench for the pipeline, which will then be buried. The construction activity and

[5] The construction right-of-way (ROW) has been set at 30 m for the purposes of impact assessment; however typically the ROW will vary according to site circumstances – e.g. for straight sections of pipeline the ROW will be approx. 24 m, whereas for rivers and road crossings, the ROW may need to be 50 m wide.

concomitant environmental disturbances (visual, noise, lighting, physical barrier) are likely to temporarily reduce its value as a wildlife movement corridor.

Indications are that populations of highly mobile wildlife within the area, which may depend on the corridor, are not substantial, and potentially severely depleted (see Section 6.1). In particular, those species that could utilise this corridor, such as large ungulates, predators, primates and birds, are very rare in the area, apart from birds. Nevertheless, during the construction phase, the trenches for the pipeline could present a barrier to movement for fauna, in particular smaller mammal and reptile species. However, the feeder line is not expected to be a barrier for birds; for example, White-backed Vultures were seen moving south down the escarpment corridor during the surveys (see Section 6.1.4). What impact the feeder line could have on the movement of those terrestrial individuals and species that may utilise this corridor is unknown. The corridor is recognised as an important climate change refugium for a range of threatened species, which may become increasingly important for those species in the future (Ayebare et al. 2013).

Direct impacts from the changes to ecosystem configuration on the escarpment as a result of the feeder line are, therefore, predicted to be beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The vegetation community of the escarpment's sensitivity is medium because these habitats are already under stress from livestock grazing and harvesting of fuel wood and non-timber forest products. However, these communities do form part of a wider, regionally-important wildlife corridor.

Impacts to the representativeness of the habitat will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA, and will only constitute a loss of 4.1 ha, in a total area of escarpment vegetation in the CHAA of 2233.8 ha (Table 27). This amounts to 0.18% of the vegetation in the escarpment corridor in the CHAA. The impact is expected to be medium to long term; while rehabilitation of the affected pipeline corridor will occur immediately after construction is completed, the steep and rocky slopes make it unlikely that habitat recovery by plants other than pioneer species will occur in the short-term. Whether there is relatively complete habitat recovery will depend largely on the effectiveness of the rehabilitation strategy. If normal construction management methods are used (without a high degree of specialist rehabilitation intervention), full recovery is unlikely. Nevertheless, the small area affected is not expected to materially impact on the representativeness of the escarpment vegetation corridor, either within the CHAA or at regional scale, and the magnitude of the impacts of the feeder line on representativeness of the vegetation communities of the escarpment is rated as low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to representativeness during the construction phase of the Project, pre-mitigation (Table 28). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to low, providing that the recommended mitigation measures (rehabilitation of the soil and vegetation cover on top of the buried pipeline) are implemented, with a high degree of management intervention necessary both during and after construction.

Impacts to the ecosystem composition will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. The impact is expected to be medium to long term; while rehabilitation of the affected pipeline corridor will occur immediately after construction is completed, the steep and rocky slopes make it unlikely that habitat recovery by plants other than pioneer species will occur in the short-term. There is also potential for changes to the vegetation community composition to occur through the introduction or spread of invasive plant species, often themselves pioneer-type species. The magnitude of the impact on ecosystem composition is medium because, prior to any mitigation, the potential for changes to ecosystem composition potentially brought about by edge effects is possible. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to ecosystem composition during the construction phase of the Project, pre-mitigation (Table 28). Following the application of appropriate mitigation measures (rehabilitation of the soil and vegetation), vegetation recovery to primary levels of succession would be expected in the short term, with further recovery in the medium and long-term (dependent on a high degree of management and specialist intervention both during and after construction); therefore the impact significance is expected to be reduced to minor, as the magnitude will become negligible, and the sensitivity of the receptor will remain the same.

Impacts to the ecosystem configuration will be adverse. The geographical extent of impacts will be regional because impacts are restricted to the CHAA. Impact duration will be medium-term (that is ~25 years) because impacts are expected to continue through the Project operations. The magnitude of the impact on ecosystem configuration is medium because, prior to any mitigation, the potential for changes to ecosystem configuration is possible, especially interference with wildlife movement corridors. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to ecosystem composition during the construction phase of the Project, pre-mitigation (Table 28). Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, because the burial and rehabilitation of the pipeline will restore habitat connectivity for fauna using the escarpment corridor.

**Table 28: Potential impacts in the construction phase to the vegetation communities of the escarpment**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Representativeness | Low - 2 | Medium – 3 | Moderate – 6 | Negligible – 1 | Medium – 3 | Minor - 3 |
| Ecosystem composition | Medium – 3 | Medium – 3 | Moderate – 9 | Negligible – 1 | Medium – 3 | Minor - 3 |
| Ecosystem configuration | Negligible – 1 | Medium – 3 | Minor - 3 | Negligible – 1 | Medium – 3 | Minor - 3 |

### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential impacts of the feeder line to the vegetation communities of the escarpment, and the wildlife corridors of which they form part. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future is uncertain. Indications are that they will increase in importance (Ayebare et al. 2013), provided human pressures do not overwhelm them.

The spatial extent of habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 7.1.2). The actual extent of possible habitat may have been over-estimated.

## 11.1.1.3 What impact could the construction of the Feeder line have on wetlands and riparian habitat in the CHAA?

### Impact Indicators

Indicators used to assess impacts of the Feeder line on the habitat and ecosystem integrity of the wetlands of the CHAA were changes in: regional representativeness; ecosystem composition; and ecosystem configuration.

Loss of habitat due to direct disturbance and clearing associated with the Feeder line was quantified by overlaying the current, baseline extent of the vegetation communities with the Feeder line footprint, plus a 30m construction right of way.

Additional, indirect impacts to habitat were estimated by applying a 0.50 km buffer to the Feeder line footprint. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by edge effects, fragmentation, sensory disturbance, changes in water quantity and quality (drivers of ecosystem processes and functions), and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential changes in species composition that could occur, and the disruption of known corridors. This was accomplished by examining available scientific literature about the ecology of wetlands (permanent and seasonally flooded grasslands).

### *Impact Assessment*

- Representativeness

The CHAA supports approximately 1157.9 ha of wetlands, of which 85.3 ha are classified as seasonal. In addition, 840 ha of riparian vegetation communities associated with drainage lines and riparian systems occur within the CHAA. Table 29 quantifies the impact of the pipeline on the CHAA wetlands and riparian habitats, based on the area of physical disturbance during construction.

**Table 29: Area of wetland and riparian habitat impacted along the 30m wide pipeline construction right of way**

| Habitat | Area in the CHAA (ha) | Area in the 30m-wide pipeline corridor (ha) |
|---|---|---|
| Cultivation and Settlement | 31860.9 | 108.9 |
| Dense Bushland | 1097.6 | 1.6 |
| Dense Wooded Grassland | 613.2 | 1.7 |
| Open Bushland and Shrubland | 2896.3 | 14.9 |
| Open Grassland | 568.5 | 3.1 |
| Wooded Grassland | 184,3 | 3.9 |
| Open Wooded Grassland | 1900.9 | 0.8 |
| Riverine Woodland and Bushland (riparian habitat along drainage lines) | 74.8 | 0.0 |
| Riverine Bushland (riparian habitat along drainage lines) | 640.3 | 1.6 |
| Seasonal Wetland | 85.3 | 0.6 |
| Permanent Wetland | 83.8 | 0.0 |
| Wetland | 1072.6 | 0.4 |

Approximately 2.6 ha of wetlands, seasonal wetlands and riparian habitat along drainage lines will be directly affected, which is 0.13% of the total area of similar wetland and riparian habitat in the CHAA. Further indirect impacts could result from edge effects and channel incision, affecting downstream wetland function. The loss of this quantity of wetlands in relation to their representation in the wider CHAA is not substantial; however, because this loss is brought about by the construction of a linear feature, there is a potential for the downstream wetland habitat to be affected if proper management controls are not implemented.

Impacts from the changes to representation of the wetlands in the CHAA are predicted to be beyond the expected range of natural disturbance perturbations.

- Wetland and Riparian Habitat Structure and Ecosystem Composition

The construction of linear infrastructure, such as pipelines, through wetland communities is known to have detrimental impacts on the functioning, processes and species composition of these communities (Roise et al. 2004). Pipeline construction may result in significant loss of biodiversity at both local and regional scales due to restricted movement between populations, increased mortality, habitat fragmentation and edge effects, invasion by exotic species, or increased human access to wildlife habitats, all of which are expected to increase local extinction rates or decrease local recolonisation rates (Findlay and Bourdages 2000). Consequently, it could be expected that the construction of the pipeline through wetlands and riparian habitats, could alter the ecosystem processes and functions driving these wetlands, especially downstream.

Buried pipelines crossing rivers and wetlands will not (of themselves) obstruct surface water flow. The risk to wetland function is mainly due to the disruption of wetland vegetation and soils by heavy machinery, particularly when tracked vehicles are used that have greater impact on soil structure and the soil profile is overturned due to careless construction management. Disruption of flows and ecosystem composition may also occur if fill material is imported into the wetland to provide stability for excavators and pipe layers, and is not completely removed and replaced with the natural soils after construction.

Alteration of wetland and riparian vegetation community composition could occur if flow paths for water, both surface and sub-surface, are not maintained. If these flow paths are not maintained, there is a potential that wetland vegetation community composition downstream of the obstruction could become altered – typically via flow concentration and channel incision in downstream wetlands that were previously supplied by diffuse, dispersed flows. The risk of incised drainage and associated loss of wetland function due to concentration of water flows is high. The vegetation within the seasonally flooded grasslands and riparian habitats is adapted to seasonal inundation, and, therefore, is dependent upon that cycle of wet and dry for survival. Additional, associated impacts that could occur in tandem with channel incision and wetland desiccation include exotic species invasion.

As part of standard construction methods, culverted wetland/drainage line crossings have been installed as part of the in-field road and airstrip construction. Nevertheless, even with such measures in place, there is still a potential for changes to the structure and ecosystem composition of wetland and riparian habitats to occur.

The wetland and riparian vegetation communities on the escarpment are already under pressure from livestock grazing, and harvesting of fibre for house construction. It is possible that these communities may change in the long-term as grazing pressure increases, and the human population of the region increases (Golder Associates 2014e). These changes could alter the habitat structure and composition, which, in turn, could affect the utilisation of these habitats by the currently resident species guilds.

Impacts on wetland and riparian fauna will depend on the changes in vegetation communities as a result of construction; in addition, the noise and sensory disturbances created by the construction equipment could alter the behaviour of species frequenting the wetlands during construction/decommissioning. For example, wading birds and Grey Crowned Cranes are unlikely to tolerate construction nuisance within 500 m and could avoid these areas entirely during the construction period. If construction occurs during the breeding season of the Grey Crowned Crane (that is, the dry season (Archibald et al. 2013)), which could occur in wetlands on the escarpment, then disturbance from the construction activities could cause nest abandonment (Strasser et al. 2013).

Impacts to ecosystem composition of the wetlands in the CHAA are predicted to be beyond the expected range of natural disturbance perturbations.

- Water Quality and Ecosystem Composition

Impacts to ecosystem composition of the wetlands in the CHAA are predicted to be beyond the expected range of natural disturbance perturbations.

*Erosion and Sedimentation*

The construction of the feeder line could cause increased erosion and sediment-laden run-off to report to the wetlands and riparian habitats being crossed by the pipeline. With the construction of the pipeline, and the consequent exposure of areas of soil, there is a potential that, without adequate erosion and sediment control measures in place, sediment loads within the watercourses draining the pipeline footprint could increase. Hence, there is a potential for increased sediment loads in the wetland and riparian habitats. The watercourses and associated wetlands draining the LSA support dense emergent vegetation (see Section 6.1.1). Such vegetation can form an impactive filter for most sediment (IECA 2008); therefore, it can be expected that sediment loads reporting to downstream wetland and riparian habitats could be minimal. Nevertheless, if sediment loads are substantial, there is a potential for that sediment to smother wetland vegetation and interfere with aquatic invertebrates. If this occurs, it could detrimentally affect the wetland and riparian processes and functions, which, in turn, could alter wetland and riparian community composition, albeit on a localised scale.

*Hydrocarbon and Chemical Spills*

Accidental spillage of fuels and chemicals during the construction of the feeder line are probable, where most construction activities will take place over a period of 10-12 months. Certain invertebrate species (for example, aquatic snails (Araujo et al. 2012), mayflies (Savić et al. 2011)) and juvenile fish (for example, Agamy 2013) are highly sensitive to chemical pollutants, particularly hydrocarbons; therefore, accidental spillages during construction could detrimentally affect aquatic species as well as the wetland and riparian habitat processes and functions, which, in turn, could alter ecosystem composition, albeit on a localised scale.

*Sewage Disposal*

Sewage at the personnel camp will be treated by a package sewage treatment plant, designed to comply with the Ugandan requirements for effluent disposal and the IFC guidelines for domestic wastewater. Treated effluent will be discharged into a soakaway. The personnel construction camp is situated more than 500 m from the nearest drainage line/riparian habitat, and since the discharge will be to a soakaway, potential impacts are discussed under  Groundwater.

*Increase in Population*

Indirect impacts on wetlands and riparian habitats as a result of water quality impacts could occur as a result of the migration of people into the CHAA in search of work. Existing sanitary conditions in the CHAA are poor, with all of the streams being contaminated with faecal waste from both animals and humans ( Social Impact Assessment). Increasing population pressures will exacerbate these conditions. Increased grazing pressure and erosion from denuded areas around expanding settlements will increase erosion and sedimentation in the wetlands.

- Ecosystem configuration

Linear infrastructure such as pipelines can present significant barriers to, or can alter behaviours of, a range of wetland and riparian wildlife, from: amphibians (for example, Pontoppidan et al. 2013); to turtles (for example, Langen et al. 2012). The construction of the pipeline through the wetlands and riparian habitats of the CHAA could present a barrier to movement for those species inhabiting them, during those project phases. However, the pipeline will be buried, therefore once construction is complete, they are not expected to be major barriers.

The pipeline will cut currently contiguous wetlands in the LSA. If not managed correctly during the construction process, that is, the installation of appropriate drainage connections, the pipeline could cause permanent barriers between the two newly separated wetland habitats. The process of clearing the wetlands for the construction of pipeline will create edge impacts, and result in the fragmentation of the wetland habitats. As already discussed, vegetation clearing creates edges or boundaries where habitat meets a disturbance. These edges open up habitat in areas where it was previously continuous, and this generally changes the abiotic conditions (for example, temperature, light, and moisture regimes) (Porensky and Young 2013). Edges also often result in changes in species composition along the edge, with the edges typically becoming dominated by pioneer and weedy species adapted to the particular microclimate experienced on the edge (Porensky and Young 2013). Fragmentation of wetland habitat is known to reduce the viability of many species and the wetland as a whole, with the viability of the particular fragment dependent on its size, proximity and, hence, connectivity to other wetland habitats (Uzarski et al. 2009). These wetland communities are already under pressure from livestock grazing, and harvesting of fibre for house construction.

Impacts to ecosystem configuration of the wetlands and riparian habitats in the CHAA are therefore predicted to be beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The sensitivity of wetlands and riparian habitats is high, because permanent and seasonal wetlands are important breeding and foraging habitat for Grey Crowned Crane, a species of concern; and wetlands are susceptible to degradation as a result of changes in water flow patterns brought about by infrastructural developments. The habitats are also already under stress from livestock grazing and harvesting of fibre. This high sensitivity is weighed against the magnitude of each of the impacted indicators as described in the paragraphs below, in order to derive the overall impact level for each indicator.

- Representativeness

Impacts to the representativeness of the habitat will be adverse. The geographical extent of impacts will be local because impacts are restricted to the feeder line construction right of way on the escarpment, and will only constitute loss of approximately 0.13% of wetland and riparian habitat in relation to the CHAA. The magnitude of the impacts of the feeder line on representativeness is therefore considered to be low. In the context of high wetland sensitivity, this results in impacts of moderate significance.

Following the application of appropriate mitigation measures, the impact significance is expected to be reduced to minor, as rehabilitated wetlands re-establish following completion of construction activities.

- Wetland Structure and Ecosystem Composition

Impacts to the ecosystem composition will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be medium-term, because impacts are expected last as long as it takes the wetland rehabilitation to become established post-construction. The magnitude of the impact on ecosystem composition is low because, although changes to wetland structure and ecosystem composition in wetland areas crossed by the feeder line are likely, which could result in edge effects, changed flow regimes, and erosion and sedimentation of affected wetlands, the extent of the area affected is relatively small. Therefore, the magnitude and high sensitivity of the wetlands combine to produce a moderate overall impact level to ecosystem composition during construction of the feeder line, pre-mitigation (Table 30).

Following the application of site-specific mitigation measures (Section 12.2), including appropriate construction management methods, the impact significance is expected to be reduced to minor, because, as the magnitude will become negligible, the sensitivity of the receptor will remain the same.

- Water Quality and Ecosystem Composition

Impacts to the ecosystem composition will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be for the duration of construction, which is expected to take approximately 3 years. The magnitude of the different project-specific impacts on ecosystem composition varies, as discussed under each of the subheadings below.

*Erosion and Sedimentation*

Clearing of vegetation will result in increased sediment loads in stormwater flows. These impacts will be of short duration, most likely occurring as a result of significant rain events, and will be most frequent in the early stages of construction when bulk earthworks are in progress and large areas of exposed earth are available. Impacts will be local (mainly in the catchment of wetlands that will be crossed by the pipeline). They will generally be reversible, and, consequently, have a low magnitude in the context of the feeder line construction. Wetland and riparian plant species are generally tolerant of occasional increases in sediment load in stormwater flows, and can serve as an effective sediment filter. In cases of severe and/or ongoing sediment loading, detrimental impacts on wetland and riparian vegetation and macro-invertebrates could be likely, which could detrimentally affect wetland processes and functions and, in turn, wetland composition at a localised scale. The high wetland and riparian habitat sensitivity, in combination with the low magnitude of predicted effects, will result in a moderate overall impact level to ecosystem composition during construction of the Project, pre-mitigation (Table 30).

Following the application of appropriate mitigation measures, the impact significance is expected to reduce to minor.

*Hydrocarbon and Chemical Spills*

The baseline concentrations of hydrocarbons and other industrial pollutants in the wetlands and riparian habitats of the LSA were below levels that cause harm in the aquatic environment (Golder Associates 2014b).

Some invertebrate species (such as aquatic snails, described in Araujo et al. 2012), mayflies (Savić et al. 2011)) and juvenile fish (Agamy 2013) are particularly sensitive to these pollutants.

Equipment working in the wetlands could contribute small quantities of oil into the aquatic environment as a result of leakages or spills. Hydrocarbon spills will only occur if insufficient care is taken during construction to prevent them, and will have a low probability of occurrence. In the absence of daily monitoring and management of site activities by competent personnel, an impact of low magnitude could occur, resulting in an overall impact of moderate significance (Table 30).

Following the application of appropriate mitigation measures, the impact magnitude is expected to reduce to negligible, which in combination with the high sensitivity of the wetland habitat, results in an overall impact of minor significance.

*Increase in Population*

In the absence of project interventions, the impact of increased population density (and associated increases in grazing livestock) on the Buhuka Flats is expected to be long-term, and to have a material effect on water quality in the wetlands across the Flats through reductions in sanitary water quality, exacerbation of wetland erosion, increased harvest of plant species used for traditional home construction, increased fire frequency and increased grazing pressure. The effects will be irreversible, and of medium magnitude. In the context of the high wetland sensitivity, the predicted impact significance is major, prior to mitigation (Table 30).

Following the application of appropriate mitigation measures, including appropriate construction management methods, the impact significance associated with population increase is expected to remain moderate, as although the magnitude will become low, the sensitivity of the receptor will remain the same.

i **Ecosystem Configuration**

Impacts to the ecosystem configuration will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be short-term and reversible, subject to the avoidance of permanent structural damage at the crossing points and the length of time that the rehabilitated crossing points (wetlands and riparian bank vegetation) takes to successfully re-establish. Taking into consideration the very localised geographic extent of construction through the wetlands and small drainage lines and the intensive cultivation in all of the surrounding areas, as well as the fact that the pipeline will be buried, the magnitude of impact is considered to be low.

Combined with the high sensitivity of wetland and aquatic environments, the overall impact on wetland and drainage line configuration, without mitigation, is expected to be of moderate significance. This suggests that project-specific measures will be necessary to minimize the impacts of construction equipment operating in the wetlands and drainage lines.

Following the application of project-specific mitigation measures (Section 11.2), the impact significance is expected to be reduced to minor (Table 30).

### *Impact Significance Rating*

**Table 30: Potential impacts of construction of the feeder line on the wetlands of the CHAA**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Representativeness | Low - 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor - 4 |
| Ecosystem composition – wetland structure | Low - 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor - 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Water quality | | | | | | |
| Erosion and sedimentation | Low – 2 | High – 4 | Moderate – 8 | Negligible - 1 | High – 4 | Minor - 4 |
| Hydrocarbon and chemical spills | Low – 2 | High – 4 | Moderate – 8 | Negligible - 1 | High – 4 | Minor - 4 |
| Population increase | Medium – 3 | High – 4 | Major – 12 | Low – 2 | High – 4 | Moderate – 8 |
| Ecosystem configuration | Low – 2 | High – 4 | Moderate – 8 | Negligible - 1 | High – 4 | Minor - 4 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential feeder line impacts to the wetlands of the CHAA. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future is uncertain.

The spatial extent of habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1.1). The actual extent of possible habitat may have been over-estimated.

## *11.1.1.4 What impact could the construction of the Feeder line have on Bugoma CFR?*

### *Impact Indicators*

Bugoma Central Forest reserve (Bugoma CFR) will not be directly affected by pipeline construction, which at its nearest point will be at least 1,8 km from the Bugoma CFR boundary. The indirect impacts of population influx, due to expectations of work on the construction contract, are considered since this could impact on the forest reserve.

A formal impact classification based on indicators was developed for induced and cumulative impacts to the Bugoma Central Forest Reserve; the impacts are discussed, and their significance assessed through a **reasoned narrative**. An overall impact significance classification was then developed. This was accomplished by examining available literature about the ecology of the Bugoma Central Forest Reserve (BCFR), and scientific literature regarding the effects of migration and human population pressure on forests in Africa.

The impacts were assessed in light of the guidance provided by IFC (2013), and in consideration of other known projects being developed in the wider area. In particular, the development of the oil processing facility at Kabaale, the oil developments around the Kaiso-Tonya area (AECOM 2012), the Hoima-Mputa-Fort Portal-Nkenda power line, and the potential for regional population increases in the wider area.

### *Impact Analysis*

Bugoma CFR is identified as a valued component for this impact assessment, certainly in terms of biodiversity (see Section 6.3.1.1.4). As identified in that section, apart from being one of the last stands of tropical semi-deciduous forests in the region, it also supports known populations of the Endangered Eastern Chimpanzee and range-restricted Nahan's Francolin (Plumptre et al. 2011), potential non-breeding habitat for the Endangered Madagascar Pond Heron (see Section 6.3.3.1), as well as elephants and a host of other threatened and irreplaceable species.

Although Bugoma CFR will not be directly affected by pipeline construction, which at its nearest point will be at least 1,8 km from the Bugoma CFR boundary, the indirect effects of project-induced migration to the pipeline construction region due to expectations of work on the construction contract have the potential to affect the ecological integrity of the habitats within the CFR, as well as the species of conservation concern that occur within it.

Bugoma CFR is under severe pressure from the human population surrounding it. In 2013, more than 1,500 people evicted illegally after settling within the forest (Mugerwa 2013), and recent (2016) reports from the area suggest that land-grab activity has resulted in the conversion of an estimated 8000 ha for sugar cane plantation development. The land cover study (see Figure 4) clearly shows that the areas surrounding the forest have largely been transformed for agricultural and subsistence purposes, and the transformation is now encroaching within the boundary of the CFR. This trend of encroachment of protected areas is not unique. Protected areas are known to be particularly vulnerable to changes in human demographics and deforestation; and Wittemyer et al. (2008) identified that human population growth and encroachment around protected areas is significantly higher than the average population growth in rural areas. This difference was largely due to the immigration of people into these areas because of the perceived increased availability of opportunities, natural resources and potential jobs (Wittemyer et al. 2008). This is supported by research conducted in the forests of the Albertine Graben, and the wider CHAA. For example, in a study of Budongo Central Forest Reserve, Zommers and MacDonald (2012), identified that of the local communities that hunted bush meat in the forest, nearly 73% were immigrants to the area. Furthermore, these workers identified that the households of immigrants were also more likely to be involved with deforestation.

The results of the recently-updated (Nov 2017) social baseline data gathering fieldwork indicated that in-migration to the CHAA has escalated significantly since the opening of the escarpment road, and commencement of preliminary construction works at the Kingfisher Development Area.

An Influx Management Strategy and Framework Plan (Golder Associates 2018) was developed to manage the potential influx of people into the LSA. However, this plan can only focus on those measures over which CNOOC has control, and to support the range of government and donor projects in Uganda aimed at socio-economic development and environmental conservation. How this translates to the potential influx of people towards the feeder line route and construction camp is unknown.

### *Impact Classification*

Indirect impacts on Bugoma CFR due to population influx to the region during construction of the feeder line will be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR, in the CHAA. Impact duration will be short-term (that is, limited to the construction phase of the feeder line, that is, 10-12 months). The magnitude of the effects of population influx associated with pipeline construction on the Bugoma Central Forest Reserve is expected to be low, given the short duration of the construction period, and the distance of the construction activities from the Bugoma CFR boundary.

The sensitivity of the Bugoma Central Forest Reserve is high because it is a threatened ecosystem that is already under pressure. Therefore, the intensity and sensitivity combine to produce a moderate overall impact level during the construction phase of the pipeline, prior to the implementation of strict Project-specific mitigation measures (**Table 31**).

The mitigation hierarchy is an important process that has been used to minimise impacts to Bugoma CFR. The focus for the continued use of the mitigation hierarchy during the feeder line construction phase will be continued development and implementation of mitigation measures through monitoring and adaptive management (see Section 12.0).

With the implementation of such mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude of impact could become negligible, and the sensitivity of the receptor will remain the same (**Table 31**).

**Table 31: Potential impacts in the construction phase to the Bugoma Central Forest Reserve**

| | Pre-mitigation | Post-mitigation (pre-offsets) |
|---|---|---|

| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
|---|---|---|---|---|---|---|
| Habitat and ecosystem integrity | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |

As noted above, the focus for reducing impacts to the Bugoma Central Forest Reserve is mitigation to lessen various types of disturbance that may occur (Section 12.0). Optimising mitigation will reduce residual impacts on the CFR to minor, and reduce the need for offsetting. However, possible offsetting options to ultimately achieve 'net gain' for the natural habitats of the forest have been identified and are discussed in Section 13.0.

### 11.1.2 What impact could the construction of the Feeder line have on species of concern?

This section presents the assessment of impacts that the construction of the Feeder line could have on those species of concern that trigger critical habitat, as identified in Section 8.0; that is, the Mud Snail (*G. candida*), Nahan's Francolin, and Eastern Chimpanzee; as well as Grey Crowned Crane which was also included as a valued component (see Table 25). Potential impacts to other species of concern are assessed at the habitat level (see Section 11.1.1).

Only Mud Snail and Grey Crowned Crane are potentially directly affected by construction of the feeder line. Other species, including the Eastern Chimpanzee and Nahan's Francolin, occur in the Bugoma Central Forest reserve (BCFR) but are not directly affected by pipeline construction, which at its nearest point will be at least 1,8 km from the BCFR boundary. The indirect impacts of population influx, due to expectations of work on the construction contract, are considered since this could impact on the forest reserve and the species of concern that it supports.

#### *11.1.2.1 What impact could the construction of the Feeder line have on the Mud Snail?*

The Mud Snail (*Gabbiella candida*) is a Critically Endangered and range restricted species. Currently, the only known populations occur around Butiaba (see Section 9.1.1.1), which is on the eastern shore of Lake Albert approximately 90 km north of the LSA. Although this species was not confirmed within the CHAA during the course of baseline studies, there is a potential that this species could occur in the near-shore habitats of the CHAA, based on its known habitat preferences, and those of other Mud Snail species (*Gabbiella* spp.), which have previously been recorded in both the same locality as this species at Butiaba, as well as in the LSA. Hence, a precautionary approach has been adopted, and *G. candida* is assumed to occur in the near-shore habitats of the CHAA.

##### *Impact Indicators*

No habitat loss due to direct disturbance and clearing of habitat is expected during construction of the feeder line, as these habitats lie outside that portion of the LSA. It is unlikely that construction of the feeder line could alter the habitat connectivity of the near-shore habitats in the CHAA. No structures are being put in place that will alter the natural connectivity of the aquatic habitats of the lake. It is expected that the connectivity amongst the aquatic habitats will remain the same during construction as they were during baseline.

Predicted construction phase impacts of the feeder line on the Mud Snail were therefore limited to the proposed discharge of hydrotest water to Lake Albert and subsequent effects on habitat quality.

The assessment of changes to habitat quantity and quality was focussed on the prediction of changes to water quality in the water column from construction-related activities.

##### *Impact Assessment*

- Habitat Quality and Quantity

Very little information is available for this species. Information about the genus *Gabbiella* indicates that this group is generally found in lakes, rivers and, less commonly, in small water bodies, and rarely in habitats that dry out (Kristensen and Stensgaard 2010). Two sister species (*G. humerosa* and *G. walleri*) were recorded in the LSA (see Section 3.3.2.4, Appendix D). These two species have also been recorded in the same locality and habitat as *G. candida* (GBIF, 2014). Therefore, the habitat preferences of those two species were used as a model to predict the potential impacts of changes to habitat quantity and quality for this species.

The two sister Mud Snail species recorded from the CHAA were collected from bottom substrates in the open sandy shore habitats in the LSA. These habitats are characterised by a gently sloping lake bed extending from the shore line to deeper water. The substrate is typically comprised of sand and finer sediments (Wandera and Balirwa 2010). This habitat constitutes approximately linear (lake shore) 10.5 km of the CHAA; however it should be noted that the near-shore habitat is located well beyond the feeder line construction right-of-way.

Despite the large buffering capacity of Lake Albert, the proposed direct discharge of the feeder line hydrotest water to Lake Albert could ultimately report to the near-shore habitats of the CHAA, with subsequent effects on the Mud Snail.

Aquatic snails are highly sensitive to chemical pollutants, particularly hydrocarbons (Araujo et al. 2012). Currently, the concentrations of hydrocarbons and other pollutants in the lake waters of the near-shore habitats are below levels that could cause harm to the environment (Golder Associates 2014b); this is supported by the healthy aquatic communities that were observed in the lake's near-shore habitats at baseline (see Section 6.2). As such, the direct discharge of the hydrotest fluid to Lake Albert could have a detrimental impact on the near-shore habitats of the LSA through the introduction of toxic compounds and pollutants, and subsequent effects on the Mud Snail.

Impacts on habitat quality and quantity for *G. candida* arising from discharge of the feeder line hydrotest fluid following construction are predicted to be beyond the expected range of natural disturbance perturbations. Potential loss of critical habitat for the Mud Snail requires the consideration of offsets to meet IFC requirements.

### *Impact Classification*

The Mud Snail's sensitivity is high because this species is Critically Endangered, and potentially triggers a Tier 1 critical habitat designation.

Impacts to the Mud Snail's habitat quantity and quality will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Although the impact duration will be short-term, and should be reversible with time as the Lake waters dilute and disperse the contaminants, the magnitude of the impacts of a potentially-toxic discharge to *G. candida's* habitat could be high. Therefore, the magnitude and sensitivity combine to produce a major overall impact on habitat quality and quantity as a result of contamination, prior to the implementation of the recommended mitigation (Table 32).

The strict application of the recommended mitigation measures (Section 12.2) will reduce the risk, and thus the likely magnitude, of potential habitat contamination for the Mud Snail, reducing the overall impact significance to moderate.

**Table 32: Potential impacts in the construction phase to the Mud Snail**

| **Indicator of potential impact** | **Pre-mitigation** | | | **Post-mitigation (pre-offsets)** | | |
|---|---|---|---|---|---|---|
| | **Magnitude** | **Sensitivity of the Receptor** | **Significance** | **Magnitude** | **Sensitivity of the Receptor** | **Significance** |
| Habitat quality and quantity | High – 4 | High – 4 | Major - 16 | Negligible - 1 | High - 4 | Minor - 4 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts to the near-shore habitats of the CHAA, and hence potential local populations of Mud Snail. However, there is some uncertainty with regard to this species actually occurring in the CHAA. As such, the above assessment has been undertaken based on a precautionary approach.

The spatial extent of the near-shore habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1.1). The actual extent of possible habitat may have been over-estimated.

## *11.1.2.2 What impact could the construction of the Feeder line have on Grey Crowned Crane?*

The Grey Crowned Crane is an Endangered species. Up to 14 individuals were regularly recorded on the Buhuka flats during baseline surveys, and a pair of Grey Crowned Crane was observed on the Flats near Well

Pad 1 during social baseline survey work conducted in November 2017. The local population of Grey Crowned Crane is regarded as highly sensitive, and the wetlands of the CHAA are considered an important conservation unit for the species.

The construction of the Feeder line could directly impact Grey Crowned Crane breeding and foraging habitat, given that construction impacts on wetlands above the escarpment are expected (Section 10.1.1.2).

The potential direct, indirect and induced impacts of the construction of the Feeder line on Grey Crowned Crane are presented below.

### *Impact Indicators*

Indicators used to assess effects of the construction of the Feeder line on Grey Crowned Crane were: habitat quantity and quality, habitat connectivity, abundance and distribution, and survival and reproduction.

Habitat loss due to direct disturbance and clearing of habitat was assessed by calculating the loss of suitable habitat from the CHAA as a result of the construction of the Feeder line, consisting of a 30m construction right of way. Changes to habitat quality due to indirect disturbance were estimated by applying a 200m buffer to the pipeline footprint. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality caused by indirect disturbance arising from light, noise, vibration, and edge effects.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and loss of corridors. This was accomplished by visually examining the spatial distribution of critical habitat for Grey Crowned Crane in relation to the Feeder line to qualitatively identify areas where habitat becomes fragmented.

Potential changes in abundance and distribution, and survival and reproduction were assessed qualitatively by considering changes in disturbances (that is, vehicle traffic, light, noise, vibration) and site clearing activities. These disturbances were considered in light of known or inferred effects to the survival and reproduction of Grey Crowned Crane, where data on these types of effects are available.

### *Impact Assessment*

- Habitat Quality and Quantity

Grey Crowned Crane is distributed across eastern and southern Africa. Populations in many areas including Uganda have experienced rapid declines during the past 45 years (BirdLife International, 2018) for reasons including habitat loss to farming, human presence causing disturbance, collection of chicks for domestication, disruption of breeding activity, loss of roosting sites (large trees located remotely from areas frequented by humans) and dry-season fires in wetland habitats (Olupot, 2014). Its habitat preferences are diverse, including wetlands with tall emergent vegetation, open riverine woodland, shallowly flooded plains and temporary pools with adjacent grasslands, open savannas, croplands, pastures, fallow fields and irrigated areas (Archibald et al, 2018). It prefers short to medium height open grasslands adjacent to wetlands for foraging, which is consistent with the seasonally flooded grassland wetlands in the Buhuka Flats. For breeding, it prefers marshes with water 1 m deep and emergent vegetation 1 m above the water (Archibald et al, 2018); habitat which corresponds to the permanent wetlands of the Buhuka Flats. They are also often found foraging in agricultural land wherever available, in close proximity to the preferred mixture of wetlands and open grassland or savanna (Morrison, 2015).

Approximately 2.6 ha of wetlands, seasonal wetlands and riparian habitat along drainage lines will be directly affected by the construction of the pipeline, which is 0.13% of the total area of similar wetland and riparian habitat in the CHAA. In the context of available foraging and breeding habitat in the CHAA for Grey Crowned Crane, the direct losses are not substantial.

Although Grey Crowned Crane can tolerate a degree of anthropogenic disturbance in foraging habitat (e.g. in agricultural lands), in Ugandan wetlands it has been observed to be intolerant of human proximity within 100-200m (Olupot, 2014), flying away on approach; a factor which also affects breeding success as breeding birds flush from nests on approach, causing increased rates of predation, reduced time at the nest (either incubating or feeding), and ultimately nest abandonment. How tolerant foraging/roosting/breeding Grey Crowned Crane may be to indirect disturbances, such as noise, light, vibration and edge effects, is not known. The application of a 200m buffer around the 120 m length of the Feeder line that intercepts wetlands indicates that approximately 2.4 ha of wetland habitat will be reduced in quality as a result of sensory disturbance.

This equates to a total potential habitat loss in the CHAA from direct losses from vegetation clearing, and indirect losses from sensory disturbances and edge effects of up to 5 ha (0.43%).

Effects from loss of habitat are predicted to be beyond the expected range of natural disturbance perturbations (for example, fire), although not beyond the human-induced rate of degradation via cattle grazing pressure etc.

- Habitat Connectivity

The impact of the feeder line construction as a barrier to the movement of Grey Crowned Crane is likely to be adverse. The construction activity will create sensory disturbances in the short-term, which can elicit reduced use or complete avoidance of affected areas, thereby creating temporary movement barriers (for example, see Kolowski and Alonso 2009, Gleeson and Gleeson 2012). Construction of linear infrastructure (pipelines and service roads) through wetlands has the potential to create temporary barriers to movement as a result of the associated disturbance due to human presence in the area.

Impacts on habitat connectivity are predicted to be beyond the expected range of natural disturbance perturbations.

- Abundance and Distribution

Up to 14 individuals of Grey Crowned Crane were frequently observed on the Flats during the baseline fieldwork conducted in 2014, and a pair were observed in the same area during social baseline fieldwork conducted in November 2017. Grey Crowned Crane has potential to nest in wetland habitats and forage in the wetland/grassland/cultivated lands mosaic that occurs throughout the CHAA.

For the purposes of this assessment, it is assumed that Grey Crowned Crane is present in suitable habitat (permanent and seasonal wetlands) in the CHAA. The construction of the Feeder line is likely to generate increased levels of sensory disturbance in the locality, with resultant effects on habitat quality and the distribution of the species. Although significant losses of preferred seasonal grassland-type foraging habitat to the Feeder line construction right-of-way could affect the abundance and distribution of Grey Crowned Crane in the CHAA; the predicted potential habitat loss amounts to 5 ha or (0.43%) of similar habitat in the CHAA, which is miniscule in the context of the available foraging habitat for cranes, which includes wetlands and agricultural lands.

Effects on the abundance and distribution of Grey Crowned Crane are predicted to be beyond the expected range of natural disturbance perturbations.

- Survival and Reproduction

During the baseline fieldwork conducted in May 2014, the formation of breeding pairs of Grey Crowned Crane was indicated. Grey Crowned Crane nests are typically constructed within or on the edges of marshes with water of 1m depth and emergent vegetation 1m high (BirdLife International, 2018). Loss and disturbance of wetland habitat in the CHAA is expected to decrease the likelihood of Grey Crowned Crane selecting these areas for breeding.

Above the escarpment, migration into the area due to expectations about work on the construction projects could result in increased settlement in the CHAA. In the vicinity of the areas of permanent wetland, this could cause greater pressure on natural resources, including harvesting of reeds and an increased threat of discovery and removal of crane chicks for sale/domestication. Direct disturbance via human proximity within 100-200m causes breeding birds to flush from nests on approach (Olupot, 2014), which may result in increased rates of predation, reduced time at the nest, either incubating or feeding, and ultimately nest abandonment, affecting reproductive success. It is assumed for this assessment that indirect disturbances arising from mechanical noise, site lighting, vibration and edge effects during construction are also likely to affect the breeding success of Grey Crowned Crane in the CHAA.

Removal of large trees which have importance as night-time roosts and day-time shelter from the midday sun has been indicated in localised declines in Grey Crowned Crane in Uganda (Olupot, 2014); the loss of such trees during vegetation clearance for pipeline construction is therefore expected to have implications for the survival of flocks and individuals in the area.

These effects to the survival and reproductive success of Grey Crowned Crane are predicted to be well beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The Grey Crowned Crane sensitivity is high because it is Endangered.

Impacts to Grey Crowned Crane habitat quantity and quality will be adverse. The geographical extent of impacts will be local because effects are restricted to those areas within 200 m of the Production Facility infrastructure footprint, with approximately 0.36 ha (0.5%) of potential habitat being cleared, and 2.4 ha (3.47 %) of potential habitat indirectly affected. Impact duration will be short-term (that is, limited to the construction phase of the Project, approx. 10-12 months. Changes to the habitat quality and quantity from sensory disturbances arising from construction activities are expected to be reversible after completion of the works. The magnitude of the effects of construction on Grey Crowned Crane habitat quantity and quality is considered low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, because the magnitude of effects could be reduced to negligible, and the sensitivity of the receptor will remain the same (Table 14).

Impacts to Grey Crowned Crane habitat connectivity will be adverse. The geographical extent of impacts will be local because effects are restricted to the 30m construction right-of-way within which wetlands will be crossed by the feeder line. Impact duration will be short-term, as the pipeline will be buried and vegetation rehabilitated, and sensory disturbances arising from construction activities are expected to dissipate within a short time after completion of the construction phase. The magnitude of the effects of construction on Grey Crowned Crane habitat connectivity is considered to be low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the construction phase of the Feeder line, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, because the magnitude of effects could be reduced to negligible, and the sensitivity of the receptor will remain the same (Table 14).

Impacts to Grey Crowned Crane abundance and distribution will be adverse. The geographical extent of impacts will be local because effects are restricted to wetlands within 200m of the proposed feeder line construction right of way. Impact duration will be short-term (that is, limited to the construction phase of 10-12 months) because physical and sensory disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities. There is a possibility that individuals could be killed or severely disturbed during the construction phase (e.g. chicks on nests during clearance works); however, in the context of overall species abundance, these losses or disturbances are expected to be reversible after completion of the works. The magnitude of the effects of construction on Grey Crowned Crane abundance and distribution is thus considered low. Therefore, the magnitude and sensitivity combine to produce an impact of moderate significance during the construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, because the magnitude of effects could be reduced to negligible, and the sensitivity of the receptor will remain the same (Table 14).

Impacts to the survival and reproduction of Grey Crowned Crane will be adverse. The geographical extent of impacts will be local because effects are restricted to wetlands within 200m of the proposed feeder line construction right of way. Although physical and sensory disturbances arising from construction activities are expected to dissipate within a short time after cessation of activities, the effects of in-migration on Grey Crowned Crane are expected to be permanent, once households/settlements are established. The likelihood of impacts is uncertain (it is not known whether there are any breeding pairs of the crane in the permanent wetlands of the CHAA above the escarpment and the extent of migration into the area cannot be determined with certainty). A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is considered unlikely that this number of individuals in the CHAA will be affected. The magnitude of the effects of construction on the survival and reproduction of the Grey Crowned Crane is considered to be medium. The magnitude and sensitivity combine to produce a major overall impact level during the construction phase of the Project, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to decrease to moderate, because the magnitude of impact will be reduced to low, and the sensitivity of the receptor will remain the same (Table 33).

**Table 33: Potential construction phase impacts to Grey Crowned Crane**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Low – 2 | High – 4 | Moderate - 8 | Negligible - 1 | High – 4 | Minor – 4 |
| Habitat connectivity | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor – 4 |
| Abundance and distribution | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor – 4 |
| Survival and reproduction – direct construction effects e.g. mortality | Low – 2 | High – 4 | Moderate - 8 | Negligible - 1 | High – 4 | Minor – 4 |
| Survival and reproduction – population influx | Medium | High – 4 | Major - 12 | Low – 2 | High – 4 | Moderate - 8 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts on the Grey Crowned Crane and its habitat in the CHAA.

The spatial extent of the wetland habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.1). The actual extent of possible habitat may have been over-estimated.

### *11.1.2.3 What impact could the construction of the Feeder line have on Nahan's Francolin?*

Nahan's Francolin is a Vulnerable and range-restricted species. It has a very restricted distribution, being found only in north-east DRC and western and south-central Uganda; in particular, the forests of Budongo, Bugoma and Mabira (McGowan and de Juana 1994). In the CHAA, it is restricted to the Bugoma Central Forest Reserve. It triggers Tier 2 critical habitat under Criterion 2 (Section 9.0, Appendix G).

Tier 2 habitats are considered to be sensitive, and, therefore, if a project is located in such a habitat, the IFC considers that compliance with the provisions of paragraph 17 of PS 6 (IFC 2012a) would be difficult. In summary, a project will not be developed in Tier 2 habitat unless: no other viable alternatives exist; and, the project does not lead to measurable and irreversible adverse impacts to the valued component that triggered critical habitat; and, the project does not lead to a net reduction in the global and/or national/regional population of the triggering species (such as Nahan's Francolin) over a reasonable period of time; and, a robust, appropriately designed, and long-term biodiversity monitoring and evaluation programme is part of the project's Environmental and Social Management System (ESMS). A Biodiversity Action Plan (BAP) will then be developed to achieve net gain for the affected species.

It is expected that the construction of the Feeder line will not have direct impacts to Bugoma CFR; its nearest point will be at least 1,8 km from the pipeline, and therefore no direct impacts on Nahan's Francolin are predicted. However, the indirect impacts of population influx, due to expectations of work on the construction contract, are considered since this could impact on the forest reserve and subsequently Nahan's Francolin.

### *Impact Indicators*

As the pipeline will be at least 1.8 km from the Bugoma CFR boundary, no effects on habitat connectivity are predicted. Therefore, the indicators used to assess effects of the population influx associated with the construction of the feeder line on Nahan's Francolin were: habitat quantity and quality, abundance and distribution, and survival and reproduction.

Potential changes in habitat quantity and quality, abundance and distribution, and survival and reproduction were assessed qualitatively by considering changes in disturbances arising from increased human presence in the CHAA. These disturbances were considered in light of known or inferred effects to the survival and reproduction of buttonquail species for which data on these types of effects are available.

### *Impact Assessment*

- Habitat Quality and Quantity

This species is confined to dense, mature, moist, sometimes swampy medium-altitude forest below 1,500 m (McGowan and de Juana 1994, BirdLife International 2014i); and is reasonably common in Budongo Central Forest Reserve (Plumptre et al. 2010, 2011). Suitable habitat was predicted to cover an area of ~35,201 ha (352 $km^2$) in the CHAA, principally in the Bugoma Central Forest Reserve. No direct losses or impacts on the quantity of habitat suitable for Nahan's Francolin are predicted as a result of the construction of the feeder line. However, indirect effects on habitat quality and quantity may arise as a result of human-induced disturbance associated with population influx to the region,

The Nahan's Francolin's degree of vulnerability to disturbance is unknown. Birds are known to be sensitive to land use and habitat alteration (Lussier et al. 2006). The behavioural response of species to disturbance will depend on species-specific tolerance levels, disturbance type and frequency, group size for socially-foraging animals, and local conditions, such as the availability of alternative foraging sites (Madsen 1998). A reduction in habitat quality and quantity may have conservation implications and consequences for the population of this species.

The construction phase of the feeder line, as a component of the Project, could result in an influx of people into the CHAA seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma Central Forest Reserve will put pressure on the forest. These pressures could manifest in increased rates of habitat alteration and deforestation. Nahan's Francolin is a shy, forest-dependent species (Sande et al. 2009a) and thus is also probably sensitive to disturbance arising from deforestation/human presence in the forest; individuals may avoid the resultant sub-optimal habitat. These factors could combine to reduce the habitat quality and quantity for Nahan's Francolin.

Effects from reductions in habitat quality are predicted to be beyond the expected range of natural disturbance perturbations, although not beyond the baseline rate of direct loss as a result of the human induced deforestation rate.

- Abundance and Distribution

Although the pipeline will be at least 1.8 km from the Bugoma CFR boundary, the indirect impacts of population influx to the CHAA, due to expectations of work or opportunities generated during construction of the pipeline, could ultimately affect the abundance and distribution of Nahan's Francolin in the CHAA.

The construction of the pipeline, as a component of the overall Project, could result in an influx of people into the area seeking jobs and/or opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma CFR and within the CFR itself will exacerbate existing pressures on the forest. These pressures are likely to manifest in increased rates of bush meat hunting and habitat alteration, which could reduce the abundance and distribution of Nahan's Francolin in Bugoma CFR. Although this species within the forest is reported to be relatively common (*viz.*, Plumptre et al. 2011), the distribution of individuals within this habitat is unknown. For the purposes of this assessment, it is assumed that the current distribution of this species is evenly spread within suitable habitat in the Bugoma Central Forest Reserve.

Effects from the population influx to the CHAA associated with the construction of the pipeline are predicted to be beyond the expected range of natural disturbance perturbations, although not beyond the baseline disturbance levels from the human-induced deforestation rate.

- Survival and Reproduction

The Nahan's Francolin's degree of vulnerability to direct disturbance, particularly during the breeding season, is not well understood. Nahan's Francolin is reliant upon large trees, with appropriate buttress formation, for breeding sites (Sande et al. 2009a). No direct losses or impacts on breeding habitat suitable for Nahan's Francolin are predicted as a result of the construction of the feeder line. However, indirect effects on habitat quality and quantity may arise as a result of human-induced disturbance associated with population influx to the region.

How tolerant the Nahan's Francolin may be to indirect disturbances during the breeding season, are not completely understood. What is known is that disturbance of mature forest generally appears to reduce the home range of this species (Sande et al. 2009b), and hence its potential to find suitable mates. Generally, for birds, the behavioural response of species to disturbance will depend on species-specific tolerance levels, disturbance type and frequency, group size for socially-foraging animals, and local conditions such as the availability of alternative breeding sites (Madsen 1998). Many studies have reported a reduction in breeding success attributable to human disturbance (for a review, see Hill et al. 1992). Mechanisms include: increased rates of predation, nest abandonment and reduced time at the nest, either incubating or feeding. Clearly, a reduction in breeding output may have conservation implications and consequences for the local population of Nahan's Francolin.

The construction of the pipeline, as a component of the overall Project, could result in an influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma CFR and within the CFR itself will exacerbate existing pressures on the forest. These pressures could manifest in increased rates of bush meat hunting and habitat alteration, which could reduce the survival and reproductive success of Nahan's Francolin. Assuming it is sensitive to sensory disturbance because it is a shy, forest-dependent species (Sande et al. 2009a), the disturbance generated by increased human presence in Bugoma CFR could further affect the breeding success of those individuals living in close proximity to the boundaries of Bugoma CFR in particular.

These effects to the survival and reproductive success of Nahan's Francolin are predicted to be well beyond the expected range of natural disturbance perturbations, although not beyond the current, baseline human-induced deforestation rate.

### *Impact Classification*

The Nahan's Francolin's sensitivity is high because it is range-restricted and triggers Tier 2 critical habitat.

Impacts to the Nahan's Francolin's habitat quantity and quality will be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term (that is, extending far beyond the pipeline construction period of 10-12 months), as once settlements created by migrants to the area become established, they may be difficult to reverse. The magnitude of the impact of population influx associated with the pipeline construction on the habitat quantity and quality of the Nahan's Francolin is expected to be low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the construction phase of the feeder line, pre-mitigation (**Table 34**). Following the application of appropriate mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (**Table 34**).

Impacts to the Nahan's Francolin's abundance and distribution could be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term (that is, extending far beyond the pipeline construction period of 10-12 months), as once settlements created by migrants to the area become established, they may be difficult to reverse. There is a possibility that as a result of influx during the construction phase, the distribution and abundance of Nahan's Francolin in Bugoma CFR could be affected. The magnitude of the effects of population influx associated with pipeline construction on the abundance and distribution of the Nahan's Francolin is Low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level, pre-mitigation (**Table 34**). Following the application of site-specific mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (**Table 34**).

Impacts to the survival and reproduction of Nahan's Francolin could be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term (that is, extending far beyond the pipeline construction period of 10-12 months), as once settlements created by migrants to the area become established, they may be difficult to reverse. No direct effects on breeding habitat or direct species mortalities are anticipated as a result of pipeline construction; however indirect effects arising from sensory disturbance and poaching associated with population influx to Bugoma CFR could result in the injury, mortality and reduced breeding success of some individuals. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is expected that this number of individuals in the local population within Bugoma Central Forest Reserve will not be affected by the indirect impacts of pipeline construction. The magnitude of the effects of construction on the survival and reproduction of the Nahan's Francolin is therefore low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the pipeline construction phase of the Project, pre-mitigation (**Table 34**).

Following the application of site-specific mitigation measures, the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same (**Table 34**).

**Table 34: Potential impacts in the construction phase to the Nahan's Francolin**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |
| Abundance and distribution | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |
| Survival and reproduction | Low – 2 | High – 4 | Moderate – 8 | Negligible – 1 | High – 4 | Minor – 4 |

## Prediction Confidence

Given the information available, there is a reasonable understanding of the potential direct, indirect and induced impacts that the operation of the feeder line could have on the Nahan's Francolin and its habitat in the CHAA.

The spatial extent of the dense forest habitat in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.1.1). The actual extent of possible habitat may have been over-estimated.

#### 11.1.2.4 What impact could the construction of the Feeder line have on Eastern Chimpanzee?

The Eastern Chimpanzee is an Endangered species. The population of Eastern Chimpanzees in the Bugoma CFR is recognised as being one for the four largest in the region (Plumptre et al. 2010). Hence, the forest is recognised as an important chimpanzee conservation unit by the IUCN (Plumptre et al. 2010).

This species triggers Tier 1 critical habitat (Section 6.3.2.2, Appendix G). Tier 1 habitats are considered to be very sensitive, and, therefore, if a project is located in such a habitat, the IFC considers it unlikely that the client will be able to comply with the provision of PS 6, in particular paragraphs 17, 18 and 19 (IFC 2012a, as presented in Appendix C). In summary, a project will not be developed in Tier 1 habitat unless: no other viable alternatives exist; and, the project does not lead to measurable and irreversible adverse impacts to the valued component that triggered critical habitat; and, the project does not lead to a net reduction in the global and/or national/regional population of the triggering species (i.e. Eastern Chimpanzee) over a reasonable period of time; and, a robust, appropriately designed, and long-term biodiversity monitoring and evaluation programme is part of the project's Environmental and Social Management System (ESMS). A Biodiversity Action Plan (BAP) will be developed to achieve net gain for the affected species.

Bugoma Central Forest reserve (Bugoma CFR) will not be directly affected by pipeline construction, which at its nearest point will be at least 1,8 km from the Bugoma CFR boundary. The indirect impacts of population influx, due to expectations of work on the construction contract, are considered since this could impact on the forest reserve, and the population of Eastern Chimpanzee that lives there.

##### Impact Indicators

As the pipeline will be at least 1.8 km from the Bugoma CFR boundary, no effects on habitat connectivity during operation are predicted. Therefore, the indicators used to assess effects of the population influx associated with the operation of the feeder line on Eastern Chimpanzee were: habitat quantity and quality, abundance and distribution, and survival and reproduction.

Potential changes in habitat quantity and quality, and abundance and distribution, were assessed qualitatively by considering changes in disturbances arising from increased human presence in the CHAA. These disturbances were considered in light of known or inferred effects to the survival and reproduction of other populations of chimpanzees for which data on these types of effects are available.

To assess effects to survival and reproduction as a result of in-migration and potential associated increases in poaching and disease spread, in-migration rates were assessed based on the data presented in the social impact assessment. A literature review of the impact of contact with humans was also conducted.

##### Impact Assessment

- Habitat Quality and Quantity

The entire Bugoma Central Forest Reserve is considered suitable habitat for Eastern Chimpanzees, as well as the areas beyond the boundaries of the forest reserve (see McLennan 2008). However, for the intents of this impact assessment, the habitat within and immediately surrounding the Bugoma Central Forest Reserve was only considered.

The potential for the construction of the feeder line (as a component of the overall Project) to be attractive for people seeking opportunities could result in a substantial increase the current population around the Bugoma Central Forest Reserve. An increasing human population could lead to an increase in the demand for agricultural and timber resources, resulting in increased rates of habitat alteration and deforestation, which, in turn could further fragment, change, and degrade Bugoma CFR and surrounding habitat, resulting in reduced habitat quantity and quality for Eastern Chimpanzee.

The degree of vulnerability to disturbance experienced by chimpanzees is reasonably well known (for example, see Parren and Byler 2003, Rabanal et al. 2010, Thompson and Wrangham 2013). The chimpanzees living in and around the Bugoma Central Forest Reserve most likely experience sensory disturbances at present from human activities, given the high human populations living around the reserve. Indeed, groups are known to forage in the agricultural fields surrounding the forest, and hence, would more than likely be used to human noises and disturbances (McLennan 2008). As such, the potential sensory disturbances arising from population influx associated with the construction of the pipeline are likely to be minimal. Nevertheless, the magnitude of noise may not be the most important determinant of chimpanzee response. Instead, chimpanzees may respond to 'new' noises or may associate particular noises with other occurrences (for example, machine noise may be associated with human presence, which chimpanzees may, in turn, associate with the presence of danger). Where humans pose a threat, chimpanzees generally avoid them (Hockings and Humle 2009, Parren and Byler 2003). Therefore, the degree of avoidance may depend on the behaviour of people, resulting in varying levels of indirect effects on the quality of available habitat for Eastern Chimpanzee, and highlighting the importance of managing contractor activity during construction.

Effects from the reduced habitat quantity and quality during construction are predicted to be beyond the expected range of natural disturbance perturbations.

- Abundance and Distribution

The Bugoma Central Forest Reserve supports one of the top four Eastern Chimpanzee populations in Uganda, with a population of between 450 and 850 individuals (Plumptre et al. 2010). Given its distance from the forest, the construction of the feeder line is not expected to detrimentally affect the abundance or distribution of chimpanzees in the forest directly.

However, the construction of the feeder line could influence influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population both within and in the area surrounding Bugoma CFR, will put pressure on the forest. These pressures could manifest in increased rates of bush meat hunting, and reduced habitat availability due to human disturbance, which could affect the abundance and distribution of Eastern Chimpanzee within Bugoma CFR.

Effects are predicted to be beyond the expected range of natural disturbance perturbations.

- Survival and Reproduction

In-migration of people seeking opportunities associated with the construction of the feeder line may adversely affect survival and reproduction of chimpanzees through poaching and disease transfer. Hunting and poaching is a recognised threat to chimpanzees in Bugoma Central Forest Reserve (Plumptre et al. 2003), and this pressure could increase as in-migration of people from other areas occurs. Mitigation and management of in-migration (see Golder Associates 2018) will be very important to minimise potential effects on chimpanzees and other fauna species.

Disease is one of the major threats to Eastern Chimpanzees (Oates et al. 2008); increased abundance of people and competition for land and food resources between humans and chimpanzees could lead to higher rates of disease spread from humans to chimpanzees. Chimpanzees are closely related to humans; therefore, many diseases are transferrable between chimpanzees and humans (Formenty et al. 2003; Isabirye-Basulta and Lwanga 2008). Either direct or indirect contact with humans can spread disease. For example, there is evidence to suggest that respiratory illnesses have been transferred directly to chimpanzees from humans as a result of researcher and tourist contacts, often leading to outbreaks and death (Formenty et al. 2003). Human defecation in forest undergrowth can indirectly lead to spread of intestinal diseases, such as *Clostridium perfringens*, which can be fatal to chimpanzees (Fujita 2011). As forest fragments decrease in size, risks of contact with, and transmission of, disease from humans increases (Isabirye-Basulta and Lwanga 2008). Factors that lead to increased crop raiding or sharing of water resources can also increase the risk of disease spread (Hockings and Hulme 2009). As identified in the social impact assessment, communicable respiratory diseases are a significant concern in the LSA; as such there is a risk of loss of Eastern Chimpanzee individuals due to transmission of diseases as a result of construction-phase population influx.

What effect the loss of individuals from the population could have is unknown. It is doubtful that the population could be reduced by 10% and hence, reach that critical population threshold due to population influx associated with the pipeline alone, nevertheless the potential impacts are predicted to be beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The Eastern Chimpanzee's sensitivity is high because it is Endangered.

Impacts to the Eastern Chimpanzee's habitat quantity and quality will be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term (that is, extending far beyond the pipeline construction period of 10-12 months), as once settlements created by migrants to the area become established, they may be difficult to reverse. The amount of influx that could be specifically attributed to the construction of the feeder line is expected to be low, therefore the magnitude of the effects of construction on the habitat quantity and quality of the of the Eastern Chimpanzee is expected to be low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operation phase of the feeder line, to the application of Project-specific mitigation measures (Table 41). Following the application of the recommended mitigation measures (Section 11.0), the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same.

Impacts to the Eastern Chimpanzee's abundance and distribution could be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term (that is, extending far beyond the pipeline construction period of 10-12 months), as once settlements created by migrants to the area become established, they may be difficult to reverse. Given its distance from the forest, the operation of the feeder line is not expected to affect the abundance and distribution of Eastern Chimpanzee in Bugoma CFR, however the Project-associated population influx has the potential to generate impacts. The amount of influx that could be specifically attributed to the construction of the feeder line is expected to be low, therefore the magnitude of the effects of construction on the abundance and distribution of the Eastern Chimpanzee in Bugoma CFR is low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operation phase of the feeder line, to the application of Project-specific mitigation measures (Table 41). Following the application of the recommended mitigation measures (Section 11.0), the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same.

Impacts to the survival and reproduction of the population of Eastern Chimpanzee in Bugoma Central Forest Reserve could be adverse. The geographical extent of impacts will be national because effects could extend well beyond the CHAA. Impact duration will be long-term (that is, extending far beyond the pipeline construction period of 10-12 months), as once settlements created by migrants to the area become established, they may be difficult to reverse. There is a possibility that individuals could be killed or severely disturbed as a result of Project-related population influx during the operation phase. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is expected that this number of individuals in the local population within Bugoma Central Forest Reserve could be affected through direct mortality from bush meat hunting or other disturbance. However, the amount and intensity of influx that could be specifically attributed to the construction of the feeder line is expected to be low, therefore the magnitude of the effects of construction on the survival and reproduction of the Eastern Chimpanzee is expected to be low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level during the operation phase of the feeder line, prior to the application of Project-specific mitigation measures (Table 41). Following the application of the recommended mitigation measures (Section 11.0), the impact significance is expected to decrease to minor, primarily because the magnitude could become negligible, although the sensitivity of the receptor will remain the same.

**Table 35: Potential impacts in the construction phase to the Eastern Chimpanzee**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Low - 2 | High – 4 | Moderate - 8 | Negligible - 1 | High – 4 | Minor - 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Abundance and distribution | Low - 2 | High – 4 | Moderate - 8 | Negligible - 1 | High – 4 | Minor - 4 |
| Survival and reproduction | Low - 2 | High – 4 | Moderate - 8 | Negligible - 1 | High – 4 | Minor - 4 |

#### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential direct, indirect and induced impacts that the construction of the feeder line could have on the Eastern Chimpanzees and their habitat in the CHAA.

The spatial extent of the dense forest habitat in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1.1). The actual extent of possible habitat may have been over-estimated.

## 11.2 Operation Phase Impacts

For the assessment of impacts during the operations phase, the key questions were divided into sub-questions that focused on individual valued components within the CHAA and LSA. In answering each question, the individual components of the Project were considered with regards to their potential to affect a valued component. These questions are presented below.

### 11.2.1 What impact could the operation of the Feeder line have on habitats and ecosystem integrity?

This section presents the assessment of impacts that the operation of the Project could have on the habitat and ecosystem integrity within the CHAA and the LSA. These habitats either do, or could, support populations of species of concern. Therefore, the assessment of potential impacts to those species, and others, occurring in the CHAA has been assessed in this section through the determination of the impacts to potential habitat for those species.

The impacts of the Project on critical habitat, as triggered by species of concern, are covered under the individual assessment of those species in Section 10.2.2. Other triggers of critical habitat are discussed as relevant in the appropriate sections.

As discussed, construction-phase rehabilitation measures should return the site to a grassed, herbaceous vegetation cover similar to open grassland-type habitats that occur in the escarpment vegetation corridor at baseline. Ongoing recovery of vegetation cover from the initial construction-phase habitat losses, and associated edge effects, risk of alien invasive vegetation spread are considered in the construction phase impact assessment (Section 11.1.1). Operation phase impacts of the feeder line on habitats and ecosystem integrity are therefore limited to those caused by new components and activities, including:

- Maintenance activities particularly clearance of woody vegetation with roots that could damage the pipeline beneath;
- The presence of the heated pipeline approximately 1.0 m beneath the surface; and
- The effect of ongoing in-migration into the CHAA in response to the expectation of job opportunities.

#### *11.2.1.1 What impact could the operation of the Feeder line have on the escarpment vegetation corridors?*

#### *Impact Indicators*

Indicators used to assess impacts of the Feeder line on the habitat and ecosystem integrity of the vegetation corridors on the escarpment were changes in: regional representativeness; ecosystem composition, and ecosystem configuration.

Literature was reviewed to understand the long-term direct impacts of pipelines through natural habitats. Indirect affects to habitat were estimated by applying a 0.50 km buffer to the pipeline route. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by edge effects, fragmentation, sensory disturbance, changes in water quantity and quality, and air emissions and dust.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential changes in species composition that could occur over the life of the Project, and the disruption of known corridors. This was accomplished by examining available literature about the ecology of the vegetation communities on the escarpment, and scientific literature about the impacts of human activities on corridors in the long-term.

### *Impact Assessment*

- Representativeness

The CHAA supports approximately 2443 ha of escarpment corridor vegetation communities (see Section 6.3.1.1.2), which are bounded on the east by agriculturally modified landscapes, and the Buhuka Flats on the west. As mentioned, these vegetation communities form part of a contiguous vegetation corridor that is part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor (Plumptre et al. 2003) (see Section 6.3.1.2.1). Therefore, their continuous extent represents an important landscape feature in the CHAA.

Indirect effects on the representativeness of the escarpment vegetation communities during operation are expected as a result of the ongoing effects of population influx to the region. The presence of a relatively-easy to navigate, grassed linear feature through the escarpment vegetation corridor is likely to facilitate access to other areas of the escarpment vegetation communities for timber harvest and livestock grazing on accessible slopes, resulting in habitat loss and degradation in the vicinity, affecting the representativeness of this section of the escarpment vegetation corridor in the landscape.

Impacts from the changes to representativeness are predicted to be less than those experienced during the construction phase because temporary construction areas will be rehabilitated. Nevertheless, the potential for renewed reduction in habitat extent and condition during operation as a result of population influx in the area is predicted to be beyond the expected range of natural disturbance perturbations.

- Ecosystem composition

The construction phase rehabilitation measures should return the corridor to a vegetation cover similar to baseline vegetation communities that are suitable for establishment over the underground pipeline (i.e. communities that lack large trees, such as open grassland). Ongoing maintenance will be conducted throughout the operational lifetime of the pipeline to ensure that shrubs and trees, whose roots could potentially damage or penetrate the buried pipeline, do not establish on the surface directly above the pipeline, and is likely to extend to 10 m either side of the buried pipeline route, meaning that the climax vegetation community achievable for this area will be open grassland.

The pipeline will be buried to 1.0 m depth and it will be heated to 80°C. There is a potential for the heated pipeline to warm the soil overhead, which could influence the dominant type of flora species in the grass/herbaceous layer on the surface. For example, drought-tolerant or xerophytic species could dominate species that require seasonally-cold periods for dormancy, or species that require more moisture, affecting the ecosystem composition of vegetation communities and associated faunal guilds (e.g. invertebrates). However, the insulation surrounding the pipeline is expected to prevent any significant heating of the soils surrounding it, and associated potential impacts.

Ongoing migration into the CHAA are expected to increase existing pressures on escarpment vegetation communities, through harvest of woody resources for timber and fuel, overgrazing, and hunting fauna for bushmeat. Overgrazing pressures could result in shifts in vegetation community composition to more hardy species, whilst hunting pressure would further reduce the remaining mammalian fauna on the escarpment within the CHAA. Birds and other faunal community composition may also change due to hunting and a deterioration in cover.

Impacts from the long-term changes to ecosystem composition are predicted to be less than those experienced during the construction phase because temporary construction areas will be rehabilitated, but still beyond the expected range of natural disturbance perturbations.

- Ecosystem configuration

The wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor is recognised as being important for threatened species in the face of climate change adaptation (Ayebare et al. 2013), and as part of a much broader set of corridors running the length of the Albertine Rift. This corridor in the southern portion of the eastern shores of Lake Albert, in the vicinity of the Project, is very narrow compared to its extent elsewhere, and is recognised as being important for savannah species (Plumptre et al. 2010). The corridor is recognised as an important climate change refugium for a range of threatened species, which may become increasingly important for those species in the future (Ayebare et al. 2013), that is, within the life time of the Project.

The feeder line will be buried and rehabilitated following construction, and rehabilitation measures should return the site to a vegetation cover similar to baseline vegetation communities that are suitable for establishment over the underground pipeline. During operation, the pipeline is therefore not expected to be a significant barrier for species that could use the escarpment vegetation as a wildlife corridor, such as large ungulates, predators, primates (all of which are very rare in the area in any case), and birds.

Therefore, no significant changes to ecosystem configuration of the escarpment vegetation communities as a result of the long-term operation of the pipeline are predicted.

### *Impact Classification*

The vegetation community of the escarpment's sensitivity is medium because, although these habitats are already under stress from livestock grazing and harvesting of fuel wood and non-timber forest products, they form part of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor.

Impacts to the representativeness of the habitat will be negative because the indirect effects of population influx to the region are likely to result in further loss and degradation of escarpment vegetation communities, in particular in the vicinity of the short-stretch of easily traversed, grassed pipeline route. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be medium-long term because the pipeline will remain in place throughout the project lifetime. The magnitude of the impacts of operation on representativeness of the vegetation communities of the escarpment is low, given the extent of the area in question. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level to representativeness during the operational phase of the Project, pre-mitigation (Table 36). Following the application of appropriate mitigation measures during operation, the impact significance could remain moderate, as the effects of population influx on the escarpment vegetation community extent and condition in the vicinity of the pipeline. may be difficult to mitigate.

Impacts to the ecosystem composition will be adverse in the long-term, because any re-establishing woody vegetation species will be cleared from the pipeline, and the vegetation community may shift to more heat/drought-tolerant species. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be medium-term (that is, ~25 years) because the pipeline will remain in place throughout the project lifetime. The magnitude of the impact on ecosystem composition is low, as although the woody species will be removed, and the vegetation community may see a shift to more heat tolerant species, the re-established grass and herbaceous vegetation layer will remain. Therefore, low magnitude and medium sensitivity combine to produce a moderate overall impact level to ecosystem composition during the operational phase of the Project, pre-mitigation (Table 36). Following the application of appropriate mitigation measures, the impact significance is expected to become minor, as the magnitude will become negligible, while the sensitivity of the receptor will remain the same.

Impacts to the ecosystem configuration will be neutral, as the buried and rehabilitated pipeline will not present a significant barrier to movement for faunal species using the escarpment vegetation corridor. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be medium-term (that is, ~25 years) because the pipeline will remain in place throughout the project lifetime. The magnitude of the impact on ecosystem configuration is therefore negligible, and combines with medium sensitivity to produce a minor overall impact level to ecosystem composition during the operational phase of the Project (Table 36), and no further mitigation measures are required.

**Table 36: Potential impacts in the operation phase of the Feeder line to the vegetation communities of the escarpment**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Representativeness | Low – 2 | Medium – 3 | Moderate - 6 | Low – 2 | Medium – 3 | Moderate - 6 |
| Ecosystem composition | Low – 2 | Medium – 3 | Moderate - 6 | Negligible – 1 | Medium – 3 | Minor - 4 |
| Ecosystem configuration | Negligible – 1 | Medium – 3 | Minor - 4 | Negligible – 1 | Medium – 3 | Minor - 4 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Feeder line-related impacts to the vegetation communities of the escarpment, and the wildlife corridors of which they form part. However, there is some uncertainty with regards to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future is uncertain. Indications are that they will increase in importance (Ayebare et al. 2013), provided human pressures do not overwhelm them.

The spatial extent of habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1.1). The actual extent of possible habitat may have been over-estimated.

## *11.2.1.2 What impact could the operation of the Feeder line have on wetlands and riparian habitat in the CHAA?*

### *Impact Indicators*

Indicators used to assess impacts of the Feeder line on the habitat and ecosystem integrity of the wetland and riparian habitats in the CHAA were changes in: regional representativeness; ecosystem composition; and ecosystem configuration.

Literature was reviewed to understand the long-term direct impacts of pipelines through natural habitats. Indirect affects to habitat were estimated by applying a 200 m buffer to the pipeline route. Specifically, the buffer was selected to account for changes in habitat quantity and/or quality that could be caused by edge effects, fragmentation, sensory disturbance, and changes in water quantity and quality.

Changes in habitat composition and ecosystem configuration were assessed by identifying potential changes in species composition that could occur over the life of the Project, and the disruption of wetland and riparian systems. This was accomplished by examining available literature about wetland ecology, and scientific literature about the impacts of human activities on wetland systems in the long-term.

### *Impact Assessment*

- Representativeness

The CHAA supports approximately 1157.9 ha of wetlands, and 840 ha of riparian vegetation communities associated with drainage lines and riparian systems, of which, approximately 2.6 ha will have been directly affected by construction activity.

During operation, no additional direct effects on the extent and/or condition of wetland and riparian habitats are predicted. However, indirect effects on the representativeness of the wetland and riparian habitats during operation are expected, as a result of the ongoing effects of population influx to the region. Knock-on effects on the ecological integrity and resilience of the wetlands are predicted, as increased levels of livestock grazing, harvest of reeds and grasses for home construction, and conversion of wetland and riparian habitats for subsistence cropping are likely to occur.

The construction phases losses of habitat are expected to be partially recovered because the pipeline will be buried and rehabilitated following construction. Rehabilitation measures should return the affected areas to a vegetation cover similar to that that was there before the pipeline was constructed.

Impacts from the changes to representativeness are predicted to be less than those experienced during the construction phase because temporary construction areas will be rehabilitated. Nevertheless, the potential for renewed reduction in habitat extent and condition during operation as a result of population influx in the area is predicted to be beyond the expected range of natural disturbance perturbations.

- Ecosystem Composition

The presence of linear infrastructure, such as pipelines, through wetlands is known to have detrimental impacts on the functioning, processes and species composition of these communities (Roise et al. 2004). Buried pipelines passing through wetlands may result in losses of biodiversity at local and downstream scales largely due to changes in geomorphological properties and interruption in hydrological regimes, which could affect the maintenance of flow to wetland areas downstream of the crossing, or result in increased erosion potential around the buried pipeline. Alteration of wetland structure and composition could occur if flow paths for water, both surface and sub-surface, are not maintained. If these flow paths are not maintained throughout the operational lifetime of the project, there is a potential that the wetland community downstream of the obstruction could become altered – typically via flow concentration and channel incision in downstream wetlands that were previously supplied by diffuse, dispersed flows. The risk of incised drainage and associated loss of wetland function due to concentration of water flows may be relatively low, assuming that the construction mitigation measures were successfully applied.

The pipeline will be buried to 1.0 m depth and it will be heated to 80°C. The heated pipeline has the potential to warm the wetland and riparian habitat in its immediate vicinity, which could influence the moisture regime of some habitats (particularly seasonal wetlands) and associated flora and fauna community composition, albeit on a very localised basis.

Although the feeder line will have been buried and rehabilitated following construction, and rehabilitation measures should return the corridor to a vegetation cover similar to baseline vegetation communities; the likely intensification in use of the wetlands as the human population of the region increases could generate indirect impacts on wetlands. Existing sanitary conditions in the CHAA are poor, with all of the streams being contaminated with faecal waste from both animals and humans ( Social Impact Assessment). The wetland communities in the CHAA are already under pressure from livestock grazing, and harvesting of fibre for house construction. It is likely that these communities will become degraded in the long-term as the human population of the region increases. Such changes would alter the habitat structure and vegetation community composition of the wetland and riparian habitats in the CHAA, which, in turn, could affect the utilisation of these habitats by the currently resident faunal species guilds (e.g. the Endangered Grey Crowned Crane).

Impacts from the changes to ecosystem composition of wetland and riparian habitats are predicted to be less than those experienced during the construction phase, because temporary construction areas will be rehabilitated. Nevertheless, the potential for renewed reduction in habitat extent and condition during operation as a result of population influx in the area is predicted to be beyond the expected range of natural disturbance perturbations.

- Ecosystem configuration

Linear infrastructure such as pipelines can present significant barriers to, or can alter behaviours of, a range of wetland wildlife, from: amphibians (for example, Pontoppidan et al. 2013); to turtles (for example, Langen et al. 2012).

Although the feeder line will cross currently contiguous wetlands and riparian habitats in the LSA, it will be buried and rehabilitated following construction, and rehabilitation measures should eventually return the affected areas to a vegetation cover similar to baseline vegetation communities. During operation, the pipeline is not expected to represent a significant barrier to movement, or break in habitat connectivity, for wetland and riparian faunal species.

Therefore, no significant changes to ecosystem configuration of the wetland and riparian habitats as a result of the long-term operation of the pipeline are predicted.

### *Impact Classification*

The sensitivity of wetlands and riparian habitats is high, because permanent and seasonal wetlands are important breeding and foraging habitat for Grey Crowned Crane, a species of concern; and wetlands are susceptible to degradation as a result of changes in water flow patterns brought about by infrastructural developments. The habitats are also already under stress from livestock grazing and harvesting of fibre. This high sensitivity is weighed against the magnitude of each of the impacted indicators as described in the paragraphs below, in order to derive the overall impact level for each indicator.

- Representativeness

Impacts to the representativeness of the habitat will be adverse because the indirect effects of population influx to the region are likely to result in further loss and degradation of wetland and riparian habitat. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be medium-long term because the pipeline will remain in place throughout the project lifetime. The magnitude of the impacts of operation on representativeness of the wetland and riparian habitats is low, given the extent of the potentially-affected areas in question. In the context of high wetland sensitivity, this results in impacts of moderate significance.

Following the application of appropriate mitigation measures, the impact significance could remain moderate, as the effects of population influx on the extent and condition of wetland habitats in the vicinity of the pipeline. may be difficult to mitigate.

- Ecosystem Composition

Impacts to the ecosystem composition will be adverse. The geographical extent of impacts will be local because impacts are restricted to the LSA. Impact duration will be for the duration of operation (~25 years). The magnitude of the different project-specific impacts on ecosystem composition varies, as discussed under each of the subheadings below.

Impacts to the ecosystem composition arising from the heated pipeline could be adverse in the long term, as the wetland vegetation community in its direct vicinity may be affected. The geographical extent of impacts will be highly localised with impacts restricted to the direct vicinity of the buried pipeline. Impact duration will be medium-term, lasting throughout the operational lifetime of the project. The magnitude of the impact on ecosystem composition is negligible because, although localised changes to the floral and faunal community composition could occur, the extent of the potentially affected area is small, and the likelihood of any significant changes in the wetland or riparian community composition is considered very low. Therefore, the magnitude and high sensitivity of the wetlands combine to produce a minor overall impact level to ecosystem composition during operation of the feeder line, and no project-specific mitigation measures are required (Table 37).

The ongoing in-migration to the CHAA is likely to result in increased human use of wetlands in the CHAA. In the absence of project interventions, the impact of increased population density (and associated increases in grazing livestock) in the CHAA is expected to be long-term, and to have a material effect on both wetland structure and water quality in the wetlands across the CHAA through reductions in sanitary water quality, exacerbation of wetland erosion, increased harvest of plant species used for traditional home construction, increased fire frequency and increased grazing pressure. The impacts will be irreversible; and of medium magnitude. In the context of the high wetland sensitivity, the predicted impact significance on ecosystem composition is major, prior to mitigation. Following the application of Project-specific mitigation measures during operation, the impact significance could remain moderate, as the effects of population influx on the ecosystem composition of wetlands and riparian habitat in the vicinity of the pipeline may be difficult to mitigate.

- Ecosystem Configuration

Impacts to the ecosystem configuration will be neutral, as the buried and rehabilitated pipeline will not present a significant barrier to movement for faunal species using the affected wetland and riparian habitats. The magnitude of the impact on ecosystem configuration is therefore negligible, and combines with medium sensitivity to produce a minor overall impact level to ecosystem composition during the operational phase of the Project (Table 37), and no further mitigation measures are required.

### Impact Significance Rating

**Table 37: Potential impacts of operation of the feeder line on the wetlands of the CHAA**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Representativeness | Low - 2 | High – 4 | Moderate – 8 | Low - 2 | High – 4 | Moderate – 8 |
| Ecosystem composition – (heated pipeline) | Negligible – 1 | High – 4 | Minor - 4 | Negligible – 1 | High – 4 | Minor - 4 |
| Ecosystem composition – (population influx) | Medium - 3 | High – 4 | Major - 12 | Low – 2 | High – 4 | Moderate – 8 |
| Ecosystem configuration | Negligible – 1 | High – 4 | Minor - 4 | Negligible – 1 | High – 4 | Minor - 4 |

### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential operational impacts that the feeder line may have on the wetlands of the CHAA. However, there is some uncertainty in regard to the irreplaceability and vulnerability of those habitats in the CHAA. Given the current uncertainty in relation to climate change and possible scenarios, as well as increasing human pressures, how important these habitats will become in the future is uncertain.

The spatial extent of habitats in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1.1). The actual extent of possible habitat may have been over-estimated.

## 11.2.1.3 What impact could the operation of the Feeder line have on Bugoma CFR?

### Impact Indicators

Bugoma Central Forest reserve (Bugoma CFR) will not be directly affected by pipeline operation, which at its nearest point will be at least 1,8 km from the Bugoma CFR boundary. The indirect impacts of population influx to the CHAA, due to expectations of work or opportunities generated by the Project, are considered since this could impact on the forest reserve.

An analysis of the potential impacts of such influx on the habitat and ecosystem integrity of Bugoma CFR was accomplished by examining available literature about the ecology of Bugoma CFR, and scientific literature regarding the effects of migration and human population pressure on forests in Africa. The impacts are discussed, and their significance assessed through a **reasoned narrative**.

### *Impact Analysis*

Bugoma CFR is identified as a valued component for this impact assessment, certainly in terms of biodiversity (see Table 25). As identified in that section, apart from being one of the last stands of tropical semi-deciduous forests in the region, it also supports known populations of the Endangered Eastern Chimpanzee and range-restricted Nahan's Francolin (Plumptre et al. 2011), potential non-breeding habitat for the Endangered Madagascar Pond Heron (see Section 6.3.3.1), as well as elephants and a host of other threatened and irreplaceable species.

Although Bugoma CFR will not be directly affected by pipeline operation, which at its nearest point will be at least 1,8 km from the Bugoma CFR boundary, the indirect effects of project-induced migration to the CHAA due to expectations of work on the Project or induced opportunities, have the potential to affect the ecological integrity of the habitats within the CFR, as well as the species of conservation concern that occur within it.

Bugoma CFR is under severe pressure from the human population surrounding it. In 2013, more than 1,500 people evicted illegally after settling within the forest (Mugerwa 2013), and recent (2016) reports from the area suggest that land-grab activity has resulted in the conversion of an estimated 8000 ha for sugar cane plantation development. The land cover study (see Figure 4) clearly shows that the areas surrounding the forest have largely been transformed for agricultural and subsistence purposes, and the transformation is now encroaching within the boundary of the CFR. This trend of encroachment of protected areas is not unique. Protected areas are known to be particularly vulnerable to changes in human demographics and deforestation; and Wittemyer et al. (2008) identified that human population growth and encroachment around protected areas is significantly higher than the average population growth in rural areas. This difference was largely due to the immigration of people into these areas because of the perceived increased availability of opportunities, natural resources and potential jobs (Wittemyer et al. 2008). This is supported by research conducted in the forests of the Albertine Graben, and the wider CHAA. For example, in a study of Budongo Central Forest Reserve, Zommers and MacDonald (2012), identified that of the local communities that hunted bush meat in the forest, nearly 73% were immigrants to the area. Furthermore, these workers identified that the households of immigrants were also more likely to be involved with deforestation.

The results of the recently-updated (Nov 2017) social baseline data gathering fieldwork indicated that in-migration to the CHAA has escalated significantly since the opening of the escarpment road, and commencement of preliminary construction works at the Kingfisher Development Area; this pattern of in-migration will probably continue throughout the operational lifetime of the Project.

An Influx Management Strategy and Framework Plan (Golder Associates 2018) was developed to manage the potential influx of people into the LSA. However, this plan can only focus on those measures over which CNOOC has control, and to support the range of government and donor projects in Uganda aimed at socio-economic development and environmental conservation. How this translates to the potential influx of people to the CHAA throughout the operational lifetime of the Project is unknown.

### *Impact Classification*

Indirect impacts on Bugoma CFR due to population influx to the region during the operation of the feeder line will be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR, in the CHAA. Impact duration will be long-term, lasting for at least as long as the Project is in operation, and may be irreversible.

However, the magnitude of the impacts of population influx specifically associated with the operation of the pipeline on Bugoma CFR is expected to be negligible, given that the pipeline will be buried, rehabilitated and will be generally remote from the main Production Facility where in-migration is expected to be concentrated, and taking into consideration the distance of the rehabilitated pipeline from the Bugoma CFR boundary.

The sensitivity of the Bugoma Central Forest Reserve is high because it is a threatened ecosystem that is already under pressure. Therefore, the intensity and sensitivity combine to produce a minor overall impact level during the operation phase of the pipeline (Table 31).

The mitigation hierarchy is an important process that has been used to minimise impacts to Bugoma CFR. The focus for the continued application of the mitigation hierarchy to Bugoma CFR during the feeder line operation phase will consist of monitoring and adaptive management, as well as implementation of the Influx Management Strategy and Framework Plan for the Project (see Section 12.0).

With the implementation of such mitigation measures, the impact significance is expected to remain minor for the operational lifetime of the Project. (**Table 31**).

**Table 38: Potential impacts in the construction phase to the Bugoma Central Forest Reserve**

| | **Pre-mitigation** | | | **Post-mitigation** | | |
|---|---|---|---|---|---|---|
| | **Magnitude** | **Sensitivity of the Receptor** | **Significance** | **Magnitude** | **Sensitivity of the Receptor** | **Significance** |
| Habitat and ecosystem integrity | Negligible – 1 | High – 4 | Minor – 4 | Negligible – 1 | High – 4 | Minor – 4 |

As noted above, the focus for reducing impacts to the Bugoma Central Forest Reserve is mitigation to avoid and minimise various types of disturbance that may occur (Section 12.0). Optimising mitigation will reduce residual impacts on the CFR to minor, and reduce the need for offsetting. However, possible offsetting options to ultimately achieve 'net gain' for the natural habitats of the forest have been identified and are discussed in Section 12.0.

### 11.2.2 What impact could the operation of the Feeder line have on species of concern?

This section presents the assessment of impacts that the operation of the Feeder line could have only on those relevant species of concern identified as biodiversity valued components; that is, Grey Crowned Crane, Nahan's Francolin and Eastern Chimpanzee (see Table 25). Since the operation of the feeder line will not affect the near-shore habitats of Lake Albert, potential effects on the Mud Snail *G. candida* are not considered. Potential impacts to other species of concern are assessed at the habitat level (see Section 11.2.1).

#### *11.2.2.1 What impact could the operation of the Feeder line have on Grey Crowned Crane?*

Grey Crowned Crane is an Endangered species. In the CHAA, it is associated with permanent and seasonal wetlands habitats.

Given that operational impacts on wetlands in the CHAA are expected (Section 10.2.1.2), the operation of the Feeder line could indirectly impact Grey Crowned Crane breeding and foraging habitat.

The potential direct, indirect and induced impacts to this species due to the operation of the Production Facility are presented below.

##### *Impact Indicators*

Indicators used to assess effects of the operation of the Feeder line on Grey Crowned Crane were: habitat quantity and quality, habitat connectivity, abundance and distribution, and survival and reproduction.

Potential changes in habitat quantity and quality, abundance and distribution, and survival and reproduction were assessed qualitatively by considering changes in disturbances arising from increased human presence in the CHAA. These disturbances were considered in light of known or inferred effects to the survival and reproduction of Grey Crowned Crane for which data on these types of effects are available.

Changes in habitat connectivity were assessed by identifying potential barriers to movement and loss of corridors. This was accomplished by visually examining the spatial distribution of critical habitat for Grey

Crowned Crane (permanent and seasonal wetlands) in relation to the Feeder line to qualitatively identify any areas where habitat remains/may become fragmented during operation.

### *Impact Assessment*

- Habitat Quality and Quantity

Construction-phase losses of wetland habitat (permanent wetland) to the 30m-wide Feeder line construction right of way, consisting of 0.36 ha (0.5%) of 69 ha available habitat in the CHAA, will be mitigated through rehabilitation of the vegetation following construction; the ongoing reduction in habitat quantity and quality for Grey Crowned Crane during the time it takes for vegetation to re-establish is addressed in the construction phase impact assessment (Section 10.1.2.2).

The operational phase of the feeder line, as a component of the Project, could result in an influx of people into the area seeking employment/other opportunities. It can reasonably be expected that an increased human population in the CHAA will put pressure on the wetland habitats preferred by Grey Crowned Crane. These pressures could manifest in increased rates of habitat alteration and deforestation, reducing habitat quality and quantity for Grey Crowned Crane.

Although Grey Crowned Crane can tolerate a low degree of anthropogenic disturbance in foraging habitat (e.g. subsistence and commercial farming practises), in Ugandan wetlands it has been observed to be intolerant of human proximity within 100-200m (Olupot, 2014), flying away on approach; a factor which also affects breeding success as breeding birds flush from nests on approach, causing increased rates of predation, reduced time at the nest (either incubating or feeding), and ultimately nest abandonment. Increased human presence in the CHAA is likely to further reduce habitat quality for Grey Crowned Crane in the CHAA.

Effects from reductions in habitat quality and quantity during operation are predicted to be beyond the expected range of natural disturbance perturbations.

- Habitat Connectivity

The impact of the feeder line operation as a barrier to the movement of Grey Crowned Crane during operation is likely to be neutral. The pipeline will be buried and the overlying vegetation will have been rehabilitated. Disturbance levels due to human presence in the area are expected to be minimal, compared to construction phase.

Impacts on habitat connectivity are predicted to be within the expected range of natural disturbance perturbations during operation.

- Abundance and Distribution

The impact of the feeder line operation on the abundance and distribution of Grey Crowned Crane during operation is likely to be adverse. Although the pipeline will be buried and the overlying vegetation will be rehabilitated, restoring the extent of available foraging habitat, increased human presence in the CHAA throughout the operational lifetime of the feeder line is likely to result in settlement patterns that focus on wetland and riparian areas, which provide livestock grazing and crop production opportunities, and sources of freshwater. This is likely to affect the abundance and distribution of Grey Crowned Crane within the CHAA.

Impacts on species abundance and distribution are predicted to be beyond the expected range of natural disturbance perturbations during operation.

- Survival and Reproduction

The impact of the feeder line operation on the abundance and distribution of Grey Crowned Crane during operation is likely to be adverse. As mentioned, increased human presence in the CHAA throughout the operational lifetime of the feeder line is likely to result in settlement patterns that focus on wetland and riparian areas. This further reduces the likelihood that Grey Crowned Crane would use the affected wetlands for breeding during operation, and increases the likelihood of chick capture/nest abandonment if they did continue to use the area for breeding.

Impacts on species survival and reproduction are predicted to be beyond the expected range of natural disturbance perturbations during operation.

### *Impact Classification*

The Grey Crowned Crane sensitivity is high because it is Endangered, and triggers Tier 2 critical habitat.

Impacts to Grey Crowned Crane habitat quantity and quality will be adverse. The geographical extent of impacts will be regional because population influx is expected to affect wetland habitat across the CHAA which will be reduced in quality as a result of habitat degradation and sensory disturbances, associated with in-migration. Impact duration will be into the far future (~25 years). Nevertheless, the magnitude of the effects of operation of the pipeline on Grey Crowned Crane habitat quantity and quality across the CHAA is considered low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, as the pressures on Grey Crowned Crane associated with increased human presence across the CHAA are expected to be difficult to mitigate, affecting habitat quantity and quality (Table 39).

Impacts to Grey Crowned Crane habitat connectivity will be neutral. The geographical extent of impacts will be local because effects will be restricted to the 120 m of rehabilitated wetland habitat that will be crossed by the pipeline. The magnitude of the effects of operation of the pipeline on Grey Crowned Crane habitat connectivity is therefore considered negligible. The magnitude and sensitivity combine to produce a minor overall impact significance, and no further mitigation measures are considered necessary (Table 39).

The impact of the feeder line operation on the abundance and distribution of Grey Crowned Crane in the CHAA during operation is likely to be adverse. The geographical extent of impacts will be regional because population influx is expected to affect wetland habitat across the CHAA. Impact duration will be into the far future (~25 years). The magnitude of the effects of population influx during the operation of the pipeline on Grey Crowned Crane abundance and distribution is considered low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, as the pressures on Grey Crowned Crane habitat suitability associated with increased human presence in the CHAA are expected to be difficult to mitigate, affecting the local distribution of the species (Table 39).

Impacts to the survival and reproduction of Grey Crowned Crane will be adverse. The geographical extent of impacts will be regional because population influx is expected to affect wetland habitat across the CHAA. Impact duration will be into the far future (~25 years). The magnitude of the effects of in-migration during operation of the pipeline on Grey Crowned Crane survival and reproduction is considered low. Therefore, the magnitude and sensitivity combine to produce a moderate overall impact level, pre-mitigation. Following the application of appropriate mitigation measures, the impact significance is expected to remain moderate, as the pressures on Grey Crowned Crane habitat suitability for breeding associated with human presence in the CHAA are expected to be difficult to mitigate, and the sensitivity of the receptor will remain the same (Table 39).

**Table 39: Potential operation phase impacts to Grey Crowned Crane**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation (pre-offsets) | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Low – 2 | High – 4 | Moderate - 8 | Low – 2 | High – 4 | Moderate - 8 |
| Habitat connectivity | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor - 4 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Abundance and distribution | Low – 2 | High – 4 | Moderate - 8 | Low – 2 | High – 4 | Moderate - 8 |
| Survival and reproduction | Low – 2 | High – 4 | Moderate - 8 | Low – 2 | High – 4 | Moderate - 8 |

### *Prediction Confidence*

Given the information available, there is a reasonable understanding of the potential Project impacts on the Grey Crowned Crane and its habitat in the CHAA.

The spatial extent of wetland habitats in the CHAA was broadly mapped based on knowledge of the study area, baseline studies, literature and reports (see Section 6.1.1). The actual extent of possible habitat may have been over-estimated.

## *11.2.2.2 What impact could the operation of the Feeder line have on Nahan's Francolin?*

Nahan's Francolin is a Vulnerable and range-restricted species. In the CHAA, it is restricted to the Bugoma Central Forest Reserve. It triggers Tier 2 critical habitat under Criterion 2 (Section 9.2, Appendix G).

Bugoma Central Forest reserve (Bugoma CFR) will not be directly affected by pipeline operation, which at its nearest point will be at least 1,8 km from the Bugoma CFR boundary. The indirect impacts of population influx to the CHAA, due to expectations of work or opportunities generated by the Project, are considered since this could impact on the forest reserve, and subsequently Nahan's Francolin.

### *Impact Indicators*

As the pipeline will be at least 1.8 km from the Bugoma CFR boundary, no effects on habitat connectivity are predicted. Therefore, the indicators used to assess effects of the population influx associated with the operation of the feeder line on Nahan's Francolin were: habitat quantity and quality, abundance and distribution, and survival and reproduction.

Potential changes in habitat quantity and quality, abundance and distribution, and survival and reproduction were assessed qualitatively by considering changes in disturbances arising from increased human presence in the CHAA. These disturbances were considered in light of known or inferred effects to the survival and reproduction of buttonquail species for which data on these types of effects are available.

### *Impact Assessment*

- Habitat Quality and Quantity

The Nahan's Francolin's degree of vulnerability to disturbance is unknown. Birds are known to be sensitive to land use and habitat alteration (Lussier et al. 2006). The behavioural response of species to disturbance will depend on species-specific tolerance levels, disturbance type and frequency, group size for socially-foraging animals, and local conditions, such as the availability of alternative foraging sites (Madsen 1998). A reduction in habitat quality and quantity may have conservation implications and consequences for the population of this species.

The operational phase of the feeder line, as a component of the Project, could result in an influx of people into the CHAA seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma Central Forest Reserve will put pressure on the forest. These pressures could manifest in increased rates of habitat alteration and deforestation. Nahan's Francolin is a shy, forest-dependent species (Sande et al. 2009a) and thus is also probably sensitive to disturbance arising from deforestation/human presence in the forest. These factors could combine to reduce the habitat quality and quantity for Nahan's Francolin.

Effects from loss of habitat are predicted to be beyond the expected range of natural disturbance perturbations.

- Abundance and Distribution

Nahan's Francolin is reported to be relatively common in the Bugoma Central Forest Reserve (Plumptre et al. 2011). Although the pipeline will be at least 1.8 km from the Bugoma CFR boundary, the indirect impacts of population influx to the CHAA, due to expectations of work or opportunities generated by the Project, could ultimately affect the abundance and distribution of Nahan's Francolin in the CHAA.

The operation of the pipeline, as a component of the overall Project, could result in an influx of people into the area seeking jobs and/or opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma CFR and within the CFR itself will exacerbate existing pressures on the forest. These pressures are likely to manifest in increased rates of bush meat hunting and habitat alteration. These factors could reduce the abundance and distribution of Nahan's Francolin.

Effects from the operation of the pipeline are predicted to be beyond the expected range of natural disturbance perturbations.

- Survival and Reproduction

The Nahan's Francolin's degree of vulnerability to direct disturbance, particularly during the breeding season, is not well understood. Generally, for birds, the behavioural response of species to disturbance will depend on species-specific tolerance levels, disturbance type and frequency, group size for socially-foraging animals, and local conditions such as the availability of alternative breeding sites (Madsen 1998). Many studies have reported a reduction in breeding success attributable to human disturbance (for a review, see Hill et al. 1992). Mechanisms include: increased rates of predation, nest abandonment and reduced time at the nest, either incubating or feeding. Clearly, a reduction in breeding output may have conservation implications and consequences for the local population of Nahan's Francolin.

The operation of the pipeline, as a component of the overall Project, could result in an influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding the Bugoma CFR and within the CFR itself will exacerbate existing pressures on the forest. These pressures could manifest in increased rates of bush meat hunting and habitat alteration, which could reduce the survival and reproductive success of Nahan's Francolin.

These effects to the survival and reproductive success of Nahan's Francolin are predicted to be beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The Nahan's Francolin's sensitivity is high because it is range-restricted, and triggers Tier 2 critical habitat.

Impacts to the Nahan's Francolin's habitat quantity and quality will be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term. The magnitude of the impact of population influx associated with the operation of the pipeline, on the habitat quantity and quality of the Nahan's Francolin is expected to be negligible (see Section 10.2.1.3). Therefore, the intensity and sensitivity combine to produce a minor overall impact level during the operational phase of the Project, and no further project-specific mitigation measures for the operation phase are considered necessary (Table 23).

Impacts to the Nahan's Francolin's abundance and distribution could be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term. The magnitude of the impact of population influx associated with the operation of the pipeline on the abundance and distribution of the Nahan's Francolin is expected to be negligible (see Section 10.2.1.3). Therefore, the intensity and sensitivity combine to produce a minor overall impact level during the operational phase of the feeder line, and no further project-specific mitigation measures for the operation phase are considered necessary (Table 23).

Impacts to the survival and reproduction of Nahan's Francolin could be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term. There is a possibility that individuals could be killed or severely disturbed as a result of population influx to the region during the operation phase. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is not expected that this number of individuals in the local population within Bugoma CFR will be affected. The magnitude of the effects of operation of the feeder line on the survival and reproduction of the Nahan's Francolin is therefore negligible. Therefore, the intensity and sensitivity combine to produce a minor overall impact level during the operational phase of the feeder line, and no further project-specific mitigation measures for the operation phase are considered necessary (Table 23).

**Table 40: Potential impacts in the operational phase to the Nahan's Francolin**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude | Sensitivity of the Receptor | Significance | Magnitude | Sensitivity of the Receptor | Significance |
| Habitat quality and quantity | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor - 4 |
| Abundance and distribution | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor - 4 |
| Survival and reproduction | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor - 4 |

## Prediction Confidence

Given the information available, there is a reasonable understanding of the potential direct, indirect and induced impacts that the operation of the feeder line could have on the Nahan's Francolin and its habitat in the CHAA.

The spatial extent of the dense forest habitat in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.3.1.1). The actual extent of possible habitat may have been over-estimated.

### *11.2.2.3 What impact could the operation of the Feeder line have on Eastern Chimpanzee?*

Eastern Chimpanzee is an Endangered species. A population occurs in the Bugoma Central Forest Reserve. This species triggers Tier 1 critical habitat.

Bugoma Central Forest reserve (Bugoma CFR) will not be directly affected by pipeline operation, which at its nearest point will be at least 1,8 km from the Bugoma CFR boundary. The indirect impacts of population influx to the CHAA, due to expectations of work or opportunities generated by the Project, are considered since this could impact on the forest reserve, and subsequently Eastern Chimpanzee.

### *Impact Indicators*

As the pipeline will be at least 1.8 km from the Bugoma CFR boundary, no effects on habitat connectivity during operation are predicted. Therefore, the indicators used to assess effects of the population influx associated with the operation of the feeder line on Eastern Chimpanzee were: habitat quantity and quality, abundance and distribution, and survival and reproduction.

Potential changes in habitat quantity and quality, and abundance and distribution, were assessed qualitatively by considering changes in disturbances arising from increased human presence in the CHAA. These disturbances were considered in light of known or inferred effects to the survival and reproduction of other populations of chimpanzees for which data on these types of effects are available.

To assess effects to survival and reproduction as a result of in-migration and potential associated increases in poaching and disease spread, in-migration rates were assessed based on the data presented in the social impact assessment. A literature review of the impact of contact with humans was also conducted.

### *Impact Assessment*

- Habitat Quality and Quantity

The potential for the feeder line (as a component of the overall Project) to be attractive for people seeking opportunities could result in a substantial increase the current population around the Bugoma Central Forest Reserve. An increasing human population could lead to an increase in the demand for agricultural and timber resources, resulting in increased rates of habitat alteration and deforestation, which, in turn could further fragment, change, and degrade Bugoma CFR and surrounding habitat.

The degree of vulnerability to disturbance experienced by chimpanzees is reasonably well known (for example, see Parren and Byler 2003, Rabanal et al. 2010, Thompson and Wrangham 2013). The chimpanzees living in and around the Bugoma Central Forest Reserve most likely experience sensory disturbances at present from human activities, given the high human populations living around the reserve. Indeed, groups are known to forage in the agricultural fields surrounding the forest, and hence, would more than likely be used to human noises and disturbances (McLennan 2008). As such, the potential sensory disturbances arising from population influx associated with the operation of the pipeline are likely to be minimal. Nevertheless, the magnitude of noise may not be the most important determinant of chimpanzee response. Instead, chimpanzees may respond to ‘new’ noises or may associate particular noises with other occurrences (for example, machine noise may be associated with human presence, which chimpanzees may, in turn, associate with the presence of danger). Where humans pose a threat, chimpanzees generally avoid them (Hockings and Humle 2009, Parren and Byler 2003). Therefore, the degree of avoidance may depend on the behaviour of people, resulting in varying levels of indirect effects on the quality of available habitat for Eastern Chimpanzee.

Effects from the reduced habitat quantity and quality during operation are predicted to be beyond the expected range of natural disturbance perturbations.

- Abundance and Distribution

The Bugoma Central Forest Reserve supports one of the top four Eastern Chimpanzee populations in Uganda, with a population of between 450 and 850 individuals (Plumptre et al. 2010). Given its distance from the forest, the operation of the feeder line is not expected to detrimentally affect the abundance or distribution of chimpanzees in the forest directly.

The long-term presence of the feeder line as a component of the overall Project could continue to influence influx of people into the area seeking opportunities. It can reasonably be expected that an increased human population in the area surrounding Bugoma CFR will put pressure on the forest. These pressures could manifest in increased rates of bush meat hunting, and reduced habitat availability, which could affect the abundance and distribution of Eastern Chimpanzee within Bugoma CFR.

Effects are predicted to be beyond the expected range of natural disturbance perturbations.

- Survival and Reproduction

In-migration of people seeking opportunities associated with the Project and feeder line may adversely affect survival and reproduction of chimpanzees through poaching and disease transfer. Hunting and poaching is a recognised threat to chimpanzees in Bugoma Central Forest Reserve (Plumptre et al. 2003), and this pressure could increase as in-migration of people from other areas occurs. Mitigation and management of in-migration (see Golder Associates 2018) will be very important to minimise potential effects on chimpanzees and other fauna species.

Disease is one of the major threats to Eastern Chimpanzees (Oates et al. 2008); increased abundance of people and competition for land and food resources between humans and chimpanzees could lead to higher rates of disease spread from humans to chimpanzees. Chimpanzees are closely related to humans; therefore, many diseases are transferrable between chimpanzees and humans (Formenty et al. 2003; Isabirye-Basulta and Lwanga 2008). Either direct or indirect contact with humans can spread disease. For example, there is evidence to suggest that respiratory illnesses have been transferred directly to chimpanzees from humans as a result of researcher and tourist contacts, often leading to outbreaks and death (Formenty et al. 2003). Human defecation in forest undergrowth can indirectly lead to spread of intestinal diseases, such as *Clostridium perfringens*, which can be fatal to chimpanzees (Fujita 2011). As forest fragments decrease in size, risks of contact with, and transmission of, disease from humans increases (Isabirye-Basulta and Lwanga 2008). Factors that lead to increased crop raiding or sharing of water resources can also increase the risk of disease spread (Hockings and Hulme 2009). As identified in the social impact assessment, communicable respiratory diseases are a significant concern in the LSA.

What effect the loss of individuals from the population could have is unknown. It is doubtful that the population could be reduced by 10% and hence, reach that critical population threshold due to population influx associated with the pipeline alone, nevertheless the potential impacts are predicted to be beyond the expected range of natural disturbance perturbations.

### *Impact Classification*

The Eastern Chimpanzee's sensitivity is high because it is Endangered.

Impacts to the Eastern Chimpanzee's habitat quantity and quality will be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term. The amount of influx that could be specifically attributed to the operation of the feeder line is expected to be negligible, therefore magnitude of the impact of population influx associated with the operation of the pipeline, on the habitat quantity and quality of the of the Eastern Chimpanzee is expected to be negligible.

Therefore, the magnitude and sensitivity combine to produce a minor overall impact level during the operation phase of the feeder line, and no further project-specific mitigation measures for the operation phase are considered necessary (Table 41).

Impacts to the Eastern Chimpanzee's abundance and distribution could be adverse. The geographical extent of impacts will be regional because effects are restricted to Bugoma CFR. Impact duration will be long-term. Given its distance from the forest, the operation of the feeder line is not expected to affect the abundance and distribution of Eastern Chimpanzee in Bugoma CFR, however the Project-associated population influx has the potential to generate impacts. The amount of influx that could be specifically attributed to the operation of the feeder line is expected to be negligible, therefore the magnitude of the effects of operation on the abundance and distribution of the Eastern Chimpanzee is negligible. Therefore, the magnitude and sensitivity combine to produce a minor overall impact level during the operation phase of the feeder line, and no further project-specific mitigation measures for the operation phase are considered necessary (Table 41).

Impacts to the survival and reproduction of the population of Eastern Chimpanzee in Bugoma Central Forest Reserve could be adverse. The geographical extent of impacts will be national because effects could extend well beyond the CHAA. Impact duration will be long-term. There is a possibility that individuals could be killed or severely disturbed as a result of Project-related population influx during the operation phase. A threshold of 10% for this species' survival and reproduction in the CHAA is reasonable, and it is expected that this number of individuals in the local population within Bugoma Central Forest Reserve could be affected through direct mortality from bush meat hunting or other disturbance. However, the amount of influx that could be specifically attributed to the operation of the feeder line is expected to be negligible, therefore, the magnitude of the effects of operation on the survival and reproduction of the Eastern Chimpanzee is expected to be negligible. Therefore, the magnitude and sensitivity combine to produce a minor overall impact level during the operation phase of the feeder line, and no further project-specific mitigation measures for the operation phase are considered necessary (Table 41).

**Table 41: Potential impacts in the operation phase to the Eastern Chimpanzee**

| Indicator of potential impact | Pre-mitigation | | | Post-mitigation | | |
|---|---|---|---|---|---|---|
| | Magnitude (the expected size of the impact) | Sensitivity of the Receptor | Significance | Magnitude (the expected size of the impact) | Sensitivity of the Receptor | Significance |

| | | | | | | |
|---|---|---|---|---|---|---|
| Habitat quality and quantity | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor - 4 |
| Abundance and distribution | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor - 4 |
| Survival and reproduction | Negligible - 1 | High – 4 | Minor - 4 | Negligible - 1 | High – 4 | Minor - 4 |

#### Prediction Confidence

Given the information available, there is a reasonable understanding of the potential direct, indirect and induced impacts that the operation of the feeder line could have on the Eastern Chimpanzees and their habitat in the CHAA.

The spatial extent of the dense forest habitat in the CHAA was broadly mapped based on knowledge of the site, baseline studies, literature and reports (see Section 6.1.1). The actual extent of possible habitat may have been over-estimated.

# 12.0 RECOMMENDATIONS FOR MITIGATION AND MONITORING

In applying mitigation to the impact assessment process, it was assumed that the proposed Project design followed the mitigation hierarchy; that is: avoidance; minimisation; rehabilitation; offsets and additional conservation actions (after BBOP 2012, and CNOOC's in-house biodiversity management and aquatic and terrestrial habitat management specifications), and that the Project components and activities assessed here have taken into consideration the application of the mitigation hierarchy. The general principals of the mitigation hierarchy incorporated into the Project design are outlined in Section 12.1.

Nevertheless, additional, impact-specific mitigation measures have been developed for each impacted valued component, in order to minimise residual impacts as much as possible, and ensure that these specific measures are carried through to the Project ESMP for ongoing monitoring and management. These recommended mitigation measures for specific construction and operation-related Project impacts and the schedule for their completion is provided in Section 12.2.

## 12.1 Mitigation Hierarchy

The following sections describe, at a high level, the mitigation measures that CNOOC will use. These mitigation measures follow the mitigation hierarchy (sensu, BBOP 2012), as embodied in CNOOC's *Biodiversity Management Specification* (CNOOC 2014a) and *Aquatic and Terrestrial Habitat Management Specification* (CNOOC 2014b).

### 12.1.1 Avoidance

Avoidance measures include:

- Locate Project infrastructure in already disturbed and affected habitats, where feasible.
- Locate primary roads (and other linear facilities) away from sensitive areas, where feasible.
- Reuse existing or remnant road networks where possible.
- Limit areas of surface disturbance.

### 12.1.2 Minimisation

Minimisation measures are measures taken to reduce the duration, magnitude and/or extent of impacts to valued components that cannot be completely avoided, as far as is practically feasible. Minimisation measures include:

- Footprint and Infrastructure
  - Limit width of roads and size of Project component areas.

- Plan an access and road network to minimise total length.

- Physical Hazards
  - Restrict vehicle speeds on roads.
  - Use of buses to transport workers.
  - As possible, restrict construction traffic to daylight hours to reduce the risk of vehicle collisions.
  - Install under road crossing structures (for example, culverts) suitable for amphibians and small reptiles, along the access road to reduce road mortalities and improve habitat connectivity.
  - Do not leave pipeline trenches open overnight.
  - Employ appropriate identification techniques for guy wires and other tall structure like drill rigs.

- People Management
  - Preferentially hire from the local communities to minimise regional human population growth and the associated increase in human encroachment into valued component habitat and direct mortality from illegal hunting.
  - No hunting or collection of fish, flora and fauna permitted for staff and/or contractors.
  - Identify no-go areas for Project personnel; for example, the lake shore and the Bugoma Lagoon.
  - Diseases and pests are controlled to a large extent by proper cleaning, disinfecting, and/or sterilising. To this end, for example, CNOOC will implement widely accepted protocols aimed at minimising the risk of transmitting amphibian chytrid fungus disease in/or around the Project site on footwear, vehicles, field equipment, or while handling amphibians in the wild.
  - Prevent or minimise the potential for community exposure to water-borne, water-based, water-related, vector-borne disease, and other communicable diseases that could result from Project activities. Explore opportunities during the project life cycle to improve environmental conditions that could help reduce their incidence.
  - Mandatory environmental training for all workers and contractors that highlights conservation issues and species-specific sensitivities.

- Noise
  - Noise mitigation developed for human receptors will benefit valued components receptors.
  - Limit hours of operation to avoid nocturnal valued component activity periods (that is, nocturnal species).
  - Minimise noise-related disturbances (for example, vehicular traffic) within 200 m of identified sensitive receptors. Some mitigations with special relevance to sensitive valued components include:
    - selection of equipment with lower sound power levels
    - installing enclosures or acoustic barriers without gaps, and with continuous minimum surface density of 10 $kg.m^{-2}$ to minimise transmission of sound through the barrier
    - installing vibration isolation devices for mechanical equipment or ensuring that foundations for equipment are designed to minimise transmission of vibration
    - re-locating noise sources to less sensitive areas to take advantage of distance and shielding

- installation of barriers at facility boundaries such as vegetation curtains or overburden storage areas/soil berms.

- Minimise higher frequency noises.
- Stage any progressive noise disturbances (for example, construction activities) to begin at the centre of disturbance (that is, start construction farthest away from known sensitive receptors like population centres) and move progressively towards the edge of habitats, allowing populations to adjust to increasingly closer noise.

- Light
  - Do not use bare light bulbs or any lighting pointing upward or outwards, particularly at the periphery of the project footprint or out into the lake.
  - Use the minimum number and brightness of lights required for safety.
  - Use narrow spectrum bulbs to minimise the range of species affected by lighting (for example, longer wave length red or yellow bulbs rather than “natural” or white light).
  - Light only high-risk stretches of roads such as crossings and merges.
  - Implement a Light Management Plan, where lighting that is not needed at a given time is turned off.
  - Retention of at least 10 m of unlit habitat (for example, on either side of key bat commuting/foraging areas) to prevent loss of habitat connectivity.
- Other
  - Develop and adhere to airborne pollutant critical load benchmarks (see Golder Associates 2014g) for terrestrial and/or aquatic system impacts for the Project.
  - Use dust control methods, such as covers, water suppression, or increased moisture content for open materials storage piles.
  - Control garbage through incineration and covering of landfill to avoid attracting fauna.
  - Conduct site clearing in a pattern to avoid creating habitat 'islands' within the footprint.
  - Conduct site clearing so that progression of clearing moves animals towards intact habitat.

### 12.1.3 Reclamation

- Reclamation of all disturbed areas with indigenous species after decommissioning to approximate pre-existing vegetation.
- Reclamation of those areas in the Project’s construction footprint that are no longer needed for the operational phase will minimise the amount of disturbed habitat. Areas no longer required for the Project should be reclaimed as soon as possible. For example, reclamation of existing disturbances within the CHAA that will not be needed for the project.
- Access roads used for construction that will not be needed for Project operation will be closed and reclaimed to natural vegetation when they are no longer needed.

### 12.1.4 Offsetting

In line with the IFC’s PS6, offsetting has been considered as an option to achieve no net loss and, preferably, net gain, when residual impacts are identified for valued components that trigger critical habitat and/or natural habitat designations, and where reclamation following the Project’s decommissioning are expected not to meet the no net loss philosophy for a valued component. As required, possible offsetting strategies for each affected valued component are discussed in Section 13.0. Actual offsetting strategies should be developed on a landscape-scale, in liaison with other partners and as part of a Biodiversity Action Plan.

## 12.2 Site-Specific Mitigation Measures and Schedule for Completion

### 12.2.1 Pre-construction Phase

Prior to the commencement of construction activities, a number of additional studies should be conducted to gain a more thorough understanding of certain biodiversity valued components. These studies will also better inform those impacts and impacts that have a high degree of uncertainty. These include the following:

h) Confirm that the Critically Endangered Mud Snail (*Gabbiella candida*), and the range restricted and Near Threatened Snail (*Bellamya rubicunda*) do not occur in CHAA, prior to commencement of construction of the new water intake and pumping station.

i) The nesting times of Grey Crowned Crane on the Buhuka Flats.

j) The relative importance of the Buhuka Flats for migratory bird species.

k) The precise boundaries and locations of the wetlands along the pipeline route.

l) The location of caves and cavities along the escarpment that could be important for cavity-roosting bats.

### 12.2.2 Construction and Decommissioning Phase

The mitigation measures are presented below and summarised on Table 42. Possible offset mechanisms are summarised in Table 50.

#### *12.2.2.1 Construction and Decommissioning Phase Impacts on Ecosystems of Concern*

### Near-shore habitats of Lake Albert

The following impact mitigation is recommended to minimise the risks of spillages and discharges affecting the near-shore habitats of Lake Albert:

- Make provision for the designs of well pads to be checked by pollution control experts to ensure that the risks of spillage/overflow associated with drilling pollution management systems is minimised.
- Establish a pollution management system, to be fully defined in the Contractor's contractual commitments, covering personnel, training, lines of responsibility, immediate action requirements, on-site spill kits, and all other factors necessary to ensure there is a provision for effective preventative and corrective action during all stages of construction and drilling.
- All machinery and vehicles must be certified as being free of weed propagules, prior to travelling to the construction site. Issue clearance certificates for each piece of machinery and equipment. The responsibility for ensuring that vehicles are free of weed propagules lies with the vehicle operators, and certification should be verified by CNOOC prior to entry to site.
- Develop a culture of zero tolerance for pollution during the construction phase of the project.
- Provide a high level of competent environmental oversight during drilling of wells and construction of the CPF.
- Provide for thorough induction training of all construction personnel regarding pollution management, and ongoing refresher training throughout the construction/drilling contracts.
- Provide specific training to staff responsible for the oversight of pollution control systems
- Ensure structured, daily, monitoring of pollution control systems on the well pads and at the CPF to minimise the risk of inadvertent spills and to respond quickly and effectively to any spills that occur. Emphasis must be on preventative measures.

- If biocides are used in hydrotest water, then the discharge should be retained until it is confirmed to pass biotoxicity testing standards; if it fails to achieve these it should be treated appropriately to achieve required standards.
- Develop specific biological monitoring performance indicators as a part of the Construction and Drilling EMPs.

The following impact mitigation is recommended to minimise the risks of the construction of the new water intake station affecting sediment drift patterns on the near-shore habitats of Lake Albert:

- Construction of the water intake station on wooden or concrete piles, rather than extending a rock foundation-type structure (similar to the existing jetty) from the lake shore to the intake point, to minimise effects on lakeshore currents and long-shore drift of sediments.
- In the case where sediment build-up on the wave-ward side of the water-intake station structure becomes an impediment to its daily operation, excavated sediment should be redistributed to any eroded areas down-drift of the intake structure, as well as at the existing jetty structure.

## Escarpment Vegetation Corridors

The following mitigation and monitoring is proposed:

- Pre-construction surveys for species of concern associated with the escarpment vegetation corridors, in particular, bats and potential bat roosts, should be completed.
- Construction activities that generate noise and vibrations, particularly blasting activity that may be necessary to excavate trenches for the pipeline, should only occur during designated times.
- The use of high-frequency noise emitters (e.g. vehicle reverse signals) should be minimised.
- Rehabilitation of vegetation communities following completion of construction work and burial of pipeline.
- Develop plans, with Government, to reduce the risk of in-migration and subsequent increases in natural resource harvesting pressure into the area during the construction phase (further detail of the actions required are included in  Social Impact Assessment)
- Develop specific biological monitoring performance indicators as a part of the Construction and Drilling EMPs.

## Wetlands

The following impact mitigation and monitoring is recommended:

- Undertake pre-clearance surveys for wetland species of concern within and near the project footprint, such as nesting and foraging sites of the Grey Crowned Crane. Implement measures to ensure that the risk to these species is minimised.
- Minimise wetland vegetation cleared for the Kamansinig flowline crossing to the smallest possible footprint.
- Demarcate the construction right of way across the Kamansinig wetland to prevent inadvertent damage outside of this footprint.
- Preferably undertake the construction of the flowline crossing across the Kamansinig wetland in the dry season.
- Prohibit access to personnel outside of the defined project work sites and access roads. Train personnel to understand the sensitivity of the local environment in induction and ongoing tool box talks.

- Specifically prohibit project personnel from access to the Bugoma Lagoon which is resource of exceptionally high ecological and cultural value. The Bugoma Lagoon is a part of the Kamansinig wetland system, all of which is regarded as sensitive
- Ensure that erosion protection measures are in place during construction to minimise runoff from disturbed areas into the rivers and wetlands
- Develop a detailed method statement for the flowline wetland crossing of the Kamansinig River to well Pad 3; defining the requirements to contain construction equipment within the construction footprint, to minimise compaction of wetland soils, to reinstate any clay layers and replace soils in the correct order and to return the wetland to the same profile that existed before construction.
- Ensure that all vehicles and machinery are in sound mechanical order, do not have any oil leaks and are fitted with appropriate mufflers to minimise nuisance affecting wildlife.
- Ensure that any pumps, generators or other equipment containing oil used to manage water at the wetland crossing are located on impervious plastic sheeting or drip trays.
- Prohibit any refuelling of equipment within 100 m of a wetland.
- Minimise the use of backfill intended to provide firm footing for vehicles in wetlands, and implement measures to ensure that diffuse flow of water in the wetlands is maintained.
- Manage all hazardous products and wastes to minimise the risk of escaped outside of controlled areas (management according to measures recommended in Waste)
- Adjust the final design of the canals channelling stormwater and treated sewage effluent from the CPF to remain outside of the seasonally wet areas associated with River 1 as far west as possible, crossing the river channel just upstream of the road culvert.
- From the culvert onward, it may be necessary to canalise the flow to the lake. Use open cross section swales for this purpose (not concrete canalisation), reinforced if necessary and grassed. Finalise the canal design and the alignment of the stormwater drains with the assistance of a wetland ecologist.

### Bugoma CFR

The following impact mitigation and monitoring is recommended:

- De-list the R5 from the proposed oil road upgrades. CNOOC has confirmed that it does not need this road, either for construction or operational purposes. The Ugandan Government has been formally notified. CNOOC will use the P1 as the major haul road during the construction phase and, if upgraded in time, the R7.
- Limit vehicle speeds to 40 km/h along the P1 road in the section from Mpanga to Nsozi. Monitor vehicle speeds and fine drivers who do not comply with the speed limit.
- Prohibit transport of construction materials in the area of the forest at night.
- Widen the P1, where necessary, on the non-forest side of the road in order to minimise forest habitat loss.
- Ensure that all EPC contract transporters are fully aware of the risks to wildlife in the Bugoma Forest.
- Increase monitoring of population changes in the CHAA and, in particular, any incursions into the BCFR by settlement or people harvesting natural resources. A strategy for this initiative is discussed in further detail in the Cumulative Impact Assessment.
- Implement the Influx Management Strategy and Framework Plan (Golder Associates 2018) that has been developed to manage the potential influx of people into the LSA. However, this plan can only focus on those measures over which CNOOC has control, and to support the range of government and donor

projects in Uganda aimed at socio-economic development and environmental conservation. How this translates to the potential influx of people along an improved P1 road is unknown.

#### 12.2.2.2 Construction and Decommissioning Phase Impacts on Species of Concern

### Mud Snail (*Gabbiella candida*)

The following impact mitigation and monitoring is recommended:

- Undertake final targeted, once off, specialist surveys for *G. candida* before construction starts at the sites where construction disturbance will occur in Lake Albert (jetty expansion and water intake). The surveys should ascertain the presence/absence of *G. candida* in the near-shore habitats of Lake Albert within the CHAA.
- Since this species triggers Tier 1 Critical Habitat, if it is found to be present, work in near-shore habitats should be postponed until appropriate solutions for the conservation and management of *G. candida* are devised by suitably experienced molluscan specialists, and approved by NEMA.
- If found to be present, the Client will need to demonstrate that the proposed construction activities will affect less than 10% of the known global population of the species – a comprehensive survey of habitats with potential to support the Mud Snail on the shores of Lake Albert will be required to support this demonstration. Thereafter, if less than 10% of the known population would be affected, a Species-Specific Action Plan as part of the overall Biodiversity Action Plan (BAP) must be developed to achieve net gain for the affected species.
- The construction phase mitigation measures for near-shore aquatic habitats (Section 12.2.2.1) should be implemented and strictly adhered to in order to minimise potential loss, fragmentation or degradation of the Mud Snail's habitat.

### Grey Crowned Crane

The following impact mitigation and monitoring is recommended:

- Implement the mitigation set out for wetlands under Section 12.2.2.1 to reduce further loss, fragmentation and degradation of habitats.
- Implement measures to avoid and minimise impacts on Grey Crowned Crane abundance and distribution, and reproduction and survival in the CHAA, and the Buhuka Flats in particular. Measures should include:
  - Restrict access by any CNOOC staff, subcontractors and members of the public from any identified areas of breeding habitat used by Grey Crowned Crane within 200 m of suitable nesting sites.
  - Prohibit CNOOC staff and construction subcontractors from entering areas beyond the construction rights of way.
  - Develop and disseminate community education programmes on Grey Crowned Crane habitat conservation, prevention of illegal trade in wild birds and chicks, and prevention of incidences of poisoning.
  - Develop a Grey Crowned Crane conservation plan for the Buhuka Flats.
- Develop and implement a long-term research and monitoring programme to improve understanding of the behaviour and status of Grey Crowned Crane in the CHAA (this recommendation is developed further in Cumulative Impact Assessment).

### Nahan's Francolin

The following impact mitigation and monitoring is recommended:

- Implement the mitigation set out for Bugoma CFR under Section 12.2.2.1.

- Large, mature buttressed trees that constitute suitable nesting habitat for Nahan's Francolin should be avoided during vegetation clearance works for the P1 road upgrade.
- Implement measures to minimise impacts on Nahan's Francolin abundance and distribution, and reproduction and survival in the CHAA, particularly those arising from sensory disturbance caused by human presence and mechanical noise generated during construction activity associated with the P1 road upgrade activity. These should include restrictions in operating hours for heavy machinery, use of low-pitched reverse alerts, and restriction of access for road construction workers to areas beyond the road upgrade right of way.
- Develop and implement a long-term research and monitoring programme to improve understanding of the behaviour and status of Nahan's Francolin in Bugoma Forest (this recommendation is developed further in Cumulative Impact Assessment).
- Support the government in enforcement of existing government forestry policies in Uganda.

### Eastern Chimpanzee

The following impact mitigation and monitoring is recommended:

- Implement the mitigation set out for Bugoma CFR under Section 12.2.2.1.
- Implement measures to minimise impacts on Eastern Chimpanzee abundance and distribution, and reproduction and survival in the CHAA, particularly those arising from sensory disturbance caused by human presence and mechanical noise generated during construction activity associated with the P1 road upgrade activity. These should include restrictions in operating hours for heavy machinery, use of low-pitched reverse alerts, and restriction of access for road construction workers to areas beyond the road upgrade right of way.
- Develop and disseminate community education programmes on Eastern Chimpanzee habitat conservation, and prevention of illegal trade in wild animals for live trade and bushmeat, in liaison with existing Eastern Chimpanzee conservation programmes (e.g. Jane Goodall Institute Uganda's environmental education programme).
- Develop and implement a long-term research and monitoring programme to improve understanding of the behaviour and status of the Eastern Chimpanzee in Bugoma Forest (this recommendation is developed further in Cumulative Impact Assessment).
- Support the government in enforcement of existing government forestry policies in Uganda.

**Table 42: Mitigation and management measures for biodiversity, during the construction and decommissioning phases of the Project**

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| Reduced abundance/ distribution of species of concern<br><br>Reduced survival/ reproduction of species of concern | Grey Crowned Crane<br>Escarpment vegetation corridor<br>Wetlands | Pre-clearance surveys for species of concern and habitats of special significance within and near the Project footprint; e.g. nesting sites of species of concern (Grey Crowned Crane), bat roosting sites | - Number of species located<br>- Locality and populations of invasive species<br>- Location of significant habitats, including nesting sites<br>- Locations of suitable relocation sites for individuals<br>- Number of individuals relocated<br>- Realignment of Project footprint to avoid sensitive habitats | Weekly, before any clearing activities | CNOOC and Contractors | - Identification of species of concern<br>- Management and control of invasive species<br>- Impactive management of bat roosts<br>- Handling of animals<br>- Impactive translocation of threatened plants, and/or collection of reproductive material |
| | Mud Snail (*Gabbiella candida*) | Targeted surveys for Mud Snail (*Gabbiella candida*) | - Number of survey plots and samples | Once off before construction activities | CNOOC | - Specialist required to survey for, and identify, snails |
| Spread of invasive species | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR | All machinery and vehicles entering the site should be certified clear of weed propagules | - Inspection forms and clearance certificates for each vehicle and piece of machinery | As required before new machinery or vehicles arrive at site | CNOOC and Contractors | - Impactive clean down of machinery and vehicles to remove weed seeds |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| | | | working on the site | | | |
| Sensory disturbance | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR<br>Grey Crowned Crane<br>Nahan's Francolin<br>Eastern Chimpanzee | All vehicles and machinery are in sound mechanical order and fitted with appropriate mufflers | - Service records for each piece of machinery and vehicle<br>- Daily pre-start inspection logs for each vehicle and piece of machinery | Daily | CNOOC and Contractors | - Daily pre-start vehicle inspection |
| Sensory disturbance | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR<br>Grey Crowned Crane<br>Nahan's Francolin | Noise management | - Noisy construction activities only occur during designated times<br>- High frequency noise emitters minimised | Daily | CNOOC and Contractors | - Noise management |
| Clearing of vegetation | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR | Restrict access<br>Minimise clearance footprint | - No go areas identified and marked on the ground<br>- Amount of vegetation cleared kept to absolute minimum | Daily | CNOOC and Contractors | - Information on erosion and sediment control<br>- Impactive fauna management during vegetation clearing |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| | | | • Clearing of vegetation to occur at the edges of contiguous vegetation patches first to allow disturbed fauna to move away<br>• Area of bare ground exposed at any one time | | | |
| Levelling and grubbing of ground for placement of infrastructure | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR | Minimise extent of vegetation clearance<br>Implement erosion sediment and dust control measures | • Area of bare ground exposed at any one time<br>• Erosion and sediment control measures in place and functional<br>• Dust fall-out beyond the construction footprint<br>• Appropriate storage and handling of topsoil to be used in rehabilitation works | Daily, before works commence<br>Immediately before impending rain event | CNOOC and Contractors | • Impactive erosion and sediment control<br>• Topsoil handling and management |
| Levelling and grubbing | | Rehabilitation of disturbed areas | • Area of exposed soil | Monthly | CNOOC and Contractors | • Rehabilitation of disturbed ground |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| of ground for placement of infrastructure | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR | following completion of construction activities | • Success of rehabilitation measures<br>• Establishment of a cover crop | | | |
| Accidental spillages | Near-shore habitats<br>Wetlands | Management and clean-up of chemical spills | • Number of spills, including volume spilt<br>• No adverse impacts from spills | Monthly | CNOOC and Contractors | • Impactive spill response and clean-up |
| Sensory disturbance<br>Collision risk | Wetlands<br>Bugoma CFR | Traffic management | • Speed limits of traffic within Project footprint<br>• No mortality of wildlife in the LSA<br>• No driving at night | Monthly | CNOOC and Contractors | • Safe driving |
| Mortality/ injury risk | Escarpment vegetation corridor<br>Wetlands | Trenching and pipeline laying – prevention of fauna injuries and mortality | • Trenches are not left open overnight<br>• If trenches are to be left open overnight, adequate ramps for the egress of trapped animals must be installed<br>• Adequate refuges must be installed at | Every morning before work commences | CNOOC and Contractors | • Safe handling and removal of animals trapped in trenches |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| | | | regular intervals along the open trench (e.g., wet sacks)<br>• Number of animals relocated from the trench | | | |
| Vegetation clearance Earthworks Pipeline crossings | Wetlands | Construction in wetlands and watercourses | • Maintenance of natural flow regimes<br>• Flow volumes the same downstream of excavation compared to upstream<br>• No sediment-laden water leaves construction area, use of coffer dams<br>• Assessment of potential acid sulphate soils before excavation commences<br>• If acid sulphate soils detected, adequate lime must be available on site to treat spoil from the | Weekly, or as required before excavation in wetlands | CNOOC and Contractors | ■ Management and treatment of acid sulphate soils |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| | | | excavation activities | | | |
| Reductions in Habitat quality | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands | Control Night lighting | • All night lighting face in towards the Project footprint<br>• No lights face out towards the lake<br>• Lighting should be kept to a functional minimum in all areas<br>• Lamps should not emit light at angles greater than 70°<br>• Lights that emit a broad spectrum of light with a high UV component should be avoided<br>• Polarised light sources should not be used | Monthly | CNOOC | • Impactive night lighting |
| Reduction in habitat quality<br>Reduction in survival/ | Grey Crowned Crane | Putrescible and industrial waste | • All food wastes must be stored appropriately to discourage vermin | Monthly | CNOOC | • Waste management |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| reproduction due to attraction of predatory/ scavenging species | | | • Volume of waste removed, recycled, reused | | | |
| Accidental spillages | Near-shore habitats<br>Wetlands<br>Grey Crowned Crane | Water quality and water management | • In situ water quality downstream of Project footprint (pH, EC, TDS, TSS, DO)<br>• Monthly water quality parameters in the lake, wetlands and watercourses (pH, EC, TDS, TSS, DO, metals, hydrocarbons)<br>• Volume of water extracted and treated on site | Weekly and monthly | CNOOC | • Water quality monitoring<br>• Waste water treatment |
| Reduction in habitat quality | Grey Crowned Crane | Air quality | • No noticeable odours at boundary of Project footprint | Monthly | CNOOC | • Odour management and detection |
| Population influx | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands | People management | • No personnel and/or contractors allowed beyond | As required | CNOOC and Contractors | • Inductions for all staff |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| | Mud Snail<br>Grey Crowned Crane<br>Nahan's Francolin<br>Eastern Chimpanzee | | footprint of Project<br>- Designated no-go areas, e.g., Lake Albert, wetlands, Bugoma Central Forest Reserve | | | |

### 12.2.3 Operation Phase

The mitigation measures for the operation phase of the Project are presented in tabular format in Table 43. Possible offset mechanisms are summarised in Table 50.

#### *12.2.3.1 Operation Phase Impacts on Ecosystems of Concern*

#### Near-shore habitats of Lake Albert

The following impact mitigation is recommended to minimise the risks of spillages affecting the near-shore habitats of Lake Albert:

- Establish a pollution management system, to be fully defined in CNOOC's EMP as well as in any sub-contractor's contractual commitments, covering personnel, training, lines of responsibility, immediate action requirements, on-site spill kits, and all other factors necessary to ensure there is a provision for effective preventative and corrective action during all stages of operation.
- All machinery and vehicles must be certified as being free of weed propagules, prior to travelling to the site. Issue clearance certificates for each piece of machinery and equipment. The responsibility for ensuring that vehicles are free of weed propagules lies with the vehicle operators, and certification should be verified by CNOOC prior to entry to site.
- Develop a culture of zero tolerance for pollution during the operation phase of the project.
- Provide a high level of competent environmental oversight during drilling of wells and operation of the CPF.
- Provide for thorough induction training of all operation personnel regarding pollution management, and ongoing refresher training throughout the operational lifetime of the project.
- Provide specific training to staff responsible for the oversight of pollution control systems
- Ensure structured, daily, monitoring of pollution control systems on the well pads and at the CPF to minimise the risk of inadvertent spills and to respond quickly and effectively to any spills that occur. Emphasis must be on preventative measures.
- Develop specific biological monitoring performance indicators as a part of the Drilling EMPs.

#### Escarpment Vegetation Corridors

The following mitigation and monitoring is proposed:

- The use of high-frequency noise emitters (e.g. vehicle reverse signals) should be minimised.
- Ongoing monitoring and additional rehabilitation of vegetation communities over the buried pipeline as necessary, throughout the lifetime of the Project.
- Develop plans, with Government, to reduce the risk of in-migration and subsequent increases in natural resource harvesting pressure into the area during the operation phase (further detail of the actions required are included in Social Impact Assessment).
- Develop specific biological monitoring performance indicators as a part of the Project Operation EMPs.

#### Wetlands

The following impact mitigation and monitoring is recommended:

- Prohibit access to personnel outside of the defined project work sites and access roads. Train personnel to understand the sensitivity of the local environment in induction and ongoing tool box talks.

- Specifically prohibit project personnel from access to the Bugoma Lagoon which is resource of exceptionally high ecological and cultural value. The Bugoma Lagoon is a part of the Kamansinig wetland system, all of which is regarded as sensitive
- Ensure that erosion protection measures are in place during operation to minimise runoff from disturbed areas into the rivers and wetlands.
- Ensure that all vehicles and machinery are in sound mechanical order, do not have any oil leaks and are fitted with appropriate mufflers to minimise nuisance affecting wildlife.
- Ensure that any pumps, generators or other equipment containing oil used to manage water at the wetland crossing are located on impervious plastic sheeting or drip trays.
- Prohibit any refuelling of equipment within 100 m of a wetland.
- Manage all hazardous products and wastes to minimise the risk of escaped outside of controlled areas (management according to measures recommended under Waste)
- Monitoring should remain ongoing at frequent intervals to ensure that rehabilitated vegetation continues to thrive and progress, and to confirm that the recommended mitigation measures to minimise wetland erosion and flow concentration remain satisfactorily functioning.

### Bugoma CFR

The following impact mitigation and monitoring is recommended:

- De-list the R5 from the proposed oil road upgrades. CNOOC has confirmed that it does not need this road, either for construction or operational purposes. The Ugandan Government has been formally notified. CNOOC will use the P1 as the major haul road during the construction phase and, if upgraded in time, the R7.
- Limit vehicle speeds to 40 km/h along the P1 road in the section from Mpanga to Nsozi. Monitor vehicle speeds and fine drivers who do not comply with the speed limit.
- Prohibit transport of Project-related materials in the area of the forest at night.
- Ensure that all EPC contract transporters are fully aware of the risks to wildlife in the Bugoma Forest.
- Increase monitoring of population changes in the CHAA and, in particular, any incursions into the Bugoma CFR by settlement or people harvesting natural resources. A strategy for this initiative is discussed in further detail in the Cumulative Impact Assessment.
- Implement the Influx Management Strategy and Framework Plan (Golder Associates 2014) that has been developed to manage the potential influx of people into the LSA. However, this plan can only focus on those measures over which CNOOC has control, and to support the range of government and donor projects in Uganda aimed at socio-economic development and environmental conservation.

## *12.2.3.2 Operation Phase Impacts on Species of Concern*

### Mud Snail (*Gabbiella candida*)

The following impact mitigation and monitoring is recommended:

- If found to be present within the CHAA, the Client will need to demonstrate that the proposed operation of the Project will affect less than 10% of the known global population of the species –a comprehensive survey of habitats with potential to support the Mud Snail on the shores of Lake Albert will be required to support this demonstration. Thereafter, if less than 10% of the known population would be affected, a Species-Specific Action Plan as part of the overall Biodiversity Action Plan (BAP) must be developed to achieve net gain for the affected species.

### Grey Crowned Crane

The following impact mitigation and monitoring is recommended:

- Implement the mitigation set out for wetlands under Section 11.2.3.1 to reduce further loss, fragmentation and degradation of habitats.
- Implement measures to minimise impacts on Grey Crowned Crane abundance and distribution, and reproduction and survival in the CHAA, and the Buhuka Flats in particular. Measures should include:
  - Restrict access by any CNOOC staff, subcontractors and members of the public from any identified areas of breeding habitat used by Grey Crowned Crane within 200 m of suitable nesting sites.
  - Erect/plant screens between operation activities and wetland habitats in order to reduce the likelihood of disturbance of Grey Crowned Crane via human presence, and minimise noise disturbance.
  - Prohibit CNOOC staff and construction subcontractors from entering areas beyond the operational footprint.
  - Develop and disseminate community education programmes on Grey Crowned Crane habitat conservation, prevention of illegal trade in wild birds and chicks, and prevention of incidences of poisoning.
- Develop and implement a long-term research and monitoring programme to improve understanding of the behaviour and status of Grey Crowned Crane in the CHAA (this recommendation is developed further in Cumulative Impact Assessment).

### Nahan's Francolin

The following impact mitigation and monitoring is recommended:

- Implement the mitigation set out for Bugoma CFR under Section 12.2.3.1.
- Implement measures to minimise impacts on Nahan's Francolin abundance and distribution, and reproduction and survival in the CHAA, particularly those arising from sensory disturbance caused by traffic generated during operation, and effects arising from increased public access to the forest facilitate by the upgraded road. These should include restrictions in operating hours for heavy machinery, use of low-pitched reverse alerts, and restriction of access for Project employees and contractors.
- Develop and implement a long-term research and monitoring programme to improve understanding of the behaviour and status of Nahan's Francolin in Bugoma Forest (this recommendation is developed further in Cumulative Impact Assessment).
- Encourage ecotourism projects run by community groups, and initiate community conservation awareness programmes.
- Support the government in enforcement of existing government forestry policies in Uganda.

### Eastern Chimpanzee

The following impact mitigation and monitoring is recommended:

- Implement the mitigation set out for Bugoma CFR under Section 11.2.2.1.
- Implement measures to minimise impacts on Eastern Chimpanzee abundance and distribution, and reproduction and survival in the CHAA, particularly those arising from sensory disturbance caused by human presence and mechanical noise generated by traffic and enhanced public access to the forest.
- Develop and disseminate community education programmes on Eastern Chimpanzee habitat conservation, and prevention of illegal trade in wild animals for live trade and bushmeat, in liaison with existing Eastern Chimpanzee conservation programmes (e.g. Jane Goodall Institute Uganda's environmental education programme).

- Develop and implement a long-term research and monitoring programme to improve understanding of the behaviour and status of the Eastern Chimpanzee in Bugoma Forest (this recommendation is developed further in Cumulative Impact Assessment).
- Support the government in enforcement of existing government forestry policies in Uganda.

**Table 43: Mitigation and management measures for biodiversity, during the operation phase of the Project**

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| Reductions in Habitat quality and quantity<br>Sensory disturbances<br>Collision risk | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR<br>Grey Crowned Crane<br>Nahan's Francolin<br>Eastern Chimpanzee | Ongoing monitoring of sensitive habitats and populations of species of concern | • Population abundance and distribution of species of concern<br>• Locality and populations of invasive species<br>• Condition and extent of significant habitats, including nesting sites<br>• Collision mortalities | Six-monthly | CNOOC | • Identification of species of concern<br>• Management and control of invasive species<br>• Impactive management of bat roosts<br>• Impactive translocation of threatened plants, and/or collection of reproductive material |
| Reductions in Habitat quality and quantity | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR | Ongoing monitoring of rehabilitated areas | • Extent of area of exposed soil<br>• Success of rehabilitation measures<br>• Establishment of a cover crop | Six-monthly | CNOOC | • Monitoring and assessment of vegetation |
| Introduction/ spread of invasive species | Near-shore habitats<br>Wetlands | Inspection of vehicles entering the site for weed propagules | • Inspection forms and clearance certificates for each vehicle and piece of machinery working on the site | As required before new machinery or vehicles arrive at site | CNOOC and Contractors | • Impactive clean down of machinery and vehicles to remove weed seeds |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| Sensory disturbance | Grey Crowned Crane<br>Nahan's Francolin<br>Eastern Chimpanzee | All vehicles are in sound mechanical order and fitted with appropriate mufflers | - Service records for each piece of machinery and vehicle<br>- Daily pre-start inspection logs for each vehicle and piece of machinery | Daily | CNOOC and Contractors | - Daily pre-start vehicle inspection |
| Sensory disturbance | Grey Crowned Crane<br>Nahan's Francolin<br>Eastern Chimpanzee | Noise management | - Noisy activities only occur during designated times<br>- High frequency noise emitters minimised | Daily | CNOOC and Contractors | - Noise management |
| Accidental spillages | Near-shore habitats<br>Wetlands | Management and clean-up of chemical spills | - Number of spills, including volume spilt<br>- No adverse impacts from spills | Monthly | CNOOC and Contractors | - Impactive spill response and clean-up |
| Collision risk | Grey Crowned Crane<br>Nahan's Francolin<br>Eastern Chimpanzee | Traffic management | - Speed limits of traffic within Project footprint<br>- No mortality of wildlife in the LSA<br>- No driving at night | Monthly | CNOOC and Contractors | - Safe driving |
| Reductions in Habitat quality | Grey Crowned Crane<br>Nahan's Francolin | Night lighting | - All night lighting faces in towards the Project footprint | Monthly | CNOOC | - Impactive night lighting |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| | Eastern Chimpanzee | | • No lights face out towards the lake<br>• Lighting should be kept to a functional minimum in all areas<br>• Lamps should not emit light at angles greater than 70°<br>• Lights that emit a broad spectrum of light with a high UV component should be avoided<br>• Polarised light sources should not be used | | | |
| Reduction in habitat quality<br>Reduction in survival/ reproduction due to attraction of predatory/ scavenging species | Grey Crowned Crane | Putrescible and industrial waste | • All food wastes to be stored appropriately to discourage vermin<br>• Volume of waste removed, recycled, reused | Monthly | CNOOC | • Waste management |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| Accidental spillages | Near-shore habitats<br>Wetlands | Water quality and water management | • In situ water quality downstream of Project footprint (pH, EC, TDS, TSS, DO)<br>• Monthly water quality parameters in the lake, wetlands and watercourses (pH, EC, TDS, TSS, DO, metals, hydrocarbons)<br>• Volume of water extracted and treated on site | Weekly and monthly | CNOOC | • Water quality monitoring<br>• Waste water treatment |
| Reduction in survival/ reproduction<br>Reduced habitat quality | Grey Crowned Crane | Air quality | • No noticeable odours at boundary of Project footprint | Monthly | CNOOC | • Odour management and detection |
| Population influx | Near-shore habitats<br>Escarpment vegetation corridor<br>Wetlands<br>Bugoma CFR<br>Mud Snail<br>Grey Crowned Crane<br>Nahan's Francolin | People management | • No personnel and/or contractors allowed beyond footprint of Project<br>• Designated no-go areas, e.g., Lake Albert, wetlands, Bugoma Central | As required | CNOOC and Contractors | • Inductions for all staff |

| Specific impact | Affected ecosystem/species of Concern | Mitigation Measures | Monitoring Indicators | Monitoring Frequency | Responsible Entity | Training Necessary |
|---|---|---|---|---|---|---|
| | Eastern Chimpanzee | | Forest Reserve, wetlands | | | |

# 13.0 OFFSETTING STRATEGY

Possible offset options as part of the mitigation strategy for the Project are outlined on Table 50. Post-offset residual risks are discussed in the sections that follow. It is noted that a biodiversity action plan for the design and implementation of appropriate offsets to ensure no-net-loss of natural habitat, and net gain of critical habitat, must be developed in association with partnering organisations, including the other partners (TUOP and TOTAL) and BLAC. This is outside the current scope of the ESIA, but will be required to demonstrate compliance with Lender standards.

## 13.1 Construction and Operation Phase Impacts on the Near-Shore Environment of Lake Albert

Successful application of offsets means that the overall impact level from the Project becomes negligible or positive. A positive overall result for natural habitat, such as the near-shore habitats of Lake Albert, is a target that CNOOC is working towards to meet IFC requirements, and partner expectations.

Offsetting is required to compensate for adverse residual impacts to natural habitat. A possible offsetting mechanism is supporting improved management of the near-shore aquatic habitats within the CHAA, which should curb degradation of these habitats. However, to be considered an offset, this improved management must work to reduce human disturbance that may be affecting habitat.

One way to do this is to educate the local population about the potential impacts their activities could have on the near-shore aquatic habitats. For example: the safe handling and disposal of fuels and oils used for out-board motors; and the use of less destructive fishing methods in the near-shore habitats, such as seining, which are known to affect these habitats detrimentally (Wandera and Balirwa 2010).

The mitigation hierarchy is an important process that has been used to minimise impacts to the near-shore habitats. The focus for the continued use of the mitigation hierarchy during construction will be continued development and implementation of mitigation measures through monitoring and adaptive management during construction. Direct footprint impacts have largely been avoided and the level of realisation of impacts from disturbance is uncertain.

As noted above, the focus for reducing impacts to near-shore habitats is mitigation to lessen various types of disturbance that may occur. Optimising mitigation will reduce the need for offsetting. However, offsetting options to compensate for impacts to these habitats have been identified above. The goal of these offsets would be to work towards no net loss of natural habitats within in the CHAA. Although reasonable mechanisms exist, there is still uncertainty associated with offsetting because proposed actions require third-party participation beyond the control of the Project. Offset feasibility is classed as possible at this time, which results in a high-risk level for the Project (Table 44).

**Table 44: Post-offset residual risk: construction phase impacts on near-shore environment of L. Albert**

| Description of Offsets | Residual Impact | Risk Level for not being successful |
|---|---|---|
| Education of the local people about the potential impacts their activities could have on the near-sure aquatic habitats. For example: the safe handling and disposal of fuels and oils used for out-board motors; and the use of less destructive fishing methods in the near-shore habitats, such as seining. | positive | high risk |

## 13.2 Construction and Operation Phase Impacts on Wetlands in the CHAA

The construction and operation of the airstrip, flowlines and in-field roads will be see the direct and indirect loss of natural habitat on the Buhuka Flats; the construction of the feeder line will also result in direct and indirect losses of natural wetland habitat. Under PS6, no net loss of natural habitat is required to meet the standards. Successful application of offsets means that the overall impact level from the Project becomes negligible or positive. A positive overall result for highly sensitive and unique biodiversity values is a target that CNOOC is working towards to meet IFC requirements, and partner expectations.

Offsetting is required to compensate for loss of natural habitat supported on the Buhuka Flats. A possible offsetting mechanism is the support of improved management of wetlands in the wider Albertine Graben; in particular, known breeding sites for Grey Crowned Cranes and Shoebills. However, to be considered an offset, this improved management must work to reduce human disturbance that may be affecting the habitat.

One way to do this is to provide assistance to UWA, and other research organisations, with monitoring and conservation of the Grey Crowned Crane and Shoebill.

The mitigation hierarchy is an important process that has been used to minimise impacts to the wetlands of the CHAA. The focus for the continued use of the mitigation hierarchy during construction will be continued development and implementation of mitigation measures through monitoring and adaptive management during construction.

As noted above, the focus for reducing impacts to the wetlands of the CHAA to lessen various types of disturbance that may occur. Optimising mitigation will reduce the need for offsetting. However, natural vegetation of permanent wetlands and seasonally flooded grasslands will still be lost. Therefore, offsetting options to compensate for that loss have been identified above. The goal of those offsets would be to work towards no net loss of the habitats in the CHAA. Although reasonable mechanisms exist, there is still uncertainty associated with offsetting because proposed actions require third-party participation beyond the control of the Project. Offset feasibility is classed as possible at this time, which results in a high-risk level for the Project (Table 45).

**Table 45: Post-offset residual risk: construction phase impacts on wetlands in the CHAA**

| Description of Offsets | Residual Impact | Risk Level for not being successful |
|---|---|---|
| Assistance to UWA, and other research organisations, with monitoring and conservation of the Grey Crowned Crane and Shoebill in the local area and their habitats. | positive | high risk |

## 13.3 Construction and Operation Phase Impacts on the Mud Snail *G. candida*

Successful application of offsets means that the overall impact level from the Project becomes negligible or positive. A positive overall result for highly sensitive and unique biodiversity values, such as the Mud Snail, is a target that CNOOC is working towards to meet IFC requirements, and partner expectations.

Offsetting is required to compensate for adverse residual impacts to Mud Snails. A possible offsetting mechanism is supporting improved management of the near-shore aquatic habitats within the CHAA, which should curb degradation of these habitats. However, to be considered an offset, this improved management must work to reduce human disturbance that may be affecting habitat.

One way to do this is to educate the local population about the potential impacts their activities could have on the near-sure aquatic habitats. For example: the safe handling and disposal of fuels and oils used for out-board motors; and the use of less destructive fishing methods in the near-shore habitats, such as seining, which are known to affect these habitats detrimentally (Wandera and Balirwa 2010).

The mitigation hierarchy is an important process that has been used to minimise impacts to the Mud Snail. The focus for the continued use of the mitigation hierarchy during construction will be continued development and implementation of mitigation measures through monitoring and adaptive management during construction.

Direct footprint impacts have largely been avoided and the level of realisation of impacts from disturbance is uncertain.

As noted above, the focus for reducing impacts to Mud Snails is mitigation to lessen various types of disturbance that may occur. Optimising mitigation will reduce the need for offsetting. However, offsetting options to compensate for impacts to Mud Snails have been identified above. The goal of these offsets would be to work towards no net loss and eventually net gain to Mud Snail habitat and populations in the CHAA. Although reasonable mechanisms exist, there is still uncertainty associated with offsetting because proposed actions require third-party participation beyond the control of the Project. Offset feasibility is classed as possible at this time, which results in a high-risk level for the Project (Table 46).

**Table 46: Post-offset residual risk: construction phase impacts on Mudsnails in the CHAA**

| Description of Offsets | Residual Impact | Risk Level for not being successful |
|---|---|---|
| Education of the local people about the potential impacts their activities could have on the near-sure aquatic habitats. For example: the safe handling and disposal of fuels and oils used for out-board motors; and the use of less destructive fishing methods in the near-shore habitats, such as seining | positive | high risk |

## 13.4 Construction and Operation Phase Impacts on Bugoma CFR

Successful application of offsets means that the overall impact level from the Project becomes negligible or positive. A positive overall result for highly sensitive and unique biodiversity values, such as the Bugoma Central Forest Reserve, is a target that CNOOC is working towards to meet IFC requirements, and partner expectations. Indeed, because the Bugoma Central Forest Reserve is identified as critical habitat under criteria 1 and 4, a net positive impact will be the goal.

Offsetting is required to compensate for adverse residual impacts to Bugoma Central Forest Reserve from induced and cumulative effects (see Cumulative Impact Assessment).

A possible offsetting mechanism is supporting improved management of the Bugoma Central Forest Reserve, and research on the threatened species that inhabit the forest. However, to be considered an offset, this improved management must work to reduce human disturbance that may be affecting habitat.

One way to do this is to provide assistance to the NFA for management of the Bugoma Central Forest Reserve, and the UWA, and other research organisations involved with the monitoring and conservation of threatened species.

The mitigation hierarchy is an important process that has been used to minimise impacts to the Eastern Chimpanzee. The focus for the continued use of the mitigation hierarchy during the road upgrade and construction will be continued development and implementation of mitigation measures through monitoring and adaptive management; including suggested measures for the Ugandan Government to apply in the management of the upgrade of the Hoima-to-Ikamiro Road.

As noted above, the focus for reducing impacts to the Bugoma Central Forest Reserve is mitigation to lessen various types of disturbance that may occur. Optimising mitigation will reduce the need for offsetting. However, offsetting options to compensate for impacts to the forest have been identified above. The goal of these offsets would be to work towards no net loss of this forest in the CHAA and net positive impact for the reserve. Although reasonable mechanisms exist, there is still uncertainty associated with offsetting because proposed actions require third-party participation beyond the control of the Project. Offset feasibility is classed as unlikely at this time due to increased human pressures around the forest, which results in a high-risk level for the Project (Table 47).

**Table 47: Post offset residual risk: Construction and operation phase impacts on Bugoma CFR**

| Description of Offsets | Residual Impact | Risk Level for not being successful |
|---|---|---|
| Supporting improved management of the Bugoma Central Forest Reserve. | positive | high risk |

## 13.5 Construction and Operation Phase Impacts on Nahan's Francolin

Successful application of offsets means that the overall impact level from the Project becomes negligible or positive. A positive overall result for highly sensitive and unique biodiversity values, such as the Nahan's Francolin, is a target that CNOOC is working towards to meet IFC requirements, and partner expectations.

Offsetting is required to compensate for adverse residual impacts to Nahan's Francolin from induced and cumulative effects. Within Bugoma Central Forest Reserve, the population trend of this species appears to be decreasing, with the primary threats thought to be habitat loss through logging and clearance of forest for charcoal burning and agriculture (BirdLife International 2017).

A possible offsetting mechanism is supporting improved management of the Bugoma Central Forest Reserve, and research on the population of Nahan's Francolin in that forest. However, to be considered an offset, this improved management must work to reduce human disturbance that may be affecting habitat.

One way to do this is to provide assistance to UWA and other research organisations with monitoring and conservation of the Nahan's Francolin, and the NFA for management of the Bugoma Central Forest Reserve.

The mitigation hierarchy is an important process that has been used to minimise impacts to the Nahan's Francolin. The focus for the continued use of the mitigation hierarchy during construction will be continued development and implementation of mitigation measures through monitoring and adaptive management during construction; including suggested measures for the Ugandan Government to apply in the management of the upgrade of the P1 Road.

As noted above, the focus for reducing impacts to Nahan's Francolin is mitigation to lessen various types of disturbance that may occur. Optimising mitigation will reduce the need for offsetting. However, offsetting options to compensate for impacts to Nahan's Francolin have been identified above. The goal of these offsets would be to work towards no net loss and eventually net gain to Nahan's Francolin populations in the CHAA. Although reasonable mechanisms exist, there is still uncertainty associated with offsetting because proposed actions require third-party participation beyond the control of the Project. Offset feasibility is classed as possible at this time, which results in a moderate risk level for the Project (Table 48).

**Table 48: Post offset residual risk: construction and operation phase impacts on Nahan's Francolin**

| Description of Offsets | Residual Impact | Risk Level for not being successful |
|---|---|---|
| Supporting improved management of the Bugoma Central Forest Reserve, and research on the population of Nahan's Francolin. | positive | moderate risk |

## 13.6 Construction and Operation Phase Impacts on Chimpanzee

Successful application of offsets means that the overall impact level from the Project becomes negligible or positive. A positive overall result for highly sensitive and unique biodiversity values, such as the Eastern Chimpanzee, is a target that CNOOC is working towards to meet IFC requirements, and partner expectations.

Offsetting is required to compensate for adverse residual impacts to Eastern Chimpanzee from induced and cumulative effects. Within Bugoma Central Forest Reserve, the population trend of this species appears to be decreasing, with the primary threats thought to be habitat loss through logging and clearance of forest for charcoal burning and agriculture, bush meat hunting, and killing of crop raiding individuals (Plumptre et al. 2003, 2010).

A possible offsetting mechanism is supporting improved management of the Bugoma Central Forest Reserve, and research on the Eastern Chimpanzee population in that forest. However, to be considered an offset, this improved management must work to reduce human disturbance that may be affecting habitat.

One way to do this is to provide assistance to UWA and other research organisations involved with the monitoring and conservation of the Eastern Chimpanzee, and the NFA for management of the Bugoma Central Forest Reserve.

The mitigation hierarchy is an important process that has been used to minimise impacts to the Eastern Chimpanzee. The focus for the continued use of the mitigation hierarchy during the road upgrade and construction will be continued development and implementation of mitigation measures through monitoring and adaptive management; including suggested measures for the Ugandan Government to apply in the management of the upgrade of the P1 Road.

As noted above, the focus for reducing impacts to Eastern Chimpanzees is mitigation to lessen various types of disturbance that may occur. Optimising mitigation will reduce the need for offsetting. However, offsetting options to compensate for impacts to Eastern Chimpanzees have been identified above. The goal of these offsets would be to work towards no net loss and eventually net gain to Eastern Chimpanzee populations in the CHAA. Although reasonable mechanisms exist, there is still uncertainty associated with offsetting because proposed actions require third-party participation beyond the control of the Project. Offset feasibility is classed as possible at this time, which results in a moderate risk level for the Project (Table 49).

**Table 49: Post offset residual risk: construction and operation phase impacts on Eastern Chimpanzee**

| Description of Offsets | Residual Impact | Risk Level for not being successful |
|---|---|---|
| Supporting improved management of the Bugoma Central Forest Reserve, and research on the population of Nahan's Francolin. | positive | moderate risk |

**Table 50: Possible offset options as part of the mitigation strategy for the Project**

| Offset required | Mechanism | Responsibility | Details |
|---|---|---|---|
| Natural habitat - near-shore aquatic<br>Critical habitat – Mud Snail | • Improved management of the near-shore aquatic habitats within the CHAA | CNOOC | • Education programme for the local population about the potential impacts their activities could have on the near-shore aquatic habitats<br>• The safe handling and disposal of fuels and oils used for out-board motors<br>• The use of less destructive fishing methods in the near-shore habitats, such as seining |
| Natural habitat - vegetation of the escarpment | • Improved management of the wider Murchison Falls National Park-Budongo-Bugoma-Kagombe-Itwara Forest Reserves-Semliki/Toro Wildlife Reserve corridor | CNOOC, TOTAL, Tullow | • Provision of assistance to UWA, and other research organisations, in forming and collaborating in a committee to devise long-term management goals and measures for the wildlife corridor<br>• Action plan to ensure that the management goals and measures devised by the committee are actioned, implemented and monitored on the ground |
| Natural habitat - wetlands | • Improved management of wetlands in the wider Albertine Graben; in particular, known breeding sites for Grey Crowned Cranes and Shoebills | CNOOC | • Provision of assistance to UWA, and other research organisations, with monitoring and conservation of the Grey Crowned Crane and Shoebill |
| Natural habitat – Bugoma Central Forest Reserve<br>Critical habitat – Nahan's Francolin<br>Critical habitat – Eastern Chimpanzee | • Improved management of the Bugoma Central Forest Reserve, and research on the threatened species that inhabit the forest | CNOOC | • Assistance to the NFA for management of the Bugoma Central Forest Reserve, and the UWA, and other research organisations involved with the monitoring and conservation of threatened species. |

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# APPENDIX A

## Document Limitations

# APPENDIX B

## Critical Habitat Approach and Method of Assessment

The purpose of defining critical habitat is to identify areas of a particularly sensitive nature for biodiversity conservation that deserve special attention and may require extraordinary mitigations. Importantly, as mentioned in Section 3.1.1, critical habitat exists independent of a project, and can be identified without reference to a project; that is, a project may be proposed in critical habitat, but the critical habitat is present under baseline conditions and is not defined by the size of the project footprint or other project effects. As such, the critical habitat assessment does not focus solely on the project footprint, which, in this case is the Kingfisher Development Area and the proposed feeder line route (Figure 1). Rather, it focuses on a wider area, as encompassed by the CHAA (Figure 2).

The concepts of irreplaceability and vulnerability are important when identifying critical habitat. These concepts are widely used in systematic conservation planning as the basis for determining relative ecological importance (Langhammer et al. 2007). Systematic conservation planning is a structured approach to prioritising and managing areas considered important for the protection of natural values (Sarkar and Illoldi-Rangel 2010). The irreplaceability (that is, rarity or uniqueness) of a site is the degree to which geographic options for conservation will be lost if that particular site is lost (Margules and Pressey 2000). For example, a site is irreplaceable if it contains one or more endemic species found only in that location. Vulnerability (or degree of threat) refers to the likelihood that a site's biodiversity value will be lost in the future (Margules and Pressey 2000). Hence, vulnerability can also be seen as a measure of irreplaceability over time, rather than space. Sites facing low threat can still be conserved in the future, but highly vulnerable sites will have to be protected now or they may be lost entirely (Langhammer et al. 2007).

Vulnerability can be measured on a site-basis (that is, the likelihood that the species will be locally extirpated from a site) or a species-basis (that is, the likelihood that the species will go globally extinct) (Langhammer et al. 2007). Sites with both high irreplaceability and high vulnerability should, therefore, receive priority for conservation to prevent biodiversity loss (Margules and Pressey 2000, Langhammer et al. 2007). Habitats supporting irreplaceable and extremely vulnerable biodiversity features are likely to constitute critical habitat, and such features should be identified under baseline conditions at the ecological scales appropriate for their designation.

### *Assessment Criteria*

Critical habitat designation, typically, should be determined on a case-by-case basis according to the concepts of irreplaceability and vulnerability (IFC 2012b). Hence, when applying this guidance, it is often possible to identify critical habitat using the five primary criteria provided by the IFC (2012a), that is:

1) Habitat of significant importance to critically endangered and/or endangered species.

2) Habitat of significant importance to endemic and/or restricted-range species.

3) Habitat supporting globally significant concentrations of migratory species and/or congregatory species.

4) Highly threatened and/or unique ecosystems.

5) Areas associated with key evolutionary processes.

However, these are only a guideline, and it is important to remember that critical habitat can include values that do not necessarily discretely fit into the above categories, and are often important in their own right on the local scale. Therefore, in addition to the above five criteria, the following criteria were also considered for the Kingfisher Area and proposed pipeline route (after, IFC (2012b)). These criteria do not have quantitative thresholds for assessment, or much qualitative guidance suggested in the guidance notes (that is, IFC 2012b). Nevertheless, they were considered in the critical habitat screening process:

6) Areas required for seasonal refugia for critically endangered and/or endangered species.

7) Ecosystems of known special significance to critically endangered or endangered species for climate adaptation purposes.

8) Concentrations of vulnerable species in cases where there is uncertainty regarding the listing, and the actual status of the species may be critically endangered or endangered.

9) Areas of primary/old-growth/pristine forests and/or other areas with especially high levels of species diversity.

10) Landscape and ecological processes (for example, water catchments, areas critical to erosion control, disturbance regimes) required for maintaining critical habitat.

11) Habitat necessary for the survival of keystone species; that is, species that act as ecosystem engineers and drive ecosystem process an functions, for example, elephants in savannah woodlands and their foraging behaviours that maintain vegetation structure.

12) Areas of high scientific value, such as those containing concentrations of species new and/or little known to science.

13) An area of known high concentrations of natural resources exploited by local people.

14) Areas that meet the criteria of the IUCN's Protected Area Management Categories Ia, Ib and II, although areas that meet criteria for Management Categories III-VI may also qualify depending on the biodiversity values inherent to those sites.

15) KBAs, which encompass inter alia Ramsar Sites, IBAs, Important Plant Areas (IPA) and Alliance for Zero Extinction Sites.

16) Areas determined to be irreplaceable or of high priority/significance based on systematic conservation planning techniques carried out at the landscape and/or regional scale by governmental bodies, recognized academic institutions and/or other relevant qualified organizations (including internationally-recognized NGOs).

17) High Conservation Value (HCV) areas.

Given the above, the determination of critical habitat is not absolute. Consequently, gradients of critical habitat can be recognised based on the relative vulnerability (that is, degree of threat) and irreplaceability (that is, rarity or uniqueness) of the habitat. The IFC, therefore, subdivides critical habitat into Tier 1 and Tier 2 for Criteria 1 to 3 (Table 1, IFC, 2012a, b). Although the same restrictions and mitigation standards apply regardless of which tier of critical habitat is identified, the tiers are intended to distinguish degree of biodiversity value, and identify the likelihood that effective mitigation is possible. Paragraph 61 of GN6 (IFC 2012b) reveals that the IFC considers compliance with all aspects of paragraphs 17 to 19 of PS6 "possible" in Tier 2 critical habitat, but "unlikely" in Tier 1 critical habitat. For Criteria 1 to 3, quantitative and qualitative thresholds for distinguishing the tiers of critical habitat have been developed by the IFC, whereas no such thresholds are presented for criteria 4 to 17.

**Table B1: Thresholds for Tier 1 and Tier 2 critical habitat**

| Criteria | Tier 1 | Tier 2 |
|---|---|---|
| **1 (EN or CR species)** | (a) Habitat required to sustain ≥ 10 percent of the global population of a CR or EN species/subspecies where there are known, regular occurrences of the species and where that habitat could be considered a discrete management unit for that species.<br>(b) Habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species.<br>(c) Wide ranging, large EN and CR mammals may be Tier 1 despite not triggering a threshold through the discrete management unit concept, due to additional considerations (e.g., great apes due to anthropological and evolutionary significance, as well as ethical considerations). | (a) Habitat that supports the regular occurrence of a single individual of a CR species and/or habitat containing regionally- important concentrations of a Red-listed EN species where that habitat could be considered a discrete management unit for that species/ subspecies.<br>(b) Habitat of significant importance to CR or EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species.<br>(c) As appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing. |
| **2 (Endemic or Restricted-range species)** | (a) Habitat known to sustain ≥ 95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species (e.g., a single-site endemic). | (a) Habitat known to sustain ≥1 percent but <95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where data are available and/or based on expert judgment. |

| Criteria | Tier 1 | Tier 2 |
|---|---|---|
| **3 Migratory and/or congregatory species** | (a) Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 95 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle where that habitat could be considered a discrete management unit for that species. | (a) Habitat known to sustain, on a cyclical or otherwise regular basis, ≥1 percent but <95 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle and where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment.<br>(b) For birds, habitat that meets BirdLife International's Criterion A4 for congregations and/or Ramsar Criteria 5 or 6 for Identifying Wetlands of International Importance.<br>(c) For species with large but clumped distributions, a provisional threshold is set at ≥5 percent of the global population for both terrestrial and marine species.<br>(d) Source sites that contribute ≥1 percent of the global population of recruits. |

From: IFC 2012

Note: EN = endangered; CR = critically endangered; ≥ = more than or equal to; < = less than; > = more than

Given all of the above, for the purposes of this impact assessment, the identification of critical habitat followed a three-step approach:

a) Identification of DMUs within the CHAA.

b) Screen valued components within the spatial unit of analysis against the 17 critical habitat criteria described above.

c) Map critical habitat for those valued components that trigger it in the CHAA.

### *Discrete Management Units*

The IFC define a DMU as an area with a "clearly demarcated boundary within which the biological communities and/or management issues have more in common with each other than they do with those in adjacent areas" (IFC 2012b, GN6, paragraph 65). The DMU represents the scale at which critical habitat was assessed using the quantitative thresholds identified in IFC PS6 GN6 for Criteria 1 to 3 (IFC 2012b) within the CHAA. The delineation of a DMU varied depending on the species, subspecies or biodiversity feature of concern, yet, as mentioned, was confined to the CHAA. For example, a small, rare ecosystem (for example, vegetation type) may be an appropriate DMU for a locally endemic plant species; however, this would not be appropriate for a large-ranging fauna species. Depending on the size of the ecosystem and geographic range of the species, the DMU may more appropriately include several patches along a topographical feature that expands across a region, rather than constraining the analysis to the CHAA.

DMUs were evaluated on a case-by-case basis and assigned for a particular species or feature. We defined DMUs using both ecological and management boundaries. For many biodiversity features, the DMU was the same spatial extent as the CHAA because of marked differences in biodiversity management practices across the area. The DMUs for Criteria 4 and 5 were delineated using the CHAA or other ecological boundary to encompass the biodiversity values of interest.

### *Screening Valued Components*

The determination of critical habitat for valued components required that each valued component potentially present in the CHAA was screened against each of the 17 criteria presented above, as summarised below. It should be noted that the screening occurred for all valued components, that is, ecosystems and habitats and species of concern, although quantitative thresholds are only applicable to Criteria 1 to 3. For the remainder, qualitative thresholds were derived.

To distinguish between Tier 1 and Tier 2 (Criteria 1 to 3), using the defined quantitative thresholds (see IFC 2012b), the proportion of the global population occurring within a DMU for a given species was estimated. The quantitative threshold was strictly applied where DMUs were small, but expert judgment was used to assess irreplaceability and vulnerability when identifying critical habitat for large DMUs. A hierarchy of approaches was used to achieve this, from most to least preferred:

1) population estimates
2) global area of occupancy
3) global extent of occurrence
4) expert opinion.

Estimates of population size within a DMU, if known, were compared to global estimates when available. When population data were unavailable (as was the case in most instances), the proportion of the known range extent for the species of concern was calculated to approximate the population size, using either area of occupancy (AOO) (if available) or extent of occurrence (EOO) as a surrogate. The AOO consists of the area within the EOO that is truly occupied by a species, excluding cases of vagrancy (IUCN 2001). This metric takes into account the fact that a species does not generally occupy the full extent of its range, which may contain unsuitable or unoccupied habitats. The global EOO is a boundary that encompasses all known, inferred or projected occurrences of a species (IUCN 2001). The EOO is generally measured as a minimum convex polygon that contains all occurrence sites for a given species. The EOO can be continuous or, in some cases, is disjunct and consists of many polygons. The proportion of the global EOO within the CHAA was the most commonly applied surrogate for population size for critical habitat assessment. The number of DMUs for a particular species present globally was also used as a surrogate for population size, when that information was available. Where data were unavailable, global EOO was estimated using expert opinion.

- Criterion 1

  For Criterion 1, the protected status of all identified species of concern potentially occurring within the CHAA (see Section 3.3.3.2 of the main report and the associated probability analysis for species of concern in the CHAA) was searched on the IUCN's Red List of Threatened Species (IUCN 2014a). Actual records of species within the CHAA were obtained from the Global Biodiversity Information Facility (GBIF 2014) to determine their local AOO. Where records did not exist within the GBIF, inferred distribution records were obtained from: Kalema and Beentje (2012) (plants); Mandahl-Barth G (1954) (freshwater molluscs); Greenwood (1966) (fish); Carder and Tindimubona (2002), Davenport (2003) (butterflies); Miller and Miller (2003) (Odonata); Channing and Howell (2006) (amphibians); Spawls et al. (2004) (reptiles); Stevenson and Fanshawe (2002) (birds); and Butynski et al. (2013), Happold (2013), Happold and Happold (2013), Kingdon and Hoffman (2013a, b), Kingdon et al. (2013) (mammals). Due to the lack of information for most invertebrate taxa, the majority of these groups were not considered in this assessment.

  Regional importance of the critical habitat was set based on published expert opinion, especially bearing in mind the distinct nature of the Albertine Graben and Lake Albert area compared to the wider area; that is, the wider area is a highly modified landscape.

- Criterion 2

For Criterion 2, the global EOO for all species of concern potentially present within the CHAA (see Section 3.3.3.2 of the main report, and the associated probability analysis for species of concern in the CHAA) was searched in the literature, or in available databases. EOO data were obtained from the Integrated Biodiversity Assessment Tool (IUCN 2014b) where they existed. Actual records of species within the CHAA were obtained from the Global Biodiversity Information Facility (GBIF 2014) to determine their local EOO. Where records did not exist within the GBIF, inferred distribution records were obtained from: Kalema and Beentje (2012) (plants); Mandahl-Barth G (1954) (freshwater molluscs); Greenwood (1966) (fish); Carder and Tindimubona (2002), Davenport (2003) (butterflies); Miller and Miller (2003) (Odonata); Channing and Howell (2006) (amphibians); Spawls et al. (2004) (reptiles); Stevenson and Fanshawe (2002) (birds); and Butynski et al. (2013), Happold (2013), Happold and Happold (2013), Kingdon and Hoffman (2013a, b), Kingdon et al. (2013) (mammals). Due to the lack of information for most invertebrate taxa, the majority of these groups were not considered in this assessment. It is noted that for many species EOO and AOO data were not available in any of these sources. As such, a precautionary approach was assumed.

Restricted-range criteria for species of concern were defined based on guidance provided by the IFC (2012b). All species with ranges (EOO) of 50 000 $km^2$ or less were considered restricted range, and were assessed for critical habitat against Criterion 2. In cases where both the AOO and EOO were known, only the AOO was used to define the range size and screen species. For invertebrates and aquatic species, restricted-range species were defined based on guidance provided by the IFC (GN6 paragraph 80, IFC 2012). All species with global ranges of 20 000 $km^2$ or less were considered as restricted-range (Holland et al. 2012).

- Criterion 3

All observed (see Appendix B) and potential migratory or congregatory species (see Section 3.3.3.2 of the main report, nd the associated probability analysis for species of concern in the CHAA) that may occur in the CHAA were screened. This list of species was used to determine if the area contained irreplaceable and/or extremely vulnerable habitats used either periodically or consistently by migratory or congregatory species. All migratory species were identified using information from BirdLife International (2013b), the CMS (2014), the IUCN (2014a), or other published literature.

- Criterion 4

Criterion 4 is triggered by ecosystems that are threatened, house unique assemblages of biome-restricted species, or are recognized for high conservation value, including protected areas. Where data permitted, quantitative categories and criteria from Rodriguez et al. (2011) were applied to evaluate ecosystem status. Ecosystems considered critically endangered or endangered were identified as critical habitat, and ecosystems rated as vulnerable were evaluated on a case-by-case basis in consultation with appropriate experts. Ecosystems with unique assemblage of species, or of high conservation value were evaluated based on field data, literature and consultation with experts.

It should be noted that there is a distinction between habitat (that is, a consistent assemblage of adapted flora and fauna) and ecosystem (that is, a group of habitats with similar function). Ecosystem level analyses were focused on ecosystems delineated using vegetation communities identified within the CHAA as mapped as part of the baseline studies (Appendix C) and land use and land cover class assessment (Appendix D).

- Criterion 5

Critical habitat for key evolutionary processes does not have quantitative thresholds (for example, see IFC, 2012a). For the purposes of this assessment, expert opinion was used to identify critical habitat with respect to Evolutionarily Distinct and Globally Endangered (EDGE) species, and other unique qualifiers, if they were identified to occur within the CHAA.

Criterion 5 applies to landscape-level features that can influence key evolutionary processes. Key landscape features such as habitat islands, and areas important for climate change adaptation were identified using literature review and consultation with experts. Criterion 5 also applies at the species level for "distinct species" which include those coined as "Evolutionarily Distinct and Globally Endangered" (EDGE) (GN 95 IFC 2012b, Jetz et al. 2014, ZSL 2014). Species screened included all those identified by a geographically-based search of the EDGE species database that covered the spatial extent of the CHAA.

To assess whether critical habitat exists in the CHAA for identified EDGE species, a two-fold approach was applied. First, habitat associations of a given species were summarised and the relative uniqueness or rarity of those habitats was qualitatively discussed. Second, the relative importance of the CHAA for a particular species was evaluated. This is a useful guide because here we are only considering EDGE species, rather than other aspects of key evolutionary processes. Essentially this is a check that additional species not picked up under other criteria, may trigger the critical habitat definition.

- Criteria 6 to 17

For the remaining criteria, screening involved: a review of available reports, *viz.*: Emerton and Muramira (1999); AWE (2008a, b, 2013a, b, 2014a, b); Lamprey (2009); NEMA (2010); Plumptre et al. (2003, 2005, 2007, 2010, 2011); AECOM (2012, 2013); consultation with local experts (for example, Makerere University, Wildlife Conservation Society (WCS), Fisheries Department of Fisheries Resources (DFR), Uganda Wildlife Authority (UWA), Wetlands Management Department (WMD), National Forest Authority (NFA); as well as expert knowledge. These criteria are important for the screening of habitat and ecosystem integrity valued components, as well as ecosystem services valued components. In particular:

- Areas required for seasonal refugia for critically endangered and/or endangered species were screened qualitatively using the information contained in the available reports and in scientific literature, and using the knowledge gained from consultation.
- Ecosystems of known special significance to critically endangered or endangered species for climate adaptation purposes were screened qualitatively using the information contained in the available reports and in scientific literature, and using the knowledge gained from consultation.
- Concentrations of vulnerable species in cases where there is uncertainty regarding the listing, and the actual status of the species may be critically endangered or endangered, were screened qualitatively using the information contained in the available reports and in scientific literature, and using the knowledge gained from consultation.
- Areas of forests and/or other areas with especially high levels of species diversity were screened for the entire CHAA based on the data contained in Plumptre et al. (2010, 2011) and AECOM (2012, 2013).
- Landscape and ecological processes (for example, water catchments, areas critical to erosion control, disturbance regimes) for maintaining critical habitat were screened qualitatively using the information contained in the available reports and in scientific literature.
- Habitat necessary for the survival of keystone species were screened qualitatively using the information contained in the available reports and in scientific literature, and using the knowledge gained from consultation.
- Areas of high scientific value, such as those containing concentrations of species new and/or little known to science were screened qualitatively using the information contained in the available reports and in scientific literature, and using the knowledge gained from consultation.
- Areas of known high concentrations of natural resources exploited by local people were screened qualitatively and quantitatively using the information gained from the stakeholder engagement (see Golder Associates 2014a), available reports and in scientific literature.

- Protected areas meeting the IUCN's management categories, and overlapping the CHAA, were screened based on data obtained from the World Database on Protected Areas (WDPA 2014) and the IBAT (IUCN 2014b).
- KBAs overlapping the CHAA were screened based on data obtained from the IBAT (IUCN 2014b).
- The CHAA was screened for other areas of high priority/significance based on information gained from consultation and contained within Plumptre et al. (2010, 2011) and AECOM (2012, 2013).
- The CHAA was screened for areas of HCV based on information gained from consultation and contained within Plumptre et al. (2010, 2011) and AECOM (2012, 2013).

### *Distribution of Critical Habitat*

Critical habitat should be defined spatially in an ecologically sensible manner specific to the biodiversity feature for which it was designated, and cannot be focused either only on sampling points or on an entire study site, without appropriate support. Therefore, the critical habitat was delineated using the following approaches, from most to least preferred:

1) Occupancy or habitat association models derived from empirical data.
2) Occupancy or habitat association models derived from literature review and consultation with experts.
3) Range maps or population locations derived from empirical data and/or expert opinion.
4) Entire CHAA identified as critical habitat where uncertainty concerning range or habitat associations precluded more precise mapping.

The final product was a series of critical habitat maps developed individually for each biodiversity value triggering critical habitat. During the impact assessment process, these maps were used as the basis for applying the mitigation hierarchy (Section 9.1).

# APPENDIX C

## Terrestrial Ecology Baseline Study

# APPENDIX D

## Aquatic Ecology Baseline Study

# APPENDIX E

## Land Cover Classification

# APPENDIX F

## Impact Assessment Approach and Methods

## Reasoned Narrative

The written analysis section for each key question first presents an outline of the methods used to estimate a change in condition for each valued component associated with that key question. Changes in condition were defined, for example, as changes to the size or function of a population, habitat, ecosystem, or ecosystem service from the baseline condition. Methods to estimate change in condition included calculations, and qualitative analyses based on available information from reports, scientific literature, and expert consultation. Methods used in the analysis section were specific to groups of valued components, or individual valued components.

After outlining the methods, the analysis was structured using indicators. Indicators are quantifiable (that is, measurable) expressions of change to a valued component, which were used to answer the key questions. The indicators selected for a valued component (see Table 1, Section 3.4.1 of the main report) were those that helped to understand whether the fundamental properties of a valued component that should be conserved, such as self-sustaining and ecologically-effective populations of plants and animals, and would be meaningfully affected by the development of the Project. As noted in the assessment timeframe (Section 3.1.2 of the main report), indicators were evaluated and described for the construction case, the operation case, and the decommissioning case.

For each indicator, the effect attributes described below were used to guide the assessment and description of the intensity, or magnitude, of the impact. These included direction, geographic extent, duration, and frequency. These criteria were considered together to determine the overall magnitude of the effect of the Project on a valued component, and these effects were described using a reasoned narrative. Where possible, magnitude was quantified as a specific value, such as change in population size or number of hectares of critical habitat lost.

The potential effect of the development in the CHAA was described with respect to the known, or inferred, ability of each valued component to absorb or otherwise accommodate disturbance. The ability of a valued component to accommodate disturbance was evaluated using the concepts of ecological adaptability and ecological resilience. Adaptable valued components are those that can change their behaviour, physiology, or population characteristics (for example, birth rate) in response to a disturbance such that the property of the valued component that should be conserved remains more or less unchanged. For example, certain animal and plant populations can accommodate loss of some individuals without a change in overall population status or trajectory (known as compensatory mortality), or can adjust their behaviour to accommodate disturbance (Cooley et al. 2009). Less adaptable valued components will be affected more than valued components with higher adaptability.

A concept closely related to ecological adaptability is ecological resilience. Ecosystems and populations often have inertia and will continue to function after disturbance up to the point where the disturbance becomes severe enough that the system or population changes. Adaptability influences the time it takes for this to happen, whereas resilience is the ability of a species or ecosystem to recover or bounce back from a disturbance (Mellin et al. 2014). Highly resilient valued components have the potential to recover quickly after rehabilitation, whereas valued components with low resilience will recover more slowly or may not recover at all.

The ability to absorb or accommodate disturbance through adaptability and resilience is a property of the valued component within the CHAA, and is not necessarily related to global conservation status. For example, a species that is highly threatened globally may also have low adaptability and resilience at the CHAA scale, or it may have a robust population that is both adaptable and resilient. Adaptability and resilience were, therefore, considered for each valued component at the CHAA scale, without taking global threat status into account.

At the species level, the concept of a self-sustaining, ecologically-effective population was used as a benchmark when describing level of effect. By definition, self-sustaining populations are not populations at the brink of extirpation; they are healthy, robust populations capable of withstanding environmental change and accommodating random population processes (Reed et al. 2003). For valued components that have strong effects on ecosystem structure and function (that is, highly interactive species), the concept of ecologically effective populations was also considered (Soulé et al. 2003). An ecologically effective population of a highly interactive species is one that is large or influential enough to maintain ecosystem function through its behaviours, that is, they could act as ecosystem engineers (Chapman et al. 2013, Nummi and Kuuluvainen 2013).

The level of effect to each valued component depended substantially on mitigations applied as part of the Project design, including the mitigation hierarchy. These mitigations were considered when describing the Project effect for each development stage; that is, construction case, operation case and decommissioning case. Rehabilitation of biodiversity values through habitat rehabilitation and offsets was considered when assigning residual impacts for the post-rehabilitation case.

After considering all mitigation, except rehabilitation, effects at maximum disturbance for each case were evaluated with a special focus on the potential for the Project to cause unacceptable loss of valued components in the CHAA, prior to decommissioning and rehabilitation. That is, the potential for the Project to breach an ecological threshold for a valued component. Most ecological threshold values in the literature point to a 40% or greater loss of habitat before irreversible decline occurs in populations of species or ecosystems (for example, Rompré et al. 2010, Swift and Hannon 2010). However, the amount of change due to the development of the Project, prior to meeting an ecological threshold, will depend on historical conditions and trends (that is, current drivers of change) with respect to a particular valued component. For the intents of this impact assessment, a conservative threshold value of 10% was set given the Project's expected small physical footprint, and unknown implications of induced impacts. This value was also set because of the IFC PS6 requirement of ensuring not only species persistence, but also to be able to plan for no-net-loss and eventual net gain as the Project proceeds. Larger impacts are less likely to be offset, so a low value of 10% was set with this in mind.

By the far future, reclamation and rehabilitation is expected to improve for most valued components relative to the construction and operations phases. Any residual adverse effects to unique and highly vulnerable valued components, for which critical habitat is predicted to be affected by the Project, must be offset to achieve net positive gain and to meet the target of compliance with IFC PS6. The Business and Biodiversity Offset Program (BBOP 2012, pg. 13) defines offsets as "measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate mitigation measures have been taken". Offsets occur along a continuum of compensation actions, and are achieved once a level of no-net-loss or better is reached. Any action that contributes to achieving no-net-loss or net gain can be considered part of the offset.

Whether or not offsetting would be necessary to comply with PS6 was identified for each valued component, and the magnitude of the predicted effect to that valued component was used to define the amount of offsetting required. Magnitude used to define offsetting requirements was taken either from the maximum disturbance case for construction and operation, or the decommissioning case, depending on the confidence in reclamation success. The case used to define offset requirements varied by individual valued component and a rationale for the selected case was provided for each valued component.

The objective of offsetting is to achieve, at least, no-net-loss and preferably net gains for the valued component for which it is applied. Therefore, where offsetting is successfully applied, the effects of the Project and its contribution to any existing and future cumulative effects will be positive. Where offsetting would be required, and sufficient information was available, specific actions that could contribute to achieving an offset for a particular valued component were identified. The likelihood that the offset would be achieved was also discussed. Given that offsets are designed to achieve a positive effect of the Project for the valued component in question, the purpose of the assessment with respect to offsetting was to evaluate the risk that the offset might not be achieved.

Part of the risk of achieving an offset relates to the size of the effect that must be offset. The extent to which critical habitat was affected by the Project, and hence the amount of loss that must be offset, was conservatively estimated for each valued component. This was accomplished by identifying critical habitat as broad spatial units containing habitats potentially used by the valued component for which critical habitat is present in the CHAA. Identifying locations where a particular species was found during baseline data collection and designating only those locations as critical habitat is not considered appropriate. Most species may be present in locations that were not sampled, or may move into different areas over time. Defining only areas where a particular species was found during baseline surveys as critical habitat also would have failed to consider supporting ecological functions that may come from outside of the areas identified (for example, habitat supporting the prey consumed by a predator). Critical habitat was, therefore, defined broadly based on appropriate ecological constraints, and the breadth of critical habitat designation increased with uncertainty about the distribution and ecological requirements of a valued component. Hence, the total amount of critical habitat (that is, number of hectares) affected by the Project, and the offset requirements in order to achieve net gains, may have been overestimated but was not likely underestimated.

However, inappropriate conclusions are possible when broad definitions of critical habitat are used to infer changes in valued component status based on the proportion of critical habitat in the CHAA affected by the Project. Broad critical habitat designation may overestimate the actual critical habitat for the valued component across the entire CHAA, and underestimate the proportion affected by the Project if the true distribution of critical habitat is concentrated in the Project footprint. When evaluating population level effects, therefore, the proportion of critical habitat lost was considered in context of all other information available, including the proportion a population or series of populations estimated inside and outside the footprint, and within the wider CHAA. In some cases where critical habitat was broadly mapped due to high uncertainty about species-habitat associations, the proportion of the known population within the CHAA affected by the Project was used to predict population-level consequences of the Project, if and when such information was available.

## Impact Classification

A formal impact assessment rating was completed using the results described in the reasoned-narrative analysis above. The purpose of the impact classification was to provide a system for ranking the significance of impacts, based on the intensity of the impact and the sensitivity of the receptor (described below), in a clear and repeatable way that permits comparison among valued components, and categorises the overall impact level for each valued component in light of the suggested mitigation measures described in Section 8.0 of the main report.

### Magnitude of Impact

The first step in the impact significance classification was to determine the intensity, or magnitude, of the effect of the Project within the LSA and CHAA. The effect was quantified by combining the rankings of the criteria for direction, geographic extent, duration, and reversibility into a single measure of magnitude for each key question and valued component.

Magnitude describes the significance or intensity of the effect. To classify magnitude using an ordinal scale (that is, negligible, low, medium, or high) in a manner meaningful for biodiversity valued components, the effect size must be placed in the context of the valued component. That is, classifying magnitude in a meaningful way depends on the historical and ecological context of the valued component, which includes effects of previous and existing developments and population trajectories of the valued component in the CHAA, and were valued component-specific. For example, a 20% additional habitat loss from the baseline condition in the CHAA may be required to cause a high magnitude effect on some valued components, whereas a 2% habitat loss may be sufficient for others, depending on context. Fixed quantitative thresholds to define ordinal magnitude categories were therefore not applied. Instead, qualitative descriptions of the potential for an effect of a given size to contribute to a substantial change in the structural integrity (for example, self-sustaining population) or ecological function were used (Table F1).

All of these steps were deliberately kept transparent so that the impact assessment process can be readily understood by stakeholders.

To help readers understand the results of the impact assessments, each assessment answered the same questions to derive the magnitude:

a) Is the effect good or bad? This is the direction of an effect.

b) How large an area will be affected? How far will the effect reach? This is the geographic extent of an effect.

c) How long will the effect last? This is the duration of an effect.

d) Will the effect be reversible or not?

Each of these is discussed in more detail below.

- **Direction**

  Direction describes the trend of the effect compared with baseline conditions. There are three options for direction:

  - Adverse – effect is worsening or is undesirable.
  - Neutral – effect is not changing compared with baseline conditions and trends.
  - Positive – effect is improving or is desirable.

- **Geographic Extent**

  Geographic extent describes the quantitative measurement of area within which an effect occurs. Effects are described in terms of whether they are limited to the LSA, the CHAA, or extend farther:

  - Local – effect is limited to the LSA.
  - Regional – effect extends beyond the LSA, but is limited to the CHAA.
  - Beyond regional – effect extends beyond the CHAA.

- **Duration**

  Duration refers to how long an effect lasts. Duration is described in relation to the phases of the development of the Project within the CHAA, although effects may last longer than the phases of the Project for some valued components. The following framework was used: construction, operations, decommissioning, and far-future.

  For the purposes of this impact assessment, the far future is a duration criterion that is meant to capture effects lasting several generations after decommissioning and rehabilitation. This relates to effects that the Project may have on the area's environmental and social sustainability (or not), including cumulative impacts.

  - Short-term – effect is limited to the construction period (~2 years), or the period of decommissioning activities (~2 years).
  - Medium-term – effect extends throughout the project operations, that is, 25 years.
  - Long-term – effect extends beyond the 25 years of operation.
  - Far future – effect extends more than 30 years after closure.

- **Reversibility**

  This criterion describes whether the effect is reversible or not. This can be associated with duration, as many effects eventually could be considered to be reversible (that is, in geological time). However, the extinction of a species can be considered as irreversible.

**Table F1: Intensity assessment rating scale for CHAA-level impacts**

| Criterion | Rating scales |
|---|---|
| **Negligible 1** | Where the impact affects the environment in such a way that natural, and /or cultural and social functions and processes are negligibly affected and valued, important, sensitive or vulnerable systems or communities are negligibly affected. |
| **Low 2** | Where the impact affects the environment in such a way that natural, and/or cultural and social functions and processes are minimally affected and valued, important, sensitive or vulnerable systems or communities are minimally affected. No obvious changes prevail on the natural, and / or cultural/ social functions/ process as a result of project implementation |
| **Medium 3** | Where the affected environment is altered but natural, and/or cultural and social functions and processes continue albeit in a modified way, and valued, important, sensitive or vulnerable systems or communities are moderately affected. Near the limits of the ability of the valued component to adapt. |
| **High 4** | Where natural and/or cultural or social functions and processes are altered to the extent that they will temporarily or permanently cease, and valued, important, sensitive or vulnerable systems or communities are substantially affected. The changes to the natural and/or cultural / social- economic processes and functions are drastic and commonly irreversible. |

In light of the above, it should be noted that defining quantitative ecological benchmarks to bound regional effect-level categories for biodiversity is challenging, and each valued component and situation requires specific analysis (Fahrig 2003, Petchey and Gaston 2006). Ideally, effect threshold values are known, and indicators can be quantified accurately with a high degree of confidence; however, critical thresholds and target levels for indicators, such as habitat quality, quantity, and configuration (for example, patch size, number and isolation), are frequently not available for biodiversity. This was certainly the case for the majority of valued components of the CHAA. Moreover, thresholds vary by species, landscape type, and spatial scale (Fahrig 2001), and some species that avoid human features in relatively undisturbed landscapes can change their behaviour to accommodate disturbance where it is more prevalent (Martin and Blackburn 2010).

Intensity classification was, therefore, based on the inferred or known ability of the valued component to accommodate the predicted change in condition due to the Project based on available scientific literature and consultation with experts. Where ecologically defensible valued component-specific thresholds could be identified, they were applied to indicators to classify effect. Definitions of the different levels of Project effect at the CHAA-scale are presented in Table F1. Intensity classes relate to the level of change compared to natural variation, plus the valued components' ability to absorb or otherwise accommodate the predicted amount of change.

## Sensitivity of Receptor

To derive an overall level of impact significance, which also reflected the expected conservation outcome for the particular valued component in a global context (*sensu* IFC 2012a), the predicted effect intensity was combined with a sensitivity value for the valued component.

For the intents of this biodiversity impact assessment, sensitivity represents the valued component's irreplaceability and vulnerability. It was based on, amongst other aspects, the valued components resilience, as well as national and global conservation status. As such, sensitivity was based on scientific principles of biodiversity conservation and human values regarding valued components associated with ecosystem services.

Sensitivity for each valued component ranged from very low to high according to increasing level of threat (Table F2).

**Table F2: Sensitivity assessment rating scale**

| Criterion | Rating scales |
|---|---|
| **Negligible 1** | • None of the below. |
| **Low 2** | • Where natural recovery of the impacted area to the baseline or pre-project condition is expected in the short-term (1-2 years), or where the potentially impacted area is already disturbed by non-project related activities occurring on a scale similar to or larger than the proposed activity.<br>• Biome or ecoregion endemic.<br>• At baseline, ecosystem's or species's distribution significantly reduced from historical extent, but is currently stable.<br>• Ecosystem service is readily substitutable or replaceable. |
| **Medium 3** | • Where natural recovery to the baseline condition is expected in the medium term (2-5 years), and where marginal disturbance or modification of the receiving environment by existing activities is present.<br>• Ugandan and/or IUCN status of Vulnerable, Near Threatened, or Data Deficient.<br>• Regional endemic.<br>• At baseline, ecosystem's and/or species's distribution fragmented and/or under stress.<br>• Ecosystem service is substitutable or replaceable. |
| **High 4** | • Where natural recovery of the receiving environment is expected in the long-term (>5 years) or cannot be readily predicted due to uncertainty over the nature of the potential impact, and where unique or highly valued ecological, social or cultural resources could be adversely affected.<br>• Locally endemic or range is restricted to the CHAA.<br>• Ugandan and/or IUCN status of Critically Endangered or Endangered.<br>• Local temporal concentrations of individuals significant to global population<br>• At baseline, a much reduced and/or highly fragmented ecosystem and/or species distribution compared to historical extent.<br>• Ecosystem representation whose presence or processes support Critically Endangered or Endangered species's habitat, or buffers it.<br>• Keystone species.<br>• Species new to science.<br>• Ecosystem service is not substitutable and/or irreplaceable. |

## Impact Significance

Sensitivity was combined with the CHAA-level intensity classification to obtain an overall impact significance using the matrix presented in Table F3. Overall impact severities were classified for the construction, operation and decommissioning cases. Descriptors of the impact significance levels are presented in Table F4.

**Table F3: Determination of impact severity**

| | | | Sensitivity of receptor | | | |
|---|---|---|---|---|---|---|
| | | | Negligible | Low | Medium | High |
| | | | 1 | 2 | 3 | 4 |
| Intensity of Impact in CHAA | Negligible | 1 | 1<br>Negligible | 2<br>Minor | 3<br>Minor | 4<br>Minor |
| | Low | 2 | 2<br>Minor | 4<br>Minor | 6<br>Moderate | 8<br>Moderate |
| | Medium | 3 | 3<br>Minor | 6<br>Moderate | 9<br>Moderate | 12<br>Major |
| | High | 4 | 4<br>Minor | 8<br>Moderate | 12<br>Major | 16<br>Major |

**Table F4: Overall impact level**

| Attribute | Definition |
|---|---|
| **Negligible** | • No adverse impacts to valued components from the Project. |
| **Minor** | • Impact level is acceptable to viability or integrity of valued components.<br>• Mitigation is adequate and achievable and monitoring may be necessary. |
| **Moderate** | • Impact level requires follow up action, including the possibility of offsetting.<br>• Monitoring necessary to evaluate continued viability or integrity of valued components and provide opportunities for adaptive management |
| **Major** | • Impact level is unacceptable. Depending on valued component, impact level requires careful, specific, higher-level mitigation design (e.g., offsetting).<br>• Resilience of valued components stressed to the extent that recovery may not be considered possible<br>• Exceedance of legal standards and widely-accepted conservation good practice.<br>• Implies proximity to, and uncertain risk of exceedance of, Project design thresholds. |

As noted above, overall impact severity was derived separately for the construction, operation and decommissioning cases. For example, a high CHAA-level impact intensity scored against a high-ranked sensitivity for a valued component would result in a major overall impact severity. A major overall impact severity level means that, with current baseline understanding and current Project designs, the requirements of IFC PS6 and a no-net-loss and/or NPI are predicted to be exceeded. Such a situation would necessitate one or more of: a complete design change; additional mitigation; or additional understanding of baseline conditions that would lead to a predicted lower consequence. Major overall impact severity levels are obtained from several combinations of CHAA-level impact ranking and sensitivity, and have a potential to exceed no-net-loss and NPI requirements. These impacts may require a design change or additional understanding of baseline conditions. Additional requirements, if required, were described in detail in the Analysis Sections of the assessment for each Key Question and valued component.

Where the overall impact severity levels were moderate or major, and in light of the currently proposed decommissioning and rehabilitation, offsets were considered. This was done on a case-by-case basis for the individual valued components. The intensity, or magnitude, of effect from the case selected was used to define requirements for augmentation.

Successful application of offsets means that the overall impact severity level becomes negligible or positive for the valued component considered. A positive overall result for highly sensitive and unique biodiversity values is the target that CNOOC is progressively working to achieve. However, understanding the likelihood of achieving an offset has important implications for managing risk, because failure to achieve an offset may result in unacceptable outcomes for biodiversity values. The likelihood of achieving an offset (offset feasibility) was used in conjunction with the overall impact severity level to define an overall post-offset risk level (Table F5). Offsetting requirements for those valued components triggering them were ranked according to the following prediction confidence levels to facilitate this classification:

- Certain – proven mechanism, no risks of failure.
- Likely – highly feasible and, with good levels of risk management, should achieve desired outcomes.
- Possible – a reasonable mechanism and strategy exists, but significant risks are present (for example, technical uncertainties or third-party actions beyond Project control affect outcomes).
- Unlikely – in theory, a potential offset mechanism exists but considering technical difficulty, ecological uncertainty, or, economic, political or social challenges, or any combination of the above, with information available, it is considered unlikely to succeed.
- Impossible – no offset mechanism or opportunity exists for the valued component in question.

**Table F5: Overall post-offset risk level matrix as a function of offset feasibility and overall impact severity level**

| Risk Level (post-offsetting) | | Offset Feasibility | | | | |
|---|---|---|---|---|---|---|
| | | Certain | Likely | Possible | Unlikely | Impossible |
| Overall Impact Severity Level | Major | No Risk | Moderate Risk | High Risk | High Risk | Unacceptable Risk |
| | Moderate | No Risk | Low Risk | Moderate Risk | High Risk | Unacceptable Risk |

Offset feasibility was conservatively identified for this assessment. Where information about offset options was scarce, offset feasibility was usually ranked unlikely, based on a precautionary approach. This assessment may change as more information is gathered and additional consultation with experts has taken place during the operation of the Project. In general, sufficient information was not available to assign offset feasibility to impossible or certain categories.

If offset feasibility was identified as impossible based on available information, risk to the valued component was unacceptable and the Project cannot proceed in a manner consistent with IFC PS6. As previously mentioned, such a situation would necessitate one or more of: a Project design change; additional mitigation, including additional study of offsetting potential; or additional understanding of baseline conditions that would lead to a lower predicted impact level. Where a high risk was identified, there is a chance that the proposed design criteria would be exceeded, and additional research to improve prediction confidence concerning offset feasibility or changes to Project design to reduce overall impact level at the maximum disturbance or decommissioning cases would be required. Moderate and low risk classifications represent acceptable risk levels with a reasonable chance of achieving a positive impact level for a valued component as a result of the Project. However, continuing efforts are recommended, as appropriate, to achieve as much certainty about offset success as possible, particularly in cases where a very high overall impact level was identified. Given uncertainty at this stage of the impact assessment, an offset feasibility assessment should be planned to improve prediction confidence for valued components for which offsetting was identified as a requirement.

## Prediction Confidence

Identified impacts were discussed in light of confidence in impact predictions based on data quality, model accuracy and any uncertainty about ecological processes or efficacy of mitigation, including rehabilitation.

# APPENDIX G

## Critical Habitat Screening and Appraisal

**Table G1: Probability analysis for identified species of concern to actually occur in the CHAA**

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| **Plants** | | | | | | | | | |
| *Afrothismia winkleri* var. *budongensis* | Budongo Afrothismia | Restricted | DD | - | - | - | No | The type species of this tree is listed as Critically Endangered in Cameroon (IUCN SSC 2013a). The variety recorded from Budonga Central Forest Reserve (GBIF 2017), is listed as Data Deficient (IUCN SSC 2013b). It has not yet been recorded from Bugoma Central Forest Reserve (Plumptre et al. 2010, 2011).<br>The population trend of this species is unknown (IUCN SSC 2013b) | Possible |
| *Aloe* sp. (Aloaceae) | Aloe | - | ? | - | App. II | - | No | Recorded in the CHAA (Appendix B, GBIF 2017) in thickets on the Buhuka Flats.<br>All *Aloe* species are listed under Appendix II of CITES (UNEP 2014). | Probable |
| *Cordia millenii* (Boraginaceae) | Drum Tree/West African Cordelia | Restricted | LR/LC | - | - | - | No | Recorded in the CHAA (Appendix B, GBIF 2017) in cultivated land on the plateau.<br>Less common and more seriously threatened in the eastern parts of its range through widespread exploitation for timber (ARW 1998). | Probable |
| *Euphorbia candelabrum* (Euphorbiaceae) | Candelabra Tree | - | NE | - | App. II | - | No | Recorded in the CHAA (Appendix B) in thickets on the Buhuka Flats.<br>All *Euphorbia* species are listed under Appendix II of CITES (UNEP (2017). | Probable |
| *Milicia excelsa* (Moraceae) | Mvule Tree/African Teak | Restricted | LR/NT | - | - | - | No | Recorded in the CHAA in fallow land, Bushland and Wooded Grassland. (Appendix B)<br>A common species known to occur in the regions of Bunyoro, Mengo, Masaka, Mubende, Toro, West Nile, Madi, Acholi, Lango, Teso, Mbale and Busoga, and is widespread in Africa (Kalema and Beentje 2012, WCMC1998). | Probable |
| *Polypogon schimperianus* | Grass | - | DD | - | - | - | No | This species has not been recorded in the CHAA (GBIF 2017, Appendix B).<br>No information in this species habitat preferences or populations within Uganda are known (Lansdown et al. 2013). | Possible |
| *Tamarindus indica* | Tamarind | Restricted | NE | - | - | - | No | Recorded in the CHAA (Appendix B) in Woodland and Wooded Grassland on the escarpment.<br>This is a widespread species (Board of Trustees Kew 2014). | Probable |
| **Macro-invertebrates** | | | | | | | | | |
| *Bellamya rubicunda* | Snail | - | NT | | | Range restricted | Yes Criterion 2 | This species is endemic to Lake Albert, and has an EOO of <5000 $km^2$, and is close to meeting the criteria for an Endangered listing based on its EOO (Kyambadde 2010b).<br>It has not been found in the CHAA (GBIF 2017, Appendix B), although it sister species *B. unicolor* was a very abundant species in the lake (Appendix B). | Possible |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | ¡ The population trend of this species is unknown, and its known habitat is declining in quality (Kyambadde 2010b). | |
| *Gabbiella candida* | Mud Snail | - | CR | - | - | Range restricted | Yes Criterion 1 and 2 | ¡ This species is only known from a small area around Butiaba, and has a predicted AOO of <10 km$^2$ (Kyambadde 2010a).<br>¡ It has not been found in the CHAA (GBIF 2017, Appendix B).<br>¡ The population trend of this species is unknown, and its known habitat is declining in quality (Kyambadde 2010a). | Possible |
| *Potamonautes bipartitus* | Crab | - | DD | - | - | Range restricted | Yes Criterion 3 | ¡ This species has not been recorded from the CHAA (GBIF 2017).<br>¡ It is known only from five localities: Alibuaki, 900 m asl, west of Issango; Undussuma; Mbeni (Fort Mbeni in the Semliki Forest); Bundeko, south of Lake Albert, Semiliki Valley; Koganos, and has been collected since 1892 (Cumberlidge 2008).<br>¡ The population trend of this species is unknown (Cumberlidge 2008). | Unlikely |
| **Fish** | | | | | | | | | |
| *Alestes macrolepidotus* | *Imberi* | Restricted | LC | - | - | Commercially important | Yes Criterion 13 | ¡ Recorded in the CHAA and the wider Lake Albert (GBIF 2017, Appendix C).<br>¡ Found more commonly in rivers than in lakes where it feeds on insects, crustaceans, small fish, vegetation and debris (Azeroual et al. 2010a).<br>¡ The populations of this species are unknown, however, heavy fishing pressure, including from commercial fisheries, may threaten populations of this species (Azeroual et al. 2010a, Taabu-Manyahu et al. 2012). | Probable |
| *Alestes baremose* | *Angara* | - | LC | - | - | Commercially important | Yes Criterion 13 | ¡ Recorded in the CHAA and the wider Lake Albert (GBIF 2017, Appendix C).<br>¡ Typically found in inshore zones of lakes, but is also potamodromous and benthopelagic. It has a very cosmopolitan diet and shifts from zooplankton to zoobenthos, detritus and macrophytes as plankton densities decline. Breeding fishes of both sexes are found in sheltered bays around the lakes shores (Akinyi et al. 2010a).<br>¡ The populations of this species are unknown, however, heavy fishing pressure, including from commercial fisheries, may threaten populations of this species (Akinyi et al. 2010a). | Probable |
| *Alestes dentex* | *Angara* | - | LC | - | - | Commercially important | Yes Criterion 13 | ¡ Recorded in the CHAA and the wider Lake Albert (GBIF 2017)<br>¡ Typically found in inshore zones of lakes, but is also potamodromous and benthopelagic. It has a cosmopolitan diet and shifts from zooplankton to zoobenthos, detritus and macrophytes as plankton densities decline (Akinyi et al. 2010c).<br>¡ The populations of this species are unknown, however, heavy fishing pressure, including from commercial fisheries, may threaten populations of this species (Akinyi et al. 2010c).<br>¡ Reported by Wandera and Balirwa (2010) to be extremely rare in the lake. | Possible |
| *Citharinus latus* | *Mpoi* | - | LC | - | - | Commercially important | Yes Criterion 13 | ¡ Recorded in Lake Albert (GBIF 2017). | Possible |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | ¡ Occurs in open water and vegetation beds of lakes and flowing water. Ingests mud containing benthic and sediment algae, as well as phytoplankton and benthic invertebrates (Azeroual et al. 2010b).<br>¡ The populations of this species are unknown, however, heavy fishing pressure, including from commercial fisheries, may threaten populations of this species (Azeroual et al. 2010b).<br>¡ Reported by Wandera and Balirwa (2010) to be almost extinct in the lake. | |
| *Citherinus citherius* | *Mpoi* | - | NE | - | - | Commercially important | Yes Criterion 13 | ¡ Occurs in open water and vegetation beds of lakes and flowing water. Ingests mud containing benthic and sediment algae, as well as phytoplankton and benthic invertebrates (Azeroual et al. 2010b).<br>¡ The populations of this species are unknown, however, heavy fishing pressure, including from commercial fisheries, may threaten populations of this species (Azeroual et al. 2010b).<br>¡ Reported by Wandera and Balirwa (2010) to be almost extinct in the lake. | Possible |
| *Clarias lazera* | African Catfish | - | LC | - | - | Commercially important | Yes Criterion 13 | ¡ Recorded in Lake Albert (GBIF 2017).<br>¡ A bottom dwelling species with a diet dominated by larvae of mayflies, non-biting midges, and caddis flies. This species undergoes lateral migration into swamps for feeding and spawning. (Lalèyè et al. 2010).<br>¡ The populations of this species are unknown, however, heavy fishing pressure, including from commercial fisheries, agricultural development and dams pose threats (Lalèyè et al. 2010). | Probable |
| *Distichodus niloticus* | *Mpoi* | - | LC | - | - | Commercially important | Yes Criterion 13 | ¡ Recorded in the CHAA and the wider Lake Albert (Appendix C, GBIF 2017).<br>¡ A macro-herbivorous species that feeds on submerged water plants, water hyacinth roots and periphyton. It is found in shallow inshore zones, especially in river deltas, but also sometimes in pelagic zones (Akinyi et al. 2010b).<br>¡ The populations of this species are unknown, however, heavy fishing pressure, including from commercial fisheries, may threaten populations of this species (Akinyi et al. 2010b, Taabu-Manyahu et al. 2012).<br>¡ Reported by Wandera and Balirwa (2010) to be extremely rare in the lake. | Probable |
| *Hydrocynus vittatus* | *Ngassa* | Restricted | LC | - | - | Commercially important | Yes Criterion 13 | ¡ Recorded in the CHAA and the wider Lake Albert (Appendix C, GBIF 2017).<br>¡ This species feeds on whatever prey is most abundant. Breeding takes place on a few days each year, when the first good rains have swollen rivers and streams, at which time it undertakes a spawning migration up rivers and into small streams (Azeroual et al. 2010c).<br>¡ The populations of this species are unknown, however, unregulated gillnet fisheries locally threaten the species. East African populations are threatened by heavy fishing pressure, silt loading due to agricultural activities/ deforestation, and pollution due to pesticides for agricultural use. (Azeroual et al. 2010c).<br>¡ Reported by Wandera and Balirwa (2010) to be rare in the lake. | Possible |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| *Malapterurus electricus* | African Electric Catfish | Threatened | LC | - | - | - | No | • Recorded in the wider Lake Albert (GBIF 2017).<br>• Widespread, it lives in shallow water, with muddy or sandy bottom neighbouring rocky areas, and favours sluggish or standing water (Azeroual et al. 2010d).<br>• The populations of this species are unknown; however, this species is threatened by overfishing in eastern Africa. (Azeroual et al. 2010d). | Possible |
| *Oreochromis niloticus* | Nile Tilapia | - | NE | - | - | Commercially important | Yes Criterion 13 | • Recorded in wider Lake Albert and the CHAA (GBIF 2017, Appendix C).<br>• It feeds on both plankton and aquatic plants and prefers shallow water. | Probable |
| *Sarotherodon galilaea* | Mango Tilapia | - | NE | - | - | Commercially important | Yes Criterion 13 | • Recorded in wider Lake Albert and the CHAA (Appendix C).<br>• It feeds on both plankton and aquatic plants and prefers shallow water. | Probable |
| *Schilbe niloticus* | African Butter Catfish | - | LC | - | - | Commercially important | Yes Criterion 13 | • Recorded in the CHAA and the wider Lake Albert (GBIF 2017).<br>• This species prefers standing or slowly flowing open water with emergent or submerged vegetation, it is also abundant in shallow swamps, and occasionally in shallow flood plains. It feeds from mid-water and surface waters on a wide variety of foods including fish, insects, shrimps, snails, plant seeds, and fruit. Migrates into the tributaries of rivers and streams during the rainy season to breed (Azeroual et al. 2010e).<br>• The populations of this species are unknown, however, heavy fishing pressure, including from commercial fisheries, may threaten populations of this species (Azeroual et al. 2010e).<br>• Reported by Wandera and Balirwa (2010) to be extremely rare in the lake. | Possible |
| *Synodontis nigrita* | Shield-head Catfish | - | LC | - | - | Commercially important | Yes Criterion 13 | • Recorded in the wider Lake Albert (GBIF 2017).<br>• The populations of this species are unknown (Awaïss et al. 2010), and it is reported by Wandera and Balirwa (2010) to be extremely rare in the lake. | Possible |
| *Tilapia zillii* | Zill's Tilapia | - | NE | - | - | Commercially important | Yes Criterion 13 | • Recorded in wider Lake Albert and the CHAA (Appendix C).<br>• It feeds on both plankton and aquatic plants and prefers shallow water. | Probable |
| **Butterflies** | | | | | | | | | |
| *Acleros neavei* | - | - | NE | - | - | Albertine Rift endemic | No | • This species has not been recorded within the CHAA (GBIF 2017).<br>• Although it is an Albertine Rift endemic species, indications are that, within the CHAA, it is restricted to the Budongo Central Forest Reserve; although it has also been reported in the DRC and other areas of the Albertine Rift. (Davenport 2003). | Unlikely |
| *Cymothoe ochreata* | Blood-red Glider | - | NE | - | - | Albertine Rift endemic | No | • This species has been recorded within the CHAA (GBIF 2017).<br>• Although it is an Albertine Rift endemic species, indications are that, within the CHAA and wider area, it is restricted to the Budongo and Bugoma Central Forest Reserves (Davenport 2003). Elsewhere, it has been recorded in suitable habitat in the southern rift and the DRC (Davenport 2003). | Possible |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| *Micropentila bunyoro* | - | - | DD | - | - | Albertine Rift endemic | No | ¡ This species has not been recorded within the CHAA (GBIF 2017).<br>¡ Although it is an Albertine Rift endemic species, its EOO is around 70,000 km² (Larsen 2011e), indications are that, within the wider area, it is restricted to the primary forests of Budongo Central Forest Reserve (Davenport 2003).<br>¡ The threats to this species are largely unknown at present, although as a species of primary forest, it is presumably threatened by deforestation and habitat degradation brought about by fuel wood collection, livestock grazing, shifting agriculture and illegal logging (Larsen 2011e). | Possible |
| **Dragonflies and Damselflies** | | | | | | | | | |
| *Agriocnemis palaeforma* | Damselfly | - | NT | - | - | Albertine Rift endemic | Yes Criterion 2 | ¡ This species has not been recorded from the CHAA (GBIF 2017, Appendix B).<br>¡ It appears to a papyrus swamp specialist (Claustinitzer 2010a).<br>¡ Currently, its population trend is unknown, and it has only been recorded from Bwindi, western Uganda (in papyrus swamps in the Victoria basin) (Claustinitzer 2010a).<br>¡ The papyrus swamps in Uganda have experienced a rapid decline recently, which gives cause for concern, and the habitat of this species could be rapidly lost (Claustinitzer 2010a). | Unlikely |
| *Tetrathemis corduliformis* | Dragonfly | - | LC | - | - | Albertine Rift endemic | No | ¡ This species has not been recorded in the CHAA (GBIF 2017, Appendix B), although records do exists from Budongo Central Forest Reserve (Claustinitzer 2002).<br>¡ This is a widespread species that tends to prefer pools and slow streams in rainforest (Claustinitzer 2010b).<br>¡ Major threats to this species include forest destruction caused by agriculture and non-woody vegetation collection (Claustinitzer 2010). | Possible |
| **Amphibians** | | | | | | | | | |
| *Amietia desaegeri* | DeSaeger's River Frog | - | LC | - | - | Range restricted? | No | ¡ Recorded in the CHAA in the wetlands associated with the Kamansinig River, and other localities on the Buhuka Flats (Appendix B).<br>¡ This is a range restricted species with and EOO of 8805 km², although it may have a much larger extent and requires further investigation considering that published accounts record it from only montane areas of the Virungas, and hence its range restricted status (IUCN SSC Amphibian Specialist group 2014b). However, this current record from the CHAA is approximately 100 km north-east of that known distribution, and may well increase the known EOO of the species by an order of magnitude.<br>¡ This species has not been considered as a critical habitat trigger for this impact assessment given that its range is possibly far larger than believed (*viz.*, IUCN SSC Amphibian Specialist group 2014b). | Probable |
| *Amietophrynus vittatus* | Lake Victoria Toad | - | DD | - | - | - | No | ¡ Recorded in the CHAA (Appendix B) in the wetlands associated with the Kamansinig River, and other localities on the Buhuka Flats (Appendix B, AWE 2008a, 2008b, 2013a). | Probable |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES[#] | Other | | | |
| | | | | | | | | • A species with an unknown population trend that appears to be restricted to localities within Uganda; other records in the region require confirmation, as does its taxonomy (IUCN SSC Amphibian Specialist group 2014a).<br>• This species favours marshy areas (Channing and Howell 2006), and occurs in large numbers in suitable habitat (Appendix B). | |
| *Ptychadena christyi* | Christy's Grass Frog | - | DD | - | - | - | No | • Not recorded in the CHAA (GBIF 2017).<br>• This is a very poorly known species which is taxonomically confused; with little know about its ecology and population trends (Largen and Howell 2004).<br>• It favours lowland rainforest habitat, where it breeds in temporary water bodies (Channing and Howell 2006), such as areas along the pipeline route. | Possible |
| **Reptiles** | | | | | | | | | |
| *Chamaeleo gracilis* | Graceful Chamaeleon | - | NE | - | App. II | - | No | • Recorded in the CHAA (Appendix B, GBIF 2017).<br>• It occurs in a wide variety of habitats, preferring moist and dry savannah, although its population trends are unknown (Spawls et al. 2004). | Probable |
| *Chamaeleo laevigatus* | Smooth Chamaeleon | - | NE | - | App. II | - | No | • Recorded in the CHAA (Appendix B, GBIF 2017).<br>• It occurs in a wide variety of habitats, preferring moist and dry savannah, although its population trends are unknown (Spawls et al. 2004). | Probable |
| *Crocodylus niloticus* | Nile Crocodile | - | LR/LC | - | App. II | - | No | • Recorded in the CHAA (Appendix B, GBIF 2017).<br>• The populations in Uganda are listed under CITES Appendix II, and appear stable (CSG 1996). | Probable |
| *Kinixys erosa* | Serrated Hinge-back Tortoise | - | DD | | App. II | | No | • Recorded in the CHAA (AWE 2008a, b, c, 2013a, b, 2014a, b).<br>• Prefers forest habitat, and is widespread in suitable habitat, and probably not under direct threat, although its population trends are unknown (Spawls et al. 2004).<br>• Listed under CITES Appendix II (TFTSG (1996). | Probable |
| *Pelomedusa neumannii* | Neumann's Helmeted Terrapin | - | ? | - | - | - | No | • The original taxon, *P. subrufa*, has been recorded in the CHAA (GBIF 2017).<br>• This species is newly described, and, although not yet recorded in Uganda, it is expected from the forest areas of western Uganda (WR Branch pers. comm., Petzold et al. 2014).<br>• Found in a large variety of waterbodies, although rarely in larger rivers and lakes, preferring stagnant, smaller waterbodies like puddles, rock pools, swamps, pans, small streams (Spawls et al. 2004). | Possible |
| *Pelomedusa schweinfurthi* | Schweinfurth's Helmeted Terrapin | - | ? | - | - | - | No | • The original taxon, *P. subrufa*, has been recorded in the CHAA (GBIF 2017).<br>• This species is newly described, and, although not yet recorded in Uganda, it is expected from the savannah areas of western Uganda (WR Branch pers. comm., Petzold et al. 2014). | Possible |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | ¡ Found in a large variety of waterbodies, although rarely in larger rivers and lakes, preferring stagnant, smaller waterbodies like puddles, rock pools, swamps, pans, small streams (Spawls et al. 2004). | |
| *Stigmochelys pardalis* | Leopard Tortoise | - | NE | - | App. II | - | No | ¡ Recorded in the CHAA (AWE 2008a, b, 2013a, 2014a).<br>¡ Prefers dry and moist savannah, woodlands and thickets, not in forest (Spawls et al. 2004).<br>¡ Although current populations are unknown, it is not believed to currently be under any threat, and is very widely distributed (Spawls et al. 2004). | Probable |
| *Trionyx triunguis* | Nile Soft-shelled Turtle | - | NE | - | - | Under local threat | No | ¡ Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a).<br>¡ Although this species is yet to be evaluated by the IUCN, the population within Lake Albert is threatened by human activities including: eating adults and eggs as a delicacy, and for medicinal purposes; its carapace is sold for high value (Appendix B).<br>¡ Prefers permanent lakes and dams, large and small rivers (Spawls et al. 2004).<br>¡ Within Uganda, it is only known from Lake Albert and the White Nile (Spawls et al. 2004). | Probable |
| *Varanus niloticus* | Nile Monitor | - | NE | - | App. II | - | No | ¡ Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a).<br>¡ Usually found near watercourses, and widespread (Spawls et al. 2004).<br>¡ In parts of Africa they are exploited for their skins, yet no their populations appear to be stable (Spawls et al. 2004). | Probable |
| **Birds** | | | | | | | | | |
| *Acrocephalus schoenobaenus* | Sedge Warbler | - | LC | App. II | - | - | No | ¡ Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014).<br>¡ It has an extremely large range; it overwinters in East Africa preferring reed beds, marshes and lakeside vegetation (Stevenson and Fanshawe 2002).<br>¡ The population trend for this species appears to be stable, (BirdLife International 2014g). | Probable |
| *Ardea cinerea* | Grey Heron | Schedule 1A, NT | LC | - | - | - | No | ¡ Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014).<br>¡ This species is a generalist in its habitat use, it inhabits any kind of shallow water, fresh, brackish or saline, either standing or flowing, and shows a preference for areas with trees as it is commonly an arboreal rooster and nester. (BirdLife International 2012e). | Probable |
| *Ardea purpurea* | Purple Heron | Schedule 1A, NT | LC | App. II | - | - | No | ¡ Recorded in the CHAA (Appendix B).<br>¡ This species is a wetland habitat generalist inhabiting densely vegetated swamps, shore lines and artificial water bodies (BirdLife International 2012f).<br>¡ Indications are that the populations are decreasing (BirdLife International 2012f). | Probable |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| *Ardeola idae* | Madagascar Pond-Heron | Schedule 1A, VU | EN | App. I/II | - | - | Yes Criterion 1 | ¡ This species has not been recorded from the CHAA (GBIF 2017). Non-breeding individuals have the potential to occur in suitable habitat within the CHAA.<br>¡ In its non-breeding range, it is commonly found along the banks of small streams, including those inside forests (BirdLife International 2012a).<br>¡ The populations of this species appear to be declining (BirdLife International 2012a). | Possible |
| *Balaeniceps rex* | Shoebill | Schedule 1A, VU | VU | - | App. II | - | Yes Criterion 5 | ¡ This species has not been recorded from the CHAA. Non-breeding individuals have the potential to occur in suitable habitat within the CHAA.<br>¡ This species if a wetland specialist; It breeds and forages in seasonally flooded marshes or Papyrus swamps, although it tends to avoid areas where the vegetation is taller than itself (BirdLife International 2012g).<br>¡ The populations of this species appear to be declining (BirdLife International 2012g).<br>¡ This species is recognised as an evolutionarily distinct species (Jetz et al. 2014, ZSL 2014). | Possible |
| *Balearica regulorum* | Grey Crowned-Crane | Schedule 1A, EN | EN | - | - | - | Yes Criterion 1 | ¡ Recorded in the CHAA (Appendix B, EAC 2013). Mature individuals have been observed on the Buhuka Flats, with individuals appearing to begin to pair up in May (R Skeen pers. comm.).<br>¡ In east Africa, the populations tend to have peak breeding during the dry season (BirdLife International 2014d). Typically, this species nests in solitary, territorial pairs at the edges of wetlands and in marshes with water at least 1 m deep and tall, emergent vegetation (Morrison and Bothma 1998, BirdLife International 2013a, 2014d).<br>¡ The populations of this species appear to be declining (BirdLife International 2013a). | Probable |
| *Bycanistes cylindricus* | Brown-cheeked Hornbill | - | VU | - | - | - | No | ¡ This species has been recorded in the CHAA (GBIF 2017, Plumptre et al. 2010).<br>¡ It prefers primary and mature secondary forest, although it has been recorded but generally prefers undisturbed forest. It has also been recorded in plantations, but it is not known whether these represent viable breeding populations. It is dependent on the presence of large emergent trees and dead standing trees for nest sites (BirdLife International 2012af).<br>¡ The population trend of this species appears to be undergoing a rapid decline owing to the impacts of habitat destruction and degradation, and hunting pressure (BirdLife International 2012af). | Probable |
| *Charadrius hiaticula* | Common Ringed Plover | - | LC | App II | - | - | Yes Criterion 3 | ¡ Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). Less than 100 individuals were recorded in the LSA during March when Palearctic migrants were expected to be common. It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix C.<br>¡ This is a specialist shore bird; it prefers to nest on shores and sandbars of inland rivers and lakes, or on short grassland, farmland and other well- | Probable |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | drained sites. Non-breeding birds tend to inhabit to the shores of inland waterbodies and coastal areas (BirdLife International 2012h).<br>¡ The populations of this species appear to be declining (BirdLife International 2012h).<br>¡ | |
| *Charadrius pecuarius* | Kittlitz's Plover | - | LC | App II | - | - | Yes Criterion 3 | ¡ Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). Less than 50 individuals were recorded in the LSA during March when Palearctic migrants were expected to be common. It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>¡ This species primarily inhabits dry ground near the margins of lakes, reservoirs and rivers, or on small permanent and temporary pools, flood plains, dry sandy riverbeds (BirdLife International 2012i).<br>¡ The populations of this species are unknown (BirdLife International 2012i). | Probable |
| *Chlidonias leucopterus* | White-winged Tern | - | LC | App. II | - | - | Yes Criterion 3 | ¡ Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). Less than 10 individuals were recorded in the LSA during March when Palearctic migrants were expected to be common. It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>¡ This species primarily inhabits freshwater lakes, swampy standing water, rivers and shallow naturally flooded grassland (BirdLife International 2012j).<br>¡ The populations of this species are stable (BirdLife International 2012j). | Probable |
| *Circus macrourus* | Pallid Harrier | - | NT | - | - | - | No | ¡ This species has not been recorded in the CHAA (GBIF 2017); however, it may occur in the area within suitable habitat.<br>¡ The species is migratory, with most birds wintering in sub-Saharan Africa or south-east Asia where semi-desert, scrub, savannah and wetland habitat is preferred (BirdLife International 2013c).<br>¡ The populations of this species are decreasing (BirdLife International 2013c). | Possible |
| *Cisticola carruthersi* | Carruther's Cisiticola | NT | LC | - | - | - | No | ¡ This species has not been recorded in the CHAA; however, it may occur within suitable habitat.<br>¡ The populations of this species are decreasing (BirdLife International 2012k). | Possible |
| *Columba albinucha* | White-naped Pigeon | - | NT | - | - | - | No | ¡ This species has not been recorded in the CHAA (Plumptre et al. 2011, GBIF 2017).<br>¡ This species prefers dense lowland forest and forested slopes, with an altitudinal range in Uganda of between 700 and 1800 m (BirdLife International 2012ah).<br>¡ The population trend of this species is unknown, with main threats presumed to be forest clearance for small-holder cultivation and grazing and subsistence-level logging (BirdLife International 2012ah).. | Unlikely |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES[#] | Other | | | |
| *Coracias garrulus* | European Roller | - | NT | App. II | - | - | No | • This species has not been recorded in the CHAA (GBIF, Appendix B); however, it is very likely to occur given the suitable habitat.<br>• A migrant that overwinters in East Africa preferring dry wooded savanna and bushy plains and wooded grassland (Stevenson and Fanshawe 2002, BirdLife International 2002).<br>• The current population trend appears to be declining globally, with major threats occurring in the summer breeding ranges in Europe and Asia Minor<br>• (BirdLife International 2012ao) | Possible |
| *Ephippiorhynchus senegalensis* | Saddle-billed Stork | Schedule 1A; VU | LC | - | - | - | No | • Recorded in the LSA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014).<br>• Tends to prefer wetlands and the margins of water bodies (BirdLife International 2012d).<br>• This species has an extremely large range. Its population trend appears to be decreasing (BirdLife International 2012d). | Probable |
| *Falco vespertinus* | Red-footed Falcon | - | NT | App. II | - | - | No | • This species has not been recorded in the CHAA (GBIF 2017).<br>• It prefers open lowlands with trees and plenty of insects, on which it feeds, including steppe and forest-steppe, open woodland, cultivation and pastureland with fringing trees, agricultural areas (BirdLife International 2013f)<br>• This species has an extremely large range; it spends winters in southern Africa north to Kenya (BirdLife International 2013f), and is a very rare migrant in Uganda (Stevenson and Fanshawe 2002).<br>• Its population trend appears to be decreasing, with between 300,000 and 800,000 individuals (BirdLife International 2013f). | Unlikely |
| *Ficedula semitorquata* | Semi-collared Flycatcher | - | NT | App. II | - | - | No | • This species has not been recorded within the CHAA (GBIF 2017).<br>• This migratory species overwinters in East Africa, where it can be locally common (Stevenson and Fanshawe 2002, BirdLife International 2012aj).<br>• Its population trend appears to be decreasing, with between 15,000 and 53,000 breeding pairs, where habitat destruction in some areas is likely to be responsible for recent declines (BirdLife International 2012aj). | Possible |
| *Hieraaetus ayresii* | Ayres's Hawk-Eagle | Schedule 1A; VU | LC | - | - | - | No | • This species has not been recorded in the CHAA (GBIF 2017).<br>• It prefers woodland and forest (Stevenson and Fanshawe 2002), yet is considered to be very scarce in the Western Ugandan forests Plumptre et al. 2010).<br>• This species has an extremely large range. Its population trend appears to be stable (BirdLife International 2012ag). | Possible |
| *Hirundo atrocaerulea* | Blue Swallow | - | VU | App. I/II | - | - | No | • This species has not been recorded in the CHAA (GBIF 2017).<br>• This is an intra-African migratory species that breed in southern Africa. It is a non-breeding migrant in Uganda favouring wet grasslands, cultivation and swamp edges (Stevenson and Fanshawe 2002, BirdLife International 2012al). | Unlikely |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | • The population trend of this species is decreasing, with the main threats affecting breeding habitat in southern Africa (BirdLife International 2012al). | |
| *Gallinago media* | Great Snipe | - | NT | App. II | - | - | Yes Criterion 3 | • This species has not been recorded in the CHAA; however, it may occur within suitable habitat. It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>• Non-breeding, migrant individuals tend to frequent wetland areas, including marshlands and short grass or sedges on lake edges, or in old cultivation (BirdLife International 2012l).<br>• The populations of this species are decreasing (BirdLife International 2012l). | Possible |
| *Glareola nordmanni* | Black-winged Pratincole | - | NT | App. II | - | - | Yes Criterion 3 | • This species has not been recorded in the CHAA (GBIF 2017); however, it may occur within suitable habitat. It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>• Non-breeding, migrant individuals tend to frequent seasonally wet grasslands, savannahs, and sandbanks along large river (BirdLife International 2012m).<br>• The populations of this species are decreasing (BirdLife International 2012m). | Possible |
| *Glareola pratincola* | Collared Pratincole | - | LC | App. II | | | Yes Criterion 3 | • Recorded in the CHAA (Appendix B).<br>• This species has an extremely large range, and the populations in northern Africa are nomadic or migratory. Their population trend appears to be decreasing (BirdLife International 2012c). | Probable |
| *Gyps africanus* | White-backed Vulture | - | EN | - | - | - | Yes Criterion 1 | • Recorded in the CHAA (Appendix B).<br>• This species prefers open wooded savannah, where it requires tall trees for nesting (BirdLife International 2012b).<br>• Their population trend is decreasing (BirdLife International 2012b). | Probable |
| *Lamprotornis purpureus* | Purple Glossy Starling | - | LC | - | - | Biome restricted | No | • This species has not been recorded in the CHAA. It is likely to occur in the CHAA within suitable habitat.<br>• Prefers open woodland and cultivated habitats (Stevenson and Fanshawe 2002).<br>• Their population trend appears to be stable (BirdLife International 2012n). | Possible |
| *Laniarius mufumbiri* | Papyrus Gonolek | NT | NT | - | - | - | No | • This species has not been recorded in the CHAA (GBIF 2017).<br>• It is restricted to restricted to papyrus swamps (BirdLife International 2013g).<br>• The population trend appears to be decreasing, with major threats arising from drainage, burning and the over-exploitation of wetlands, as well as pollution caused by fertiliser run-off from agricultural fields, leading to algal blooms (BirdLife International 2013g) | Possible |
| *Limosa limosa* | Black-tailed Godwit | - | NT | App. II | - | - | Yes Criterion 3 | • This species has been recorded in the CHAA (AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). It is noted that September may be a better | Probable |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>¡ Non-breeding migrants tend to prefer freshwater habitats, including swampy lake shores, pools, and flooded grassland (BirdLife International 2012o).<br>¡ Their population trend appears to be stable (BirdLife International 2012o). | |
| *Malimbus malimbicus* | Crested Malimbe | - | LC | - | - | Biome restricted | No | ¡ This species has not been recorded in the CHAA. It could likely occur in the CHAA within suitable habitat.<br>¡ This species prefers subtropical or tropical moist lowland forests (Stevenson and Fanshawe 2002).<br>¡ Their population trend appears to be stable (BirdLife International 2012p). | Possible |
| *Merops oreobates* | Cinnamon-chested Bee-eater | Schedule 1A, NT | LC | - | - | - | No | ¡ This species has not been recorded in the CHAA. It could likely occur in the CHAA within suitable habitat.<br>¡ This species prefers associated with wooded hillsides and forest edges (Stevenson and Fanshawe 2002).<br>¡ Their population trend is unknown (BirdLife International 2012q). | Possible |
| *Necrosyrtes monachus* | Hooded Vulture | - | EN | - | - | - | Yes Criterion 1 | ¡ This species has not been recorded in the CHAA (GBIF 2017). It may occur in the CHAA within suitable habitat.<br>¡ This species is often associated with human settlements, but is also found in open grassland, forest edge, wooded savannah, and desert (BirdLife International 2014f).<br>¡ Their population trend is decreasing (BirdLife International 2012r). | Possible |
| *Nectarinia erythrocerca* | Red-chested Sunbird | Schedule 1A; NT | LC | - | - | - | - | ¡ This species has been recorded within the CHAA (AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014, Appendix B).<br>¡ This species prefers associated with wooded hillsides and forest edges (Stevenson and Fanshawe 2002).<br>¡ Their population trend appears to be stable (BirdLife International 2012s). | Probable |
| *Numenius arquata* | Eurasian Curlew | - | NT | App. II | - | - | Yes Criterion 3 | ¡ This species has been recorded in the CHAA (AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>¡ Non-breeding migrants prefer inland lakes and rivers, wet grassland and arable fields during migration (BirdLife International 2012t).<br>¡ Their population trend is decreasing (BirdLife International 2012t). | Probable |
| *Phoeniconaias minor* | Lesser Flamingo | - | NT | - | - | - | Yes Criterion 2 | ¡ This species has not been recorded in the wider CHAA (GBIF 2017).<br>¡ This species breeds exclusively in three main breeding sites in the saline Rift Valley Lakes where it forms very large colonies. When not breeding, it disperses widely to suitable wetland habitat, and can be quite rare (Stevenson and Fanshawe 2002, BirdLife International 2012am). | Unlikely |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | The population trend appears to be decreasing, with the main threat from proposed soda-ash mining and hydroelectric power schemes affecting the main breeding site, Lake Natron in Tanzania, although currently put on hold, could cause rapid overall population declines owing to disturbance and the introduction of an alien brine shrimp to clean the soda of algae (BirdLife International 2012am). | |
| *Polemaetus bellicosus* | Martial Eagle | Schedule 1A | VU | - | - | - | No | This species has been recorded in the CHAA (Appendix B).<br>This species prefers open woodland, wooded savannah, bushy grassland, thorn bush and, in southern Africa, more open country and even sub-desert, and requires large trees for breeding (BirdLife International 2013d).<br>Their population trend is decreasing (BirdLife International 2013d). | Probable |
| *Psalidoprocne albiceps* | White-headed Saw-wing | - | LC | - | - | Biome restricted | No | This species has been recorded in the CHAA (Appendix B).<br>This species prefers Savannah, woodland, scrub and forest in upland areas, including miombo woodland and montane areas (Stevenson and Fanshawe 2002).<br>Their population trend appears to be stable (BirdLife International 2012u). | Probable |
| *Psittacus erithacus* | Grey Parrot | Schedule 1A | VU | - | App. II | - | No | This species has been recorded in the CHAA, from the Bugoma Central Forest Reserve (Plumptre et al. 2010).<br>This species tends to prefer dense forest, they are commonly observed at forest edges, clearings, gallery forest, mangroves, wooded savannah, cultivated areas, and even gardens (BirdLife International 2013e).<br>Their population trend is decreasing (BirdLife International 2013e). | Possible |
| *Ptilopachus nahani* | Nahan's Francolin | Schedule 1A; VU | VU | - | - | - | Yes Criterion 5 Possibly 2 | This species has been recorded in the CHAA, particularly, Bugoma Central Forest Reserve (Plumptre et al. 2010, GBIF 2017)<br>It is confined to dense, mature, moist, sometimes swampy medium-altitude forest below 1,500m; and is reasonably common in Budongo Central Forest Reserve (Plumptre et al. 2010, 2011).<br>It appears to have a very restricted EOO, although populations in the wider DRC are unknown, hence its distribution may be larger than thought (BirdLife International 2012ad).<br>Large trees with appropriate buttress formation are important for breeding sites for this species (Sande et al. 2009a). Forest disturbance appears to reduce the home range of this species (Sande et al. 2009b).<br>The population trend of this species appears to be decreasing, with the primary threats thought to be habitat loss through logging and clearance of forest for charcoal burning and agriculture. Fragmentation alone probably does not appear to adversely affect the species, but it does appear to be affected by habitat changes associated with human-induced fragmentation, such as the extensive removal of large trees (BirdLife International 2012ad). | Probable |
| *Ptilostomus afer* | Piapiac | - | LC | - | - | Biome restricted | No | This species has been recorded from the CHAA (AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). | Probable |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES[#] | Other | | | |
| | | | | | | | | ¡ It favours more open country of cultivated land with fields and pasture and small associated towns and villages (Stevenson and Fanshawe 2002).<br>¡ Their population trend appears to be stable (BirdLife International 2012v). | |
| *Rynchops flavirostris* | African Skimmer | - | NT | App. II | - | - | Yes Criterion 3 | ¡ This has been recorded from the CHAA (AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014, Appendix B).<br>¡ It favours expanses of calm water for feeding, while it breeds along broad rivers on large, dry sandbars that are largely free from vegetation (Stevenson and Fanshawe 2002).<br>¡ Their population trend appears to be decreasing (BirdLife International 2012w). | Probable |
| *Sagittarius serpentarius* | Secretarybird | - | VU | - | App. II | - | Yes Criterion 5 | ¡ This species has not been recorded in the CHAA (GBIF 2017).<br>¡ It inhabits grasslands, ranging from open plains to lightly wooded savanna, but is also found in agricultural areas and sub-desert (BirdLife International 2013h), although current distribution records do not indicate that it occurs in the southern portion of Lake Albert (Stevenson and Fanshawe 2002).<br>¡ The population trend for this species appears to be decreasing, with major threats coming from the excessive burning of grasslands, which may suppress populations of prey species, intensive grazing of livestock is also probably degrading otherwise suitable habitat (BirdLife International 2013h). | Possible |
| *Scotopelia peli* | Pel's Fishing-owl | Schedule 1A; VU | LC | - | - | - | No | ¡ This species has been recorded in the CHAA (Plumptre et al. 2010, 2011).<br>¡ It preferred habitat is around rivers, especially in clumps of large riparian trees with branches overhanging the water, which provide dense shade, and riverine forest (Plumptre et al. 2010).<br>¡ Their population trend appears to be decreasing (BirdLife International 2012ae). | Probable |
| *Scleroptila streptophora* | Ring-necked Francolin | - | NT | - | - | - | No | ¡ This species has not been recorded in the CHAA (GBIF 2017).<br>¡ This species is regularly recorded in Murchison Falls National Park, where it prefers bushed, wooded grassland, stony hillsides with sparse grass and shrub cover, and wooded grasslands (Stevenson and Fanshawe 2002, BirdLife International 2012ak)<br>¡ The population trend appears to be decreasing, and the reasons for this decrease are not known, although habitat loss is suspected (BirdLife International 2012ak). | Possible |
| *Stephanoaetus coronatus* | African Crowned Eagle | Schedule 1A; VU | NT | - | - | - | No | ¡ This species has not been recorded from the CHAA (GBIF 2017). It may occur in suitable habitat.<br>¡ Prefers forest, woodland, savannah and shrub land, as well as some modified habitats, such as plantations and secondary growth (Stevenson and Fanshawe 2002). | Possible |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | • Their population trend appears to be decreasing (BirdLife International 2012x). | |
| *Terathopius ecaudatus* | Bateleur | - | NT | - | - | - | No | • This species has not been recorded in the CHAA (GBIF 2017), but it could occur given the suitable habitat.<br>• It prefers inhabits open country, including grasslands, savanna and sub-desert thornbush. It is generally considered resident, but some adults, as well as immature individuals, are nomadic (BirdLife International 2012an). The nest is built in the canopy of a large tree (Stevenson and Fanshawe 2002).<br>• The population trend appears to be decreasing, with threats from many areas, including poisoned baits, which appears to be the major cause of the decline caused by farming communities, pesticides, trapping for international trade, nest disturbance from spreading human settlements, and increased intensification and degradation of agricultural land (BirdLife International 2012an). | Possible |
| *Tricholaema lacrymosa* | Spot-flanked Barbet | - | LC | - | - | Range restricted | No | • This species has been recorded in the CHAA (Appendix B).<br>• Inhabits wet woodland, wetter areas in dry woodland, also riverine woods, patches of forest (Stevenson and Fanshawe 2002).<br>• Their population trend appears to be stable (BirdLife International 2012y). | Probable |
| *Trigonoceps occipitalis* | White-headed Vulture | - | VU | - | - | - | No | • This species has not been recorded in the CHAA (GBIF 2017).<br>• It has an extremely large range in sub-Saharan Africa preferring mixed, dry woodland, avoiding semi-arid thorn belt areas (Stevenson and Fanshawe 2002, BirdLife International 2012ai).<br>• The population trend appears to be decreasing, with an estimate of between 7000 and 12,500 mature individuals extrapolated from a number of regional estimates. This equates to between 10,500 and 18,750 individuals in total (BirdLife International 2012ai). Reductions in populations of medium-sized mammals and wild ungulates, as well as habitat conversion throughout its range best explain the current decline (BirdLife International 2012ai). | Possible |
| *Tringa hypoleucos* | Common Sandpiper | - | LC | App. II | - | - | Yes Criterion 3 | • Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). Less than 50 individuals were recorded in the CHAA during March when Palearctic migrants were expected to be common. It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>• Non-breeding migrants frequent a wide variety of habitats, such as small pools, ditches, riverbanks, streams, lake shores, marshy areas (BirdLife International 2012z).<br>• The populations of this species are decreasing (BirdLife International 2012z). | Probable |
| *Turdoides sharpei* | Black-lored Babbler | - | LC | - | - | Range restricted | No | • This species has been recorded in the CHAA (Appendix B).<br>• It prefers forest-edge thickets and scrub, wooded plains and acacia savannah, dense Bushland, riverine woodland (Stevenson and Fanshawe 2002). | Probable |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | The populations of this species are decreasing (BirdLife International 2012aa). | |
| *Vanellus senegallus* | African Wattled Lapwing | - | LC | App II | - | - | Yes Criterion 3 | Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). Less than 20 individuals were recorded in the CHAA during March when Palearctic migrants were expected to be common. It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>This species demonstrates ecological plasticity, in some areas occupying the same habitat all year round, in others changing habitat seasonally and opportunistically, although it tends to frequent marshes, damp grass and muddy or sandy ground beside lakes, rivers and streams, inundated grassland, and temporary pools (BirdLife International 2012ab).<br>The populations of this species are stable (BirdLife International 2012ab). | Probable |
| *Vanellus spinosus* | Spur-winged Lapwing | - | LC | App II | - | - | Yes Criterion 3 | Recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014). Less than 20 individuals were recorded in the CHAA during March when Palearctic migrants were expected to be common. It is noted that September may be a better time to identify numbers of Palearctic migrants in the CHAA (Appendix B).<br>This species frequents dry ground close to fresh or saline pools, lakes, rivers, lagoons or marshes, as well as burnt grassland, cultivated, flooded or irrigated fields, marshes, damp grass and muddy or sandy ground beside lakes, rivers and streams, inundated grassland, and temporary pools (BirdLife International 2012ac).<br>The populations of this species are increasing (BirdLife International 2012ac). | Probable |
| **Mammals** | | | | | | | | | |
| *Crocidura selina* | Ugandan Lowland Shrew | - | DD | - | - | - | No | This species has not been recorded in the CHAA (GBIF 2017).<br>It prefers lowland evergreen forest (Mabira, Kibanda, and Mbanga Forest) (Hutterer 2013).<br>This species has only been recorded from three lowland forests in Uganda (including the type locality of Mabira Forest), and there is a possible record from an isolated forest patch in the Kyulu Hills of southern (Hutterer et al. 2008).<br>The population trend is unknown, and no threats are known for this species (Hutterer et al. 2008). | Unlikely |
| *Dologale dybowskii* | Pousargues' Mongoose | - | DD | - | - | - | No | This species has not been recorded from the CHAA (GBIF 2017), and is known from 31 museum specimens<br>This species is very poorly known. It is apparently confined to a narrow belt of savanna-forest mosaic north of the Equator, and is known to occupy the thicketed shores of Lake Albert, as well as montane forest grasslands (Stuart et al. 2008, Stuart and Stuart 2013).<br>The population trend is unknown, and no threats are known for this species (Stuart et al. 2008). | Possible |
| *Eidolon helvum* | African Straw-coloured Fruit-bat | - | NT | App. II | - | - | Yes Criterion 3 | This species has not been recorded in the CHAA (GBIF 2017). | Possible |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | ¡ This is a widespread and adaptable species, which inhabits all forest and woodland savannah habitats (Thomas and Henry 2013).<br>¡ It forms large colonies of thousands to even millions of individuals, with colonies showing extreme roost-site fidelity (Mickleburgh et al. 2008, Thomas and Henry 2013). It also migrates (Thomas and Henry 2013).<br>¡ The population trend appears to be decreasing, yet no major threats are known, It is locally threatened in parts of its range by severe deforestation, and hunting for food and medicinal use. Large pre-migration colonies are considered particularly vulnerable to any threats (Mickleburgh et al. 2008). A well-known colony in Kampala declined in numbers over a forty-year period from ca. 250,000 animals to 40,000 in 2007 (Monadjem et al. 2010). | |
| *Glauconycteris humeralis* | Allen's Spotted Bat | - | DD | - | - | - | No | ¡ This species has not been recorded in the CHAA (GBIF 2017).<br>¡ It appears to be associated with lowland tropical rainforest (Happold 2013d). Presumably it roosts within hollow trees and dense vegetation, although this needs confirmation (Schlitter 2008b).<br>¡ Little is known of this species's population trend, although habitat loss, through deforestation resulting from logging and mining activities, and the conversion of forest to farmland, is suspected to be a main threat (Schlitter 2008b). | Possible |
| *Hippopotamus amphibius* | Hippopotamus | Schedule 1C | VU | - | App. II | - | No | ¡ This species has been recorded in the CHAA (Appendix B, AWE 2008a, b, 2013a, 2014a, EAC 2013, 2014).<br>¡ This species's habitat is restricted to suitable grassland and grassland-bushland mosaics adjacent to rivers, lakes and swamps (Klingel 2013).<br>¡ Major threats to this species include poaching, habitat loss and fragmentation (Lewinson and Oliver 2008, Klingel 2013).<br>¡ Although this species's population trend is decreasing, within Uganda, it is recognised as having a restricted distribution, although it is locally abundant; as such, it is fully protected under the law (Lewinson and Oliver 2008) | Probable |
| *Loxodonta africana* | African Elephant | Schedule 1A, VU | VU | App. II | App. I | - | Yes Criterion 3 | ¡ This species has been recorded in the CHAA, specifically within Bugoma Central Forest Reserve (Plumptre et al. 2010, 2011).<br>¡ It is a very wide ranging species, found in many habitat types including dense forest, open and closed savanna, swamps, gallery and montane forests, grassland and arid deserts (Blanc 2008, Poole et al. 2013).<br>¡ Major threats are primarily from illegal poaching and habitat loss (Blanc 2008).<br>¡ Current indications are that the global population trend is decreasing (Wittemyer et al. 2014), although recent census data from Uganda suggest that these populations (of between 2000 and 3000 individuals) are increasing (Poole et al. 2013). | Probable |
| *Miniopterus* sp. | Bent-wing Bat | - | ? | App. II | - | - | Yes Criterion 3 | ¡ Bent-wing, or long-fingered bats are obligate cave roosters, and they can form enormous colonies (Dietz et al. 2009, Happold 2013b) (for example, *M. natalensis* is known to form roosting colonies of upwards of 260,000 individuals in de Hoop Guano cave (Monadjem et al. 2010)). | Probable |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | ¡ These bats are also known migratory species, with species migrating from winter hibernacula to maternity roosts, which may be separated by up to 150 km (Monadjem et al. 2010).<br>¡ African species of *Miniopterus* are very difficult to distinguish (Happold 2013b), yet further investigation is warranted to diagnose the species recorded in the CHAA. Most likely, the Lesser Long-fingered Bat (*M. fraterculus*) (IUCN LC, Schlitter et al. 2008), or the Greater Long-fingered Bat (*M. inflatus*) (IUCN LC, Schlitter 2008a) could occur. | |
| *Otomops martiensseni* | Large-eared Free-tailed Bat | - | NT | App. II | - | - | Yes Criterion 3 | ¡ This species has not been recorded in the CHAA (GBIF 2017).<br>¡ Found in a wide variety of habitats, from semi-arid scrub to montane forests, urban and agricultural areas (Yalden and Happold 2013).<br>¡ The population trend appears to be decreasing, with the major threat roost disturbance. Indeed, the major colonies of this species (consisting of hundreds of bats) from caves in East Africa have declined severely and now have few or no bats (Mickleburgh et al. 2008c). | Possible |
| *Pan troglodytes schweinfurthii* | Eastern Chimpanzee | Schedule 1A, VU | EN | - | App. I | - | Yes Criterion 1 | ¡ This species has been recorded in the CHAA, in particular, Bugoma Central Forest Reserve (Plumptre et al. 2010, 2011).<br>¡ Preferred habitat includes predominantly mature moist and dry forests, either evergreen or semi-deciduous, and forest galleries extending into savanna woodlands (Wilson et al. 2008).<br>¡ The population trend of this species is decreasing, with recent estimates identifying between 4000 and 5700 individuals in Uganda (Thompson and Wrangham 2013).<br>¡ Major threats include habitat destruction and degradation (slash and burn agriculture, deforestation, logging), poaching (bush meat, pet trade, traditional medicine, crop protection), and disease (Oates et al. 2008). | Probable |
| *Panthera pardus* | Leopard | - | NT | - | App. I | - | No | ¡ This species has not been recorded from the CHAA (GBIF 2017), although it may be present.<br>¡ It has a wide habitat tolerance and is the only African cat to occupy rainforest and desert, yet they prefer woodland, grassland savannah, and forest, mountainous habitats, shrubland and semi-desert (Hunter et al. 2013).<br>¡ They are very tolerant of habitat conversion, and, provided cover and prey is present, they can persist in close proximity to large human populations (Hunter et al. 2013).<br>¡ The global population trend for this species appears to be decreasing, with major threats from intense persecution and habitat degradation, particularly prey numbers (Henschel et al. 2008). | Possible |
| *Phataginus tricuspis* | White-bellied Pangolin | - | VU | - | App. II | - | No | ¡ This species has not been recorded in the CHAA (GBIF 2017).<br>¡ It prefers moist tropical lowland forests and secondary growth, but also occurs in dense woodlands, especially along water courses. Fallows and forest mosaics (Kingdon and Hoffman 2013, Waterman et al. 2014).<br>¡ Although this is the most widespread of the pangolin species (Kingdon and Hoffman 2013), its populations are decreasing (Waterman et al. 2014). | Possible |

| Species | Common Name | Status | | | | | Potential Critical Habitat Trigger | Assessment Criteria and Evidence | Likelihood of occurrence in the CHAA |
|---|---|---|---|---|---|---|---|---|---|
| | | Uganda* | IUCN** | CMS*** | CITES# | Other | | | |
| | | | | | | | | ¡ Major threats to this species include bush meat hunting and an increased demand from the international markets, as Asian pangolin populations decline, smuggling syndicates become more sophisticated and economic ties between Africa and China strengthen (Waterman et al. 2014). | |
| *Profelis aurata* | African Golden Cat | - | NT | - | App. II | - | No | ¡ This species has not been recorded from the CHAA (GBIF 2017), yet it is conceivable that it could occur (Plumptre et al. 2010).<br>¡ This is a forest-dependent species that prefers primary moist forest, although on the periphery of its range it penetrates savanna regions along riverine forest, as well as montane forest and alpine moorland (Henschel et al. 2008, Ray and Butynski 2013).<br>¡ The population trend of this species is decreasing, with the main threats arising from habitat loss (in particular, deforestation, which has also reduced prey numbers), trapping for the medicinal trade (Henschel et al. 2008). | Possible |
| *Smutsia gigantea* | Giant Ground Pangolin | - | VU | - | App. II | - | No | ¡ This species has been recorded in Kaiso-Tonya Community Wildlife Area (GBIF 2017) about 8 km north-west of the CHAA.<br>¡ It prefers forest habitat, but will also frequent forest mosaics, high rainfall, secondary grasslands and the edges of swamps (Kingdon et al. 2013).<br>¡ The population trend for this species is decreasing, and it has become very rare in parts of its range (Waterman et al. 2014).<br>¡ Major threats to this species include bush meat hunting and an increased demand from the international markets, as Asian pangolin populations decline, smuggling syndicates become more sophisticated and economic ties between Africa and China strengthen (Waterman et al. 2014). | Possible |
| *Tadarida trevori* | Trevor's Free-tail Bat | - | DD | - | - | - | No | ¡ This species has not been recorded in the CHAA (GBIF 2017), although it may potentially occur.<br>¡ It has been recorded from lowland forest, and may be a rainforest-savanna mosaic specialist (Mickleburgh et al. 2008, Happold 2013c).<br>¡ Little is known of this species's population trend, although habitat loss, from the conversion of land to agricultural use, and the extraction of firewood and timber, is suspected to be a main threat (Mickleburgh et al. 2008a). | Possible |
| *Tadarida ventralis* | African Giant Free-tailed Bat | - | DD | - | - | - | No | ¡ This species has not been recorded from the CHAA (GBIF 2017), although it may potentially occur.<br>¡ This species is poorly known, although it is believed to be associated with dry woodland savanna areas containing rocky crevices and gorges wherein it prefers to roost (Cotterill 2013).<br>¡ The population trend is unknown, and may be threatened through the conversion of suitable habitat to agricultural land and the use of pesticides in these modified areas (Mickleburgh et al. 2008b). | Possible |

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