Intended for
Bugesera Airport Company Limited

Date
February 2018

Project Number
UK11-24483

NEW BUGESERA INTERNATIONAL AIRPORT BIODIVERSITY ACTION PLAN

RAMBOLL

NEW BUGESERA INTERNATIONAL AIRPORT
BIODIVERSITY ACTION PLAN

Project No.	**UK11-24483**
Issue No.	**3**
Date	**16/02/2018**
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Version Control Log

Revision	Date	Made by	Checked by	Approved by	Description
1	05/02/2018	PB/LS	PB/SRK	DW	Preliminary Draft
2	15/02/2018	LS/PB	PB/SR	DW	Final Draft
3	16/02/2018	LS/PB	PB/SR	DW	Final Issue

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

Appendix 1
Institutional, Legal and Policy Framework in Rwanda

Appendix 2
Detailed Species Accounts

Appendix 3
Automated Image Classification Methodology

Appendix 4
Potential Additional Conservation Interventions for Ningu

ACRONYMS AND ABBREVIATIONS

BAC:	Bugesera Airport Company Limited
BAP:	Biodiversity Action Plan
CBD:	Convention on Biological Diversity
C-ESMP:	Construction Phase Environmental and Social Management Plan
CHA:	Critical Habitat Assessment
CITES:	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DMU:	Discrete Management Unit
GIIP:	Good International Industry Practice
GOR:	Government of Rwanda
IBA:	Important Bird/Biodiversity Area
IFC:	International Finance Corporation
IUCN:	International Union for the Conservation of Nature
KII	Key Informant Interview
KPI	Key Performance Indicator
NBIA:	New Bugesera International Airport
NBSAPs:	National Biodiversity Strategies and Action Plans
NEWPLAN:	NEWPLAN Limited
O-ESMP:	Operation Phase Environmental and Social Management Plan
OPIC:	Overseas Private Investment Corporation
PS6:	Performance Standard Six
RDB:	Rwanda Development Board
SEP:	Stakeholder Engagement Plan
TOR:	Terms of Reference

1. INTRODUCTION

1.1 Background

New Bugesera International Airport (NBIA, also referred to as the 'Proposed Project') is a new airport being constructed by the Bugesera Airport Company Limited (BAC – 'the Developer') within the Bugesera District, in the Eastern Province of Rwanda. BAC has adopted international standards, notably the International Finance Corporation Performance Standards (IFC PS) and the African Development Bank Integrated Safeguards System[1]. During 2017, an Environmental and Social Impact Assessment (ESIA) was completed to assess potential environmental, social and community health impacts associated with the Proposed Project. The ESIA included Chapter 11 Biodiversity, which identified the presence of Tier 2 critical habitat within the Proposed Project's Area of Influence (AOI) in relation to Nyabarongo Wetlands International Bird Area (IBA) and the assemblage of bird species supported by this internationally recognised area. Tier 2 critical habitat was also identified in relation to Madagascar pond heron *Ardeola idea,* which is assessed by the IUCN Red List[2] as Endangered, and a critically endangered fish species, Ningu *Labeo victorianus.* As a result, BAC has committed to preparing this Biodiversity Action Plan (BAP) that will be implemented throughout the lifetime of the Proposed Project. This BAP also includes actions in relation to the only natural habitat present within the Proposed Project AOI, swamp and aquatic vegetation, as well as Hippopotamus *Hippopotamus amphibious*.

1.2 Requirement for a Biodiversity Action Plan

Due to the presence of critical habitat for Nyabarongo Wetlands IBA, Madagascar pond heron and potentially also the fish species Ningu, it is necessary for the Project to deliver a net gain for these biodiversity features. As described in Paragraph 18 of IFC PS6, a BAP is the document which sets out how that net gain will be achieved through a project's mitigation strategy:

"In such cases where a client is able to meet the requirements defined in paragraph 17, the project's mitigation strategy will be described in a Biodiversity Action Plan and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated."

In addition, the Nyabarongo Wetlands IBA meets the IFC Performance Standard 6 (2012)[3] definition of an internationally recognised area and therefore the requirements of PS6 paragraph 20 apply:
"In circumstances where a proposed project is located within a legally protected area or an internationally recognized area, the client will meet the requirements of paragraphs 13 through 19 of this Performance Standard, as applicable. In addition, the client will:

- *Demonstrate that the proposed development in such areas is legally permitted;*
- *Act in a manner consistent with any government recognized management plans for such areas;*
- *Consult protected area sponsors and managers, Affected Communities, Indigenous Peoples and other stakeholders on the proposed project, as appropriate; and*
- *Implement additional programs, as appropriate, to promote and enhance the conservation aims and effective management of the area."*

This BAP sets out the additional programs that will be implemented to promote and enhance Nyabarongo Wetlands IBA.

[1] African Development Bank Group, 2013. Integrated Safeguards System.
[2] IUCN 2017. The IUCN Red List of Threatened Species. Version 2017-3. <http://www.iucnredlist.org>.
[3] IFC (2012) Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Hippopotamus does not trigger critical habitat within the Project AOI, as it does not meet any of the criteria for critical habitat (e.g. Critically Endangered (CR) and/or Endangered (EN) species; Endemic and/or restricted-range species; or Migratory and/or congregatory species). However, the Proposed Project ESIA committed to include the species within its BAP and biodiversity monitoring strategy, as the IUCN has assessed its threat status as Vulnerable[4]. It is also a large and charismatic mammal species that could also be considered as a keystone species within wetland ecosystems[5]. The Hippopotamus population occurs within the wetland habitats of the Nyabarongo Wetlands IBA and therefore it is possible to combine the necessary actions into a single action plan.

1.3 Definition of Critical Habitat

Paragraph 16 of IFC PS6 defines critical habitat as follows:

"Critical habitats are 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."

For projects located within critical habitat, paragraph 17 of IFC PS6 requires:

"In areas of critical habitat, the client will not implement any project activities unless all of the following are demonstrated:

- *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 adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;*
- *The project does not lead to a net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time; and*
- *A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program."*

The Proposed Project ESIA included Technical Appendix 11.1 that provided a detailed Critical Habitat Assessment and identified the relevant critical habitat features within the Proposed Project AOI.

1.4 Objectives of the Biodiversity Action Plan

The overarching objectives of this BAP are:

- to promote and enhance the Nyabarongo Wetlands IBA, to deliver a net gain in its assemblage of bird species, including Madagascar Pond Heron;
- to deliver a net gain for the fish species Ningu (if confirmed to be present);
- to achieve no net loss of natural habitats (i.e. swamp and aquatic vegetation);
- to achieve no net loss in Hippopotamus;
- Provide a framework for engaging stakeholders during the BAP process; and

[4] Lewison, R. & Pluháček, J. 2017. Hippopotamus amphibius. The IUCN Red List of Threatened Species 2017: e.T10103A18567364. http://dx.doi.org/10.2305/IUCN.UK.20172.RLTS.T10103A18567364.en. Downloaded on 8th January 2018.
[5] IUCN/SSC Hippo Specialist SubGroup website: http://www.ml.duke.edu/projects/hippos/index.html, accessed 8th January 2018.

- Provide a robust, appropriately designed, and long-term biodiversity monitoring and evaluation programme that will inform adaptive management of the relevant biodiversity features and enhance knowledge underpinning their conservation programmes.

1.5 Definition of No Net Loss and Net Gain

In a footnote to paragraph 15 in IFC PS6, no net loss is defined as 'the point at which project-related impacts on biodiversity are balanced by measures taken to avoid and minimize the project's impacts, to undertake on-site restoration and finally to compensate significant residual impacts, if any, on an appropriate geographic scale (e.g. local, landscape-level, national, regional).' In relation to critical habitat, net gains are defined as 'additional conservation outcomes that can be achieved for the biodiversity values for which the critical habitat was designated'. The conceptual difference between no net loss and a net gain is illustrated by Figure 1.1. Actions to deliver a net gain are required to address residual impacts following avoidance measures and implementation of the mitigation hierarchy (avoid > minimise > restore > compensate). In most instances, additional conservation programmes are likely to be required to achieve a net gain.

The Project has implemented the mitigation hierarchy in relation to biodiversity. The mitigation measures to avoid, minimise and restore biodiversity are set out within the ESIA Chapter 11: Biodiversity. This BAP focusses on the actions required to deliver additional conservation outcomes to deliver no net loss of natural habitats and a net gain in critical habitat. For the purposes of the BAP, the scale at which the proposed actions must achieve a net gain are assessed to be proportional to the scale of impact caused by the Project.

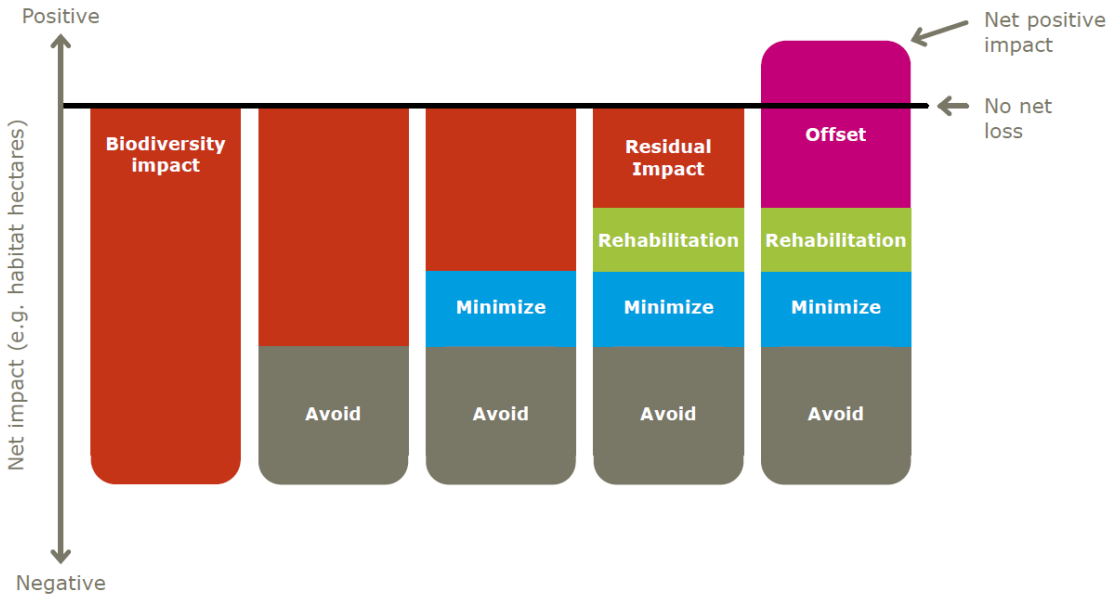

Figure 1.1: Conceptual differences between not net loss and net gain

1.6 Implementation

As with the overall Project Environmental and Social Management System (ESMS) and in line with IFC PS1, the BAP follows elements of international good practice management practice of "plan, do, check, and act," which provides a methodological approach to managing environmental risks and impacts in a structured and ongoing basis (Figure 1.2). This also conforms with the

approach recommended by BS 8583:2015 Biodiversity – Guidance for businesses on managing the risks and opportunities[6].

- Plan - Establish the objectives, and design the processes necessary to achieve those objectives and their associated targets. The planning of objectives should be based on good baseline information and prioritise opportunities. This step is essentially represented by this BAP.
- Do - Implement the plan and execute the processes. This step is represented by the implementation of the actions set out in this BAP.
- Check - Monitor implementation (usually through regular monitoring procedures or through audit), and analyse data against targets and requirements. Determine root causes of non-conformity where necessary, and design and implement corrective actions where required in order to achieve objectives and targets. This step is delivered through the monitoring plan in Section 10 of this BAP.
- Act - Management review of system performance to determine if policy, objectives and targets have been met, and where necessary to adapt these to reflect changing circumstances. The requirements of the system (e.g. organizational structure, resources and competence) that will enable it to achieve policy, objectives and targets, are also reviewed. This BAP sets out an annual review process to be completed as an integral part of its implementation cycle.

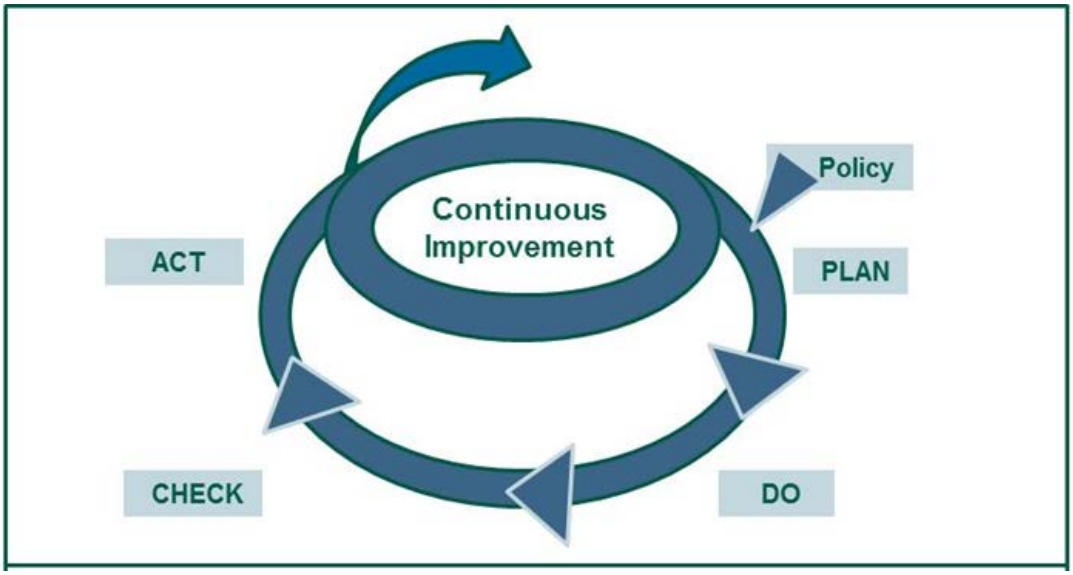

Figure 1.2: Plan-Do-Check-Act Model of Management

1.7 Structure of this BAP

This BAP describes the priority biodiversity features of relevance to the Project and the corresponding actions to maintain or enhance those features. It describes, in a systematic and verifiable manner, the process of planning and implementing actions that will contribute to achieving biodiversity commitments. It further interprets a breadth and depth of detail, including significant work that has been undertaken to collate and assess existing data, to determine effects at the project level, and to provide management mechanisms for BAP implementation, particularly in relation to stakeholder interests.

[6] British Standards Institution (2015) Guidance for businesses on managing the risks and opportunities BS 8583:2015.

To facilitate an understanding of the structure and content of this document, and the location of specific information that may be of interest to the reader, the following description summarises the focus of each section:

Section 1 provides a general introduction to the rationale, purpose, objectives, importance and implementation of the BAP.

Section 2 describes the frameworks for biodiversity planning at international and national levels. This enables the Project BAP to take into account and where possible integrate wider conservation frameworks.

Section 3 describes the interfaces between this BAP and other Project management system components and provides context in relation to Project ESMS, construction and operation phase overarching Environmental and Social Management Plans (C-ESMP and O-ESMP) and topic specific sub-plans.

Section 4 defines the spatial and temporal scope of this BAP.

Section 5 describes the baseline conditions of the features included within this BAP, summarising information from the ESIA and updating this where appropriate.

Section 6 describes the current non-project related threats and conservation actions for each of the features included within the BAP.

Section 7 summarises the impacts of the Proposed Project for each of the features included within the BAP, including direct and indirect impacts on species and habitats.

Section 8 provides a framework for additional conservation actions. Metrics for the measurement of gains required to compensate for losses that are resulting from the Project are developed. These metrics take into account assessments of ecological equivalence, feasibility and alignment with key principles, as required by IFC PS6.

Sections 9 presents the developed Action Plan. This details the specific objectives and actions necessary to achieve these objectives with appropriate methodology and timings, along with appropriate monitoring and evaluation.

Section 10 provides a monitoring and evaluation programme, outlining the monitoring requirements for each of the actions listed.

Section 11 comprises the Biodiversity Action Register. This tabular section incorporates all of the actions and sub-actions from Section 9, allocating specific task responsibilities, a programme of actions with timeframes and summarise the current status of each action. The Biodiversity Action Register is a key tool for the implementation of the BAP.

2. BIODIVERSITY PLANNING FRAMEWORK

2.1 Overview

It is important to understand the broader framework that guides and controls biodiversity management; this standard practice ensures that the BAP is not developed in isolation, and promotes integration for successful implementation. This section, therefore, provides an explanation of the broader conservation framework for the Project BAP.

2.2 International Biodiversity Context

Rwanda is a signatory to a number of international conventions relevant to biodiversity, which are implemented at the country level through its policies and legislation. These are described in Appendix 1, along with a description of the relevant Rwandan institutional framework. The Convention on Biological Convention signed in Rio De Janeiro in Brazil on 5 June 1992, as approved by Rwanda Presidential Order No 017/01 of 18 March 1995 is of particular note for the Project BAP. The Convention has three main goals: It has 3 main objectives: the conservation of biological diversity; the sustainable use of the components of biological diversity; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. It therefore links conservation efforts to the economic goal of using biological resources sustainably, and is a key treaty regarding sustainable development.

At the 10th meeting of the CBD Conference of the Parties, held in Japan in 2010, a revised and updated Strategic Plan for Biodiversity was adopted, including the Aichi Biodiversity Targets for the period 2011-2020. Some relevant examples of those targets are:

- At least halve and, where feasible, bring close to zero the rate of loss of natural habitats, including forests;
- Establish a conservation target of 17% of terrestrial and inland water areas and 10% of marine and coastal areas; and
- Restore at least 15% of degraded areas through conservation and restoration activities.

Article 6 of the Convention requires countries to develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity, and to ensure that these strategies are mainstreamed into the planning and activities of all those sectors whose activities can have an impact on biodiversity.

2.3 National Biodiversity Context

Relevant affiliated organisations and government departments associated and responsible for conservation and sustainable use of biodiversity in Rwanda are summarised in Appendix 1, along with Rwandan policies, laws and regulations relating to biodiversity. Of the legislation listed, the most relevant to the Proposed Project is the Rwanda Environment Policy, 2003 and Rwanda Wildlife Policy, 2013, the Organic Law N° 04/2005 of 08/04/2005 and the Law N° 70/2013 of 02/09/2013 Governing Biodiversity in Rwanda.

To fulfil its obligations under the CBD, Rwanda produced its first National Biodiversity Strategy and Action Plan (NBSAP) in 2003, and five National Reports, the last one was submitted in 2014. These acts set out Rwanda's formal framework for the implementation of the provisions of the Convention especially its three objectives. The NBSAP has subsequently been updated in 2016[7] and is built on five goals with 19 targets that have been defined in line with CBD objectives and its Aichi Targets. The goals are:

[7] Republic of Rwanda (2016) National Biodiversity Strategy and Action Plan.

- Goal 1: To address the main causes of national biodiversity loss by mainstreaming biodiversity conservation in the decision-making process across all governmental, private and civil society's development programs;
- Goal 2: To reduce multiple anthropogenic pressures on biodiversity and promote sustainable use of all renewable natural resources;
- Goal 3: To improve the status of national biodiversity by expanding and safeguarding priority protected ecosystems and maintaining biological communities in equilibrium state;
- Goal 4: Ensure equitable sharing of benefits arising from the use of biodiversity and ecosystem services; and
- Goal 5: To enhance NBSAP implementation through biodiversity knowledge management, participatory planning and capacity building.

Biodiversity is to be mainstreamed into sectors, poverty reduction and climate change. The NBSAP describes aims and methods to achieve this. Strategies and actions to improve protection of genetic diversity and to avoid extinctions are also described in the NBSAP, through protection of key sites (known as Alliance for Zero Extinction (or AZE) sites) as well as improving the protection of other sites which are of high biodiversity importance. An implementation plan is included, which incorporates a Capacity Building Plan, a Communication and Outreach Strategy, a Resource Mobilisation Plan and a Technology Needs Assessment.

This Project BAP has been developed in line with the overall goals of the NBSAP. In addition, it is likely to make contributions to the following NBSAP national targets:

Target 1: By 2020, at the latest, Rwandan people in at least Districts that are adjacent to protected areas are aware of the values of biodiversity and ecosystem services and understand the steps for its sustainable use and conservation.

Target 3: By 2020, at the latest, positive incentives for biodiversity conservation and sustainability towards local communities' development are boosted and applied and harmful incentives are eliminated.

Target 4: By 2020, public and private sectors and civil society organizations have promoted and implemented plans that consider ecological limits.

Target 5: By 2020, at least 50 percent of natural ecosystems are safeguarded, their degradation and fragmentation significantly reduced.

Target 6: By 2020, fishing and aquaculture, agriculture and forestry are managed sustainably taking into consideration ecosystem specificities to ensure biodiversity conservation.

Target 9: By 2020, at least 10.3 percent of national territory holding particular biodiversity and ecosystem services is protected taking into account the landscape approach in order to maintain biological diversity.

Target 13: By 2020, all ecosystems that provide essential services to human well-being and contribute to health as well as livelihoods are restored and safeguarded, taking into account the needs of women, local communities especially the vulnerable groups.

Target 14: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced through increase of forest cover up to 30 percent of the country and restoration of other ecosystems thereby contributing to Climate Change adaptation and mitigation.

Target 17: By 2020, values of traditional knowledge, cultural heritage and practices of local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and

international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of local communities, at all relevant levels.

Target 18: By 2020, knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, applied and reflected in the implementation of the NBSAP.

3. MANAGEMENT SYSTEM INTERFACES

3.1 Introduction

The BAP forms part of the Developer Environmental and Social Management System (ESMS) that serves to promote compliance with national legislation, international financial institution standards and International Standards Organisation (ISO) 14001 requirements. The ESMS comprises two overarching Environmental and Social Management Plans (ESMP) for construction and operation phase (C-ESMP and O-ESMP respectively) and topic specific sub-plans. These plans are summarised in the sub-sections below.

3.2 Project Construction Environmental and Social Management Plan and Operation Environmental and Social Management Plan

The purpose of the Developer C-ESMP is to provide a consolidated summary of the Project's environmental and social (E&S) commitments relevant to the construction phase and an overview of the Developer ESMS that is being implemented, to ensure the systematic and effective execution of these commitments. The C-ESMP also provides a summary of the relative responsibilities of the Developer and the Contractor during the construction phase. It therefore provides assurance that E&S mitigation, management and monitoring measures in the ESIA are accounted for and are being implemented during construction. This includes a suite of nine topic-specific management plans containing management and monitoring controls that build upon the management, mitigation and monitoring measures set out in the Project ESIA and sign-post to the Contractor Construction Implementation Plans (CIPs).

The individual appended topic-specific C-ESMPs are as follows:

- Biodiversity Management Plan (BMP)
- Community Health, Safety and Security Management Plan
- Cultural Heritage Management Plan
- Labour and Working Conditions Management Plan
- Soil Management Plan
- Stormwater Management Plan
- Traffic Management Plan
- Waste Management Plan

The Project O-ESMPs will be developed at a later stage to include all environmental and social actions required during operation of the Project and include an operation phase Biodiversity Management Plan (BMP).

Figure 3.1 below demonstrates the relationship between the Developer Environmental and Social Management System (ESMS), the Developer Overarching Construction Phase Environmental and Social Management Plan (C-ESMP) and other Construction Phase C-ESMPs, the Developer Overarching Operation Phase ESMP (O-ESMP) and other topic-specific Operation Phase ESMPs (O-ESMPs), the Contractor Construction Implementation Plans (CIPs) and the Contractor Operation Implementation Plans (OIPs). The Contractor CIPs will align with the Developer C-ESMPs.

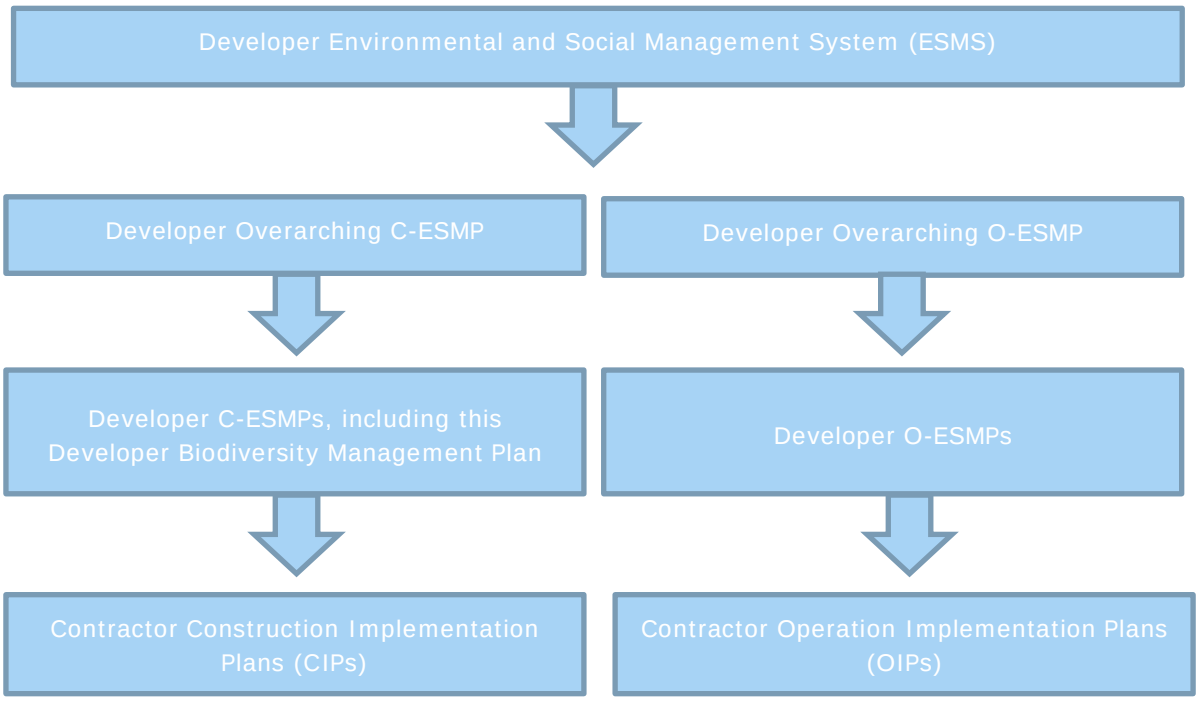

Figure 3.1: Environmental and Social Management Flowchart

The Project BAP sits alongside the Developer C-ESMP and O-ESMP as a key part of the Developer ESMS. The Project BAP sits outside the C-ESMP and O-ESMP as it will commence during construction, and continue through the operational life of the Project.

The distinction between a BMP and BAP is detailed in Annex A of the IFC Guidance Note 6. BMPs are developed to develop mitigation measures and commitments from the ESIA with the aim of avoiding, minimising and restoring impacts to biodiversity arising from Project activities. The development of a BAP is a Lender requirement when operating in critical habitats and should be developed when operating in natural habitats. BAPs are usually required for more complex programmes of work that may be required to manage interaction with stakeholders, implement actions involving land in third party ownership and when additional conservation programmes are required.

3.3 Overarching Roles and Responsibilities

Figure 3.2 illustrates the structure of the E&S management roles, for the implementation of the ESMS and C-ESMPs, and how they interface with one another. Further detail on the Contractor HSE roles is provided in the Contractor CIPs.

- Developer Director responsible for HSE, including the overarching responsibility for implementing the Project BAP.
- Developer Community Liaison Officer – reports to the Developer Director responsible for HSE.
- Developer Manager responsible for HSE - reports to the Developer Director responsible for HSE and interfaces with the Contractor Manager responsible for HSE, and communicates and interacts with government bodies.
- Contractor Manager responsible for HSE – reports to and interfaces with Developer Manager responsible for HSE, communicates and interacts with government bodies, security teams, field engineers, field supervisors, contract administrators, commercial service providers, human relations managers and relevant industrial entities.

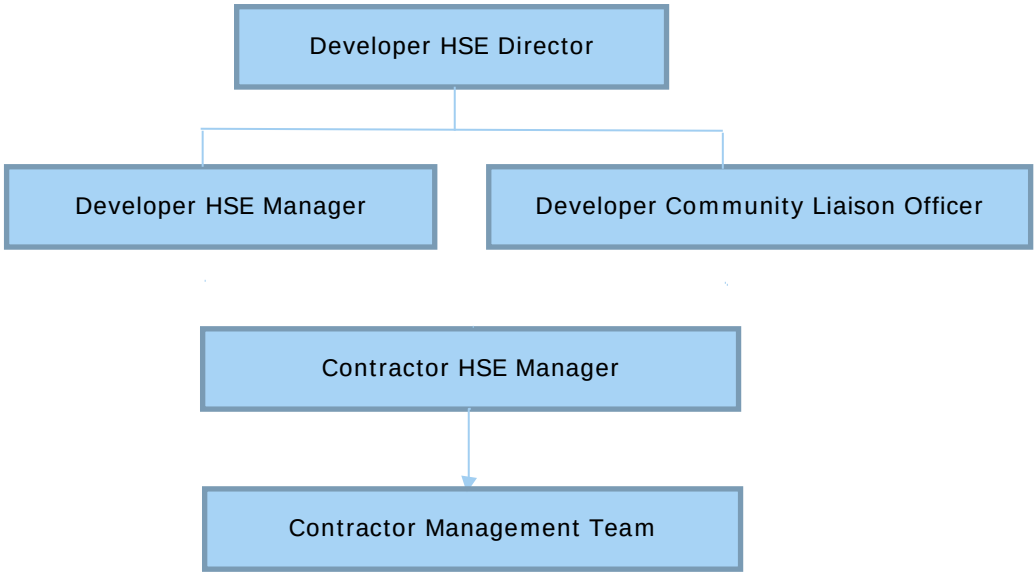

Figure 3.2: HSE Organisation Chart

4. SCOPE OF THE BAP

4.1 Project Area and Area of Influence

The airport is situated within the Rilima and Juru Sectors of the Bugesera District in the Eastern Province of Rwanda. The airport is located approximately 23 km southeast of Kigali City, off the Kicukiro-Nyamata-Nemba KK-15 Road (also referred to as the RN-15), which connects Rwanda to Burundi.

The Project includes the development, construction and operation of the following structures and infrastructure:

- Airport and associated structures and infrastructure;
- Temporary 5 km Water Pipeline for the construction phase;
- Upgrades to the road linking an existing quarry northeast of the Proposed Project to the Airport Area for the supply of aggregates during construction; and
- 14.5 km Expressway to link the airport to the national KK-15 Road (also referred to as the RN-15).

The Proposed Project ESIA minimum area of study is defined as the Area of Influence (AOI). The AOI is larger than the Proposed Project Area in order to address potential impacts that extend beyond the project boundary. In this context, the AOI is the geographic area that may experience impacts to the biological, physical or socio-economic environments from resettlement, earthworks, construction and operation of the Project components. The Proposed Project AOI includes the receptors that may be permanently and temporarily affected by the Proposed Project features. Within respect to biodiversity receptors, the ESIA assumed an AOI of approximately 15 km from the Proposed Project.

4.2 Spatial Extent

The spatial scope of the BAP will largely be within the same 15 km AOI used by the Project ESIA as described in the preceding sub-section, although it may also include parts of the Nyabarongo Wetlands IBA that extends beyond the AOI, as required.

4.3 Temporal Extent

The Proposed Project will be delivered in five phases. The first phase is planned to be completed by 2020 and the final phase by 2045. Table 4.1 summarises the five phases associated with the Proposed Project and relevant key information for each phase. This BAP will be implemented as a minimum for the first 25 years of the Project up to Phase 5 in 2045, with annual reporting and five-yearly reviews to ensure that the BAP continues to meet Lender Standards with the completion of each subsequent Phase for the duration of the Project.

Table 4.1: Master Plan Development Phases*

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Completion Year	2020	2030	2035	2040	2045
Million Annual Passengers	1,77	2,52	3,42	4,48	5,72
Design Peak Hour (Passengers)	856	1,157	1,490	1,859	2,253
Annual Cargo (Tons per Annum)	13,803	19,542	27,626	39,434	56,416
Projects per Phase	Runway	Apron	Apron	Taxiway	Taxiway

Table 4.1: Master Plan Development Phases*

Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
	Taxiway Apron Passenger Terminal Presidential Terminal Airport Facilities Cargo Area Aircraft Maintenance Landside Roads Commercial Area Parking Area	Passenger Terminal Airport Facilities Parking Areas	Airport Facilities Cargo Area Extension Office Area Hotel Aircraft Maintenance Parking Area	Apron Passenger Terminal Airport Facilities Landside Roads Parking Area	Apron Passenger Terminal Airport Facilities Cargo Area Parking Area

* Note: Any items repeated in phases 2-5 are extensions to the facilities constructed in the previous phase

5. BASELINE

5.1 Nyabarongo Wetlands IBA

The Proposed Project Area includes parts of the Nyabarongo Wetlands IBA[8], which is an internationally recognised area, as defined by IFC PS6. IFC's Guidance Note 6 (GN57) states that in general, internationally and/or nationally recognised areas of high biodiversity value will qualify as critical habitat, including the majority of Key Biodiversity Areas (KBAs), which encompass *inter alia* Ramsar Sites, Important Bird Areas (IBA), Important Plant Areas (IPA) and Alliance for Zero Extinction Sites (AZE). The Project's critical habitat assessment (Technical Appendix 11.1 of the Project ESIA) confirmed that the Nyabarongo Wetlands IBA is critical habitat as defined by the IFC. The Nyabarongo wetlands IBA is recognised for internationally important populations of the trigger species listed in Table 5.1.

Table 5.1: Nyabarongo Wetlands IBA Trigger Species

Species	IUCN Red List	Season	Year of assessment	Population estimate	IBA Criteria Triggered *
Papyrus Gonolek *Laniarius mufumbiri*	NT	Resident	1998	Present	A1, A3
Carruthers's *Cisticola carruthersi*	LC	Resident	1998	Present	A3
Papyrus Yellow Warbler *Calamonastides gracilirostris* (*Chloropeta gracilirostris*)	VU	Resident	1998	Present	A1, A3
White-winged Swamp-warbler *Bradypterus carpalis*	LC	Resident	1998	Present	A3
Black-lored Babbler *Turdoides sharpei*	LC	Resident	1998	Present	A3
Northern Brown-throated Weaver *Ploceus castanops*	LC	Resident	1998	Present	A3
White-collared Oliveback *Nesocharis ansorgei*	LC	Resident	1998	Present	A3
Papyrus Canary *Crithagra koliensis*	LC	Resident	1998	Present	A3

* IBA Criteria:

A1: Globally threatened species. The site is known or thought regularly to hold significant numbers of a globally threatened species.

A3: Biome-restricted species. The site is known or thought to hold a significant component of the group of species whose distributions are largely or wholly confined to one biome.

In addition to those species listed in Table 4.1, based on the findings of the ESIA, both red-chested sunbird and Madagascar pond heron are treated as part of the IBA bird assemblage that triggers critical habitat. These species are all highly dependent on the natural freshwater swamp and aquatic habitat and therefore this action plan focusses on delivering a net gain of these

[8] http://datazone.birdlife.org/site/factsheet/nyabarongo-wetlands-iba-rwanda/map, 22/08/2017

supporting habitats to benefit all of the identified IBA and critical habitat features through an ecosystem approach.

5.1.1 Summary of ESIA Survey Results

During the compilation of the Project ESIA, a consultation meeting was held with Association pour la Conservation de la Nature au Rwanda (ACNR), regarding the status of the IBA. ACNR indicated that the Nyabarongo Wetlands IBA is not currently accurately mapped, due to a lack of data available to the organisation at the time of the 1998 assessment. The results of the Project ESIA October/November 2017 bird surveys and associated habitat mapping provides a robust dataset by which to delineate the IBA boundary based on the presence of the relevant trigger species. In addition to the surveys completed during 2017 to describe the biodiversity baseline for the Project ESIA, previously published results of earlier surveys completed in the region have been reviewed and relevant results are referenced below. Of particular relevance to the assessment are surveys completed January-February 2010 within the Nyabarongo Wetlands IBA as part of the 2010 ESIA[9] by Ronald Mulwa, as well as surveys completed by Fischer in June 2011[10] and ACNR in 2003[11]. Detailed species accounts are provided in Appendix 2 of this BAP.

Targeted bird surveys were completed during May and June 2017 and October and November 2017 to provide accurate distribution and relative abundance for IBA trigger species for the wetlands located within the Project AOI. During the initial field surveys completed in May and June 2017, three of the IBA trigger species were recorded: Papyrus Gonolek, Black-lored Babbler and White-winged Swamp-warbler. During the targeted wetland surveys in October and November 2017, seven out of eight of the IBA trigger species were recorded (Figure 5.1).

Only White-collared Oliveback was not recorded during 2017. The species was also not recorded in the previous surveys completed in the IBA during 2003, 2010 or 2011. White-collared Oliveback is apparently more frequently seen in swamp-forest (MacClean *pers. comm.*), a habitat that is absent in the area surveyed. The species was however recorded in the Akanyaru IBA in 2008 by Nsabagasani *et al.* (undated)[12], so there is still the potential for the species to occur, albeit probably in low numbers.

Four of the species recorded are widespread within the areas of remaining wetland, three of which (Papyrus Gonolek, White-winged Warbler and Carruther's Warbler) are strongly associated with papyrus-dominated swamps. Black-lored Babbler appears to utilise both the wetlands and the nearby farmland habitats, although may use papyrus for nesting sites. Three of the species (Papyrus Yellow Warbler, Northern Brown-throated Weaver and Papyrus Canary) were all recorded as present, although rarely encountered. In addition, Red-Chested Sunbird *Cinnyris erythrocercus* was recorded. This is another biome-restricted species that is an IBA trigger species for both the Akanyaru Wetlands IBA and the Akagera National Park IBA due to its dependence on wetlands. Madagascar pond heron was not recorded during the 2017 bird surveys. However, secondary data sources have confirmed the species presence, albeit in low numbers. The Project CHA determined that the IBA is likely to represent critical habitat for this IUCN Endangered species. Therefore, both red-chested sunbird and Madagascar pond heron are treated as being included as potential IBA trigger species and treated as part of the critical habitat bird assemblage.

[9] GIBB 2010) Proposed New Bugesera International Airport (NBIA) for Ministry of Infrastructure (MININFRA), Government of Rwanda: Environmental and Social Impact Assessment

[10] Fischer, E (2011) Biodiversity Inventory for Key Wetlands in Rwanda: Final Report. Rwanda Environment Management Authority (REMA)

[11] Association pour la Conservation de la Nature au Rwanda (2004) Conservation and Sustainable Use of Wetlands in South-Eastern of Rwanda

[12] Nsabagasani, C., Nsengimana, S. and Hakizimana, E. (undated) Biodiversity Survey in Akanyaru Wetlands, Unprotected Important Bird Areas in Rwanda

The IBA trigger species meet the IBA criteria for biome restricted species, as they are strongly associated with Papyrus swamp vegetation. The 2017 ESIA surveys recorded these trigger species in both the Papyrus-dominated swamp and the Typha-dominated swamp in the Project AOI and therefore both vegetation types are treated as qualifying as part of the Nyabarongo Wetlands IBA (Figure 5.1).

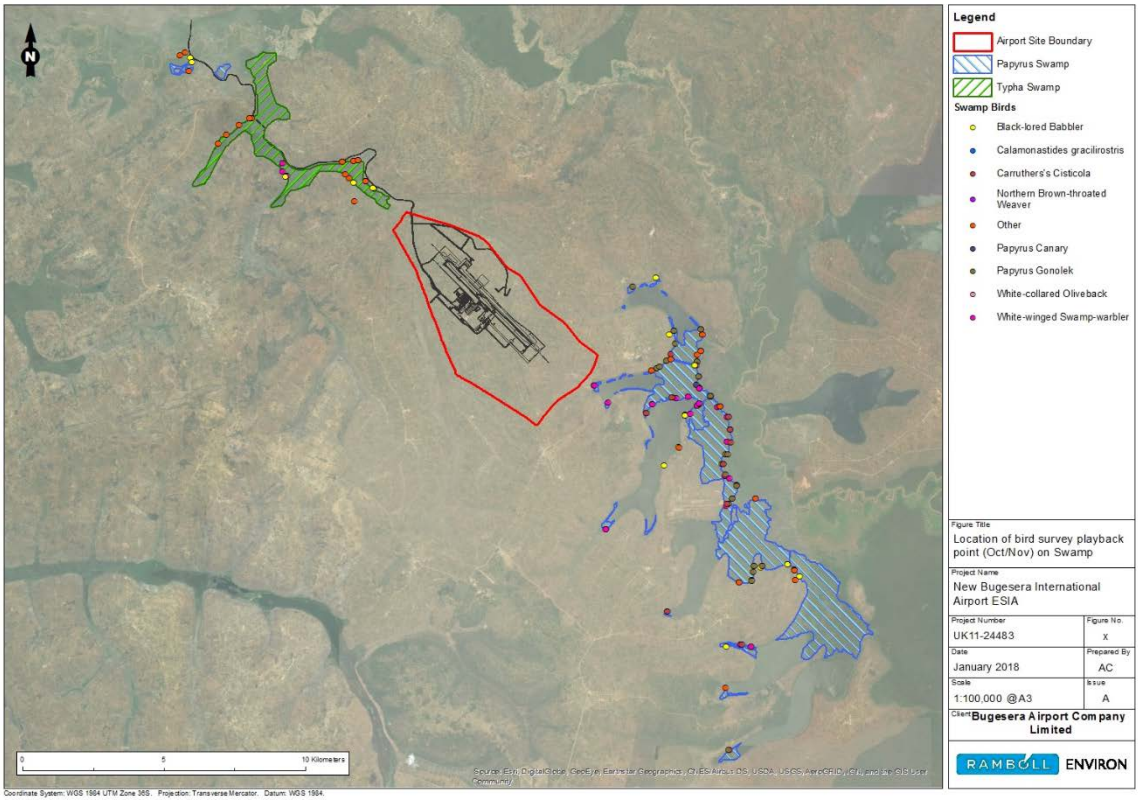

Figure 5.1: Distribution of IBA Bird Species

5.2 Ningu

The New Bugesera International Airport ESIA included a critical habitat assessment (Technical Appendix 11.1 of the ESIA) that concluded that the Proposed Project's AOI includes critical habitat for the fish species Ningu *Labeo victorianus*. Ningu has been classified as Critically Endangered by the ICUN Red List[13] due to a decline in global populations of greater than 80% in 10 years. The species is endemic to the Lake Victoria region and its global range overlaps with the Proposed Project AOI. According to literature sources, Ningu represents an important dietary and income source within the Bugesera District (MINELA 2011)[14] and therefore is currently assumed to be present within the Project AOI, although recent robust data on the continued presence of Ningu is not available. The ESIA for the Project predicted residual impacts to the species predominantly as a result of the population influx and induced access leading to additional pressure on fisheries. This action plan has been developed with the aim firstly to confirm the continued presence of the species, and if required quantify impacts resulting from the Project and develop a conservation programme to deliver a net gain for this critical habitat feature. Further species information obtained from secondary data sources about the ecology and distribution of the species is presented in Appendix 2.

[13] FishBase team RMCA & Geelhand, D. 2016. *Labeo victorianus*. The IUCN Red List of Threatened Species 2016: e.T60318A47182908. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T60318A47182908.en. Downloaded on 28 November 2017.
[14] MINELA (2011) Impacts Assessment and Evaluation of The Pilot Project for Introduction of Rainwater Harvesting and Utilization Techniques In Bugesera District (Cuep Project). Ministry of Environment and Lands.

5.3 Hippopotamus

The New Bugesera International Airport ESIA confirmed the presence of Hippopotamus within the Proposed Project's AOI (Figure 5.2), although no signs of Hippopotamus were recorded within the wetland alongside the Expressway route. The wetland in this location does not provide suitable habitat for the species as there are no large waterbodies, the areas of very wet swamps are limited in extent and there are high levels of disturbance from local communities. Local community members surrounding the wetland were asked about the presence of Hippopotamus and all were unanimous in reporting that they are absent in this location.

Hippopotamus does not trigger critical habitat within the Project AOI as it does not meet any of the criteria for critical habitat (e.g. Critically Endangered (CR) and/or Endangered (EN) species; Endemic and/or restricted-range species; or Migratory and/or congregatory species). However, the ESIA committed to include the species within its BAP and biodiversity monitoring strategy, as the IUCN has assessed its threat status as Vulnerable (VU)[15]. It is also a large and charismatic mammal species that could also be considered as a keystone species within wetland ecosystems[16]. The Hippopotamus population occurs within the wetland habitats of the Nyabarongo Wetlands IBA and therefore it is possible to combine the necessary actions into a single action plan.

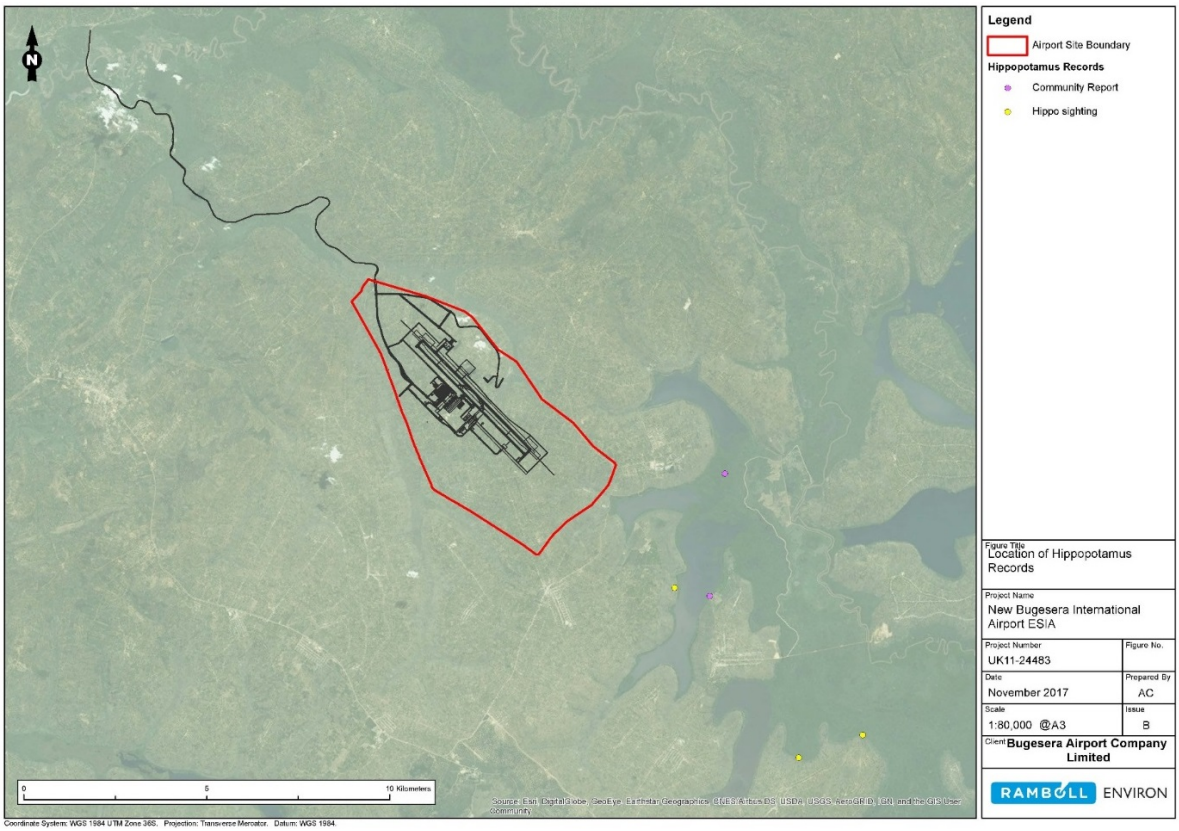

Figure 5.2: Presence of Hippopotamus within the Proposed Project AOI

[15] Lewison, R. & Pluháček, J. 2017. *Hippopotamus amphibius*. The IUCN Red List of Threatened Species 2017: e.T10103A18567364. http://dx.doi.org/10.2305/IUCN.UK.20172.RLTS.T10103A18567364.en. Downloaded on 8th January 2018.

[16] IUCN/SSC Hippo Specialist SubGroup website: http://www.ml.duke.edu/projects/hippos/index.html, accessed 8th January 2018.

6. CURRENT THREATS AND CONSERVATION ACTION (NON-PROJECT RELATED)

6.1 Nyabarongo Wetlands IBA

6.1.1 Threats (Non-Project Related)

The area of Papyrus swamp is decreasing in size across east Africa, largely due to agricultural pressure, with large areas of swamp being drained for subsistence crop production. The East African geographical extent of papyrus wetlands was previously estimated to cover approximately 40,000 km^2 (Hughes & Hughes, 1992[17]), although significant areas have been lost since this date. One study showed that changes in Papyrus cover at three IBAs in the Kenyan sector of Lake Victoria occurred between 1969 and 2000, with losses of 34% to 50% recorded (Owino and Ryan, 2007[18]). Rates of papyrus swamp drainage have been found to be almost four times higher than that of wetland habitat as a whole in areas of Uganda, Rwanda and Kenya (Maclean *et al.,* 2013). Between 1984–1987 and 1999–2001 the areal extent of papyrus declined by 6.7 % in this area. In some regions of Uganda, Rwanda and DRC, more than 75% of wetlands were drained between the early 1980s and 2001 (Maclean *et al.*, 2013).

The most recent monitoring assessment for the Nyabarongo Wetlands IBA completed by Birdlife International in 2013, concluded that the threat score (pressure) to the IBA was high due to the combination of agricultural expansion and intensification (from both agro-industry and small-holders), hunting and collecting of terrestrial animals, as well as from invasive species (covering 10-49% of the area). In addition, the assessment states that little or none of the site is covered by conservation action (<10%).

The 2013 assessment does not differ from the conclusion of ACNR's earlier assessment completed in 2004. This concluded that the Nyabarongo wetlands are under very high pressure from the population, on which it depends for many resources. The limited socio-economic survey of 20 local resident completed by ACNR found high rates of use for agriculture, building materials, fire wood and water (Table 6.1).

During the 2017 ESIA baseline surveys, multiple examples of community use of wetland resources were observed. Some of the documented uses such as collection of water for local gardens and collection of plants for medicinal and craft purposes are unlikely to have a large impact on the wetlands. The harvesting of reeds and sedge was observed in many locations (Figure 6.1), in part for use as a mulch on agricultural fields. Donaldson *et al*. (2016)[19] showed that low levels of habitat disturbance is not incompatible with maintenance of populations of papyrus specialist species, although the responses are species-specific. However, within the Nyabarongo wetlands, harvesting of reeds and sedge is being combined with the grazing of livestock and appears to be converting areas to grassland, and some areas appear to be part of a wholescale conversion process to vegetable and rice cropping. Where the level of habitat disturbance is too frequent to allow the regrowth of papyrus, it is likely to lead to the extirpation of the papyrus specialist bird species.

[17] Hughes RH, Hughes JS, 1992. A Directory of African Wetlands. IUCN, Gland, Switzerland and Cambridge, UK/UNEP, Nairobi, Kenya/ WCMC, Cambridge, UK.
[18] Owino, A.O. & Ryan, P.G. Wetlands Ecol Manage, 2007. 15: 1. https://doi.org/10.1007/s11273-006-9001-y
[19] Donaldson L, Woodhead AJ, Wilson RJ, Maclean IMD (2016) Subsistence use of papyrus is compatible with wetland bird conservation. Biol Conserv 201:414–422.

Figure 6.1: Harvesting Bundles of Reed and Sedges

Table 6.1: Community Uses of Resources in Nyabarongo Wetlands (Source: ACNR, 2004)

Use	Detail	Percentage
Fuel	Firewood	100
	Charcoal	15
Agriculture		85
	Cattle farm	35
Housing materials	Papyrus	25
Other uses	Herbs for banana wine	65
	Herbs for arts and craft	35
	Medicinal plants	20
Water		85

Figure 6.2: Recently Burnt Area of Papyrus Swamp / Brick Kiln Adjacent to the Proposed Expressway

In addition to impacts from use of resources, recently burnt areas of papyrus were observed in several locations (Figure 6.2). As with the cutting of papyrus, following infrequent burning the habitat is able to regrow from rhizomes without significant negative harm to bird populations (Donaldson *et al*., 2016). According to various sources, burning is used intentionally by local communities to concentrate or flush animals for hunting, or accidently in an attempt to smoke bees out of hives while harvesting honey. However, as reported in the Akanyaru Wetlands by Nsabagasani *et al.* (undated), it appears that burning is being used as preparation as part of conversion to cultivation.

MacClean reports that some areas of papyrus swamp in Uganda are heavily impacted from dredging for the use of clay in brick-making[20]. During 2017, within the Project AOI, brickmaking was observed in one location close to the proposed Expressway (Figure 6.2). However, it appeared that the clay was being excavated from the wetland edge, outside of the swamp habitats and is not a significant issue in the area surveyed in 2017.

6.1.2 Recorded Rates of Loss within Nyabarongo Wetlands IBA

To inform the production of this BAP, particularly to provide an accurate estimate of background rates of loss as part of the calculation of compensation requirements, an automated image classification process was completed to define the boundaries of papyrus and typha wetlands within the area of analysis in 2002, 2007 and 2017. The methodology employed to complete the automated image classification process is detailed in Appendix 3. Model results were generated as a series of polygons identified as papyrus/typha swamp in each year. The area of papyrus within the Nyabarongo Wetlands IBA extended to 18,155 hectares in 2002 (Figure 6.3). The area reduced by over 3000 hectares in the five years between 2002 and 2007 (Figure 6.4). By 2017, the area had declined by another 4560 hectares, equating to an annual rate of loss over the ten-year period of 456 hectares per year, approximately 30% of the area extant in 2007 (Figure 6.5).

[20] http://www.conference.ifas.ufl.edu/intecol/presentations/043/1120%20I%20Maclean.pdf

If the current rate of loss continues, there is unlikely to be any papyrus swamp remaining within the IBA by 2040, and likely to lead to total extirpation of the papyrus biome restricted species.

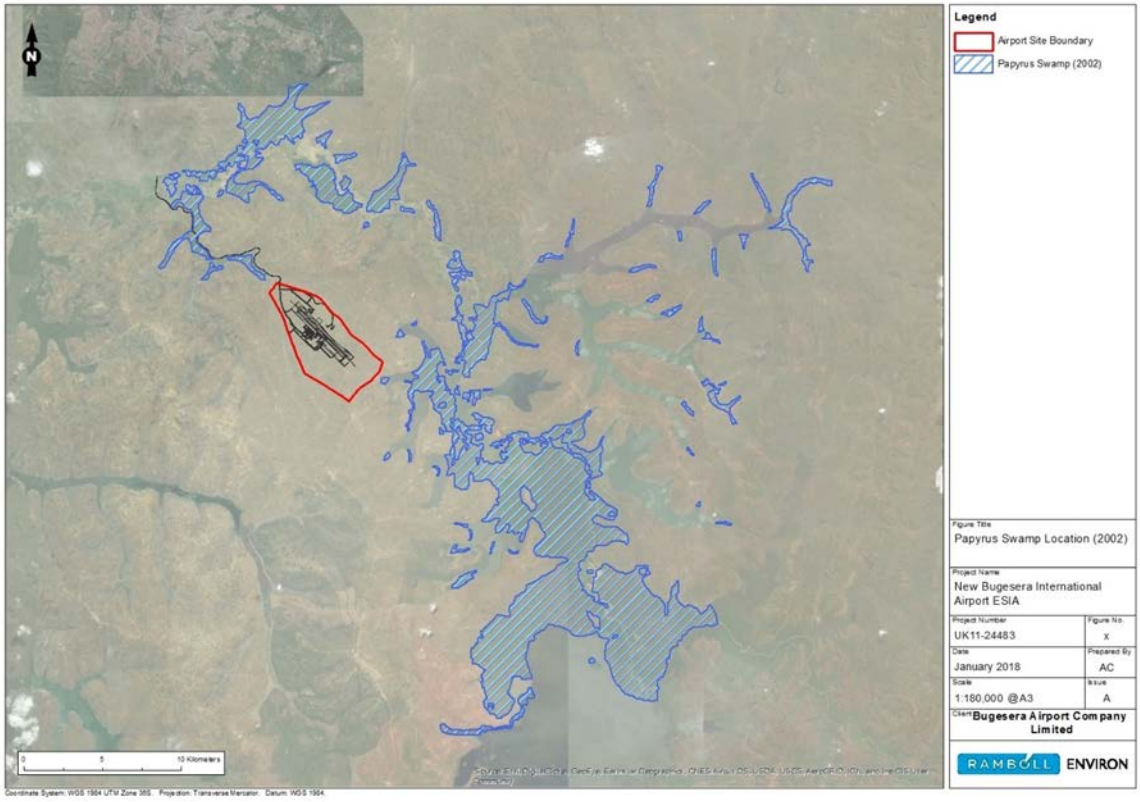

Figure 6.3: Extent of Papyrus Swamp in Nyabarongo Wetlands IBA 2002

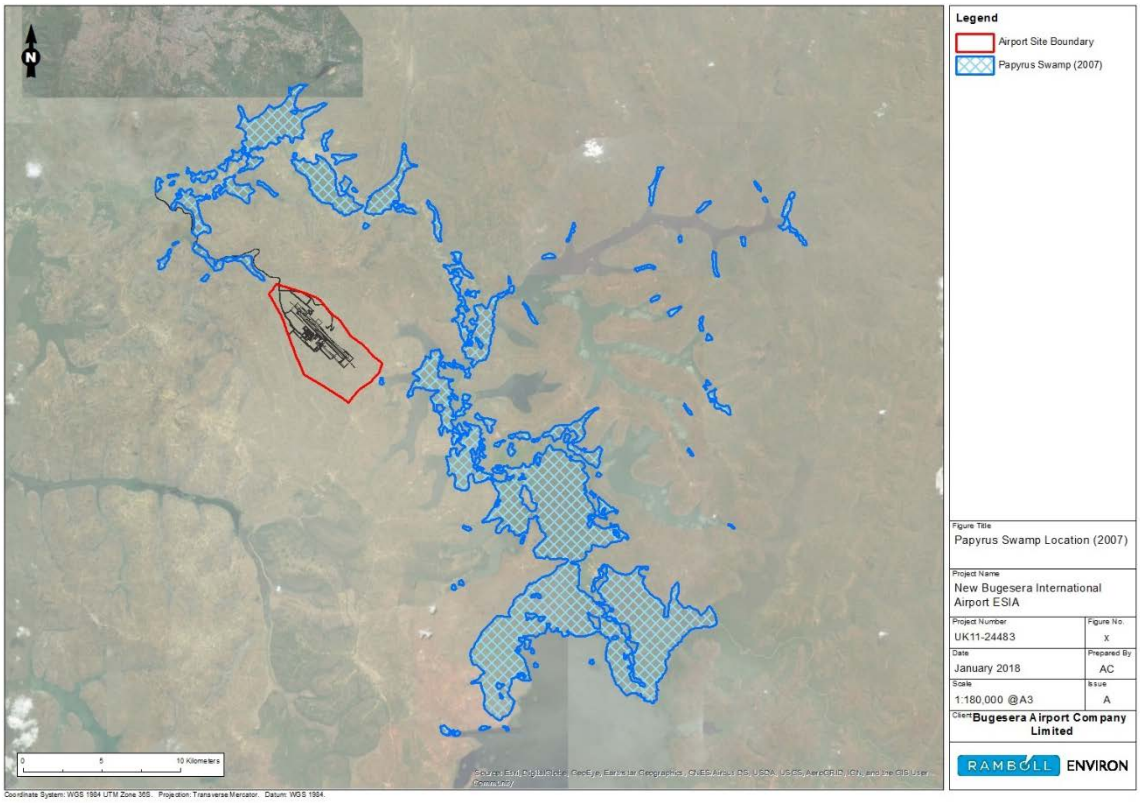

Figure 6.4: Extent of Papyrus Swamp in Nyabarongo Wetlands IBA 2007

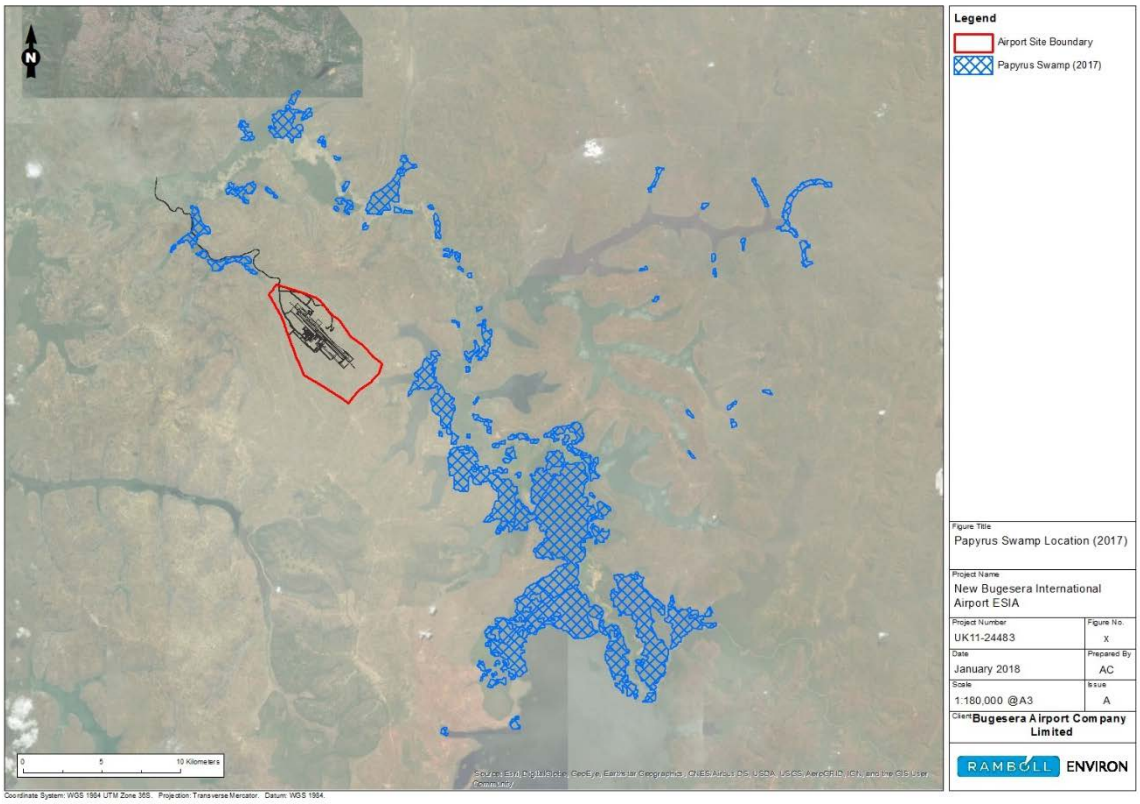

Figure 6.5: Extent of Papyrus Swamp in Nyabarongo Wetlands IBA 2017

6.1.3 Conservation Action

Legal Protection

Although the Nyabarongo wetlands have been designated as an IBA, this international recognition of importance does not confer any legal protection. Within Rwanda, however, there are some legal protections in place for wetlands. The *Ministerial Order determining the length of land on shores of lakes and rivers transferred to public property* (N° 007/16.01 of 15/07/2010), sets the boundary for development and settlement activities next to water bodies. This Order aims at setting aside the length of land on shores of lakes and rivers affected in the public domain for environmental protection. The land within a distance of 50 m from the lakeshore, and the land within a distance of 10 m and 5 m from the shore of big rivers and small rivers respectively is public property and potentially helps to protect the bankside habitats of waterbodies.

The Prime Minister's Order N° 006/03 of 30/01/2017, *drawing up a List of Swamp Lands, their Characteristics and Boundaries and Determining Modalities of their Use, Development and Management* focusses on the protection of wetlands and swamps through the country. The Order lists a number of wetlands in Bugesera District as proposed Ramsar Sites with management prescribed as Use under specific conditions. It is understood that the Ramsar designation process of assessing their status to support its designation under Ramsar convention begun in November 2017 (ACNR pers. comm.). Part of the BAP process will be to follow the Ramsar designated process closely and to engage with the relevant Government departments to provide support and engagement.

Though the wetland areas are owned by the government, the land is borrowed by cooperatives who are supposed to cultivate according to government strategies and plans. Despite the legal protections outlined above, the evidence on the ground is that these have yet to lead to the prevention of damaging levels of use and exploitation by local communities.

Conservation Management

During consultation with ACNR in 2017, they stated that they were not aware of any management plan that exists for the Nyabarongo Wetlands IBA.

6.2 Ningu

6.2.1 Threats (Non-Project Related)

According to the IUCN Red List, unregulated gill-netting fishes across rivers or river mouths during the seasonal spawning migration is an ongoing threat, along with the loss of spawning/nursery grounds due to siltation, pollution and water extraction. The IUCN Red List also makes specific reference to threats within the upper Agakera system (including the lakes and rivers within the Bugesera depression and in the Rweru-Mugesera lakes-wetlands complex). These threats include loss of swamps and other wetlands due to farming extension, sedimentation due to excessive soil erosion and pollution from agrochemicals. Loss of riverine migratory routes and competitive displacement by introduced fish species are also listed as threats. Additional studies will be completed as part of this BAP to investigate whether these identified threats have extirpated the species from the Project AOI.

6.2.2 Conservation Actions

Limited targeted conservation actions are currently being implemented to protect remaining populations of Ningu and reverse declines. Protected areas have limited applicability for protecting migratory populations, unless covering large areas, or specific areas of particular importance in key parts of a life cycle, which is not currently the case for Ningu. Restriction of fishing to protect native fish stocks has been proposed from as early as 1920, but with limited success. Within Rwanda, Law No. 58/2008 of 10/09/2008 *determining the organisation and management of Aquaculture and Fisheries in Rwanda* covers various aspects of the industry such as: restrictions in fishing, introduction of aquatic species, aquaculture practices, and grounds for refusal of an aquaculture concession, protection of aquatic organisms, fishing licences, hygiene and quality of aquaculture and fishery products. However, implementation has been limited due to the lack of regulatory structures and resources.

According to the IUCN Red List, the species was identified in the Lake Victoria Environmental Management Project (LVEMP) as one of the species for restoration. Within Rwanda, the Ministry of Agriculture and Animal Resources (MINAGRI) has produced a master plan for fisheries and fish farming that includes suggestions on a mechanism to better manage capture fisheries, although this is not specifically targeted towards Ningu. A number of studies have suggested that the species' future could be assisted if it could be reared in captivity with a view of use in aquaculture (e.g. Kembenya *et al.* 2017).[21]

6.3 Hippopotamus

6.3.1 Threats (Non-Project Related)

According to the IUCN Red List, the primary threats to Hippopotamus are habitat loss/ degradation and illegal hunting for meat and ivory (found in the canine teeth). Within Rwanda, Hippopotamus is protected from hunting by law[22]. However, according to the National Biodiversity Strategy and Action Plan, Hippopotamus are regularly illegally hunted and poached in Akagera National Park. According to Nsabagasani *et al.* (undated), Hippopotamus are not hunted

[21] Kembenya, E. M., Marcial, H. S., Outa, N. O., Sakakura, Y. and Hagiwara, A. (2017), Captive Breeding of Threatened African Carp, Labeo victorianus, of Lake Victoria. J World Aquacult Soc, 48: 955–962. doi:10.1111/jwas.12328

[22] Protected Animals and Plan Species: Ministerial Order N°. 007/2008 of 15/08/2008 Establishing the List of Protected Animal and Plant Species

for food locally in Bugesera, but are possibly killed by people protecting their crop against damage. ACNR completed a limited socio-economic study in the Nyabarongo wetlands in 2003[23], that asked 20 informants about their interactions with the wetlands. Fifty five percent of the respondents stated that the wetland animals, including Hippopotamus, damage agricultural crops (along with reported damage from monkeys, birds, mice and frogs).

Conversation of wetlands into agricultural uses and other uses has caused habitat losses in many countries (IUCN Red List). Water diversion for irrigation projects can cause direct impacts from habitat loss as well as indirect impacts from isolation and fragmentation of populations. Within the Project AOI, the conversion of wetlands within the Gashora Marshland into rice paddies has probably isolated the remaining areas of habitat in which Hippopotamus occurs and may cause long-term fragmentation (Figure 5.2).

6.3.2 Conservation Action

Hippopotamus benefit from some level of legal protection in several countries, although enforcement can be poor. The species is listed on CITES Appendix II and is protected from hunting in Rwanda, as noted above. According to the IUCN, there are numerous protected areas across the countries where Hippopotamus are found. Within Rwanda, a large population occurs within the Akagera National Park, here the population appears to be increasing (MacPherson, 2013).

[23] ACNR (2004) Conservation and Sustainable Use Of Wetlands In South-Eastern Of Rwanda: Project Report. Association pour la Conservation de la Nature au Rwanda

7. SUMMARY OF PROJECT IMPACTS

7.1 Nyabarongo Wetlands IBA

The Project ESIA provides an assessment of impacts to the Nyabarongo Wetlands IBA and the bird assemblage that it supports which triggers critical habitat. The swamp and aquatic vegetation on which the bird assemblage depends is also natural habitat as defined by IFC PS6. The following sub-sections summarise the impacts described by the ESIA, and for indirect impacts provides additional analysis to provide more accurate quantification to inform the calculation of compensation requirements to deliver a net gain.

7.1.1 Direct Impacts from Habitat Loss

None of the IBA wetlands occur within the Airport Area and therefore they will not be affected by direct habitat loss from this Project component. The majority of Expressway runs alongside, but not within, the wetland habitats. However, the Expressway will cross the IBA wetlands in one location before it joins the existing KK-15 national road (also referred to as the RN-15). This wetland crossing will lead to direct habitat loss including swamp and aquatic vegetation known to support IBA trigger species. The swamp vegetation in this location is Typha-dominated. The crossing will directly affect approximately 500 linear metres of a tributary valley to the Nyabarongo River (Figure 7.1). Assuming a road width of 44 metres, this equates to an area of 2.2 hectares.

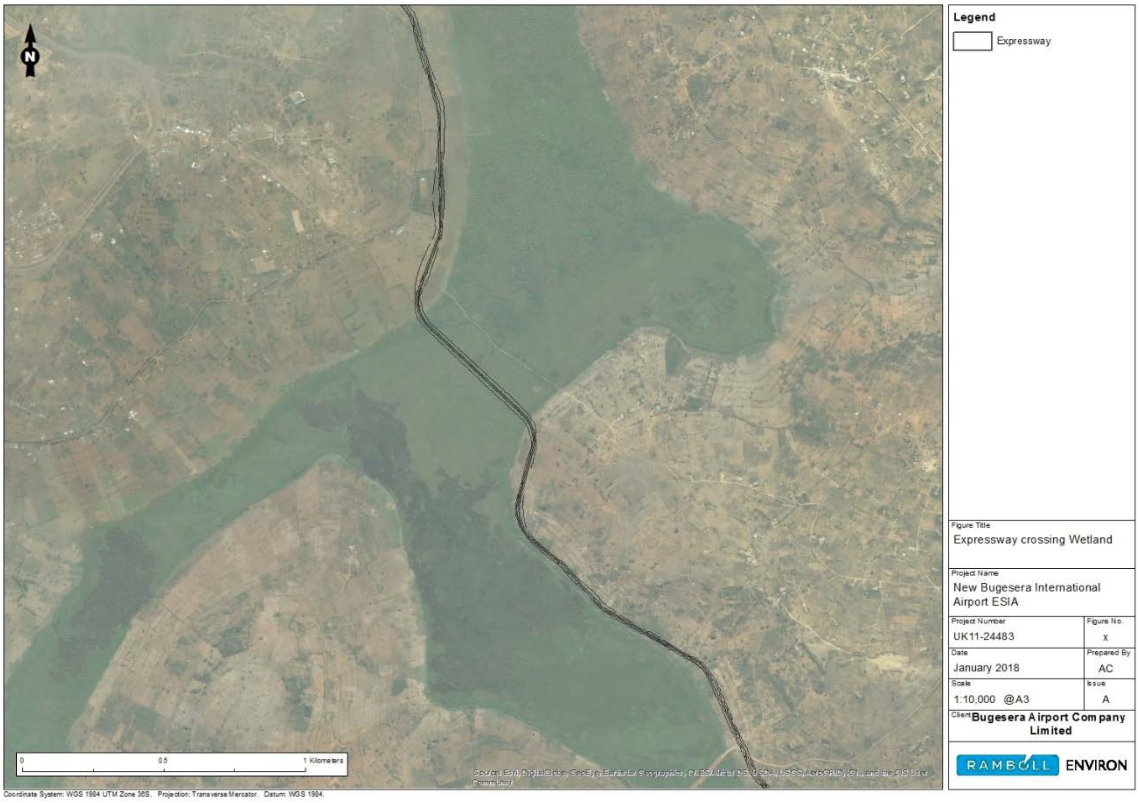

Figure 7.1: Aerial Image of Expressway Crossing Location Within Nyabarongo River Tributary Valley Wetland

7.1.2 Indirect Impacts on Wetlands Resulting from Removal of Farmland

Airfield Area

The airfield covers an area of over 2500 ha. None of this area included wetland habitats. However, a significant proportion of the area was used as farmland. Subsistence crop cultivation is the main type of agriculture in Bugesera District, with people being dependent on it for food.

There is evidence to suggest that there is severe land availability shortage within Bugesera District (UNEP, 2006). According to the 2010 ESIA, out of 17 villages surveyed (almost 50% of the total number in the survey), food production from subsistence agriculture was insufficient to meet the needs for farming households. The 2010 ESIA survey recorded a figure of 91 % of households being dependant on agriculture in the study area, and that the average land parcel size owned by a household is approximately 1.5 ha. However, this may have changed significantly in the subsequent 8 years. According to 2012 published data quoted by the Bugesera District Plan (Bugesera District, 2013)[24], 77.8% of the population depend on agriculture against 72% for national average for the same date. This indicates that the population is becoming less dependent on agriculture over time, although it remains the case for the majority.

According to a study completed by UNEP (2006), largescale conversion of savannah, forest and wetland land uses to agriculture occurred within Bugesera District between 1977 and 2000. Between 2008/9 and 2015, savannah and shrublands further reduced by nearly half, from 4751 ha to 2470 ha. The remaining area equates to approximately 2 % the district's land cover in 2015 (RNRA, 2015)[25]. This has been driven by population increase as well as the demand for fuelwood. During the period 1960-2002, more than two-thirds of the previously existing forest cover was removed in Bugesera District. Between 2008/9 and 2015 forest cover reduced from 3542 ha to 2420 ha, with the remaining area mostly comprising non-native plantations (RNRA, 2015). At the current time, the non-agricultural land uses are largely limited to urban areas, open water bodies (lakes) and the remaining areas of wetland habitats, the latter being the main source of potential additional farmland (Figure 7.2).

Figure 7.2: Cultivation within the Wetland

According to the Draft RAP (2010), land acquisition for the purposes of the Airfield Area would affect 25 villages wholly or partly located in the leased area. This included 2,079 households that were physically displaced (also most were economically displaced). In addition, a further 402

[24] Bugesera District (2013) District Development Plan (2013-2018). Republic of Rwanda, Eastern Province, Bugesera District
[25] RNRA (2015) Support Program to the Development of the Forest Sector in Rwanda – Phase II: Technical Report 10 - Bugesera District Forest Inventory Report. Rwanda Natural Resources Authority,

households located outside the area, but with land within the area were economically displaced only, giving a total number of 2,481 affected households. The resulting pressure of this displacement onto nearby wetlands has not been assessed as part of the RAP. According to the most recent MININFRA Progress Report on the land acquisition process (dated June 2017), 62 vulnerable households were relocated to Kingaju Village of Kabukuba Cell in Juru Sector and that each household was allocated ¼ ha plots of farming land. The land was allocated by Bugesera District Administration within the Rurambi marshland and according to the Progress Report cultivation has begun within the allocated areas. This equates to a potential loss of wetland habitats of 15.5 ha. Based on the aerial image of the marshland within the Kabukuba Cell, it appears that much of the swamp habitat has been cleared, with two patches potentially remaining (Figure 7.3). It is not known if wetland vegetation was cleared to provide for the 15.5 ha of compensatory farmland. This would be confirmed during stakeholder engagement.

Figure 7.3: Marshland in Kabukuba Cell

If all 2079 displaced households were allocated 0.25 ha, this would equate to 564 ha. However, only the 62 displaced households assessed as being vulnerable, were officially allocated land. The majority of those physically displaced as well as all of those economically displaced were compensated for by cash rather than in-kind. According to in initial findings of a post-resettlement audit completed by Ramboll, the majority of the PAPs only received sufficient compensation to buy a plot for a new house and could not afford replacement land for farming. One non-Project Affected Person (PAP) interviewed, estimated that that only 20% of PAPs were positively affected (benefited) by the project and the 80% was negatively affected, with the negatively affected not being able to afford to replace farmland. If 20% of affected households were able to replace farmland with areas located in wetlands, this would equate to a loss of 500 ha. The extent to which this has happened, or the location of such land, has not been currently fully quantified, although currently under further investigation through interviews with PAPs. If the full extent of farmland lost is replaced like for like by every affected household, this could lead to a worst-case scenario of 2,500 ha of wetland losses.

Expressway

The construction and operation of the Expressway will require permanent land acquisition. The Expressway will be approximately 14.5 km in length with a reservation 44 m wide. The reservation is required for two reasons: first, to provide sufficient space for an eventual upgrade from a two-lane to a four-lane road; and secondly, to prevent encroachment by people and businesses, attempting to seek financial benefit from the passing traffic or speculating by buying land/erecting structures in the hope of obtaining future benefits from compensation payments for their land and structures.

The Expressway corridor is largely situated within productive agricultural land and economic displacement will take place of land owners/occupiers/users; mostly, it may be assumed, subsistence farmers cultivating relatively small land plots. Approximately 4 km of the 14 km is located within the Airport Area and therefore accounted for above. Assuming a worst-case scenario where all of the remaining 10 km of displaced land is replaced with land located within wetlands, this would cause a loss of approximately 46 ha. It is likely that this would occur within the wetland areas closest to the current land users, adjacent to the Expressway.

7.1.3 Indirect Impacts on Wetlands Resulting from Population Influx

Migration data produced by the National Institute of Statistics of Rwanda suggests that Bugesera District has been subject to net positive migration, although at lower levels than several other districts within the Eastern Province. Bugesera District ranks the third lowest district within the Eastern Province regarding lifetime in-migrants and has had the highest number of lifetime out-migrants (Figure 7.4)[26]. The data suggest that there are nearly 50,000 people who have moved into Bugesera district since their birth. The data for recent migrants (five years prior to 2012), suggests that net positive migration continues (Figure 7.5). However, the level of net positive migration in Bugesera is the lowest of the Eastern Province districts, standing at 5,241 additional inhabitants (representing approx. 1.4% of the district's population of 361,914).

The relatively low levels of influx experienced to date is supported by results of the ESIA's 'Affected Community-level' survey. This recorded five villages near the Airport Area that have experienced in-migration of people who have moved because they wish to be located near the airport (representing 12.5% of the 40 villages surveyed). According to BAC, a total of 1,800 workers will be employed at peak (November 2018 to June 2019) over the 2.25-year construction period for the first phase of airport development. The Project has a target of 40% of the workforce being local, which excludes Kigali. However, it is not known what proportion of these posts have been filled by pre-existing residents of the district or how many are recent migrants.

At the end of September 2019, the contracts of all workers will be terminated and the construction workforce will no longer be required. Again, it is not known what the long-term influx may result from in-migrants deciding to remain in the district post-construction. During operation, the airport will be a significant local employer. BAC predicts that the number of permanent job opportunities will start at 400 for Phase 1 of operations from 2020 reaching 800 by 2045. Applying an employment multiplier ranging between 1.4 and 2 (based on figures for major European and US airports) would predict that the total permanent jobs (direct, indirect and induced) will range from 560-800 in 2030 and 1,120-2,000 by 2045. It is difficult to estimate how many of these jobs would result in additional households residing in Bugesera District, or how many more will be attracted by the general improvements of economic prospects provided by the Project. It may be possible to base an estimate for this on the increase in net positive migration recorded between 2007-2012. This recorded an additional 0.3 % per annum. It may be reasonable to predict that out-migration levels will not increase and existing levels of in-

[26] Fourth population and Housing Census, Rwanda, 2012: Main Indicators Report. Accessed from http://www.statistics.gov.rw.

migration will not decrease, meaning that net influx would be maintained at current levels for the foreseeable future. It is therefore proposed that the predicted “pressure” on adjacent wetlands will be increased by at least 0.3 % per annum over baseline levels of losses.

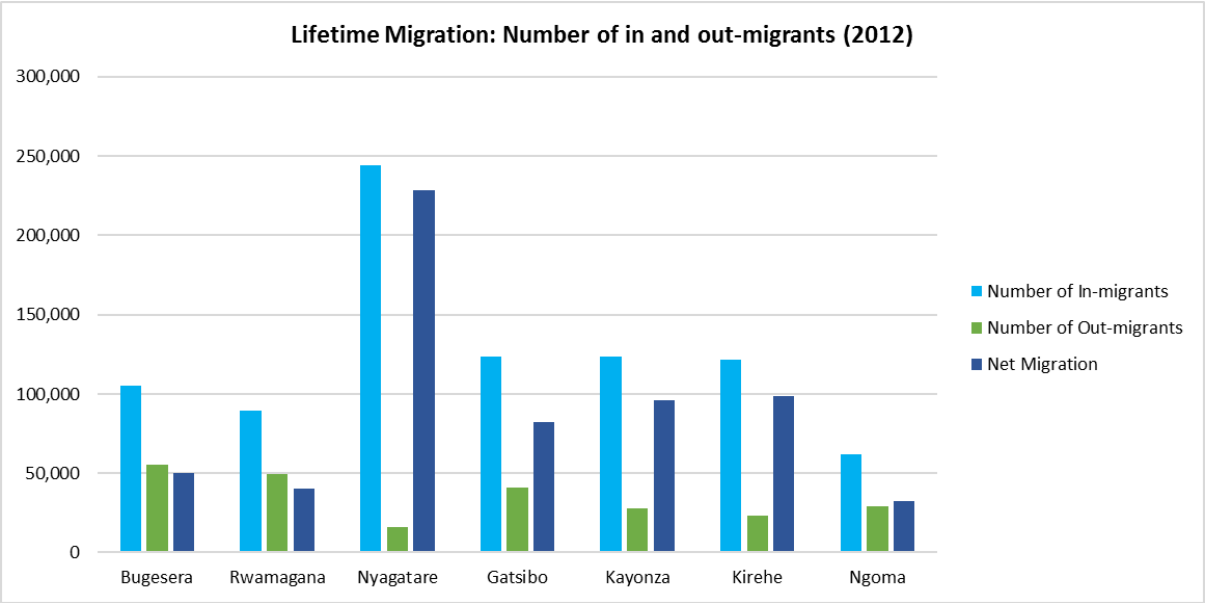

Figure 7.4: Eastern Province: Lifetime Migration

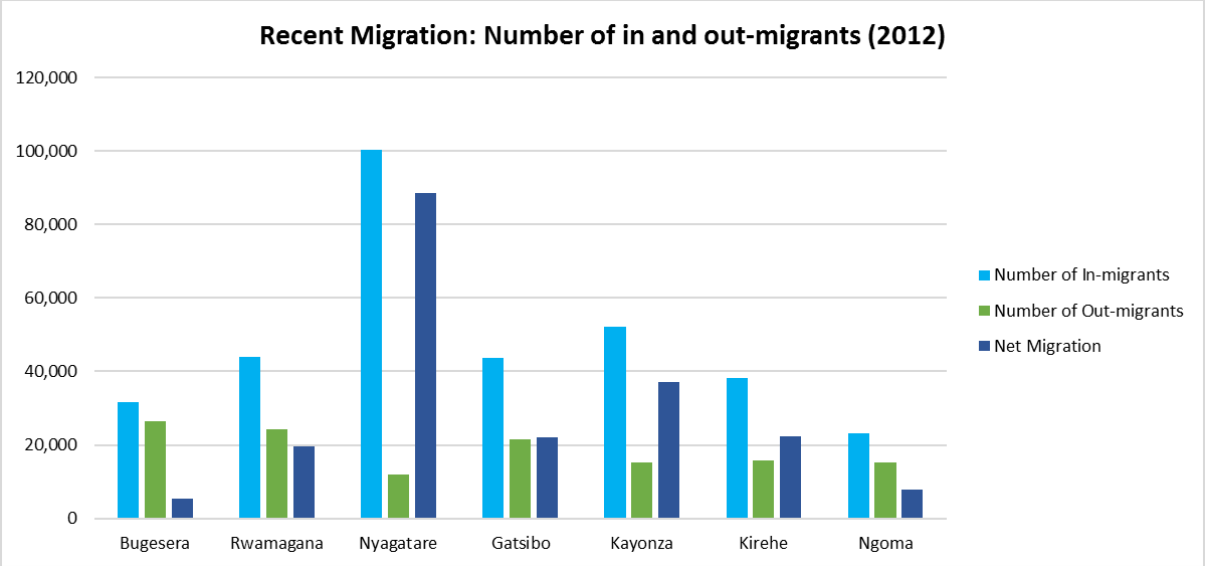

Figure 7.5: Eastern Province: Recent Migration

7.1.4 Noise and Disturbance

Noise disturbance impacts to the Nyabarongo Wetlands IBA and its component trigger bird species are likely to result from both the airport and the Expressway, particularly during the operations phase. Chapter 10: Noise and Vibration of the Project ESIA completed detailed noise modelling for both the airport and the Expressway and these can be used to inform an assessment of impacts. A number of scientific studies have shown that anthropogenic noise impacts birds and can reduce the abundance of certain species, as well as species richness (e.g.

Proppe *et al*., 2013[27], Francis *et al.*, 2009[28], McClure *et al.* 2013 [29]). Studies have also shown that aircraft can cause disturbance to wildlife and especially birds[30]. The disturbance is caused both by the noise generated by the aircraft and visual cues, which are thought likely to stimulate an anti-predator response.

Predicting the disturbance impact on birds from aircraft and road noise is challenging as the level of disturbance is known to vary according to a wide range of factors, including bird species, type of aircraft, proximity, frequency of aircraft, the landscape setting, and interaction with other sources of disturbance. There are no international guidelines on the noise disturbance thresholds for wildlife. However, many studies have recorded a range of behavioural and physiological effects in birds resulting from exposure to noise and disturbance. Whilst the evidence from studies into noise thresholds for effects on birds is complicated by the different units of measurement cited and different species involved, it is considered that 65 dB represents an appropriate precautionary LA_{max} noise threshold below which significant noise disturbance impacts to birds is unlikely.

According to the Master Plan, the total number of flight operations (one operation is a landing or a take-off) per year will be 25,580 in 2020 and increasing to 62,700 in 2045. This equates to approximately 70 operations per day in 2020, increasing to 172 operations per day by 2045. Noise contour plots show that for both the 2020 and 2045 scenarios, 65 dB_{max} is exceeded approximately 15 km to the southeast over the whole of Lake Kidogo, Lake Rumira, Lake Miravi and half of Lake Kilimbi (Figure 7.6). To the northwest, 65 dB_{max} is exceeded across an approximately 4 km wide band of the Nyabarongo River valley. The maximum noise levels for 2020 and 2045 are identical as the same types of aircraft are involved. Whilst the dB_{max} noise footprint will not change between 2020 and 2045, the large increase in number of aircraft will increase the hourly and daily average levels within the wetlands. In total, an area of approximately 2,338 ha of swamp will be affected by noise levels exceeding 65 dB_{max} levels, including 556 ha of Typha-dominated swamp and 1,782 ha of Papyrus-dominated swamp (Figure 7.6).

[27] Proppe, D. S., Sturdy, C. B., & St Clair, C. C. (2013). Anthropogenic noise decreases urban songbird diversity and may contribute to homogenization. Global Change Biology, 19(4), 1075–1084.
[28] Francis, C. D., Ortega, C. P., & Cruz, A. (2009). Noise pollution changes avian communities and species interactions. Current Biology, 19(16), 1415–9.
[29] McClure, C., Ware, H., Carlisle, J. D., Kaltenecker, G., & Barber, J. R. (2013). An experimental investigation into the effects of traffic noise on distributions of birds: avoiding the phantom road. Proceedings of the Royal Society B: Biological Sciences, 280, 20132290
[30] Drewitt, A., 1999. Disturbance effects of aircraft on birds. Birds Network: Information note. Natural England, Peterborough

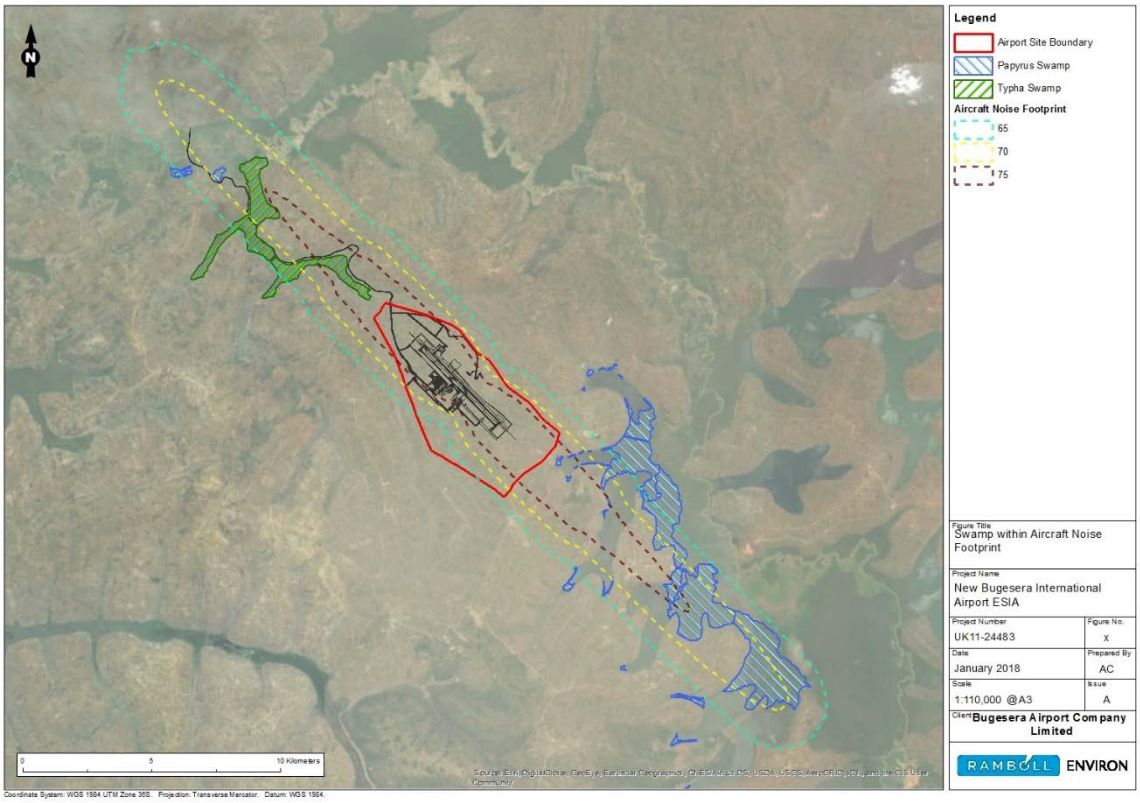

Figure 7.6: Noise Contour Isobels

The Expressway will create noise disturbance to the Nyabarongo Wetlands IBA along the much of its route. Traffic on the Expressway is projected to increase from 4,661 vehicles per day in 2020 to 22,563 vehicles per day in 2045. Chapter 10: Noise and Vibration of the ESIA calculated the predicted distances from the road that will receive average noise levels exceeding 45 dB LAeq (night) and 55 dB LAeq (daytime). In 2020, these limits will be limited to 30 m and 40 m respectively and, in 2045, these will extend to 55 m and 75 m respectively.

These figures suggest a relatively limited area of impact from noise disturbance. However, research by Summers *et al.* (2011)[31] suggests that traffic noise is not the main cause of the negative relationship between bird species richness abundance and proximity to roads. Instead, traffic mortality may be the main mechanism causing this relationship. Whatever the mechanism at play, Summers *et al.* (2011) recorded negative impacts on species richness of up to 350 m from the roads studied. In a meta-analysis, Benítez-López *et al.* (2010)[32] recorded impacts to species abundance of birds up to 1 km from infrastructure such as roads. An impact zone of 1 km would affect the majority of the tributary valley wetland alongside the Expressway, as well as part of the main Nyabarongo River valley. The majority of the area affected by disturbance from the Expressway also occurs within the 65 dB_{max} isobel noise footprint of the airfield and therefore may be subject to a combined noise impact from the two.

7.1.5 Summary

The predicted impacts described in the sub-sections above are summarised in Table 7.1, along with the estimated area of wetlands affected.

[31] Summers, P.D., Cunnington, G. M, and Fahrig L. (2011) Are the negative effects of roads on breeding birds caused by traffic noise? Journal of Applied Ecology 2011, 48, 1527–1534

[32] Benítez-López, A., Alkemade, R., and Verweij, P.A. (2010) The impacts of roads and other infrastructure on mammal and bird populations: A meta-analysis. Biological Conservation 143 (2010) 1307–1316

Table 7.1: Summary of Predicted Impacts and Area of Wetlands Affected	
Impact	**Area Affected (Hectares)**
Habitat Loss	
Airport Area	0
Expressway	2.2
Water Pipeline	0
Removal of Farmland	
Airport Area	500
Expressway	46
Water Pipeline	0
Noise	2,338
Total	**2,886.2**

7.2 Ningu

The Proposed Project will not cause any direct habitat losses of lakes or other waterbodies. However, the ESIA for the Proposed Project identified a number of potential indirect impacts during the construction and operation phases. The biological significance of such indirect impacts is very challenging to predict and measure. The refinement of the quantification of impacts will be an ongoing and iterative process, completed during the implementation of this BAP.

7.3 Hippopotamus

The construction of the Proposed Project will not cause any direct losses of habitats utilised by Hippopotamus and no direct adverse impacts are likely. The majority of construction activity within the Airport Area are is far enough away from these wetlands to make disturbance to Hippopotamus during construction unlikely. The construction of the water abstraction pipeline is unlikely to significantly affect Lake Kidogo through disturbance. However, the abstraction of water from Lake Kidogo could reduce water levels in this lake, if it is not replenished by natural recharge, thereby potentially reducing its suitability for Hippopotamus to some extent. Water levels within Lake Kidogo are being monitored throughout the construction period to avoid impacts to Hippopotamus and the papyrus wetlands. The construction of the Expressway is unlikely to cause any impacts as Hippopotamus are not present in the adjacent wetland.

The operation of the airport and Expressway is unlikely to cause any additional direct impacts to Hippopotamus due to habitat loss or fragmentation effects. The operation of the airfield has the potential to cause disturbance to Hippopotamus. The tolerance to noise of Hippopotamus is not well understood and no noise disturbance thresholds are available for this species. However, Chapter 10: Noise and Vibration of the ESIA provides noise contour plots that show that for both the 2020 and 2045 scenarios, 65 dB_{max} is exceeded to the south east over the whole of Lake Kidogo, Lake Rumira, Lake Miravi and half of Lake Kilimbi (Figure 7.6). These areas are known to support Hippopotamus and aircraft noise could potentially impact the species. Additional disturbance could also occur from population influx and the displacement of farmland from the project area. The biological significance of such indirect impacts is very challenging to predict and measure. The refinement of the quantification of impacts, including from population influx will be an ongoing and iterative process, completed during the implementation of this BAP.

8. ADDITIONAL CONSERVATION OUTCOMES

8.1 Introduction

This section sets out a framework for additional conservation outcomes for the Project, confirms the principles that will be applied and explains the conceptual basis for how they will be developed and implemented.

Paragraph 10 of PS6 defines biodiversity offsets as "*measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate avoidance, minimization and restoration measures have been taken*".

The guidance note also prescribes that the offset must be designed to deliver long-term "on-the-ground" conservation outcomes. Paragraph GN30 of Guidance Note 6 explicitly states that the term "on-the-ground" is intended to emphasize the importance of demonstrating measurable conservation outcomes that can be realized in the natural environment and on an appropriate geographic scale with respect to the particular biodiversity value in question.

IFC's Guidance Note 6 advises that when developing an offset for residual impacts in critical habitat, clients are advised to adhere to current, internationally recognised best practices such as the Business and Biodiversity Offsets Program (BBOP)[33]. BBOP (2013)[34] defines biodiversity offsets in a very similar way as IFC PS6: "*measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken*".

Thus, the Performance Standards and BBOP guidelines both make it clear that the process should be measurable so that equivalent biodiversity gains can be demonstrated to compensate for losses and achieve no net loss.

8.2 Legal Framework

There has been a rapid rise in the number of countries that have developed offset policies, with at least 17 countries that have legislation specifically requiring offsets[35]. However, no such legislation exists in Rwanda. Therefore, additional conservation programmes as developed by the Proposed Project will need to be implemented on an independent basis without the support of a specific regulatory framework.

8.3 Principles

BBOP (2013) currently provides the most comprehensive set of guidance on the development and implementation of biodiversity offsets, although other useful industry focussed guidance is available (e.g. ICMM 2012[36]). BBOP proposes a set of ten principles that a project should meet as set out below. The actions within this BAP have been developed to be in alignment with the BBOP principles, as follows:

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[33] GN109. Any offset attempted in critical habitat should be identified, designed and managed according to best international practice and be sustainable over the long term. If biodiversity offsets are part of the client's mitigation strategy, the client must demonstrate that the offset has the potential to compensate for significant residual impacts on the critical habitat. In order to do so, biodiversity offset gains should be quantified or semi-quantified using scientifically-sound metrics that accurately represent the biodiversity values at stake. When developing an offset for residual impacts in critical habitat, clients are advised to adhere to current, internationally recognized best practices. For example, the members of the Business and Biodiversity Offsets Program (BBOP) are the first to have developed a set of internationally-recognized Principles on Biodiversity Offsets. GN39 The guidance on biodiversity offsets provided in paragraphs GN29–GN33 also applies to critical habitat.

[34] Business and Biodiversity Offsets Programme (BBOP) (2013) To No Net Loss and Beyond: An Overview of the Business and Biodiversity Offsets Programme (BBOP), Washington, D.C.

[35] http://www.thebiodiversityconsultancy.com/wp-content/uploads/2012/07/Government-policies-on-biodiversity-offsets.pdf

[36] ICMM IUCN (2012) Independent report on biodiversity offsets. Prepared by The Biodiversity Consultancy. Available at: www.icmm.com/biodiversity-offsets

- *"Adherence to the mitigation hierarchy: A biodiversity offset is a commitment to compensate for significant residual adverse impacts on biodiversity identified after appropriate avoidance, minimization and on-site rehabilitation measures have been taken according to the mitigation hierarchy.*
- *Limits to what can be offset: There are situations where residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected.*
- *Landscape context: A biodiversity offset should be designed and implemented in a landscape context to achieve the expected measurable conservation outcomes taking into account available information on the full range of biological, social and cultural values of biodiversity and supporting an ecosystem approach.*
- *No net loss: A biodiversity offset should be designed and implemented to achieve in situ, measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity.*
- *Additional conservation outcomes: A biodiversity offset should achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place. Offset design and implementation should avoid displacing activities harmful to biodiversity to other locations.*
- *Stakeholder participation: In areas affected by the project and by the biodiversity offset, the effective participation of stakeholders should be ensured in decision-making about biodiversity offsets, including their evaluation, selection, design, and implementation and monitoring.*
- *Equity: A biodiversity offset should be designed and implemented in an equitable manner, which means the sharing among stakeholders of the rights and responsibilities, risks and rewards associated with a project and offset in a fair and balanced way, respecting legal and customary arrangements. Special consideration should be given to respecting both internationally and nationally recognized rights of indigenous peoples and local communities.*
- *Long-term outcomes: The design and implementation of a biodiversity offset should be based on an adaptive management approach, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the project's impacts and preferably in perpetuity.*
- *Transparency: The design and implementation of a biodiversity offset, and communication of its results to the public, should be undertaken in a transparent and timely manner.*
- *Science and traditional knowledge: The design and implementation of a biodiversity offset should be a documented process informed by sound science, including an appropriate consideration of traditional knowledge*."

8.4 Types of Biodiversity Offsets

There are two main types of offsets: those that are based on habitat restoration or creation activities (restoration offsets); and offsets that aim to reduce or reverse negative trends or losses (often referred to as averted loss offsets). These are illustrated in Figures 8.1 and 8.2.

Examples of restoration offsets might include actions such as restoring forests on land previously converted to agricultural production. Examples of averted loss offsets might include the buying up of fishing rights to reduce pressure on fish populations, or increasing levels of legal protection. Both restoration and averted loss offsets are acceptable according to IFC PS6 and BBOP.

Consideration has been given to whether restoration offsets or averted loss offsets are the most appropriate approach for addressing the residual impacts of the Proposed Project. It is understood that in Rwanda, the wetlands are essentially state-owned and therefore unlikely to be available for land purchase. Based on the recent survey findings, it appears that papyrus

wetlands within the Nyabarongo Wetlands IBA are undergoing degradation and wholesale conversion to sugar cane and rice paddies at an extremely high rate (30% over ten years 2007-2017). With a high background rate of loss, conservation actions taken to reduce or prevent future losses can be counted as an averted loss offset. In light of the high level of pressure on land resources, it is likely to be more realistic to avert potential future losses than trying to reverse losses already sustained. To reverse such losses would likely require displacement of local communities' economic activity and increase pressure on land resources elsewhere.

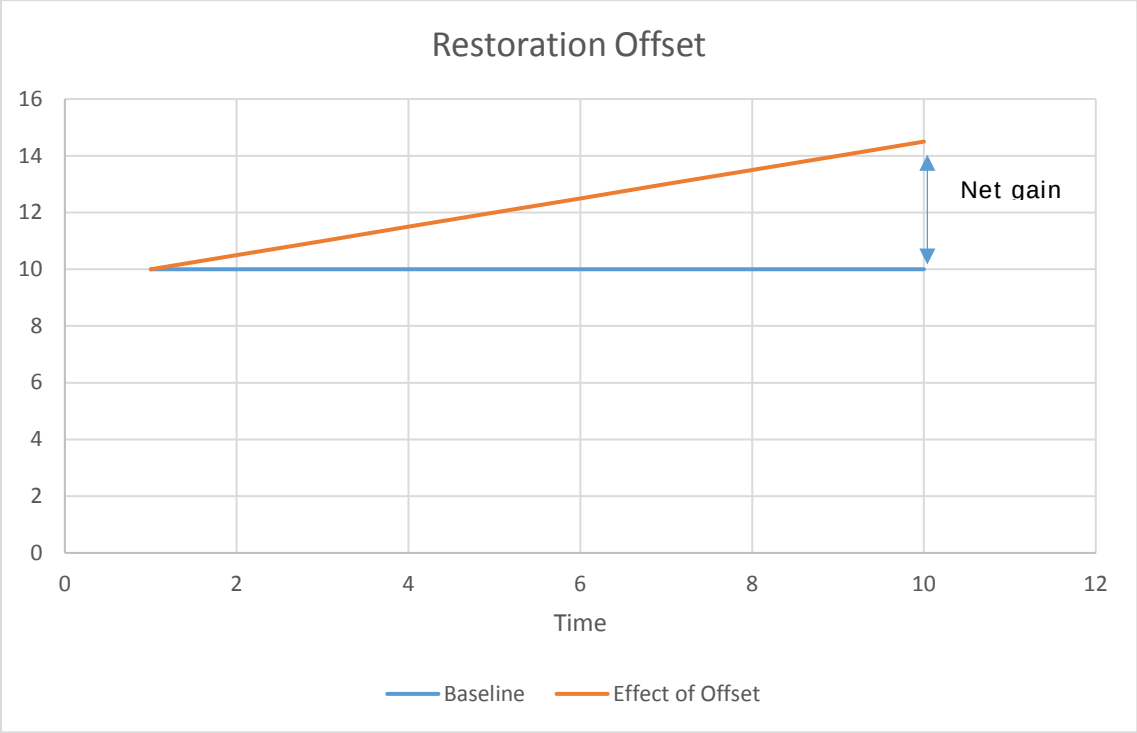


Figure 8.1: Hypothetical Restoration Offset

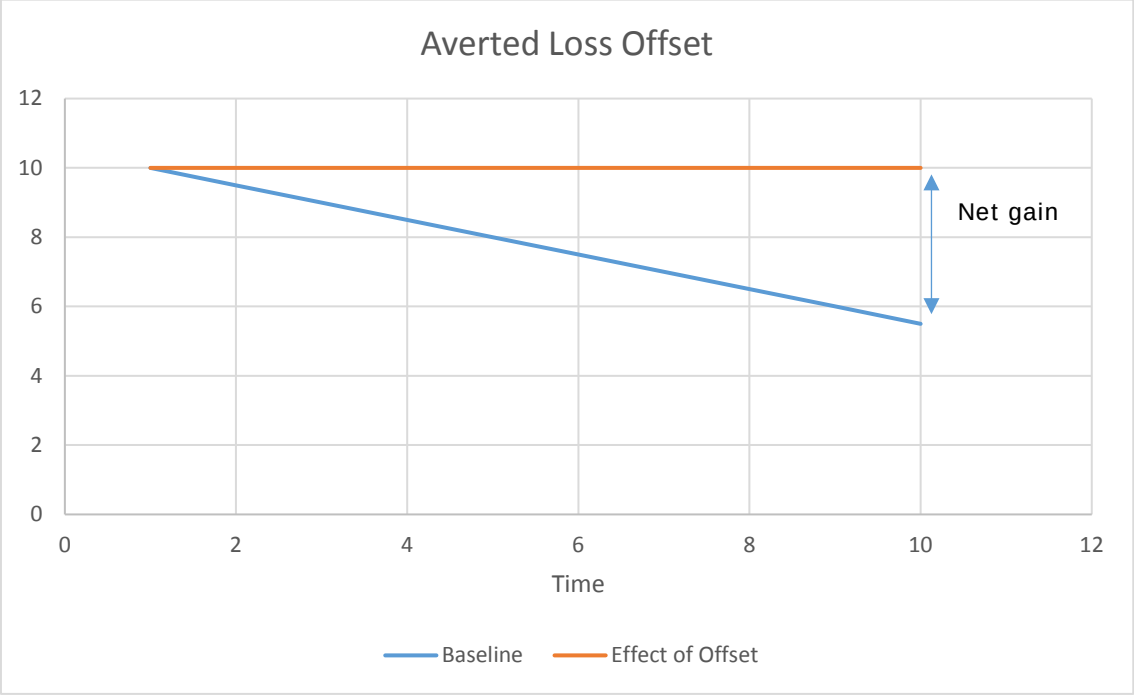


Figure 8.2: Hypothetical Averted Loss Offset

8.5 Conservation Programme Design

8.5.1 Quantification of Losses

To be able to measure no net loss / net gain, as well as to meet the principle of transparency, it is important to quantify losses using the same metric as that used to quantify gains. Whilst in their broadest sense, conservation programmes should aim to address residual losses for all affected biodiversity, there is no single metric that objectively captures the full extent of biodiversity, which itself has no universal, unambiguous definition (Bull *et al.,* 2013)[37]. The use of single metrics such as 'area of habitat' to represent biodiversity losses and gains has been widely discredited (Bull *et al.,* 2013, TEEB, 2010[38]). Most existing schemes aim to partially overcome this by using a compound metric or 'currency' that combine a measure of "extent" with "condition". This BAP follows the approach used by TBC FFI (2012)[39] whereby a simplified approach of combining habitat quantity and condition by using a metric of Quality Hectares (QH). QH was calculated by multiplying the area of habitat loss by a habitat quality multiplier, based on an estimate of how pristine the habitat impacted is. A similar approach has been taken by this BAP for terrestrial habitats affected by the Project to calculate the compensation requirements.

Once the basic currency has been decided, adjustments are required to ensure a fair exchange or equivalency is achieved (IUCN ICMM, 2013). The main factors that are discussed in relation to achieving a fair exchange are how to achieve equivalency in space, equivalency in time, and how to address uncertainty and delivery risk. It has been suggested that equivalency in space can be addressed through selecting the site as close as possible to the impacted site. There are several reasons underpinning this principle, including that closer sites are more likely to be similar in ecosystem composition and perform similar functional roles (IUCN ICMM, 2013). It may also be desirable in terms of maintaining the viability of populations and the pre-existing geographic range. It also considers that the local human communities affected by the Project benefit from the conservation interventions. This BAP has selected a spatial scope for its activities that is based on the Proposed Project AOI and so equivalency in space will be achieved.

Equivalency in time relates to time lags between the initial loss and the delivery of the outcome. This is based on the concern that some conservation interventions can take a long time to mature. For example, one hectare of mature forest at a distant point in the future is not equal to the immediate loss of one hectare at the current time. However, this concern mainly relates to restoration offsets that involve habitats that take many decades to restore. With averted loss, the reduction of losses can start with minimal time lags involved.

To address uncertainty in delivery, Defra (2011)[40] examined available evidence on the likelihood of success or failure of recreation for a number of different habitats, and developed a range of suggested multipliers for different categories of delivery risk (Table 8.1). Uncertainty is generally higher with respect to restoration offsets than averted loss offsets and therefore a maximum multiplier of x3 to adjust for uncertainty of seems sufficiently precautionary for use in this BAP.

Table 8.1: Delivery Risk Multipliers, DEFRA 2011

Delivery Risk (uncertainty)	Multiplier
Very High	x10
High	X3

[37] Bull, J., K. Suttle, A. Gordon, N. Singh, and E. J. Milner-Gulland (2013) Biodiversity offsets in theory and practice. Oryx:DOI:10.1017/S003060531200172X

[38] TEEB (THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY) (2010) TEEB for local and regional policymakers report. Http:// www.teebweb.org

[39] TBC and FFI (2012) Oyu Tolgoi Net Positive Impact Forecast. Unpublished draft report of The Biodiversity Consultancy Ltd and Fauna & Flora International, May 2012

[40] Defra (2011) Biodiversity offsetting Technical paper: proposed metric for the biodiversity offsetting pilot in England

Table 8.1: Delivery Risk Multipliers, DEFRA 2011	
Delivery Risk (uncertainty)	**Multiplier**
Medium	X1.5
Low	X1

Table 8.2 sets out the calculation of compensation requirements for the Proposed Project. This includes both direct losses from habitat loss, and indirect impacts from the removal of farmland, as well as noise and disturbance. The estimation of habitat quality differentiates the bulk of papyrus-dominated swamps that support high densities of IBA assemblage bird species, but were not pristine, and the areas of typha-dominated swamps that supported lower densities and richness of IBA assemblage bird species. The area of typha-dominated swamps is also significantly more impacted by agricultural activities. The net change in habitat quality is assumed to be 100% for where habitats area lost entirely. A reduction in habitat quality of 10% has been estimated in relation to noise and disturbance from aircraft and the Expressway. Based on these assumptions, the Proposed Project has a requirement to deliver 1840 QH to achieve no net loss of swamp and aquatic habitat.

Table 8.2: Calculation of Losses (Quality Hectares)					
Habitat Loss	**Area affected**	**Estimated Quality**	**Net Change in Habitat Quality**	**Loss (QH)**	**Uncertainty multiplier (x3)**
Direct loss from Expressway road footprint	2.2	0.5	1	1.1	3.3
Removal of Farmland					
Indirect losses from displacement of farmland from Airfield Area	500	0.9	1	450	1,350
Indirect losses from displacement of farmland from Expressway	46	0.5	1	23	69
Noise and Disturbance					
Papyrus-dominated swamps	556	0.9	0.1	50.04	150.12
Typha dominated swamps	1782	0.5	0.1	89.1	267.3
Total QH					**1,839.72**

Based on current rates of loss within IBA (Section 6.1), a relatively small reduction in rate of loss across the IBA would deliver a net gain in swamp compared to the projected declining baseline (Figure 8.3). The net gain would peak in 2,033 with a total 3,123 QH of papyrus remaining compared to what would exist without any intervention. However, after this date the rate of loss remains so high as to lead to complete loss of papyrus habitat by 2043. This is before the Proposed Project has completed Phase 5. This demonstrates that by solely reducing the current rate of decline will not provide a net gain for the entire lifetime of the project. On the other hand, it is unfeasible to expect that any conservation intervention could totally overturn external factors currently causing losses to deliver a net gain compared to an assumed stable baseline (i.e. maintaining or increasing area of habitat compared to the area extant in 2017. Even if this was feasible, the likely cost would be unreasonable to bear by a single project proponent.

As an alternative strategy, it is proposed that more intensive conservation interventions are employed within a smaller target area, with the aim to reduce the current rate of loss by 95% over ten years. Based on these assumptions, the area of wetland subject to conservation

interventions would need to be approximately 2,650 ha in extent (equating to approximately 25% of the Papyrus in the IBA extant in 2017). Based on the mapping of papyrus present in 2017, a sufficient area remains within the following seven cells: Biryogo, Kabuye, Kimaranzara, Nyabagendwa, Mwendo, Batima, and Nkanga, all of which are located within Bugesera District (Table 8.3).

Table 8.3: Area of Papyrus Swamp in 2017 in Seven Cells in Bugesera District

Cell	Area of Papyrus Swamp (ha) - 2017
Biryogo	525
Kabuye	646
Kimaranzara	273
Nyabagendwa	37
Batima	468
Mwendo	52
Nkanga	2,163
Total	**4,164**

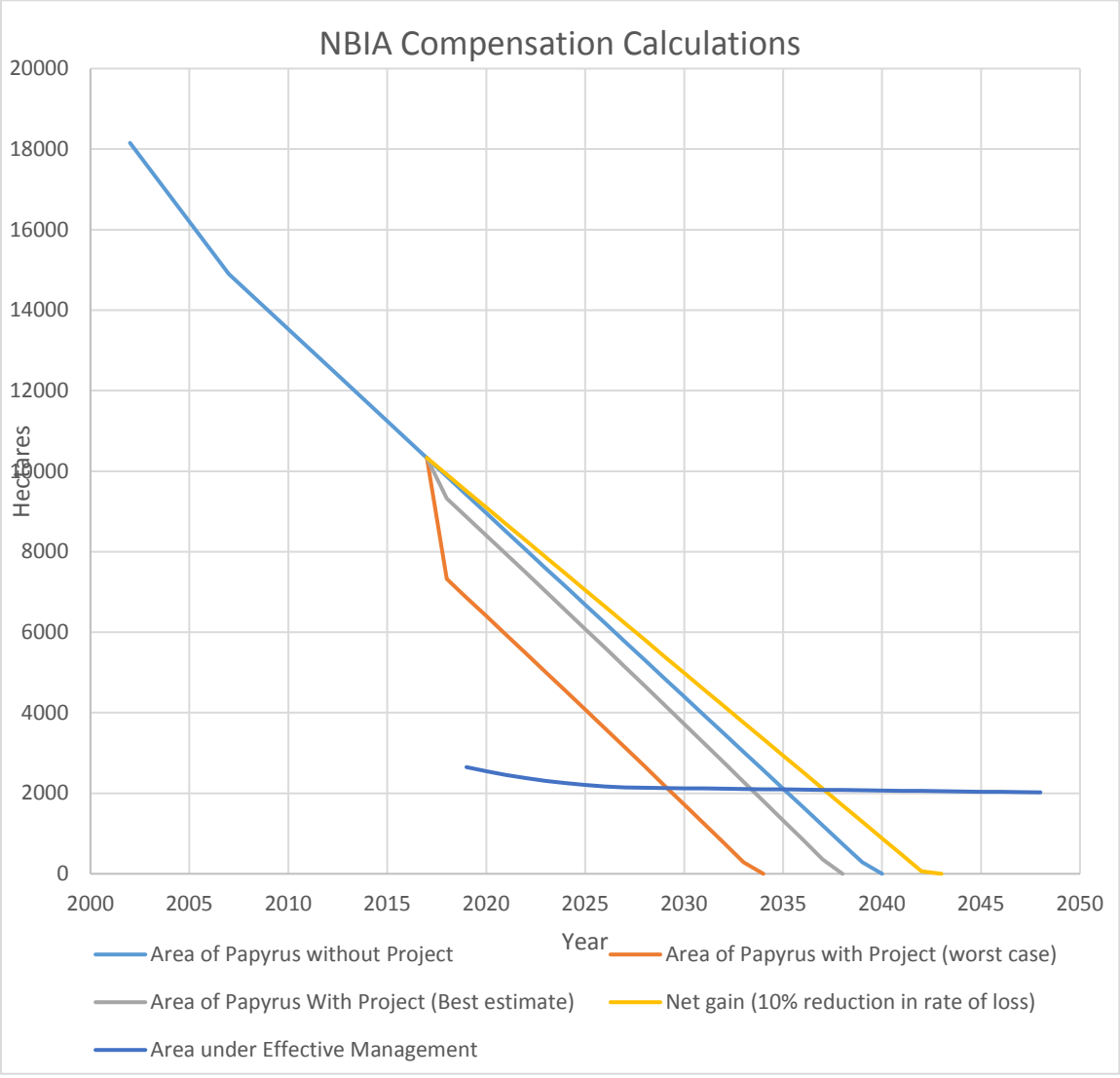


Figure 8.3: Compensation Calculations Showing the Effect of Different Approaches Compared to the Counter-Factual

9. NYABARONGO WETLANDS IBA ACTION PLAN

9.1 Action Plan Objectives

The objectives of this action plan are to:

1. Promote and enhance the Nyabarongo Wetlands IBA to achieve a net gain in relation to the IBA and critical habitat features.
2. Facilitate meaningful long-term partnerships between relevant stakeholders, to promote and enhance conservation of the Nyabarongo Wetlands IBA and critical habitat features.
3. Provide a robust, long-term monitoring and evaluation programme that will inform adaptive management of this biodiversity component and enhance knowledge underpinning relevant conservation programmes.

The bird assemblage supported by the Nyabarongo Wetlands IBA and biome-restricted species largely depend on the papyrus swamp and aquatic natural habitat. Therefore, this action plan is based on an ecosystem approach that focusses on the natural swamp and aquatic habitats that support these wetland species. Therefore, this action plan will by default deliver at least no net loss of natural habitats. This ecosystem approach will also cover Hippopotamus that occur in the same papyrus swamp and aquatic natural habitat.

The main conservation mechanism employed by the action plan will be the development and support for a community-based natural resource management programme (CNRMP). The CNRMP will be underpinned and informed by a detailed socio-economic survey on the uses and attitudes of local communities in relation to the wetlands. The detailed actions are described in the following sub-sections.

At the current time, there is still uncertainty over whether Ningu is still present within the Proposed Project AOI. Therefore, a field study will be completed to determine whether this species is present. If Ningu is confirmed to still occur within the AOI, net gains for this critical habitat feature would be delivered through the CNRMP.

9.2 Action 1A: Complete Detailed Socio-Economic Study

ACNR completed a limited socio-economic survey in 2003. Along with observations and data collected during the completion of the Project ESIA, this provides an insight on the use and attitudes of local communities towards the wetlands areas. However, much more detail is required to inform the CNRMP that will also require high levels of community engagement to develop and implement. Therefore, the following scope of works has been designed to provide the socio-economic information required to inform the following subsequent of the Action Plan.

9.2.1 Socio-Economic Study Objectives

The objectives of the socio-economic study are twofold:

Spatial dimension:

- Identify and map wetland resources currently being used and methods of exploitation;
- Identify locations of key user groups and map spatial patterns of use;
- Identify and map villages with the highest levels of dependence on wetland resources (e.g. contribution to livelihood status and proportion of income);
- Identify and map key trends in availability of wetland resources and access to these resources;
- Identify underlying causes of key trends, particularly loss and ease of access; and

- Identify and map local community cooperatives/groups with potential to be developed into Site Supports Groups (SSGs)/Local Conservation Groups (LCGs) – see Action 2 below.

Community-level factors, activities, attitudes, and perceptions:

- Record local community attitudes towards the wetlands, as well as the individual biodiversity features of interest, such as birds and animals (including Hippopotamus and Ningu) and how these attitudes differ between user groups;
- Quantify the value of resources currently being used;
- Quantify potential costs incurred by the community due to the presence of wetlands (e.g. disease, crop damage, etc.);
- Identify possible conflicts between communities' economic needs and conservation objectives, as well as potential barriers to implementation of a community-based conservation programme (e.g. people-Hippopotamus conflict); and
- Identify possible alternative income sources or alternative resources to those currently derived from wetlands.

The spatial scope of the socio-economic study will be the following seven cells, all located within the Bugesera District: Biryogo, Kabuye, Kimaranzara, Nyabagendwa, Mwendo, Batima, Nkanga (Figure 9.1).

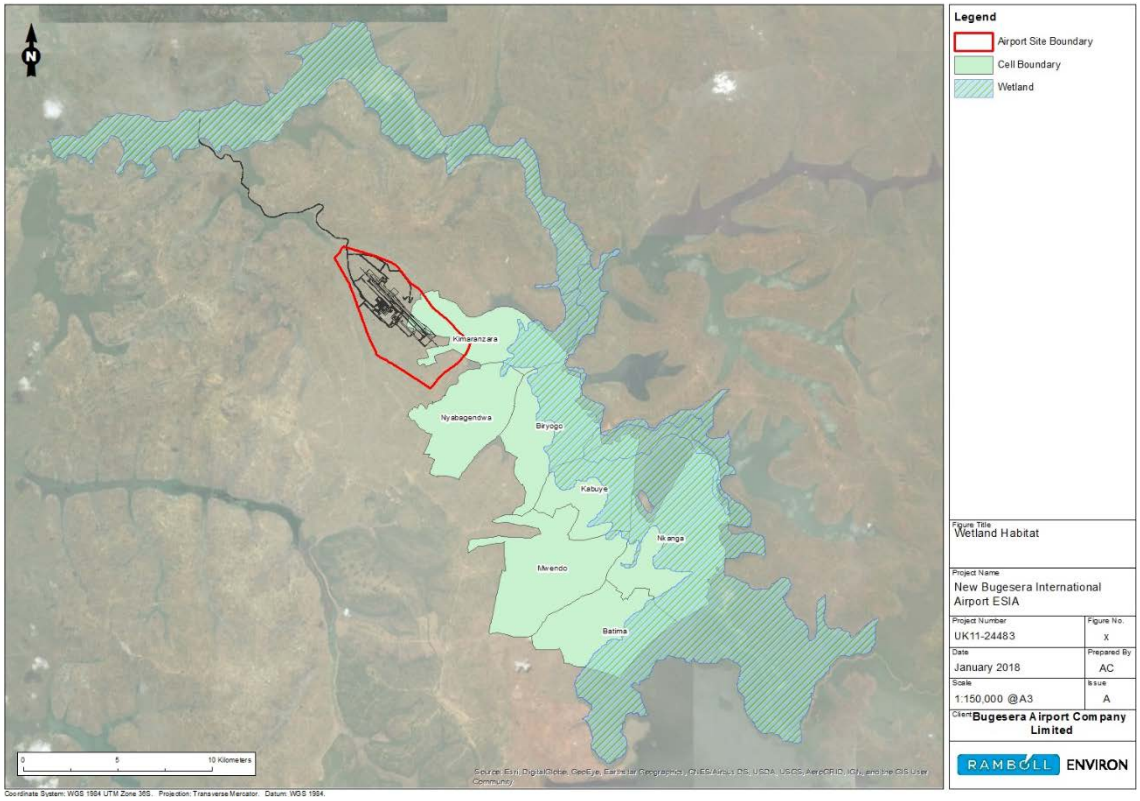


Figure 9.1: Community-based Natural Resource Management Programme (CNRMP) Target Area

9.2.2 Proposed Methodology

Spatial dimension

The first step is to obtain data/information to assist in the understanding of the spatial dimension in the CNRMP Target Area (Figure 9.1). This will be achieved by using Key Informant Interviews (KIIs) with selected cell personnel. In each Cell a meeting (in the form of a semi-structured interview) will be organised with the Cell Executive Secretary, supported by a Cell official with

responsibility for/knowledge of the local rural economy and key livelihood activities. A 'Discussion Guide' will be prepared. This 'Guide' will be subdivided into specific topics and under each topic there will be some questions rating to a topic. The format allows for 'open' answers; thus, allowing the interviewer to follow-up on answers that rise issues of interest in terms of building a picture of community use of the wetlands. Space will be provided to record answers. Use of the 'Discussion Guide' will enable consistency and continuity between all the interviews.

It is possible that cell personnel may suggest that the leader of a village is best placed to provide the needed data/information. In this case, a KII will be arranged with the village leader and the same procedure will be followed using the 'Discussion Guide'

Once the KIIs have been completed and the results analysed, the spatial dimensions of wetland use will be relatively well understood. This understanding will help to determine the scope of work to understand community-level factors, activities, attitudes, and perceptions

Community-Level Factors, Activities, Attitudes and Perceptions

A series of focus group meetings will be organized. The location and number will be determined by the results obtained from the cell/village-level KIIs. These focus groups may represent a village or a user group. These groups will be moderated and again, a 'Guide' will be prepared to be used to ensure that all key topics are discussed, and constancy/continuity applies. The scope of the discussions will be to:

- Validate information received from the KIIs;
- Close any data/information gaps and remove or reduce uncertainties (arising from the KIIs), to the extent feasible; and
- Elicit information on community practices in terms of wetland use; attitudes and perceptions relation to wetland and their exploitation.

A template to record the discussion will be prepared and completed thus providing a record of each focus group meeting.

During the lifetime of the Project, these groups can be reconvened, as necessary to discuss specific topics such as mechanisms to improve introduce and/or improve community-based management of wetlands or specific wetland resources. In addition, post-Project completion, these groups may provide an input into the monitoring and evaluation of the Project. Changing attitudes and perceptions may be seen when focus group meeting results are compared over time. This type of qualitative information can be a useful complement to quantitative monitoring obtained from tracking the status of a range of Key Performance Indicators (KPIs).

9.2.3 Dissemination of Results

The Project will ensure that the results of the socio-economic study will be written up and disclosed in an appropriate publicly accessible platform. This will maximise the potential for the study to inform future conservation actions that may be undertaken either by the Project or by other parties.

9.2.4 Schedule and Timing

The detailed study schedule is to be confirmed. It is envisaged that the study would be undertaken during Q4 2018/Q1 2019.

9.3 Action 1B: Complete Fish Study

Literature sources confirm that Ningu was historically present in the lakes located within the Project AOI. According to MINELA (2011), Ningu represented an important dietary and income source within the Bugesera District. However, no recent data or other information is provided to

substantiate that the species is still present. According to the MINAGRI master plan for fisheries and fish farming, native species populations have collapsed commercially and potentially biologically due to over-exploitation. Therefore, before finalising an action plan to achieve a net gain, it is important to first confirm the continued presence of Ningu in the Project AOI.

A draft scope of works has been developed for a targeted study to confirm the presence within the Project AOI. The study also aims to provide a baseline for this species on which to inform future conservation actions and long-term monitoring.

9.3.1 Fish Study Scope of Works - Study Area

The study area includes the lakes within the Bugesera District. Specifically, the study will include the following areas (Figure 9.2):

- Lake Gashanga
- Lake Kidogo
- Lake Rumira
- Lake Miravi (Milay)
- Lake Kilimbi
- Lake Gaharwa
- Adjacent areas of the Akagera River

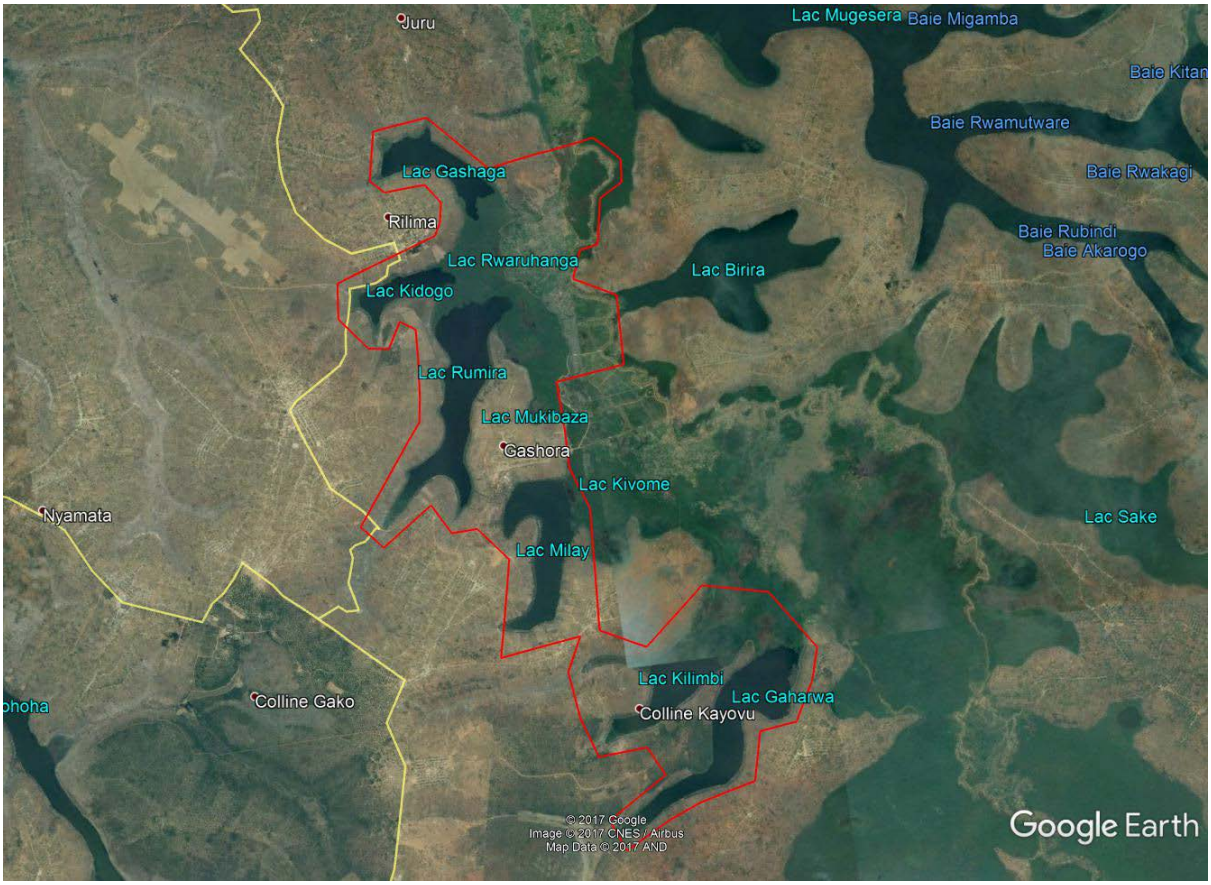


Figure 9.2: Proposed Fish Monitoring Area

9.3.2 Fish Study Objectives

The fish study would have the following objectives:

- To confirm presence or absence of Ningu in the study area;
- If present, estimate distribution Ningu in the study area;

- To assess the current number of fishermen operating within each lake within the study area and the existing level of fishing effort (e.g. length of netting, days per year, total catches);
- To assess the degree that local fishermen depend on Ningu as a proportion of their catch;
- Record the perceptions of fishermen in relation to Ningu and the value they accord to the species;
- To evaluate potential threats to Ningu, particularly from exotic fish species; and
- Assess the potential effects of increasing demand on fisheries.

9.3.3 Proposed Methodology

The proposed survey methodology is based on collecting information primarily from the local fishing communities. Studies elsewhere have demonstrated the extensive knowledge held by many fishermen of the resource base on which they are economically dependent. At the current time, no primary fish surveys using capture techniques are proposed. A standardised questionnaire will be created for use during interviews with local fishermen and fishing cooperatives with the aim of collecting the following information:

- quantify the number of fishermen and cooperatives operating;
- record the types and quantities of the fishing gear and boats operated by the fishermen/ cooperatives;
- quantify the current fishing effort (e.g. length of net, seasonality, number of days and hours employed);
- knowledge about the presence or absence of Ningu;
- record the quantities and market prices of the fish species landed, purchased, processed and/or traded by the different fishermen/cooperatives. Asses the degree that local fishermen depend on Ningu as a proportion of their catch as well as an estimate of the total annual catch size;
- record information on abundance and trends in abundance (e.g. are Ningu populations stable, declining or increasing;
- identify the extent and quantity of exotic species; and
- record the perceptions of fishermen in relation to Ningu and the value they accord to the species.

The survey will account for potential variation in the local naming of different species as well as the level of accuracy of identification by fishermen. Appropriate measures to reduce sources of inaccuracy would be employed. In addition to the interviews with fishermen and cooperatives, verification field surveys would be completed. At each lake, verification surveys would be made to meet with fishermen as they bring catches ashore to provide positive species identifications. Species identification would be confirmed, along with photographic records made for each species. In addition, the survey will record the fishermen's knowledge and attitudes to Hippopotamus.

9.3.4 Schedule and Timing

The fish study would be undertaken during the latter half of 2018 with the precise timing to be confirmed in relation to the optimal season for completion (e.g. dry/wet season).

9.3.5 Publication and Dissemination of Study Results

Irrespective of whether Ningu are confirmed present or not, the Project will ensure that the results of the study will be written up and submitted for publication in appropriate publicly accessible journal(s). This will maximise the potential for the study to inform future conservation actions that may be undertaken either by the Project or by other parties.

9.3.6 Refine Quantification of Impacts

This sub-action would only be developed further only if Ningu is confirmed to be present by the fish study. The biological significance of indirect impacts arising from population influx and induced access is very challenging to predict and measure. The refinement of the quantification of impacts will be an ongoing and iterative process, completed during the implementation of this BAP. The fish study will provide additional information on the current distribution of Ningu, as well as the existing pressure from exploitation from fisheries. This information will be used to refine the impact assessment completed as part of the Project ESIA, which was necessarily precautionary in nature. If necessary, impacts would be defined using metrics appropriate to quantify biodiversity offset requirements.

9.4 Action 2: Develop Community-Based Natural Resource Management Programme

The Project will develop a Community-|Based Natural Resource Management Programme (CNRMP), taking into account the principles of best practice and lessons learnt from many of other similar projects implemented over the last 20 years or more (e.g. Blom *et al*., 2010[41] and de Boef *et al.,* 2013[42]). Community-based approaches to conservation have an economic rationale, based on the premise that if local communities participate in wildlife management and crucially, if they economically benefit from this participation, then a "win-win" situation is created[43].

The benefits of community-based approaches have been recognised by a number of governments in Africa, who have made policy changes to devolve rights over the use of wildlife to local communities and enable the communities to retain the benefits from using the wildlife[44]. However, according to Emerton (1999), unless conservation activities meet livelihood needs and generate real income and subsistence products, it is unlikely that they will lead to an overall decrease in wildlife-damaging activities. The development and support for sustainable livelihoods derived from the wetland habitats will be a key focus for the CNRMP.

In addition, decoupled activities, whereby alternative sources of income or resources are provided, with the aim of reducing exploitation pressure on the wetlands will also be explored. Whilst decoupled interventions are not directly incurred from the wetlands, it is still important that the beneficiaries understand that the programme is a result of continued conservation of the wetlands (Blomley *et al.* 2010)[45]. According to MacClean *et al.* (2011), the overall value derived from low-intensity, multifunctional wetland use, far exceeds the value derived from swamp reclamation and generally exceeds that of conservation. Therefore, there is the opportunity for the CNRMP to provide interventions that capture the overall economic benefit for wetland conservation, by the relevant user groups to incentivise sustainable management.

Between 2013-2015, ACNR ran a community-conservation programme in the Akanyaru Wetlands IBA, based in Musenyi Sector, Bugesera District (ACNR, 2015)[46]. This project aimed at promoting conservation of the birds and biodiversity and sustaining the ecosystem benefits for the

[41] Blom, B., Sunderland, T. & Murdiyarso, D. (2010) Getting REDD to work locally: lessons learned from integrated conservation and development projects. Environmental Science & Policy 13: 164–172.
[42] de Boef, W.S., Subedi, A., Peroni, N., Thijssen, M. and O'Keeffe, E. (2013) Community Biodiversity Management. ISBN13: 978–0–415–50219–1
[43] Emerton, L. (1999) Community Conservation Research in Africa: Principles and Comparative Practice: Paper 9: The Nature of Benefits and the Benefits of Nature: Why Wildlife Conservation Has Not Economically Benefitted Communities in Africa. ISBN: 1 900728931. Available for download at https://www.cbd.int/financial/values/g-benefitsafricamunity-iucn.pdf
[44] Maclean, I.M., Boar, R.R., Lugo, C. (2011) A review of the relative merits of conserving, using, or draining papyrus swamps. Environ Manage. 2011 Feb;47(2):218-29. doi: 10.1007/s00267-010-9592-1.
[45] Blomley, T., Namara, A., Mcneilage, A., Franks, P., Rainer, H., Donaldson, A., Malpas, R., Olupot, W., Baker, J., Sandbrook, C., Bitariho, R. & Infield, M. (2010) Development AND gorillas? Assessing fifteen years of integrated conservation and development in south-western Uganda. IIED, London, UK.
[46] ACNR (2015) Empowering local communities for the conservation and sustainable development of the biodiversity of the Lake Victoria Basin, the Greatest of Africa's Great Lakes: Final Project Report.

community within the IBA. The project also aimed to improve the capacity of local communities for nature resources management and biodiversity conservation for sustainable development. The Akanyaru Wetlands IBA supports very similar habitats and species to the Nyabarongo Wetlands IBA and are subject to the same threats. ACNR's project provides a suitable model on which to base the CNRMP for the Nyabarongo Wetlands IBA. The ACNR project identified local community cooperatives which could be developed into Site Supports Groups (SSGs)/Local Conservation Groups (LCGs) and provide them with capacity building, training and sensitisation, with the aim of improving their management systems and reduce the pressure to wetland biodiversity. The three SSGs developed under the ACNR project delivered the following: 1. training and support to transform dried water hyacinth (and other plant fibres) into handicrafts to generate income; 2. support of a fishing cooperative for sustainable development of fish ponds and environmental conservation; and 3. improved crop production and land consolidation amongst rice growers. The ACNR project also held a community-planning workshop from which it developed a community climate adaptation plan (ACNR, undated)[47].

The CNRMP would aim to enhance the ability of communities to directly generate income or livelihood benefits from the wetlands. It would also seek to reduce community incurred costs associated with wetland conservation. In addition, it would identify potential alternative sources of income or sources of resource that could replace those currently derived from wetlands, especially for those community members with the highest level of dependence on the wetlands. The precise conservation intervention to be implemented would be identified in partnership with the local communities, local authorities, and other stakeholders. A similar approach to the ACNR project would be followed, whereby a series of community-planning workshops would be held with the aim of identifying the precise interventions to be implemented, as well as the most suitable local community cooperatives to be developed into Site Supports Groups (SSGs)/Local Conservation Groups (LCGs) for their delivery. The community-planning workshops would include local residents, as well as representative from the stakeholders listed in section 9.3.2. This would allow the CNRMP to be flexible enough to respond to community needs, as well as the results of project monitoring and changes in context that will occur over time. This flexible approach is likely to lead to a programme that is more resilient and less likely to fail (Blom *et al.* 2010) and meets IFC PS6 requirement for an adaptive management approach.

The precise form and nature of the support provided by the CNRMP would also be flexible and to be developed as the SSGs/LCGs are formed. However, it is likely to include:

- Supporting and mentoring decision-making processes;
- Enhancing community awareness of conservation and biodiversity;
- Addressing sources of dis-benefits incurred by local communities from wetlands (e.g. crop damage by Hippopotamus).
- Enhancing community awareness of environmental law (building on a similar programme included in the Bugesera District Local Plan);
- Reinforcing local institutions;
- Strengthening the capabilities of community organizations;
- Social learning and scaling-up for collective community action;
- Targeted training; and
- Community involvement in research and monitoring.

Wherever, possible the CNRMP would build on the existing legislative and policy framework, organisational capacities, and capabilities of the relevant stakeholders to avoid duplication of effort and maximise potential synergies.

[47] ACNR (undated) Community Adaptation Plan 2015-2020, for Akanyaru Wetland, Musenyi, Bugesera District, Rwanda

If Ningu is confirmed to be present by the fish study completed under Action 1A and if significant residual impacts are confirmed, additional conservation interventions would be integrated into the CNRMP with the objective of delivering a net gain for the species. Based on a review of the documented threats faced by Ningu and the limited existing conservation actions currently being employed, a number of appropriate conservation interventions would be available for inclusion within the CNRMP. These are discussed in more detail in Appendix 4.

9.4.1 CNRMP Targets and Spatial Scope

Based on the analysis of compensation requirements for the Proposed Project (Section 8), the CNRMP needs to achieve a 95% reduction in the background rate of loss of papyrus wetlands within the first 10 years of implementation. The CNRMP needs to focus on an area covering at least 2,500 hectares at the start of the programme (equivalent to approximately 25% of the remaining area of Papyrus swamp in the IBA). Based on these requirements, the spatial area of operation for the CNRMP will be the following seven cells, all located within the Bugesera District: Biryogo, Kabuye, Kimaranzara, Nyabagendwa, Mwendo, Batima, Nkanga (Figure 9.1).

9.4.2 Stakeholder Engagement

The CNRMP approach is based on high levels of participation from stakeholders. Therefore, a stakeholder engagement and participatory workshop programme would be developed to include relevant local experts, statutory agencies, and NGOs, as well as the relevant farming and fishing communities. The stakeholder engagement will likely to include the following*, inter alia*:

- REMA: Rwanda Environmental Management Authority;
- RSSP/MINAGRI: Rural Sector Support Project / Ministry of Agriculture;
- SACCO Umurenge (Saving and Credit Cooperative);
- RCA (Rwanda Cooperative Agency);
- Bugesera District and relevant sector authorities;
- Local Sector agronomist (employed by government and provides the technical support in terms of advice on how to plant trees, terracing and other possible activities as far as agriculture is concerned;
- National University of Rwanda: relevant experts;
- Local Cooperatives: farming and fishing cooperatives;
- Local Tourist businesses (e.g. La Palisse Hotel, Gashora);
- Local NGOs (e.g. ARCOS and Nature Rwanda);
- Rwanda national police / District; and
- National youth council and women council.

If Ningu is confirmed to be present by the fish study completed under Action 1A, the following additional stakeholders would likely be included:

- RARDA: Management and implementation of fisheries policies and aquaculture is a mandate of Rwanda Animal Resources Development Authority (RARDA) which is one of the agencies of the Ministry of Agriculture and Animal Resources (MINAGRI);
- National University of Rwanda: relevant fisheries experts. The University has an aquaculture research station at Rwasave, used for training and teaching aquaculture; and
- Inland Lakes Integrated Development and Management Support Project (PAIGELAC): Employs local Veterinary or Agricultural Officers who are in charge of livestock activities implementation of the Fishery and Aquaculture policy.

9.4.3 Implementation and Timing

At the current time it is envisaged that the Project engages ACNR as the main implementation partner. Due to ACNR's pre-existing experience of running a community-based conservation programme within Bugesera, they understand the process required for delivery and already have established many of the relationships with relevant stakeholders. The initial next steps in implementation are as follows:

4. Agree contract between BAC and ACNR (Q3 2018);
5. ACNR to identify and arrange any additional resources required, including recruitment (Q3 2018);
6. Review results of socio-economic study completed under Action 1 and complete detailed stakeholder mapping exercise (Q4 2018);
7. Refine and develop implementation strategy for CNRMP, including schedule of proposed community-planning workshops, sending invitations to relevant stakeholders (Q1 2019);
8. Complete first round of community-planning workshops (Q1 and 2 2019); and
9. Identify Site Supports Groups (SSGs)/Local Conservation Groups (LCGs) and other stakeholders to be included in CNRMP and identify conservation interventions required to provide relevant input, support and training (Q1/Q2 2019 onwards).

9.5 Action 3 Support for Protected Area Status and Legislation Enforcement

9.5.1 Support for Protected Area Status

The Prime Minister's Order N° 006/03 of 30/01/2017, *drawing up a List of Swamp Lands, their Characteristics and Boundaries and Determining Modalities of their Use, Development and Management* lists a number of wetlands in Bugesera District as proposed Ramsar Sites with management prescribed as Use under specific conditions. It is understood that the Ramsar designation process of assessing their status to support its designation under Ramsar convention began in November 2017 (ACNR *pers. Comm.*). The designation of protected areas and supporting legislation is the responsibility of Government. However, through the stakeholder engagement programme described under Action 2, the Project will make best endeavours to promote the protection of the IBA wetlands through the Ramsar designation process. This would include promotion of the inclusion of Hippopotamus as a qualifying feature for Ramsar designations. The species is assessed by the IUCN Red List as Vulnerable, and therefore it could qualify under Ramsar designation criterion 2[48]. This could add an extra layer of protection to this species and crucially for its habitats. There are also a number of Ramsar designation criteria that could be applied in the assessment of the lakes associated with the wetlands already proposed as Ramsar sites, including two that relate specifically to fish:

- Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities;
- Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity; and

[48] The Ramsar Sites Criteria, available for download at https://www.ramsar.org/sites/default/files/documents/library/ramsarsites_criteria_eng.pdf

- Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

If Ningu are confirmed to be present within the Project AOI, the Project would make best endeavours through stakeholder engagement to promote the protection of Ningu by the Government of Rwanda.

9.5.2 Support for Legislation Enforcement

MacClean *et al.* (2011) concluded that at a local level, the main driver of wetland misuse in Uganda appears to be a breakdown in collaborative management regimes. The existing legislative structure in Rwanda that maintains public ownership and confers some level of protection for wetlands, provides an opportunity to develop a CNRMP that works synergistically with legal protection to improve local management of wetlands. According to Blom *et al.* (2010), even with community engagement, threats and the need for enforcement will always exist, partly because not all community members will support the aims and objectives of the CNRMP. Maclean *et al.* (2014) cites an example from Uganda where local authority structures are used as a vehicle to train and equip District Environment Officers that assist in local enforcement of wetland protection. As part of the stakeholder engagement programme described under Action 2, discussions with local authorities would be completed to identify the existing enforcement structures and resources in place. The Project would seek ways to increase the capacity of these structures and resources to enhance local enforcement measures. Opportunities to combine improved enforcement through the CNRMP would be explored and implemented where possible.

9.6 Monitoring and Evaluation Programme

The monitoring and evaluation programme will be based on a combination of annual reporting and evaluation, with a cycle of more significant review completed every five years for the lifetime of the BAP. This is set out in detail in Section 10; however, in summary of the monitoring and evaluation programme will include the following elements:

- Annual reporting and evaluation of the CNRMP activities;
- Analysis of satellite imagery of the IBA mapping the change in extent of papyrus completed every five years;
- Bird distribution surveys completed in conjunction with the satellite image analysis to detect changes in distribution of IBA trigger species compared to the baseline recorded during the ESIA surveys as well as changes in habitat quality; and
- Socio-economic assessment completed every five years to detect changes in use and attitudes of local communities with respect to wetlands compared to the baseline collected as part of Action 1 of this Action Plan.

The results of the five-yearly monitoring of habitat, bird populations and socio-economics will be used to inform a review of the CNRMP every five years to ensure that it adapts to changing circumstances, rectifies any short-comings and delivers its objectives.

Long-term monitoring and evaluation in relation to Ningu would only be developed further only if Ningu is confirmed to be present by the fish study completed under Action 1A of this Action Plan. However, if a conservation programme is developed, the monitoring and evaluation programme will be based on the same combination of annual reporting and evaluation and more significant review completed every five years as that described above. This is set out in detail in Section 10.

10. MONITORING AND EVALUATION PROGRAMME

The monitoring and evaluation programme will be based on a combination of annual reporting and evaluation, with a cycle of more significant review completed every five years for the lifetime of the BAP as set out in Tables 10.1 and 11.1.

Table 10.1: Monitoring and Evaluation Programme

Monitoring Action ID	Subject	Method	KPI	Responsible Party	Implemented By	Date	Periodicity	Location
M1	CNRMP annual reporting and evaluation	Annual Reporting of activities	Targets in CNRMP implementation strategy achieved (e.g. number of SSGs established) - see Action ref IBA 2.1.4	Developer	ANCR (TBC)	Q4 2019 and then annual	Once per year	Seven cells: Biryogo, Kabuye, Kimaranzara, Nyabagendwa, Mwendo, Batima, Nkanga.
M2	Analysis of satellite imagery of the IBA, mapping the change in extent of papyrus	Multi-spectrum satellite image analysis	Reduction in loss of papyrus of 95% over ten years compared to background rates within CNRMP area	Developer	Suitably qualified GIS technician (TBC)	Q4 2023	Once every five years	Whole IBA
M3	Bird distribution surveys completed in conjunction with the satellite image analysis to detect changes in distribution of IBA trigger species compared to the baseline recorded during the ESIA surveys as well as changes in habitat quality	Standardised point counts completed every 500 metres along wetland edges using playback surveys	No significant change in bird distributions within CNRMP area	Developer	Suitably qualified Ornithologist (R. Mulwa/ ANCR - TBC)	Q4 2023	Once every five years	ESIA survey study area (see section 5.1 of BAP)

Table 10.1: Monitoring and Evaluation Programme

Monitoring Action ID	Subject	Method	KPI	Responsible Party	Implemented By	Date	Periodicity	Location
M4	Targeted socio-economic assessment completed every five years to detect changes in use and attitudes of local communities compared to the baseline (see Action ref IBA 1)	Method to be based on study completed under Action ref IBA1	Significant changes in attitudes detected and linked to changes in behaviour contributing to reduction in papyrus losses	Developer	Social Expert (TBC)	Q4 2023	Once every five years	Seven cells: Biryogo, Kabuye, Kimaranzara, Nyabagendwa, Mwendo, Batima, Nkanga.
(The following monitoring action is only required if Ningu confirmed present)								
M5	Complete targeted fish study every five years to detect changes in presence, abundance and exploitation of Ningu compared to the baseline (see Action 1B)	Method to be based on study completed under Action 1B	Net gain in Ningu abundance	Developer	Fish Expert (TBC)	Q4 2023	Once every five years	Seven cells: Biryogo, Kabuye, Kimaranzara, Nyabagendwa, Mwendo, Batima, Nkanga.

11. BIODIVERSITY ACTION REGISTER

This tabular section (Table 11.1) incorporates all of the actions and sub-actions from Section 9, allocating specific task responsibilities, a programme of actions with timeframes (based on a start of implementation in Q3 of 2018) and summarises the current status of each action. The Biodiversity Action Register is a key tool for the implementation of the BAP.

Table 11.1 Biodiversity Action Register

Action ID	Action	Verification Indicator	Responsible Party	Implemented By	Target Completion Date	Frequency / Duration
Action 1	**Complete Detailed Socio-Economic Survey on Uses and Attitudes in Relation to the Wetlands**					
1A.1	Agree scope of works for study and tender	Invitation to tender issued	Developer	Developer	Q3 2018	One-off
1A.2	Select local expert to execute the survey, obtain proposal and arrange contract	Contract awarded	Developer	Developer	Q3 2018	One-off
1A.3	Complete study	Report delivered	Developer	Social Expert (TBC)	Q4 2018/Q 1 2019	One-off
1A.4	Publish report in appropriate publicly accessible platform	Report published	Developer	Social Expert (TBC)	Q2 2019	One-off
Action 1B	**Complete Fish Study**					
1B.1	Agree scope of works for study and tender	Invitation to tender issued	Developer	Developer	Q3 2018	One-off
1B.2	Select local expert to execute the survey, obtain proposal and arrange contract	Contract awarded	Developer	Developer	Q3 2018	One-off
1B.3	Complete study	Report delivered	Developer	Fish Expert (TBC)	Q4 2018 and Q1 2019	One-off
1B.4	Publication and Dissemination of Study Results	Report published	Developer	Fish Expert (TBC)	Q2 2019	One-off

Table 11.1 Biodiversity Action Register

Action ID	Action	Verification Indicator	Responsible Party	Implemented By	Target Completion Date	Frequency / Duration
1B.4	Produce and disseminate non-technical versions with the aim of awareness raising and sharing with local stakeholders	Report published	Developer	Fish Expert (TBC)	Q4 2019	One-off
1B.5	Refine quantification of impacts and, if required, assess compensation requirements	Short report	Developer	Suitably Qualified Ecologist (TBC)	Q3/Q4 2019	One-off
Action 2	**Develop Community-Based Natural Resource Management Programme (CNRMP)**					
2.1	Agree Scope of works for CNRMP (set-up year 1 plus implementation to cover five years). Complete tender process.	Invitation to tender issued	Developer	Developer	Q3 2018	Once every five years
2.1.1	Agree contract between BAC and Implementation Partner	Contract awarded	Developer	Developer	Q3 2018	Once every five years
2.1.2	Implementation partner to identify and arrange any additional resources required, including recruitment	Recruitment and resources confirmed	Developer	ANCR (TBC)	Q4 2018	Once every five years
2.1.3	Review results of socio-economic study completed under Action 1A and fish study (Action 1B) and complete detailed stakeholder mapping exercise	Stakeholder map	Developer	ANCR (TBC)	Q1 2019	Once every five years
2.1.4	Refine and develop implementation strategy for CNRMP, including schedule of proposed community-planning workshops, sending invitations to relevant stakeholders	Completed CNRMP implementation strategy	Developer	ANCR (TBC)	Q2 2019	Once every five years
2.1.5	Complete first round of community-planning workshops	Records of workshops	Developer	ANCR (TBC)	Q1 and 2 2019	Once every five years
2.1.6	Complete additional stakeholder meetings as required	Minutes of meetings	Developer	ANCR (TBC)	Q4 2019 onwards	Ongoing as required

Table 11.1 Biodiversity Action Register

Action ID	Action	Verification Indicator	Responsible Party	Implemented By	Target Completion Date	Frequency / Duration
2.1.7	Identify Site Supports Groups (SSGs)/Local Conservation Groups (LCGs) to be included in CNRMP	Memorandum of understanding	Developer	ANCR (TBC)	Q2/Q3 2019	Once every five years
2.1.8	Identify conservation interventions required to provide relevant input, support and training	Short report	Developer	ANCR (TBC)	Q3 2019	Once every five years
2.1.9	Implement relevant conservation interventions	Annual review report (see IBA 2.1.10)	Developer	ANCR (TBC)	Q3 2019 onwards	Ongoing and continuous
2.1.10	Complete annual review of CRMP activities based on annual reporting and evaluation	Annual review report	Developer	ANCR (TBC)	Q4 2019 and then annual	Once per year
2.2	Complete five-yearly review of CRNMP, based on five-yearly monitoring results	Five-year review report	Developer	Developer / Appropriate 3rd party reviewer	Q4 2023	Once every five years
2.3	Confirm following five-year programme, based on Actions 2.1-2.2 above	Contract awarded	Developer	Developer	Q1 2024	Once every five years
Action 3	**Support for Protected Area Status and Legislation Enforcement**					
3.1	As part of stakeholder consultation completed under IBA 2.1.6, promote protection of the IBA wetlands Hippopotamus and Ningu through the Ramsar designation process	Minutes of meetings	Developer	Developer / ANCR (TBC)	Q4 2018 onwards	Ongoing as required
3.2	As part of stakeholder consultation completed under IBA 2.1.6, discussions with local authorities would be undertaken to identify the existing enforcement structures and resources in place	Minutes of meetings	Developer	ANCR (TBC)	Q4 2018 onwards	Ongoing as required
3.2.1	As part of IBA2.1.8, identify opportunities to combine improved enforcement through the CNRMP	CNRMP implementation strategy	Developer	ANCR (TBC)	Q3 2019	Once every five years

Table 11.1 Biodiversity Action Register

Action ID	Action	Verification Indicator	Responsible Party	Implemented By	Target Completion Date	Frequency / Duration
3.3	Complete five-yearly review, based on five-yearly monitoring results	Five-year review report	Developer	Developer / Appropriate 3rd party reviewer	Q4 2023	Once every five years
3.4	Confirm following five-year programme, based on actions IBA3.1-IBA3.2 above	Contract awarded	Developer	Developer	Q1 2024	Once every five years

APPENDIX 1
INSTITUTIONAL, LEGAL AND POLICY FRAMEWORK IN RWANDA

International Biodiversity Agreements

Table A1: International Biodiversity Agreements	
Name of Convention	**Application**
The International Convention on Biological Diversity and its habitat signed in Rio De Janeiro in Brazil on 5 June 1992, as approved by Rwanda Presidential Order No 017/01 of 18 March 1995	The Convention is a multilateral treaty with three main goals. These are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from genetic resources.
The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)	The agreement aims to conserve migratory water bird species.
The convention on International Trade and Endangered species of Wild Fauna and Flora (CITES), Washington (1973)	CITES is a multilateral treaty to protect endangered plants and animals. It aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.
The RAMSAR International Convention of February 2, 1971 on Wetlands of International importance, especially as water flows habitats as authorized to be ratified by Rwanda Law No 37/2003 of 29 December 2003.	The RAMSAR Convention is an international treaty for the conservation and sustainable use of wetlands.
Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979	The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range.
United Nations Convention to Combat Desertification (UNCCD)	The United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, particularly in Africa (UNCCD) is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements.

Rwandan Institutional Framework

Table A2: Institutional Framework		
Institution	**Roles and Responsibilities**	**Application**
Ministry of Natural Resources (MINIRENA)	MINIRENA has the responsibility for developing land utilization policies (including surveying, land classification, land laws and land tenure); the development of environmental policies and procedures (including impact assessments), protection of natural resources (water, land, flora, and fauna), environmental legislation, biodiversity, and other environmental aspects informed by the Environment Law among others.	The policies and laws that promote protection of natural resources exist and can benefit biodiversity if implemented.
Rwanda Development Board (RDB)	The institution is responsible for development projects and has a department responsible for EIA processes including reviewing all projects EIA reports before approval of the implementation of the projects.	Critical analysis of the EIA reports with specific attention to biodiversity.

Table A2: Institutional Framework		
Institution	**Roles and Responsibilities**	**Application**
Rwanda Environment Management Authority	The roles and responsibilities of REMA include: To advise the Government on legislative and other measures for the management of the environment or the implementation of relevant international conventions, treaties and agreements in the field of environment, as the case may deem necessary. To take stock and conduct comprehensive environmental audits and investigations, to prepare and publish biannual reports on the state of natural resources in Rwanda. To undertake research, investigations, surveys and such other relevant studies in the field of environment and disseminate the findings. To ensure monitoring and evaluation of development programs in order to control observance of proper safeguards in the planning and execution of all development projects, including those already in existence, that have or are likely to have significant impact on the environment. To render advice and technical support, where possible, to entities engaged in natural resource management and environmental protection.	Advice to avoid negative impacts on biodiversity.
Rwanda Natural Resources Authority (RNRA)	Rwanda Natural Resources Authority hosts the Departments: Land and Mapping, Integrated Water Resources, Geology and Mines, and Forestry and Nature Conservation. They are responsible for overseeing and management of national water resources, minerals, forests, national parks and other protected areas.	The authority ensures that all natural resources in Rwanda are utilised sustainably for the present and future generations.

Rwandan National Policy, Laws and Regulations

Table A3: Policy Framework on Biodiversity

Policy	Description	Application
Rwanda Environmental Policy, 2003	This policy's overall objective is to improve wellbeing of the people of Rwanda through sustainable utilization and fair development of natural resources, and the protection and rational management of ecosystems. The policy integrates Environmental aspects into all the development policies, planning and in all activities carried out at the national, provincial and local level, with the full participation of the population, conservation, preserve and restoration of ecosystems and maintenance of ecological and systems functions. The wildlife conservation goals set out in this policy are closely harmonised with other National Development Goals as set out in Vision 2020 and the Economic Development and Poverty Reduction Strategy – EDPRS. The Policy also supports and complements other sectoral policies in particular, the environment, biodiversity, forestry and water policies. The goal of this Policy is therefore to: provide a framework for conserving, in perpetuity, the country's wildlife, rich diversity of species, habitats and ecosystems for the well-being of its people of Rwanda and the global community. To achieve the stated goal, Government of Rwanda, on behalf of the people of Rwanda, and all the stakeholders will strive to: *I. Promote national level conservation planning ensuring that wildlife is protected;* *II. Develop and enhance National Parks;* *III. Create conditions where people and wildlife can co-exist and have as little negative impact on each other as possible;* *IV. Encourage wide stakeholder participation in the management of wildlife and equitable distribution of economic benefits;* *V. Build the human capacity for the management of wildlife at all levels of Government, civil society and the private sector; and* *VI. Develop institutional capacities to enable efficient and effective management of Wildlife.* *The precautionary principle states that "When an activity raises threats of harm to human health or the environment, precautionary measures shall be taken even if some cause and effect relationships are not fully established scientifically".*	Construction and operation activities associated with the Proposed Project has the potential to harm wildlife (i.e. flora and fauna) present at the sites, and by undertaking this ESIA, the potential impacts on wildlife have been identified, assessed and mitigation measures proposed for implementation by BAC. The precautionary principle has been applied in the completion of this chapter.

Table A3: Policy Framework on Biodiversity

Policy	Description	Application
Rwanda Wildlife Policy, 2013	The Rwanda Wildlife Policy aims to: Provide a framework for conserving, in perpetuity, country's wildlife, rich diversity of species, habitats and ecosystems for the well-being of its people of Rwanda and the global community. Achieve the stated goal, GOR, on behalf of the people of Rwanda, and all the stakeholders will strive to: • Promote national level conservation planning ensuring that wildlife is protected; • Develop and enhance National Parks; • Create conditions where people and wildlife can co-exist and have as little negative impact on each other as possible; • Encourage wide stakeholder participation in the management of wildlife and equitable distribution of economic benefits; • Build the human capacity for the management of wildlife at all levels of Government, civil society and the private sector; and • Develop institutional capacities to enable efficient and effective management of wildlife. Policy Principles include; sustainability, systematic (or integrated) conservation planning, management, wildlife conservation, parks as models, information exchange, application of adaptive management, social justice and equity, national security issues, and the precautionary principle.	Construction and operation activities associated with the Proposed Project have the potential to harm wildlife (i.e. flora and fauna) present at the sites, and by undertaking this ESIA, the potential impacts on wildlife have been identified, assessed and mitigation measures proposed for implementation by BAC. The precautionary principle has been applied in the completion of this chapter.
Land Policy, 2003	The policy also provides for development of land use plans based on suitability of the areas/lands thus distinguishing the different categories of land and their purpose. On the use and management of hillsides and marshlands, the policy stipulates that marshlands meant for agriculture should be cultivated after adequate planning and Environmental Impact Assessment.	A portion of the Expressway within the Proposed Project is situated within wetlands.

Table A4: Legal Framework Relevant to Biodiversity		
Law	**Aim and Purpose of the Law**	**Application**
The Constitution of the Republic of Rwanda of 2003, revised in 2015	The Constitution of the Republic of Rwanda promotes the protection and sustainable management of the environment and encourages the rational use of natural resources.	By undertaking the biodiversity survey as part of the Environmental and Social Impact Assessment for Bugesera Airport, Bugesera Airport Company Limited is in compliance with this law. However, the company and its contractors must ensure that all proposed mitigation measures are implemented and biodiversity monitoring undertaken.
The Organic Law N° 04/2005 Of 08/04/2005 Determining The Modalities of Protection, Conservation And Promotion Of Environment In Rwanda	This Organic law aims at: • Conserving the environment, people and their habitats; • Setting up fundamental principles related to protection of environment, any means that may degrade the environment with the intention of promoting the natural resources, to discourage any hazardous and destructive means; • Promoting the social welfare of the population considering equal distribution of the existing wealth; • Considering the durability of the resources with an emphasis especially on equal rights on present and future generations; • Guarantee to all Rwandans sustainable development which does not harm the environment and the social welfare of the population; and • Setting up strategies of protecting and reducing negative effects on the environment and replacing the degraded environment. The framework of the law on the protection and management of natural resources centres on avoiding and reducing the disastrous consequences on environment.	By undertaking the biodiversity survey as part of the Environmental and Social Impact Assessment for Bugesera Airport, Bugesera Airport Company Limited is in compliance with this law. The chapter has applied the mitigation hierarchy to avoid, reduce, and compensate impacts to biodiversity.
Ministerial Order determining the length of land on shores of lakes and rivers transferred to public property - N° 007/16.01 of 15/07/2010	This law sets the boundary for development and settlement activities next to water bodies. This Order aims at setting aside the length of land on shores of lakes and rivers affected in the public domain for environmental protection. The land within a distance of 50 m from the lakeshore, and the land within a distance of 10 m and 5 m from the shore of big rivers and small rivers respectively is public property. Law and statutory guidelines on Environmental Impact Assessment.	Implementation of this ministerial order would protect sensitive areas for amphibian, fish and water birds breeding and survival.

Table A4: Legal Framework Relevant to Biodiversity		
Law	**Aim and Purpose of the Law**	**Application**
Law N° 70/2013 Of 02/09/2013 Governing Biodiversity In Rwanda	This law provides for: • biodiversity planning and monitoring; • ecosystems, endangered and invasive species; • Bio-prospecting, access and benefit sharing; • Permits; and • Administrative sanctions.	Considering that the Airport Area and the Associated Facilities will affect biodiversity including invasive species, project activities must be undertaken in line with this law.
Prime Minister's Order N° 006/03 of 30/01/2017, drawing up a List of Swamp Lands, their Characteristics and Boundaries and Determining Modalities of their Use, Development and Management	This Order draws up a list of swamp lands, their characteristics and boundaries and determines modalities of their use, development and management. The Order provides an inventory of swamps in Rwanda and their characteristics (Annexure 1) and the boundaries of swamp lands (Annexure 2). The Order further provides for the use, development and management of swamp lands. The following wetlands are listed in Bugesera District as proposed Ramsar Sites with management prescribed as Use under specific conditions: • Cyohoha Nord-Murago 14,345 - • Gashanga 14,135 ha • Kabarali 12,016 ha • Kidogo 7,539 ha • Mparo 4710 ha • Murago Umurago 20,801 ha • Nyabarongo-Akagera 15,718 ha • Nyarubande 19,096 ha • Rucahabi 25,691 ha • Cyandayi 5,303 ha • Rweru-Mugesera Nyabarongo 162,169 ha • Nyabarongo Aval 99,890 ha • Nyabarongo Amont 346,373 ha • Akanyaru Nord 12,3412 ha And the following are described as proposed Ramsar Sites with management with full protection: • Ngenda 12,796 ha • Lac Sake aval 7,478 ha • Mugesera aval 51,189 ha	As the Proposed Project will be in close proximity to swamp lands, cognisance must be taken of the Order. Article 18: Laws governing the use, development and management of protected swamp lands states that "*The use, development and management of protected swamp lands are governed by relevant laws*." However, it is not clear which laws are relevant and what protection they confer.
Protected Animals and Plan Species: Ministerial Order	This Order prohibits the hunting of species listed within appendix I of the Order. The plants listed in appendix II are protected from	Several of the animal species listed in appendix I of the Order were recorded within the

Table A4: Legal Framework Relevant to Biodiversity		
Law	**Aim and Purpose of the Law**	**Application**
N°007/2008 of 15/08/2008 Establishing the List of Protected Animal and Plant Species	being either uprooted or cut without prior authorization from competent authorities.	Proposed Project Area of Influence (AOI), including: • Sitatunga • Hippopotamus • Black-headed Heron • Grey Crowned-crane • Swallow • Arrow-marked Babbler • Hamerkop • Sunbirds • Crocodile However, the construction of the Proposed Project will not require any hunting of any animal species. Construction workers will be strictly forbidden from hunting. A full list of plant species recorded within the Proposed Project AOI is provided in Technical Appendix 11.2. Two species listed on appendix II of the Order were recorded: • *Aloe vera* • *Erythrina abyssinica* Authorisation from Rwanda Water and Forestry Management Authority (Competent Authority) will be obtained before any identified listed plants are uprooted or cut during construction of the Airport/Expressway sites.
Management of Forests Law N° 47bis/2013 of 28/06/2013	This Law determines the management and utilisation of forests in Rwanda. The Law deals with protection of forests and licenses to clear certain forests.	Although not located in a forest area, the protection and adequate management of trees and forests have been considered during the construction and operation of the Proposed Project.

National Strategies of Relevance to Biodiversity

Table A5: National Strategies of Relevance to Biodiversity		
Law	**Aim and Purpose of the Law**	**Application to Biodiversity**
National Biodiversity Strategy and Action Plan, December 2006	This plan includes hillsides and wetlands and protected areas as some of the areas that need to be conserved, and defines the objectives and priorities for the conservation and sustainable management of biodiversity.	In line with this plan, the activities at the Proposed Project should minimise negative impacts to biodiversity.

APPENDIX 2
DETAILED SPECIES ACCOUNTS

Papyrus Gonolek

Papyrus Gonolek has been included on the IUCN Red List as Near Threatened because it is estimated to be in moderately rapid population decline owing to the on-going conversion and degradation of its wetland habitats[49]. MacClean *et al*. (2014)[50] estimated that the global population had declined by 20% over three generations to two million adults. The global range of the species is largely restricted to Uganda, Rwanda, Burundi and parts of western Kenyan adjacent to Lake Victoria, with an Area of Occupancy (AOO) of 48,000 km^2 (MacClean *et al.,* 2014).

Papyrus Gonolek is a biome-restricted species dependant on papyrus swamps and has been included as a trigger species in a total of 35 IBAs, including four in Rwanda: Akagera National Park; Akanyaru wetlands; Nyabarongo wetlands; and Rugezi Marsh IBAs. The species was not recorded during surveys in Rugezi Marsh IBA in Rwanda, completed in 2004-2005 (Barakabuye *et al.* 2005) [51], although it had previously been recorded. Fischer (2011) also did not record it in the Rugezi Complex in 2011 and therefore may no longer extant at this location. The species was also not recorded by Nsabagasani *et al.* (undated) during surveys completed in 2008 within the Akanyaru IBA.

Papyrus Gonolek was recorded in nearly half of all of the 84 point counts completed within the Project AOI in October and November 2017. It was present in nearly all of the survey locations that comprised papyrus-dominated swamp. Only in very small isolated patches of papyrus, or where papyrus swamp was limited to a thin lake fringe was the species absent from this habitat. During the October/November 2017 surveys, the species was not recorded from the Typha dominated swamp alongside the Expressway Route, although it was recorded twice in this area during the May/June 2017 surveys. Other studies have shown that the species is intolerant to degradation of papyrus habitats from impacts such as burning (MacClean *et al*., 2006) [52] and occurs at lower densities at the wetland edges compared to the centre (MacClean *et al.,* 2003)[53]. In most of the survey locations, a single pair of birds were observed, although on four occasions up to four birds were recorded, possibly when two adjacent territories were present. The species responded very quickly and strongly to the sound of the playback, suggesting that the species is highly territorial. The species was recorded by ACNR within the Nyabarongo wetlands in 2003, and in the area of the Agakera Complex surveyed by Fischer in 2011.

Carruthers's Cisticola

Carruther's Cisticola is assessed on the IUCN Red List as Least Concern[54] and has a global distribution that includes western Kenya, southern Uganda, Rwanda, Burundi and eastern DRC. MacClean *et al.* (2014) estimated that its global population has declined 10% over three generations to 370,000 adults.

Carruther's Cisticola has been included as a trigger species in a total of 28 IBAs, including four in Rwanda: Akagera National Park; Akanyaru wetlands; Nyabarongo wetlands; and Rugezi Marsh

[49] BirdLife International. 2016. Laniarius mufumbiri. The IUCN Red List of Threatened Species 2016: e.T22707593A94130975. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22707593A94130975.en. Downloaded on 11 January 2018.

[50] Maclean, I.M.D., Bird, J.P. & Hassall, M. (2014) Papyrus swamp drainage and the conservation status of their avifauna Wetlands Ecol Manage 22: 115. https://doi.org/10.1007/s11273-013-9292-8

[51] Barakabuye, N. Kahindo, C., Sande, E., Chemurot, M., Nsabagasani, C & Kayijamahe, E. (2005) Status Of Two Threatened Species In Two Ibas In Rwanda - Preliminary Project Report

[52] Maclean IMD, Hassall M, Boar RR, Lake IR (2006) Effects of disturbance and habitat loss on papyrus-dwelling passerines. Biol Conserv 131:349–358

[53] Maclean IMD, Hassall M, Boar R, Nasirwa O (2003a) Effects of habitat degradation on avian guilds in East African papyrus Cyperus papyrus swamps. Bird Conserv Int 13:283–297

[54] BirdLife International. 2016. Cisticola carruthersi. The IUCN Red List of Threatened Species 2016: e.T22713415A94373852. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22713415A94373852.en. Downloaded on 12 January 2018.

IBAs. The species was recorded during surveys in Rugezi swamp IBA in Rwanda, completed in 2004- 2005 (Barakabuye *et al.* 2005). The species was also recorded by Nsabagasani *et al.* (undated) during surveys completed in 2008 within the Akanyaru IBA.

Carruther's Cisticola has a very similar appearance to Winding Cisticola *Cisticola marginatus*, although the calls of the two species are highly distinctive. Both species were recorded in close proximity to each other during the 2017 surveys. Carruther's Cisticola however was strongly associated with papyrus-dominated swamp, whereas Winding Cisticola was seen more frequently in wetland edge and degraded wetlands. According to MacClean (*pers comm*), Carruthers's Cisticola seems to be restricted to papyrus swamps at low altitudes, particularly when it occurs alongside Winding Cisticola, but at higher altitude occupies other types of wetland (e.g. it occurs in high altitude swamps in Bwindi National Park with no papyrus).

In 2017, Carruther's Cisticola was recorded in 26 locations, 31% of the playback points. The species responded strongly to the sound of playback, which often stimulated display and territorial response behaviour. In many of the recorded locations, pairs of birds were present. The behaviour observed suggests that the birds were holding breeding territories. The species was not recorded by ANCR within the Nyabarongo wetlands in 2003, although it is likely to have been present at the time.

Papyrus Yellow Warbler

This is the most threatened of the IBA trigger species, being assessed as Vulnerable on the IUCN Red List,[55] based on estimated declines of 35% in the Albertine Rift population and 90% in the Kenyan population during the last three generations. The latest estimate completed in 2014, predicted a global population of between 10,000-20,000 mature individuals, restricted to an AOO of 3,800 km^2 (MacClean *et al*., 2014).

The species has a relatively limited and fragmented global distribution in the great lakes region of Africa, including western Kenya, Western Uganda and adjacent parts of eastern DRC and northern Rwanda, as well as southern Rwanda. The species may also occur in Tanzania and Zambia.

The species is included as trigger species for both the Akanyaru wetlands and Rugezi Marsh IBAs as a Biome-restricted species, although according to MacClean *et al.* (2006) it also inhabits swamps dominated by other sedges, reeds and Typha species. Within the Rugezi swamp IBA in Rwanda, by 2005 habitat losses had left a small population of less than 100 individuals of this species in remnant papyrus patches (Barakabuye *et al.* 2005). The species was not recorded within the Rugezi Complex in 2011 by Fischer. The species was also not recorded by Nsabagasani *et al.* (undated) during surveys completed in 2008 within the Akanyaru IBA.

During the 2017 surveys, Papyrus Yellow Warbler was only recorded in a single location within the Project AOI. This may reflect the actual rarity of the species in the area, or it may reflect poor response to the playback. Only a single playback track was obtainable from the xeno-canto website for use in the surveys and this was not a high- quality recording. The species is unobtrusive and would normally be very difficult to observe within the dense papyrus swamp. Also, MacClean *et al.* 2006 suggests that the species has a short vocalisation period during its main breeding season. The October and November 2017 surveys were completed outside of the species main breeding season and it is possible that the survey significantly under-recorded this species. The species was not recorded by ANCR within the Nyabarongo wetlands in 2003, in 2010 by R Mulwa, or in the area of the Akagera Complex surveyed by Fischer in 2011.

[55] BirdLife International. 2017. Calamonastides gracilirostris (amended version of 2016 assessment). The IUCN Red List of Threatened Species 2017: e.T103779235A111170261. http://dx.doi.org/10.2305/IUCN.UK.2017-1.RLTS.T103779235A111170261.en. Downloaded on 11 January 2018.

White-winged Swamp-warbler

Although the species is listed by the IUCN as Least Concern[56], it has experienced a 11% decline in its global population over three generations, down to 3.2 million adults and has an AOO of 130,000 km^2 (MacClean *et al.* 2014). Its global range is centred around Uganda, Rwanda and Burundi, as well as populations in western Kenya, Democratic Republic of Congo (DRC) and Zambia.

This biome restricted species has been included as a trigger species in a total of 27 IBAs, including four in Rwanda: Akagera National Park; Akanyaru wetlands; Nyabarongo wetlands; and Rugezi Marsh IBAs. According to Vande Weghe (1983)[57], in the early 1980s the species was abundant in the extensive papyrus swamps of the Agakera Basin in central and eastern Rwanda, as well as Mulindi swamp near the Ugandan border. The species was not recorded during surveys in Rugezi swamp IBA in Rwanda, completed in 2004- 2005 (Barakabuye *et al.* 2005), although had previously been recorded at this location. Fischer also did not record the species in the Rugezi complex in 2011 possibly indicating that it is no longer present. The species was also not recorded by Nsabagasani *et al.* (undated) during surveys completed in 2008 within the Akanyaru IBA.

White-winged Warbler is a shy and unobtrusive species, however it responded well to the sound of playback calls during the 2017 surveys completed in the Nyabarongo wetlands. It was recorded at 30 out of the 84 survey locations (36%). The species was recorded in many of the areas of papyrus-dominated swamp. It was absent from much of the areas of *Typha* dominated swamp, but did occur in the wetland adjacent to the proposed Expressway when papyrus exceeded approximately 15 % of the vegetation cover. This accords well with Vande Weghe (1983), who considered that the species is entirely confined to papyrus swamp habitats. In eight of the survey locations, a pair of White-winged Warblers were recorded. The behaviour observed suggests that the birds were holding breeding territories. The species was also recorded by ANCR within the Nyabarongo wetlands in 2003.

Black-Lored Babbler

Black-lored Babbler is assessed by the IUCN Red List as Least Concern and has a global distribution that includes all of the countries bordering Lake Victoria[58]. The species has been included as a trigger species in a total of 32 IBAs, including three in Rwanda Akagera National Park; Akanyaru wetlands; and Nyabarongo wetlands IBAs.

Black-lored Babbler was recorded in 19 (23%) widely distributed locations within the Project AOI. Interestingly, the species was rarely recorded within large dense areas of papyrus swamp, but was often recorded in the surrounding farmland, close to the wetland edge. However, unlike Arrow-marked Babbler *Turdoides jardineii*, the species was not recorded far from wetlands. On one occasion a bird was observed carrying nesting material into the swamp, possibly suggesting this is its preferred nesting habitat. Babblers are noisy and gregarious species and where present, Black-lored Babbler responded quickly to the sound of the playback. Both pairs and small family groups of birds were recorded, with a maximum of eight in one location. The species was not recorded by ANCR within the Nyabarongo wetlands in 2003, although it is likely to have been present at the time, as it was also recorded both by Mulwa in 2010 and within the Akagera

[56] BirdLife International. 2016. Bradypterus carpalis. The IUCN Red List of Threatened Species 2016: e.T22714461A94417565. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22714461A94417565.en. Downloaded on 12 January 2018.
[57] Vande Weghe, J-P. (1983) Sympatric occurrence of the white-winged warbler Bradypterus carpalis and Grauer's rush warbler B. graueri in Rwanda. Scopus 1983 7:85-88
[58] BirdLife International. 2016. Turdoides sharpei. The IUCN Red List of Threatened Species 2016: e.T22716462A94495776. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22716462A94495776.en. Downloaded on 12 January 2018.

Complex by Fischer in 2011. The species was not recorded by Nsabagasani *et al.* (undated) during surveys completed in 2008 within the Akanyaru IBA.

Northern Brown-Throated Weaver

Northern Brown-throated Weaver is assessed Least Concern on the IUCN Redlist and has a global range that include western Kenya, Uganda, Rwanda and northwest Tanzania[59]. This biome restricted species has been included as a trigger species in a total of 32 IBAs, mainly in Uganda. Three IBAs included the trigger species in Rwanda: Akagera National Park; Akanyaru wetlands; and Nyabarongo wetlands IBAs. The species was not recorded during surveys in Rugezi swamp IBA in Rwanda, completed in 2004-2005 (Barakabuye *et al.* 2005), although had previously been recorded at this site. It was also not recorded in the Rugezi Complex by Fischer in 2011. The species was recorded by Nsabagasani *et al.* (undated) during surveys completed in 2008 within the Akanyaru IBA.

In 2017, the species was only recorded in three locations within the Nyabarongo wetlands IBAs, two of which were within the large papyrus dominated swamp located between Lake Kidogo and Lake Gashanga. The species did not show strong responses to the sound of the playback and therefore it is possible that the survey under-recorded it. The species was recorded by ANCR within the Nyabarongo wetlands in 2003, but not by either Mulwa in 2010, or Fischer in 2011. It is hard to interpret much into the results of either the 2017 surveys or previous studies due to a lack of a consistent pattern.

Papyrus Canary

Papyrus Canary is assessed by the IUCN Red List as Least Concern[60], although its global population has declined by 15% over three generations down to 415,000 adults (MacClean, *et al.,* 2014). It has two main population clusters, one in Uganda and western Kenya, stretching northwards from Lake Victoria. The second is centred on Rwanda, and includes adjacent areas of southern Uganda, north west Tanzania, Burundi and DRC.

Papyrus Canary has been included as a trigger species in a total of 19 IBAs as a biome-restricted species, including three in Rwanda: Rugezi Marsh, Akanyaru wetlands; and Nyabarongo wetlands IBAs. The species is entirely dependent on Papyrus in which it nests, although will often forage in farmland adjacent to swamps, particularly sorghum (MacClean *et al*., 2006). The species was recorded during surveys in Rugezi Marsh IBA in Rwanda, completed in 2004-2005 (Barakabuye *et al.* 2005), but not in 2011 by Fischer. The species was recorded by Nsabagasani *et al.* (undated) during surveys completed in 2008 within the Akanyaru IBA.

Only a single pair of Papyrus Canary was recorded during the October/November 2017 survey and was not recorded in May/June 2017. The two birds observed did not appear to be holding territory and quickly moved away to the north. MacClean *et al.,* 2006 also noted that this species can be hard to record during surveys due to its highly mobile behaviour. However, the very low numbers recorded indicates that the species is likely to be rare within the Nyabarongo wetlands IBAs. The species was not recorded by ANCR within the Nyabarongo wetlands in 2003, by Mulwa in 2010, or by Fischer in the Akagera complex in 2011. The scarcity of previous sightings also supports the conclusion that it is rare in the IBA. Analysis completed by MacClean *et al.*, 2006, suggests that this species is possibly favours Papyrus swamps located at higher altitudes exceeding 1500 m.a.s.l., compared to approximately 1300 m.a.s.l. of the swamps within the Nyabarongo wetlands.

[59] BirdLife International. 2016. Ploceus castanops. The IUCN Red List of Threatened Species 2016: e.T22718850A94599395. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22718850A94599395.en. Downloaded on 12 January 2018.
[60] BirdLife International. 2016. Crithagra koliensis. The IUCN Red List of Threatened Species 2016: e.T22720109A94657845. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22720109A94657845.en. Downloaded on 12 January 2018.

Red-Chested Sunbird

This species has a larger global distribution that the other IBA trigger species, that includes areas surrounding Lake Victoria, stretching up into South Sudan and includes a number of isolated populations across Tanzania[61]. This species has been included as a trigger species in a total of 37 IBAs, including in Burundi, Kenya, Tanzania and Uganda. Only two IBAs have been designated for Red-chested Sunbird in Rwanda: Akanyaru wetlands and Agakera National Park IBAs. It is not clear why it has not been included as a trigger species for the Nyabarongo Wetlands IBA. During 2017, Red-Chested Sunbird was recorded widely at 22 locations (26%). This may represent a slight under-estimate as this only relates largely to males, with the females being very similar in appearance to other sunbird species. The species also did not respond strongly to the sound of the playback. Most of the individuals observed were highly mobile, moving rapidly between flowering plants on which they feed. However, some of the males appeared to show territorial behaviour, calling and displaying from the top of taller vegetation. Given the abundance of this biome-restricted species within the Nyabarongo Wetlands IBA, it is treated as a trigger species in the remainder of this BAP. The species was recorded by ANCR within the Nyabarongo wetlands in 2003 and by Mulwa in 2010. The species was also recorded by Nsabagasani *et al.* (undated) during surveys completed in 2008 within the Akanyaru IBA.

Madagascar Pond Heron

This heron species breeds on Madagascar and has a very small global population estimated to be between 2,000-6,000 individuals[62]. It has a large non-breeding range covering Central and East Africa including the Comoro Islands, Mozambique, Zimbabwe, Zambia, Malawi, Tanzania, Kenya, Uganda, Burundi, Rwanda and Democratic Republic of Congo. According to the Birdlife International website, the species has been recorded in the Nyabarongo Wetlands IBA. Although the species was not recorded in either of the two surveys completed in 2017, or the 2010 ESIA bird survey, it was recorded within the Nyabarongo Wetlands in 2003 by ACNR[63]. According to Nsabagasani *et al.* (undated) Madagascar Pond Heron was also recorded in the north of Akanyaru wetlands near the junction to the Nyabarongo wetlands during surveys completed July to December 2008. Neither report specified how many individuals were recorded, although the wording implies single individuals.

It is not clear why the species has not been included within the list of IBA trigger species for the Nyabarongo Wetlands IBA. The Birdlife International criteria A1. Globally threatened species for IBAs is for the regular presence of a Critical or Endangered species, irrespective of population size. This is a lower threshold that that for critical habitat as defined by IFC PS6. A total of 27 IBAs have included Madagascar Pond Heron as a trigger species, however all of these are located in the breeding range in Madagascar. No IBAs have been designated with respect to the species large wintering range, possibly because they do not occur in high densities. For critical habitat to be triggered according to IFC PS6 criteria, a site would need to support 1% of the global population, or 20 individuals. The species occurs within dense papyrus habitats that are not easy to survey comprehensively. Therefore, it is not possible to conclude that the species is no longer present based on the results of the 2010 and 2017 surveys. It is also not possible to extrapolate with confidence the population size present based on the limited sightings made in 2003 and 2008. The non-breeding range of the species is very large, estimated to be at least 500,000 km2. Even concentrated within wetland areas within this large area, it is unlikely that the area supports 1% of the non-breeding range. However, as a precautionary measure, given the

[61] BirdLife International. 2016. Cinnyris erythrocercus. The IUCN Red List of Threatened Species 2016: e.T22717994A94561470. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22717994A94561470.en. Downloaded on 12 January 2018.
[62] BirdLife International (2017) Species factsheet: Ardeola idae. Downloaded from http://www.birdlife.org on 28/11/2017.
[63] Association pour la Conservation de la Nature au Rwanda (2004) Conservation and Sustainable Use Of Wetlands in South-Eastern Of Rwanda

difficulty in surveying for this elusive species, it cannot be ruled out at the current time and therefore is treated as Tier 2 critical habitat for this species.

Ningu

Ningu occurs in shallow, inshore waters of Lake Victoria and its affluent rivers, as well as in a number of other lakes in the region. According to literature sources quoted by the IUCN Red List, the species is present in the following areas: River Nzoia and River Yala in Kenya; River Sio, the Victoria Nile and Lake Kyoga system in Uganda; the Akagera river system (Uganda and Rwanda); Lake Katwe and Lake Kubigena in Tanzania; and Ruvubu River in Burundi.

Ningu is a freshwater potamodromous migratory fish species that typically migrates from lakes (e.g. Lake Victoria) upstream into rivers such as the Akagera River to spawn during high flow levels associated with the wet seasons. However, there is evidence in Uganda that sexually mature fish are present throughout the year in the Sio River (Booth and Rutaisire, 2004)[64] and (Lysell, 2009)[65] showed that the species may show separation between migratory and sedentary populations. This behavioural and genetic separation occurs between populations within and close to Lake Victoria, and non-migratory populations detected in the larger rivers that extend some distance from Lake Victoria. Lysell (2009) detected this separation to include Ningu taken from the Agakera River in northern Rwanda. Ningu was once one of the most important fisheries along the rivers of Lake Victoria (Ogutu-Ohwayo, undated)[66], but during the 1950s the catches of this species decreased dramatically as a result of intensive and unregulated gill-net fishing across river mouths (Cadwalladr, 1965)[67]. The predictable annual migratory behaviour that concentrated large proportion of the population in an easily exploitable location makes this species very vulnerable to over-exploitation. The risk of declines in populations were identified at least as early as 1928, resulting in the recommendation of restricted fishing practices (Ogutu-Ohwayo, undated). However, these recommendations have not been implemented. Declines in fishing catches recorded from Lake Victoria between 1965 and 1988 are presented in Figure A2-1 below. The declines in native fish populations in Lake Victoria also coincided with the introduction of non-native species. Nile Perch *Lates niloticus* and four tilapiine species were introduced into Lake Victoria in the 1950s and 1960s and their populations increased rapidly between 1971 and 1983 (Ogutu-Ohwayo, undated). It is not known whether the populations with Lake Victoria are linked through direct migration to those in the upper Akagera.

[64] Booth, A.J., & Rutaisire, J. (2004). Reproductive biology of ningu, *Labeo victorianus (*Pisces: Cyprinidae), in the Kagera and Sio Rivers, Uganda. Environmental Biology of Fishes, 73, 153-162.

[65] Lysell, H (2009) Elucidating patterns of genetic differentiation in the East African Ningu *Labeo victorianus* (Pisces: Cyprinidae), using microsatellite markers. Degree Project, University of Uppsala.

[66] Ogutu-Ohwayo (undated) The fisheries of Lake Victoria: Harvesting biomass at the expense of biodiversity. Available for download at https://www.cbd.int/doc/nbsap/fisheries/Ogutu(summary).pdf

[67] Cadwalladr, D.A. (1965) The decline in the *Labeo victorianus* Blgr. (Pisces: Cyprinidae) fishery of Lake Victoria and an associated deterioration in some indigenous fishing methods in the Nzoia River, Kenya. East African Agricultural and Forestry Journal 30: 249-256.

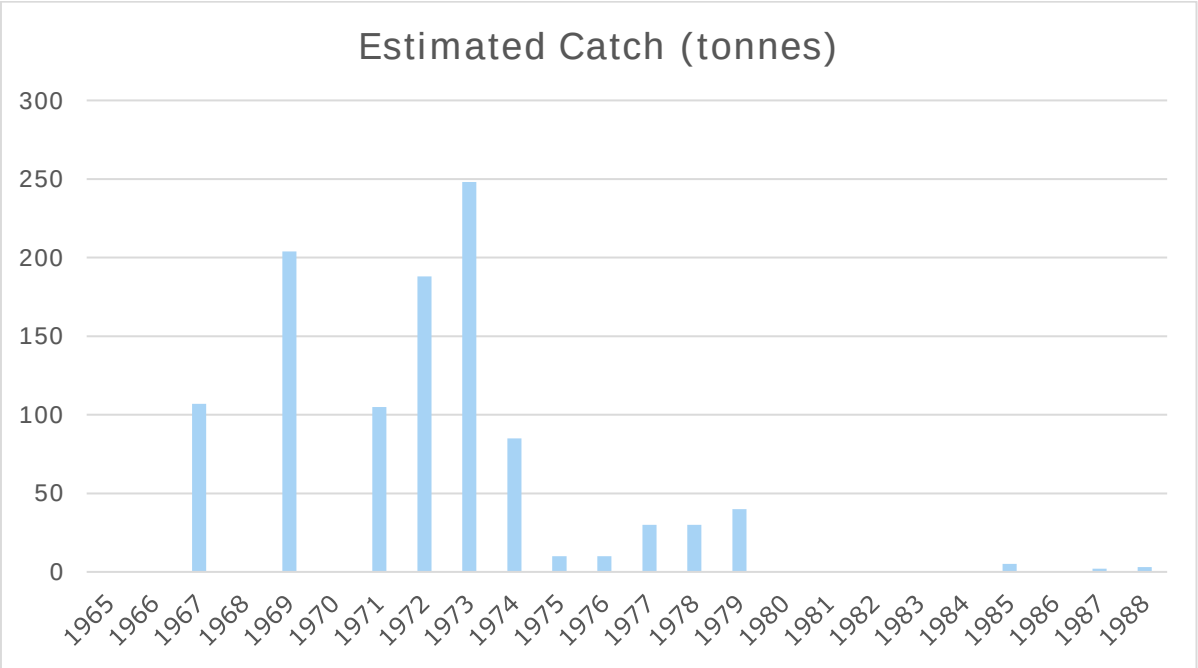


Figure A2-1: Fisheries Captures of Ningu in Lake Victoria 1965-1988 (Source: Rutaisire, 2003)[68]

Within Rwanda, van den Bossche and Bernacsek (1977)[69] records that Ningu formed part of the fisheries captured in Lake Mugesera between 1964 and 1975. The same author provides historical data on the number of fishermen active and yields from a number of lakes in the Project Area, although the species present in these lakes are not recorded (Table A2-1). Rutaisire (2003) provides a list of recorded occurrences of Ningu within the Lake Victoria basin that includes reference to Lake Mirayi in 1985 and the Nyaborongo River in 1986. Kanangir *et al.* (1999)[70] completed a standardised fish capture study of ten lakes in Rwanda. These did not include any of the lakes in the Project AOI. However, the study did record Ningu in six of the ten lakes surveyed, including the lakes Mugesera, Sake and Bilira, which are all situated to the east of the Project AOI and within the same Agakera drainage system. More recently in 2005 and 2006, Lysell (2009) sampled Ningu from two locations in northern Rwanda from the Agakera River at Muwumba River, Sofia Town and Echambo, Kinyankole.

It appears that Ningu forms part of the indigineous fish fauna of the Bugesera lake system, which comprises around ten species in total: *Barbus acuticeps*, *Barbus kerestenii, Clarias liocephalus, Mastasembelus funatus, Harpagochromis sp., Gaurochromis sp., Paralabidochromis sp.,* and *Synodontis rwandae*)[71]. A number of non-native species have also been introduced into the Bugesera lake system, including *Sclibe macrocir, Clarias ariepinus, Tilapia rendalli, Saraterodon niloticus edwardian,* and *Saraterodon macrocir*. However, it is not known what impact these have had on native fish populations. According to the Ministry of Agriculture and Animal Resources (MINAGRI, 2011)[72] native fish stocks within the whole of Rwanda, including those in the Project AOI, are commercially collapsed, which is attributed to unregulated over-fishing. Therefore, the

[68] Rutaisire, J (2003) The Reproductive Biology and Artificial Breeding of Ningu *Labeo victorianus* (PISCES: CYPRINIDAE). Phd thesis, Rhodes University

[69] vanden Bossche, J.-P. and Bernacsek, G. M. (1977) Source Book for the Inland Fishery Resources of Africa, Volume 1: Food and Agriculture Organization of the United Nations

[70] Kanangire, C. K., Depiereux, E. and. Mich J.-C (1999) Essai de caractérisation de quelques lacs rwandais par leur peuplement piscicole. Annls Limnol. 35 (2) 1999: 141-150. Available as download: https://www.limnology-journal.org/articles/limn/pdf/1999/02/limno19992p141.pdf

[71] Ministère de L'Agriculture, de L'Élevage, De L'Environnement et du Développent Rural (1998) Rapport National sur la Convention de la Diversité Biologique. https://www.cbd.int/doc/world/rw/rw-nr-01-fr.pdf

[72] MINAGRI (2011) Master Plan for Fisheries and Fish Farming in Rwanda, available for download at http://extwprlegs1.fao.org/docs/pdf/rwa151563.pdf

current status of fish species in the Project AOI is unconfirmed, pending additional studies included in this BAP.

Table A2-1: Number of Fishermen Active in Project AOI and Fish Catches Between 1968-1981

Lake	Number of Fishermen	Number of Boats	Estimated Total Annual Catch
Gaharwa	21 in 1968 *26 in 1973* 42 in 1975 37 in 1981	11 in 1968 *26 in 1973* 40 in 1975 40 in 1981	59 t in 1968 *10 t in 1973 and 1975* 28 t in 1975 149 t in 1981
Gashanga	*13 in 1973* 30 in 1981	*13 in 1973* 30 in 1981	*30 t in 1973 and 1975* 111 t in 1981
Kidogo	8 in 1973 14 in 1975 10 in 1981	8 in 1973 10 in 1975 5 in 1981	20 t in 1968 40 t in 1973 and 1975 4 t in 1975 35 t in 1981
Kilimbi (referred to as Lake Kirimbi)	15 in 1973 38 in 1975 32 in 1981	15 in 1973 38 in 1975 30 in 1981	20 t in 1973 and 1975 30 t in 1975 111 t in 1981
Miravi (referred to as Lake Mirayi)	17 in 1973 40 in 1975 33 in 1981	17 in 1973 29 in 1975 25 in 1981	20 t in 1973 and 1975 20 t in 1975 75 t in 1981
Rumira	22 in 1968 21 in 1975 31 in 1981	15 in 1968 22 in 1975 32 in 1981	20 t in 1968 12 t in 1975 153 t in 1981
Sources: van den Bossche and Bernacsek (1977) and Bimenvimana (1985)[73].			

Hippopotamus

Hippopotamus occur in a range of waterbody types, including rivers, lakes and wetlands, throughout sub-Saharan Africa, although the species strongholds are located in Eastern and Southern African countries. The latest IUCN population assessment completed in 2016 estimated a global population of between 115,000-130,000 individuals. Until recently, the population size in Rwanda was poorly known. However, an aerial survey of Akagera National Park (MacPherson, 2013)[74], recorded 885 individuals and likely to represent a significant proportion of the country's Hippopotamus population. Within Akagera National Park, it appears that the population is increasing in number over time and is recovering from losses occurred during Rwanda's civil war. A number of secondary sources mention that Hippopotamus are present within the Bugesera District, including the Akanyaru wetland (Nsabagasani *et al.,* undated)[75] and the Rweru-Mugesera wetland complex (Fischer, 2011) [76]. Fischer (2011) reports that the species is declining in the Rweru-Mugesera wetland complex due to habitat loss.

[73] Bimenvimana (1985) Contribution à L'Etude De La Pêche Continentale au Thèse Rwanda. PhD Thesis. Université De Dakar, Senegal.
[74] Macpherson, D. 2013. Report on an Aerial Census of Akagera National Park, Rwanda - August 2013. Cluny.
[75] Nsabagasani, C., Nsengimana, S. and Hakizimana, E. (undated) Biodiversity Survey in Akanyaru Wetlands, Unprotected Important Bird Areas In Rwanda
[76] Fischer, E. (2011) Biodiversity Inventory for Key Wetlands in Rwanda Final Report. Rwanda Environment Management Authority REMA

The continued presence of Hippopotamus within the Project AOI was confirmed during biodiversity baseline surveys completed during 2017 to inform the Project ESIA (Figure 5.2). During a conversation with local boatmen near Lake Kidogo, it was reported that Hippopotamus occur in the area during the wet season. Staff at the La Palisse Hotel, Gashora also reported that Hippopotamus sometimes graze on the lawns of the hotel. During the May/June baseline 2017 surveys, footprints that appeared to be of a Hippopotamus were seen around Lake Rumira.

During the October/November bird surveys, Hippopotamus footprints were seen in two locations on the edge of the large papyrus swamp between Lake Miravi and Lake Kilimbi. The local community members confirmed that Hippopotamus were present the same morning in both locations. Based on the locations of the sightings and the reports of local community members, it is likely that the wetland complex to the east of the Project, comprising a series of large lakes and papyrus swamp, supports a permanent population of Hippopotamus.

It is likely that the large area of papyrus provides a refuge for the species from disturbance from people, but that they move around the wetland complex, especially during the wet season. Hippopotamus spend daylight hours within water, mostly resting and staying cool as their skin must remain wet and is damaged if it dries out for long periods of time. It is a nocturnal feeder, but does not typically feed on aquatic vegetation. Instead it emerges from the water at night to graze surrounding grass and herbaceous vegetation.

The species can commute between 2 - 7 km to find grazing each night, and up to 10 km if no other food is available (Buruso, 2018)[77]. This behaviour can bring them into direct conflict with local farmers by causing damage to crops, as reported by local community members during the 2017 ESIA baseline surveys. In many areas of the Project AOI, cultivation is taking place right down to the edge of wetlands, which occupy the valley floors, and in some cases have extended a few metres into the wetland. In some of these areas, farmers have formed raised beds surrounded by small shallow ditches to grow crops such as sweet potato and arrowroot. A study completed in Kenya showed that Hippopotamus-human conflict increases dramatically as land use around wetlands become more intensive and tends to lead to higher levels of mortality in Hippopotamus (Kanga *et al.,* 2011)[78]. Another study completed in a predominantly farmed area of Lake Tana, Ethiopia found that 82% of the local residents surveyed had negative attitudes towards Hippopotamus (Buruso, 2017)[79].

Hippopotamus are large animals that have caused mortality in humans. Within the Bugesera district, it is reported that one fisherman was killed, and another was seriously injured in Lake Kidigo by a Hippopotamus in 2013.[80] Elsewhere in Rwanda, four people were reportedly killed in Lake Muhazi in 2014[81]. The danger posed by Hippopotamus can also negatively affect people's attitude towards the animal.

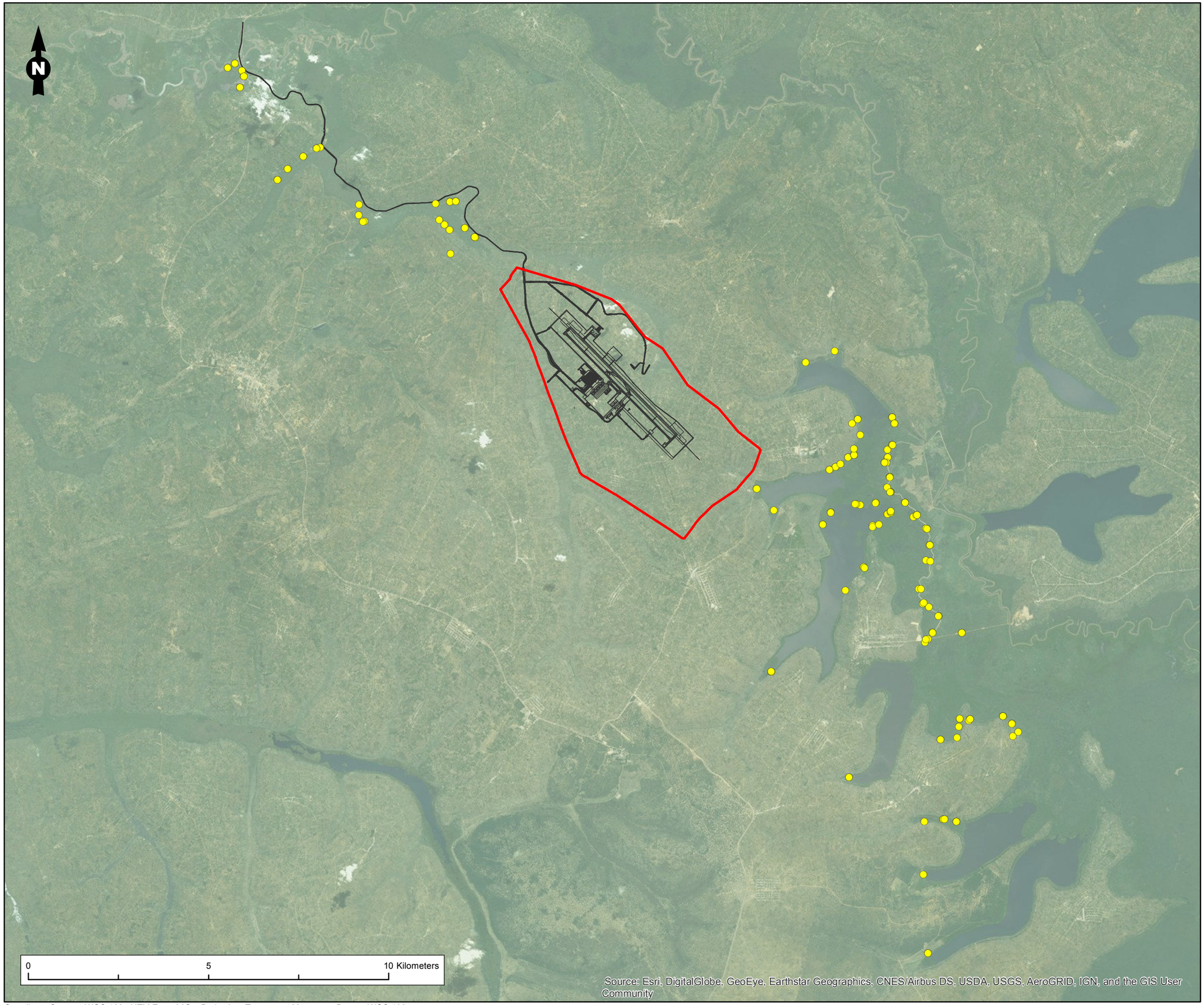
[77] Buruso, F.H. Res (2018) Habitat suitability analysis for hippopotamus (H. amphibious) using GIS and remote sensing in Lake Tana and its environs, Ethiopia. Environ Syst 6: 6. https://doi.org/10.1186/s40068-017-0083-8

[78] Erustus M. Kanga, Joseph O. Ogutu, Hans-Peter Piepho & Han Olff (2011) Human–hippo conflicts in Kenya during 1997–2008: vulnerability of a megaherbivore to anthropogenic land use changes. Journal of Land Use Science Vol. 7 , Iss. 4,2012

[79] Buruso, F.H. (2017) How small holder agriculture affect grazing habitats of common hippopotamus (H. amphibious) in south easter shore of lake Tana, Ethiopia. AMERICAN JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH. ISSN: 2153-649X, doi:10.5251/ajsir.2017.8.3.55.62

[80] http://en.igihe.com/news/bugesera-fisherman-s-genitals-eaten-by-hippo.html, accessed 8th January 2018

[81] http://allafrica.com/stories/201411250396.html http://allafrica.com/stories/201411250396.html, accessed 8th January 2018.



Legend

- Airport Site Boundary
- Locaions of Survey Points

Figure Title
Location of bird survey playback point counts completed in

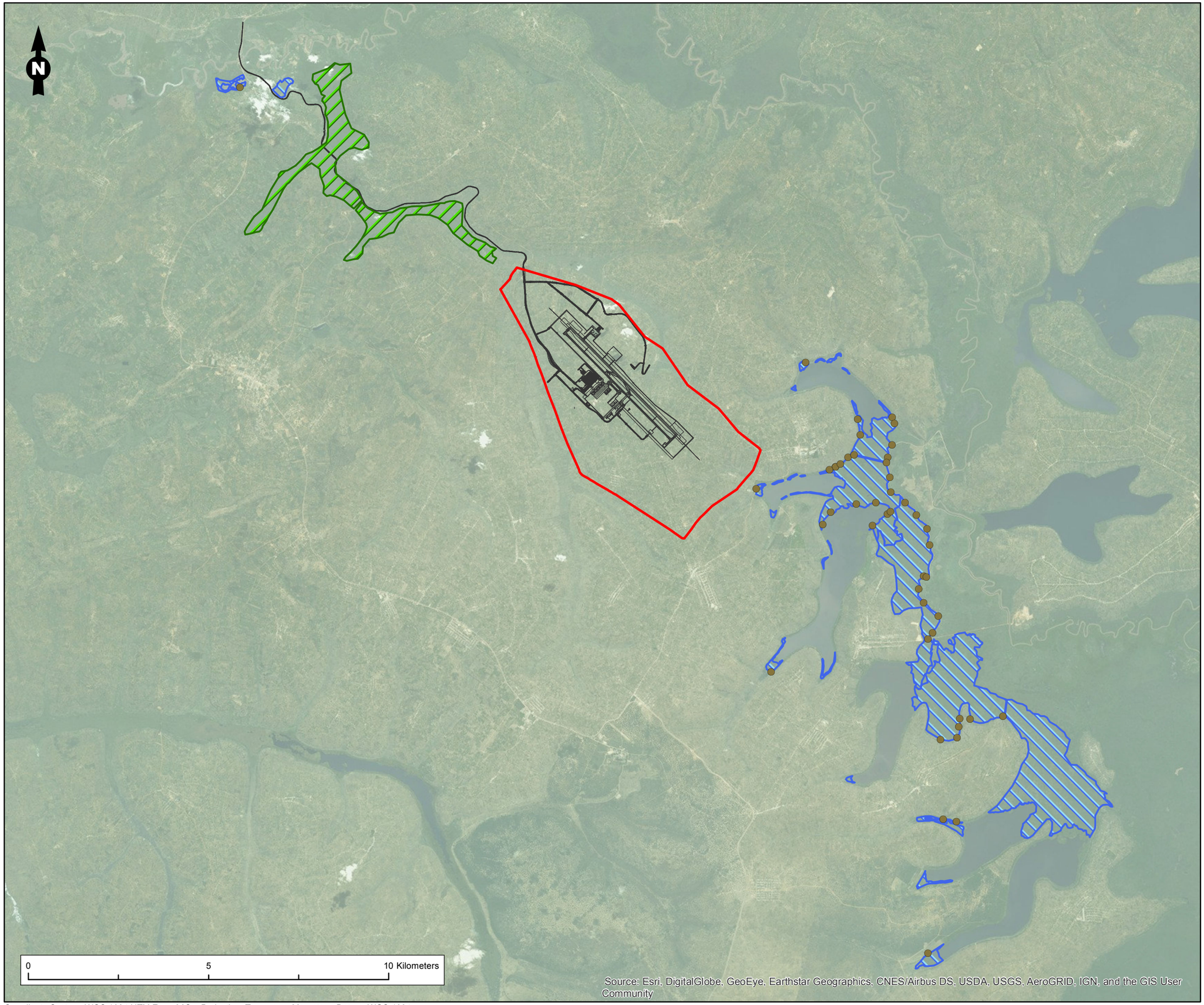
Project Name
New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	Prepared By
November 2017	AC
Scale	Issue
1:100,000 @A3	B

Client **Bugesera Airport Company Limited**

RAMBOLL ENVIRON

Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.



Legend

- Airport Site Boundary
- Typha Swamp
- Papyrus Swamp

Swamp Birds

- Papyrus Gonolek

Figure Title

Location of Papyrus Gonolek

Project Name

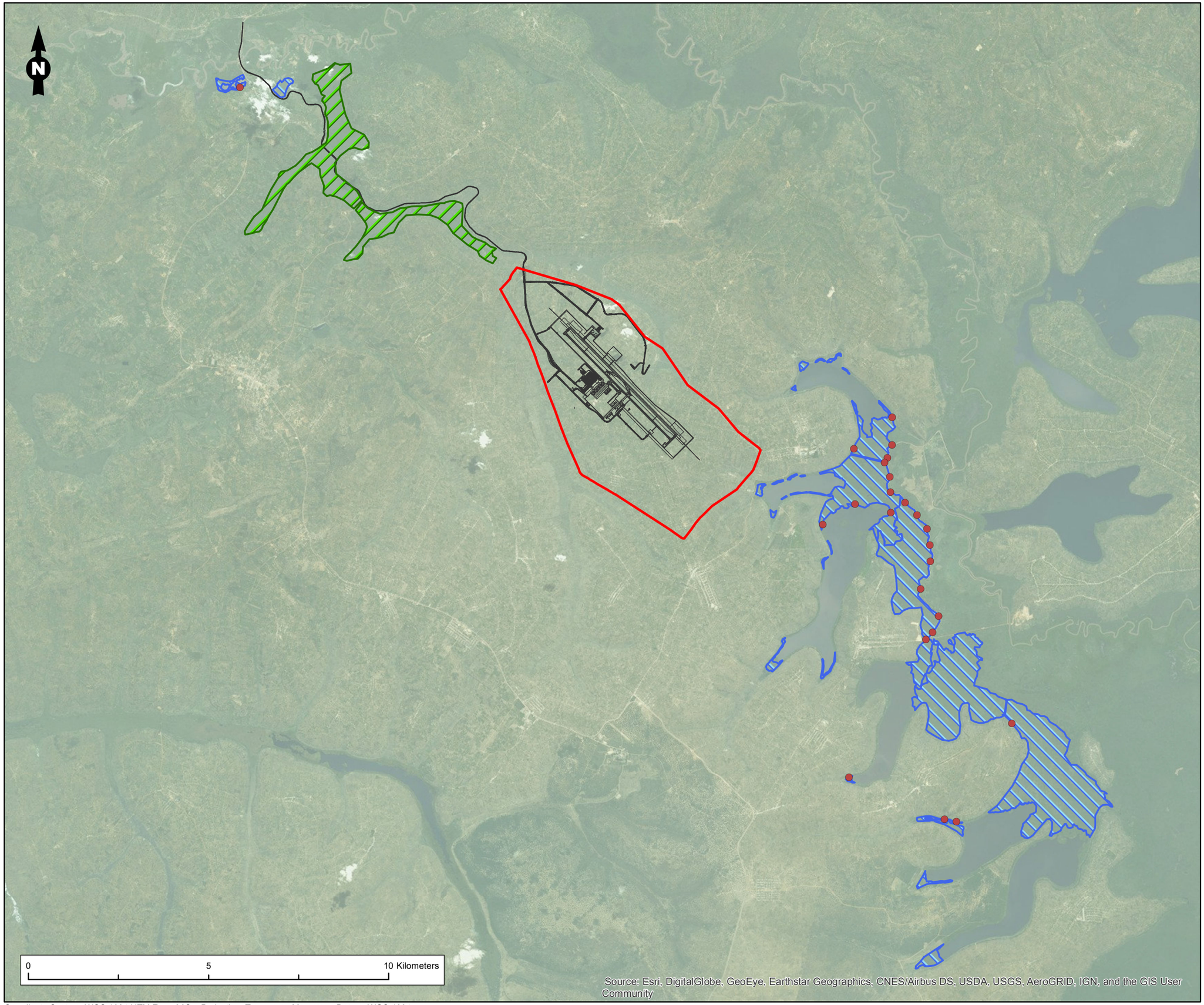
New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	Prepared By
November 2017	AC
Scale	Issue
1:100,000 @A3	B

Client **Bugesera Airport Company Limited**

RAMBOLL ENVIRON

Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.



Legend

- Airport Site Boundary
- Typha Swamp
- Papyrus Swamp

Swamp Birds

- Carruthers's Cisticola

Figure Title

Location of Carruthers's Cisticola

Project Name

New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	Prepared By
November 2017	AC
Scale	Issue
1:100,000 @A3	B

Client **Bugesera Airport Company Limited**

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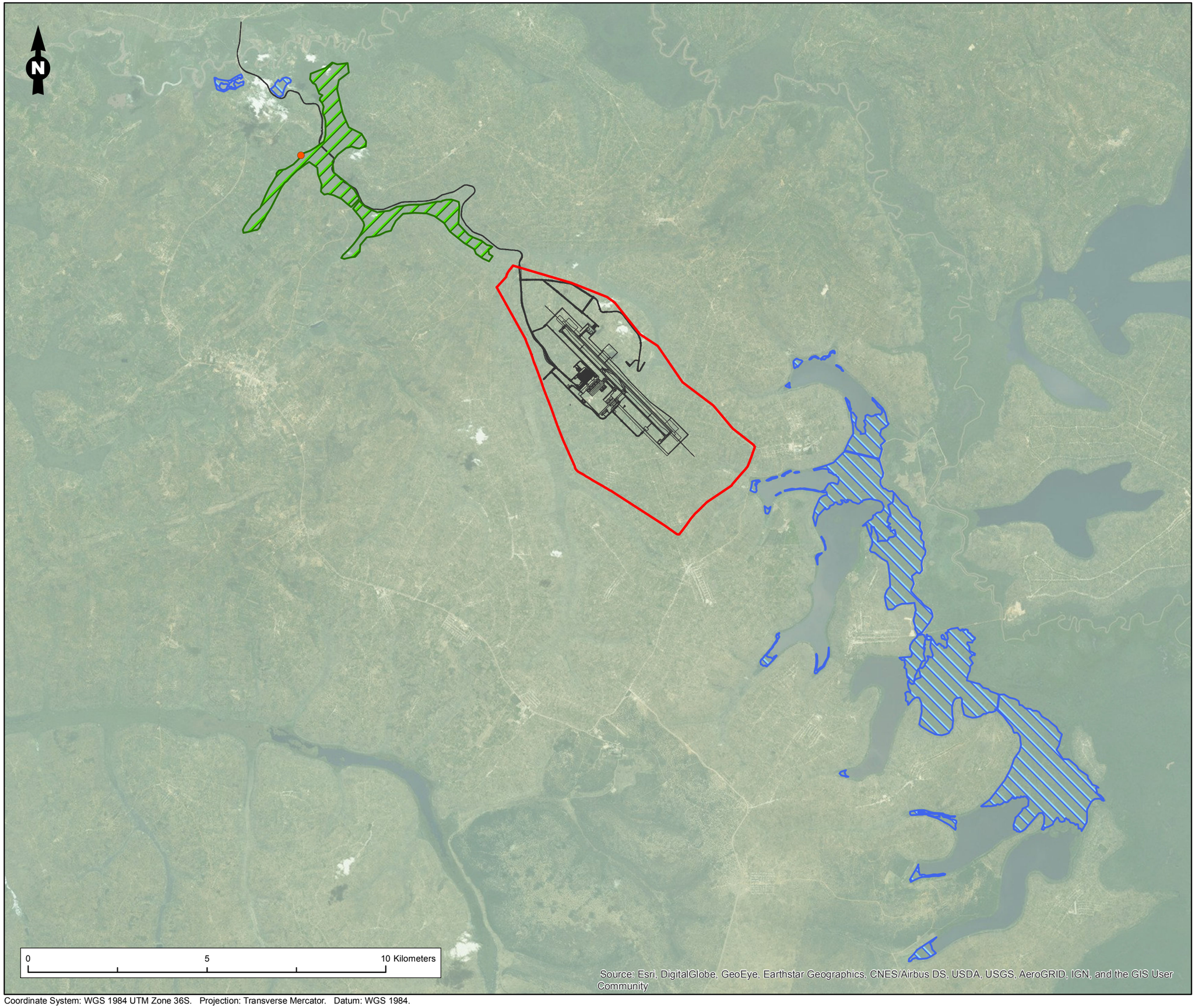
Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.



Legend

- Airport Site Boundary
- Typha Swamp
- Papyrus Swamp

Swamp Birds

- Payrus Yellow Warbler

Figure Title

Location of Payrus Yellow Warbler

Project Name

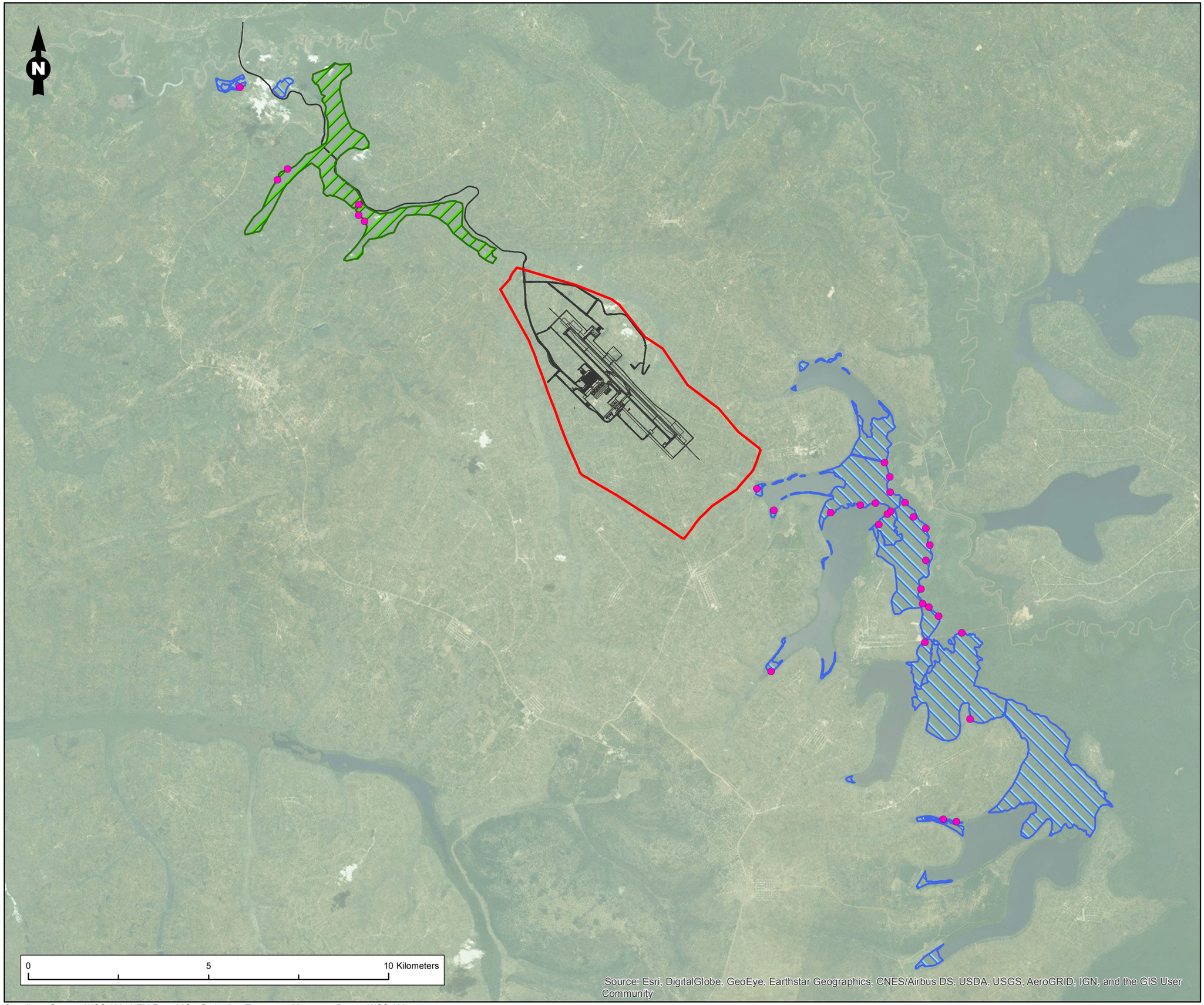
New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	Prepared By
November 2017	AC
Scale	Issue
1:100,000 @A3	A

Client **Bugesera Airport Company Limited**

RAMBOLL ENVIRON

Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.



Legend

- Airport Site Boundary
- Typha Swamp
- Papyrus Swamp

Swamp Birds

- White-winged Swamp-warbler

Figure Title

Location of White-winged Swamp-warbler

Project Name

New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	Prepared By
November 2017	AC
Scale	Issue
1:100,000 @A3	B

Client **Bugesera Airport Company Limited**

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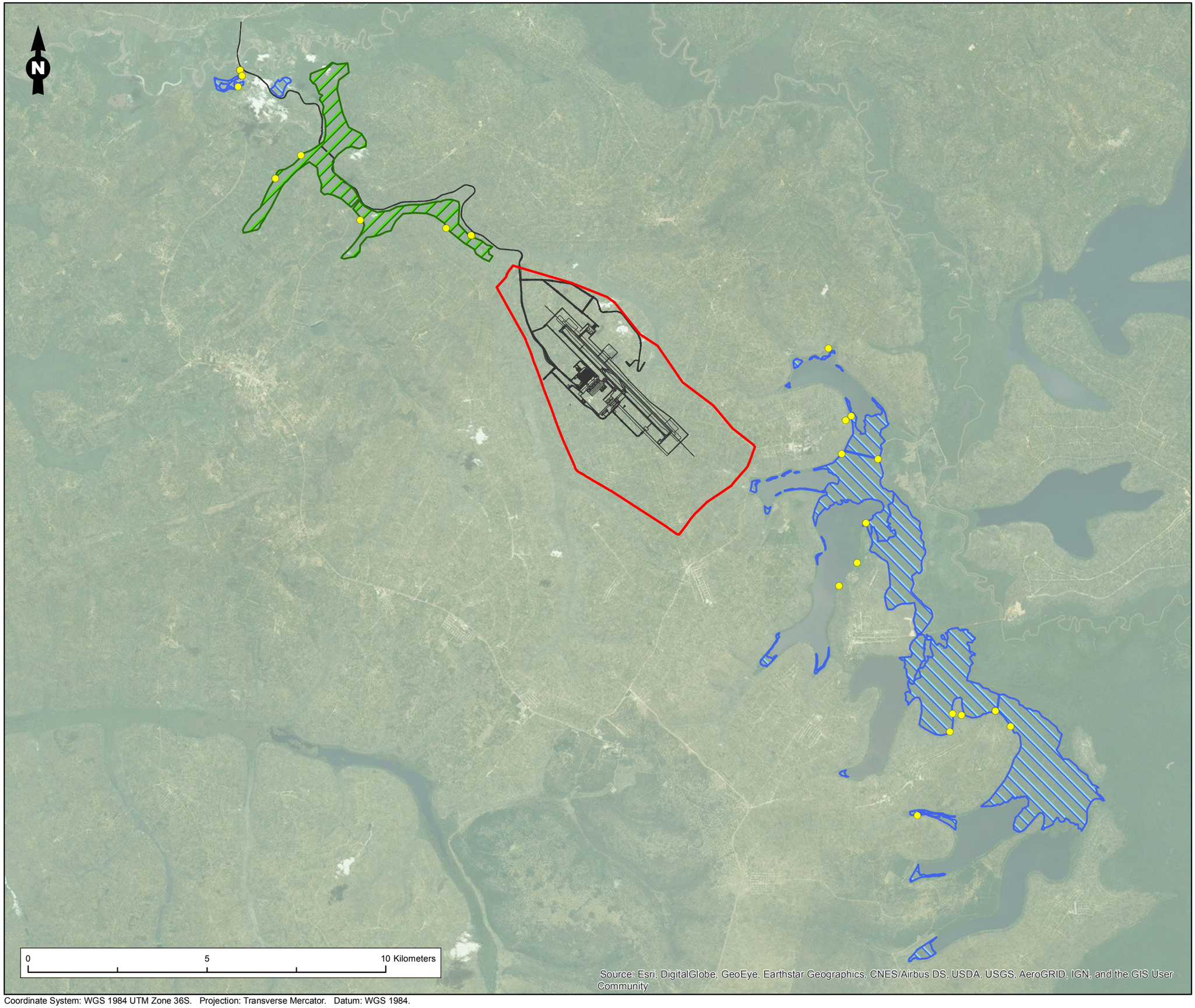
Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.



Legend

- Airport Site Boundary
- Typha Swamp
- Papyrus Swamp

Swamp Birds

- Black-lored Babbler

Figure Title

Location of Black-lored Babbler

Project Name

New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	**Prepared By**
November 2017	AC
Scale	**Issue**
1:100,000 @A3	B

Client **Bugesera Airport Company Limited**

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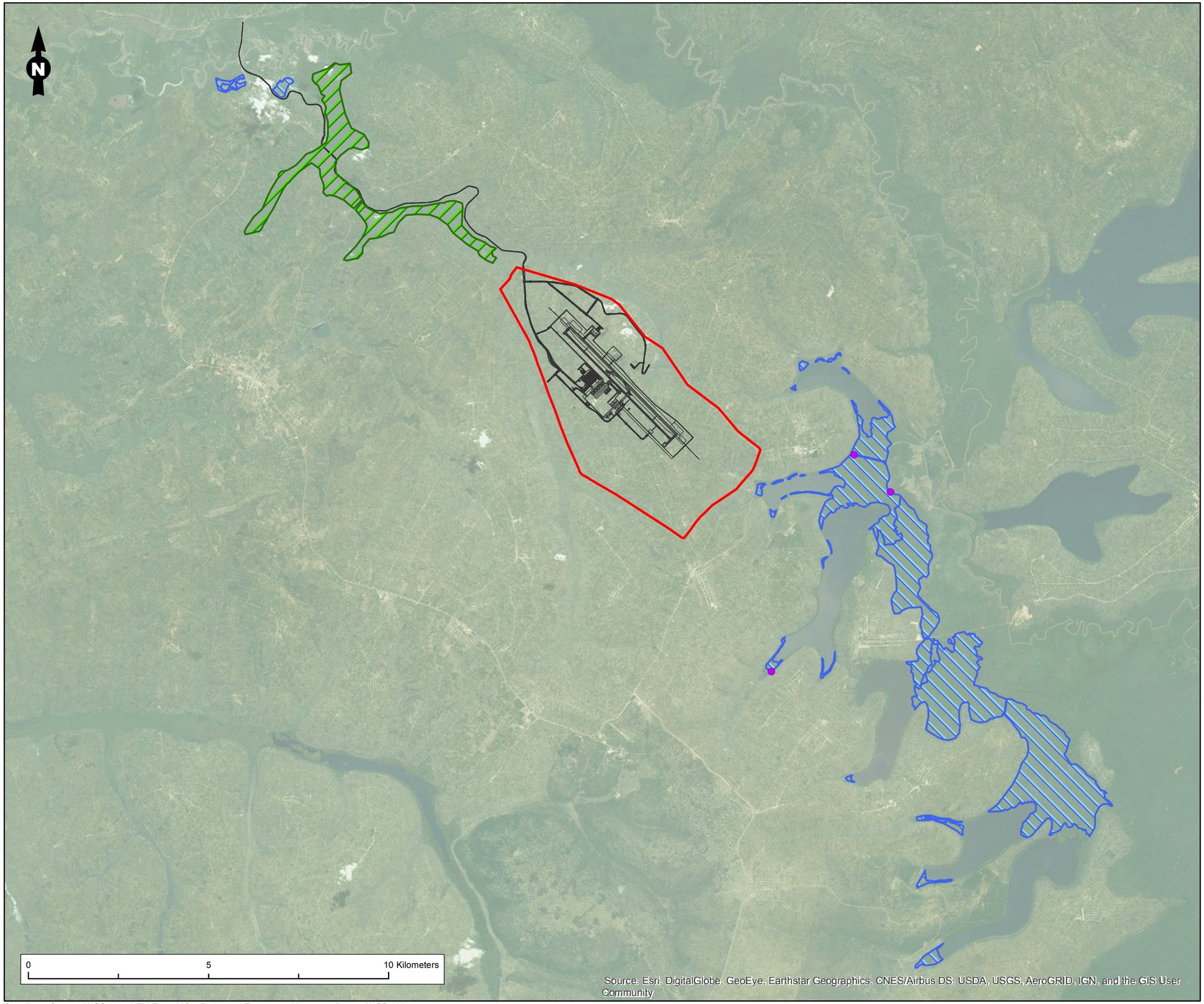
Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.



Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.

Legend

- Airport Site Boundary
- Typha Swamp
- Papyrus Swamp

Swamp Birds

- Northern Brown-throated Weaver

Figure Title
Location of Northern Brown-throated Weaver

Project Name
New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	Prepared By
November 2017	AC
Scale	Issue
1:100,000 @A3	A

Client **Bugesera Airport Company Limited**

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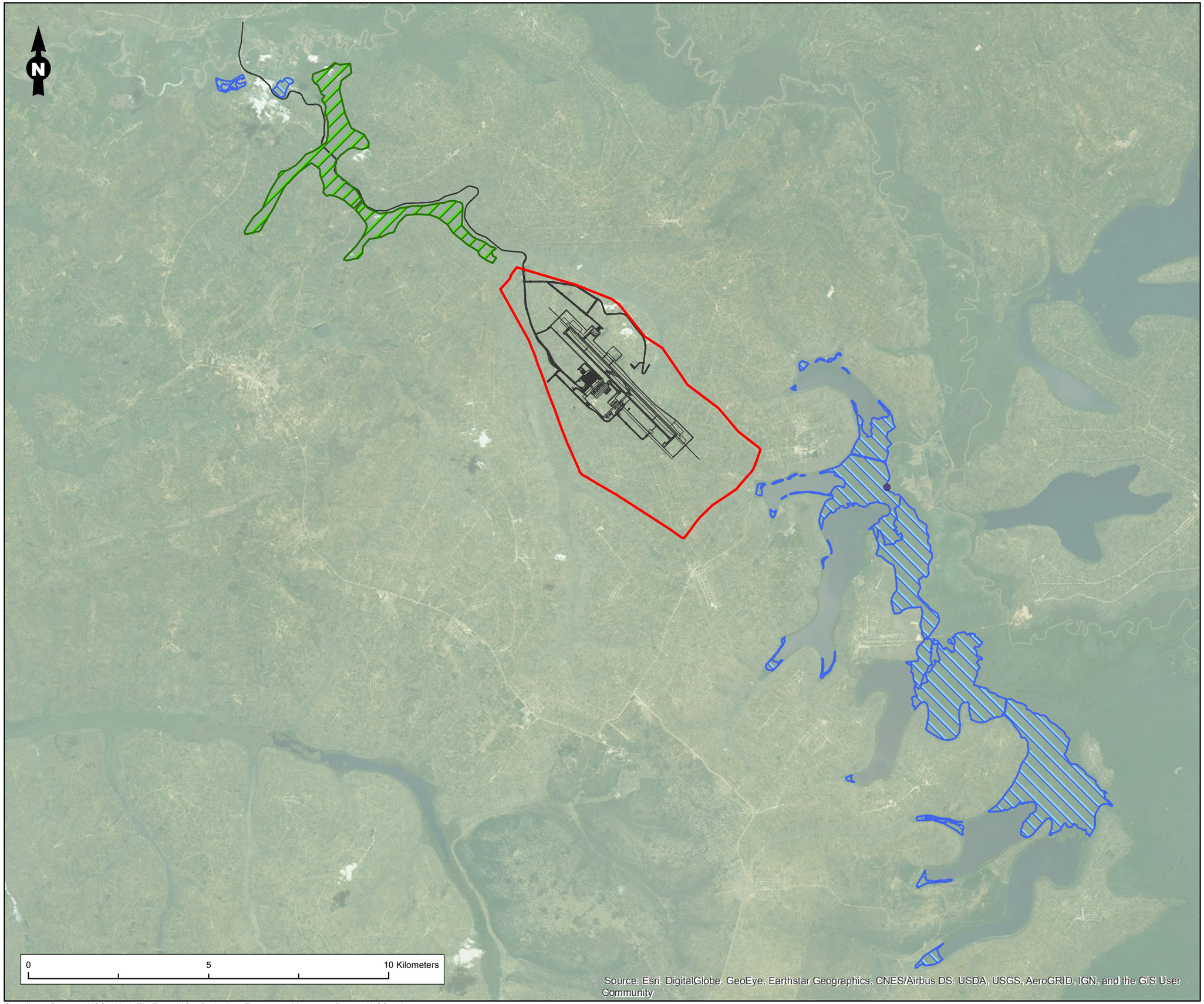

Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.

Legend

- Airport Site Boundary
- Typha Swamp
- Papyrus Swamp

Swamp Birds

- Papyrus Canary

Figure Title
Location of Papyrus Canary

Project Name
New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	**Prepared By**
November 2017	AC
Scale	**Issue**
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Client **Bugesera Airport Company Limited**

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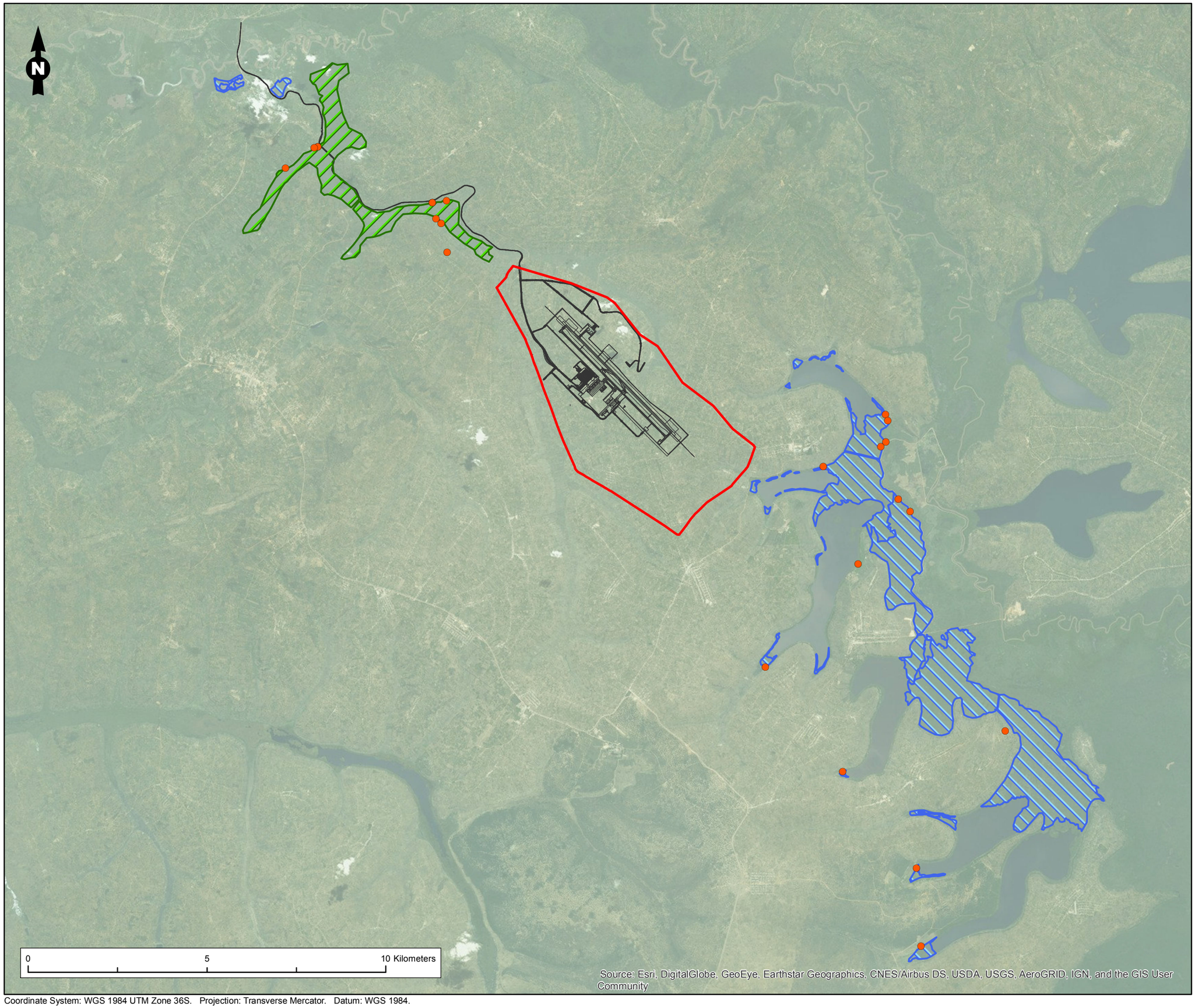

Legend

- Airport Site Boundary
- Typha Swamp
- Papyrus Swamp

Swamp Birds

- Red-chested Sunbird

Figure Title
Location of Red-chested Sunbird

Project Name
New Bugesera International Airport ESIA

Project Number	Figure No.
UK11-24483	
Date	Prepared By
November 2017	AC
Scale	Issue
1:100,000 @A3	B

Client **Bugesera Airport Company Limited**

RAMBOLL ENVIRON

Coordinate System: WGS 1984 UTM Zone 36S. Projection: Transverse Mercator. Datum: WGS 1984.

APPENDIX 3
AUTOMATED IMAGE CLASSIFICATION METHODOLOGY

Automated Image Classification Methodology

To inform the production of this BAP, particularly to provide an accurate estimate of background rates of loss as part of the calculation of compensation requirements, an automated image classification process was completed to define the boundaries of papyrus and typha wetlands within the area of analysis in 2002, 2007 and 2017. This process used data inputs from the Landsat 7 and 8 satellites and the Shuttle Radar Topography Mission (SRTM) and was trained using information obtained during site visits and by review of high-resolution satellite imagery. The output from the automated process was a series of maps classifying all locations within the area of interest as either papyrus/typha swamp or non-swamp at a 30-meter pixel resolution. Landsat imagery was one data input to the classification process. Landsat is the longest continuously acquired set of global satellite imagery. Imagery data with a 30-meter resolution is available dating from the early 1970s. Over time, a number of different Landsat satellites have been launched, with Landsat 7 and 8 currently active. Data from Landsat 7 was used as an input to analyses for 2002 and 2007, with data from Landsat 8 used for 2013 and 2017 (Landsat 8 was launched in early 2013). Landsat collects data in the visual, infrared, and thermal portions of the electromagnetic spectrum. Based on earlier work and a preliminary analysis of the area east of Lake Mugesera, the blue (0.45 - 0.52 µm for Landsat 7; 0.45 - 0.51 µm for Landsat 8), near infrared (0.77 - 0.9 µm; 0.85 - 0.88 µm), and shortwave infrared (1.55 - 1.75 µm 7; 1.57 - 1.65 µm) bands were found to be most useful for identifying papyrus and typha wetlands. Landsat satellites cross over each location on Earth approximately every 16 days, but, due to cloud cover, many of the collected images are not useful for classification. In order to improve analytical consistency from year to year and maximize the expected difference between wetland vegetation and other vegetation, imagery collected during the local dry season was used for the classification. Whenever possible, data from mid-July to mid-August was used. For the final analyses, data were used from 17 August 2002, 14 July 2007 and 1 July / 18 August 2017. Data from two overflights were used in 2017 due to clouds covering a portion of the area of analysis in each available flight.

To provide additional information to differentiate wetland vegetation from upland vegetation and terraced fields, elevation data from the SRTM in 2000 was also used in the model. The SRTM provides elevation data for nearly the entire Earth at a 1 arc-second resolution (approximately 30-meters, which is a good match for Landsat). In addition to raw elevation data from SRTM, percentage slopes were derived from the SRTM data and used as model inputs. In summary, classification model inputs for each pixel in the area of analysis were reflectance of blue, near infrared, and shortwave infrared light, elevation, and percentage slope.

Once the model inputs were obtained, training areas were identified within the area of analysis, based on observations during site visits or review of high resolution visible imagery available from Google Earth and/or ArcGIS imagery services. Training areas are locations known to be papyrus or typha swamp or non-swamps (e.g., rice paddies, sugar cane fields, other agricultural fields, water, built areas). Where possible, the same training areas were used for each year of the analysis, though changes in vegetation type and or presence of small clouds or cloud shadows required changes in some years.

Data from all five variables were used as inputs to a maximum likelihood classification model. As a first step, the number of cells, mean value, variance, and covariance matrix was calculated for each variable for each set of training samples. For all years except 2017, three classes were used in the model, papyrus/typha swamp, water, and other. For 2017, five training classes (papyrus/typha swamp; water; sugar cane, rice paddies, and other lowland fields; terraced fields; and other) were used to improve the specificity of the classification model, particularly for sugar cane vs. wetland vegetation. This was required due to the rising surface area of fields in former wetland areas in 2017. For the earlier years, agricultural field areas in the wetlands were relatively limited and use of the additional classes was not necessary for the model to

successfully delineate field areas from marshes (given the strong association of wetlands to elevation and slope in the earlier models, along with the visible and infrared data). The statistics of the selected classes were reviewed to verify that the classes were discernible from one another, and a sensitivity analysis was performed to determine whether the addition of further classes in 2017 (e.g., separating rice, sugar cane, and other lowland fields) affected model results. Classes were confirmed to be sufficiently different from one another across the five combined variables. The sensitivity analysis confirmed that use of additional classes in 2017 would not result in appreciably different characterisation of papyrus/typha area, though it did result in more accurate classification of agricultural field types. The model with fewer classes was retained for 2017 as it appeared (based on a review of high resolution aerial imagery) to more accurately delineate marshes in those areas where the default model and test model boundaries differed.

Once multivariate statistics were calculated for the training areas, the value of the five variables was identified for each 30-meter by 30-meter pixel within the area of analysis, and a probability analysis was run to determine which class each pixel was most likely to belong to. For purposes of this model, no a priori probability differentiation was assumed; each pixel was given an equal likelihood of being in any class. Once the classification was completed, a number of image generalization tools were run to remove isolated pixels that may be result of sensor error or unusual reflectance, and to generate smoother, more natural boundaries. Image generalization discriminated against small areas with a surface area less than 4.5 hectares; such areas were converted to the surrounding classification(s). This would tend to remove small areas of discontinuous marsh.

Known limitations of the models include cloud cover over the marsh area south of Kanombe in both available imagery sets for 2017. As a result, the 2017 model does not include swamp classification in this area, though swamps are potentially present, based on review of high resolution aerial imagery. In addition, the 2017 model tends to identify stressed papyrus vegetation (as identified based on reduced infrared reflectance, a common marker of vegetation stress) as non-swamp land. This can be seen most significantly in the marshes east of Gasenyi, where former marsh areas are under development. Remaining marshes in this area (somewhat more than 150 hectares) appear to be stressed and are not classified as marsh by the model. This can also be seen in other, smaller marsh areas.

APPENDIX 4
POTENTIAL ADDITIONAL CONSERVATION INTERVENTIONS FOR NINGU

Potential Additional Conservation Interventions

Specific action in relation to Ningu would only be developed further only if Ningu is confirmed to be present by the fish study completed and if significant residual impacts are confirmed. It is envisaged that any additional conservation interventions would be integrated into the CNRMP described under the IBA Action Plan. Based on a review of the documented threats faced by Ningu and the limited existing conservation actions currently being employed, a could form the basis of additional conservation interventions. The potential applicability of each of these are discussed further in the following sub-sections. The feasibility of each of these options would be assessed as a detailed strategy is developed for Ningu.

- Protected Areas / Legislation

At the current time there is no Rwandan legislation that specifically targets the conservation of Ningu. For example, *Ministerial Order N° 007/2008 of 15/08/2008: Establishing the List of Protected Animal and Plant Species* does not include protection for any fish species. However, a number of laws provide measures of potential indirect benefit, such as *Ministerial Order determining the length of land on shores of lakes and rivers transferred to public property* (N° 007/16.01 of 15/07/2010), which sets the boundary for development and settlement activities next to water bodies.

This Order aims at setting aside the length of land on shores of lakes and rivers affected in the public domain for environmental protection. The land within a distance of 50 m from the lakeshore, and the land within a distance of 10 m and 5 m from the shore of big rivers and small rivers respectively is public property and potentially helps to protect the bankside habitats of waterbodies. The *Prime Minister's Order N° 006/03 of 30/01/2017, drawing up a List of Swamp Lands, their Characteristics and Boundaries and Determining Modalities of their Use, Development and Management* focusses on the protection of wetlands and swamps through the country.

Although the Order does not cover the lakes, it does list a number of wetlands in Bugesera District as proposed Ramsar Sites with management prescribed as *Use under specific conditions*. It is understood that the Ramsar designation process of assessing the status to support its designation under Ramsar convention began in November 2017 (ACNR *pers comm*). There are a number of Ramsar criteria that could be applied in the assessment of the lakes associated with the wetlands already proposed as Ramsar sites, include two that relate specifically to fish[82]:

- Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities;
- Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity; and
- Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

The designation of protected areas and associated legislation is the responsibility of Government. However, the Project would make best endeavours through stakeholder engagement to promote the protection of Ningu by the Government of Rwanda.

- Fisheries Management

[82] The Ramsar Sites Criteria, available for download at https://www.ramsar.org/sites/default/files/documents/library/ramsarsites_criteria_eng.pdf

Any significant benefit of legislation or protected area status to Ningu populations are only likely to occur if they lead to some form of restriction or management of fishing. According the MINAGRI master plan for fisheries and fish farming, open access to fisheries resources, the use of illegal gears, and excessive fishing capacity have been the major driving forces behind degradation of fish populations in Rwanda. Furthermore, low compliance to fisheries laws are a major challenge in the management of fisheries. Within Lake Victoria, low compliance to fishery laws are explained by a shortage of manpower, financial and logistical constraints, lack of awareness within the fisheries communities, and inadequate capacity within enforcement agencies (AU-IBAR, 2016)[83]. Awareness campaigns, improvement in information exchange, greater involvement of the community in management and capacity building through training could all help to improve fisheries management. These could be included within the CRNMP.

The fisheries masterplan for Rwanda recommends that fisheries move away from open access to concessionaire fishing, where an investor maintains a sustainable stock by harvesting what is scientifically acceptable. According to the masterplan the concessions should include defining of user rights, ownership of resources, access and management of water bodies, and concessions for effective development and management of the fisheries resources in the lake. It is not currently known to what extent the masterplan has been or is likely to be implemented in Bugesera or elsewhere in Rwanda. The Bugesera District Plan 2013-1028, includes the promotion of fishing in its strategic framework, recommending that private investment should be attracted to develop fish catching and farming. No mention is made in the District Plan of sustainable management or protection of stocks. However, it does suggest that there is Government-level and District support for improved fisheries management and that it is possible that the Project could make best endeavours through stakeholder engagement to promote better fisheries management within the Project AOI.

- Controlling Non-Native Fish Species

The impact on Ningu populations within the Project AOI from non-native species is not known, although it is unlikely to be positive. It is likely to be unfeasible to eliminate non-native species from waterbodies entirely and this could have unreasonable impacts on the livelihoods of local fishermen that may depend on them. However, in combination with improved fisheries management, it may be possible to improve the balance in fish populations to improve native fish-stocks at the same time as reduce non-native stocks.

- Habitat Protection

The action plan for the Nyabarongo Wetlands IBA aims to protect and enhance the relevant bird assemblage populations that triggers the IBA designation. This will be achieved through focussing on the native swamp and aquatic habitats that support these wetland bird species. Ogutu-Ohwayo, (undated) suggests that papyrus acts as a refugia for native fish as non-native Nile perch cannot survive under low oxygen conditions found in papyrus swamps, and that they also serve as barriers to movement of Nile perch between adjacent water bodies. Studies have also shown that papyrus swamps play an important role in reducing eutrophication and providing a buffer from run-off from adjacent areas (Bavor and Waters, 2008[84], Kiwango and Wolanski, 2008)[85]. Therefore, protection of wetlands through the Nyabarongo Wetlands IBA Action Plan will also likely to provide gains for Ningu as well.

[83] AU-IBAR (2016) Fisheries Management and Development Processes in Lake Victoria - Enhancing Regional Fisheries Management Plan. AU-IBAR Reports

[84] Bavor H.J., Waters M.T. (2008) Buffering Performance in a Papyrus-Dominated Wetland System of the Kenyan Portion of the Lake Victoria Basin. In: Vymazal J. (eds) Wastewater Treatment, Plant Dynamics and Management in Constructed and Natural Wetlands. Springer, Dordrecht

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- Captive Breeding

Most of the studies on captive breeding of Ningu have been with the view of exploring its potential for aquaculture. Artificial rearing of fish populations in captivity is not appropriate as a biodiversity offset in its own right. However, (Sagwe Orina *et al.,* 2014)[86] has suggested that captive breeding could be used to supply the existing consumer demand and could reduce fishing pressure to allow wild population recovery. According to the Rwandan masterplan for fisheries, the lakes within the Project AOI are largely unsuitable for cage culture as they are too shallow and lack sandy bottoms. Instead, it suggests that land based aquaculture in tanks and raceways are an alternative to in-lake culture. The use of captive breed stock release to replenish depleted wild stocks has not been assessed. However, this would only likely to be successful if completed in combination with wider improvements to fisheries management.

DOI 10.1007/s11273-007-9072-4

[86] Sagwe Orina, P, Rasowo, J., Gichana, E., Maranga, B., and Charo-Karisa, H. (2014) Artificial Breeding Protocol and Optimal Breeding Environment for Labeo victorianus (Boulenger, 1901). International Journal of Fisheries and Aquatic Studies 2014; 1(6): 138-143