APPENDIX F
Wetland Baseline Assessment Report

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REPORT ON

WETLAND BASELINE ASSESSMENT FOR THE PROPOSED SOVEREIGN METALS MALIGUNDE FLAKE GRAPHITE PROJECT NEAR LILONGWE, MALAWI

Report Number: 2017/033/02/02

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EXECUTIVE SUMMARY

Hudson Ecology Pty Ltd was appointed by Sovereign Metals Limited ("Sovereign" or "Sovereign Metals") to conduct a wetland ecology scoping assessment for the proposed Malingunde Project ("the Project" or "Project"). The Project will involve the extraction of the flake graphite deposit near the settlement of Malingunde, south west of Lilongwe in Malawi. This report describes the results of the wetland scoping level assessment conducted during April 2017.

Three wetlands (dambos) are located in close proximity to the proposed development. Only one of these falls within the development footprint and two are located outside of the development footprint. All of the dambos investigated show moderate to extreme degradation, with the dambo inside the proposed development area being characterised as completely transformed.

The main causes of disturbance within the study area are soil disturbance, grazing, agriculture and the presence of alien vegetation. The mechanisms through which these disturbances impact upon the wetlands, in the study area, are numerous and can be summarised as follows:

- Transformation through agricultural practices, most notably through the loss of natural vegetation, results in a loss of habitats and connectivity within wetlands and obstructs or reduces the functionality of wetland systems.
- Increase in surface runoff due to a reduction in the basal cover and increase in hardened surfaces adjacent to, and within the wetlands causes an increase in erosion and changes the run-off characteristics in wetland systems.
- The use of temporary zones of wetland areas as cultivated land for commercial crop species removes all indigenous vegetation associated with the wetlands in these areas and decreases the surface roughness and basal cover within the wetlands. All these factors result in a large change in ecosystem processes and loss of natural habitat and biota.

The hydrology of the wetlands has been mainly impacted by the presence of impoundments which alter the drainage pattern within the wetlands. In addition, these dams are used for irrigation purposes. The presence of roads located adjacent to the wetlands, as well as those traversing the wetlands, has resulted in increased water input within the wetlands. The presence of roads has resulted in moderate modification of the sediment regime of the wetland features. In addition, the wetlands have been subjected to high sediment load deposition from the surrounding agricultural activities. As a result of this activity, the soil profile along the wetland boundaries has been altered.

The monitoring sites along the Lilongwe River adjacent to the study area show varying degrees of impacts, with the sites further upstream showing lower degrees of degradation. The main impacts recorded at the study sites are vegetation removal for the purposes of agriculture, introduction of exotic species and impoundments due to the construction of bridges and weirs. The construction of the Kamuzu Dam has also influenced the flow regime of the Lilongwe River downstream of the dam.

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1 INTRODUCTION

Hudson Ecology Pty Ltd was appointed by Sovereign Metals Limited ("Sovereign" or "Sovereign Metals") to conduct a wetland ecology assessment for the proposed Malingunde Project ("the Project" or "Project"). The Project will involve the extraction of the flake graphite deposit near the settlement of Malingunde, south west of Lilongwe in Malawi.

The Malingunde deposit is a substantial "saprolite-hosted" flake graphite deposit. Graphite mineralisation has been defined over a 3.4 km strike length with a cumulative across strike widths locally exceeding 200 m and averaging around 120 m. The graphite bearing host units are predominantly weathered feldspar-quartz-graphite gneisses. Depth of weathering (i.e. the base of the saprolite zone) is generally between 18-28 m vertically from surface. The major effect of weathering is the alteration of primary feldspar minerals to clays (predominantly kaolinite) and minor primary sulphides to iron oxyhydroxides. This has resulted in a significant decrease in the mechanical strength (competency) of the primary rock mass. The dominant minerals of quartz and graphite remain inert during the weathering process.

Malingunde is particularly significant for Sovereign as it is hosted within weathered, soft saprolite (clay) material. Saprolite-hosted flake graphite mining operations, similar to those in China and Madagascar, usually have significant cost and environmental advantages over hard rock mining operations due to:

- The free-dig nature and very low strip ratios of the near surface mineralised material;
- Simple processing, generally with no primary crushing and grinding circuit resulting in large capital and operating cost advantages;
- The preservation of coarse flakes in the weathering profile due to graphite's chemically inert properties; and
- The absence of sulphides offers substantial tailings and waste management advantages.

2 OBJECTIVES

Sovereign commenced the formal Environmental and Social Impact Assessment (ESIA) process, in compliance with Malawian legislative requirements, during the second half of 2017. The ESIA for the Project will adhere to generally accepted international standards and best practice, particularly those prescribed by the International Finance Corporation (IFC) Performance Standards and the Equator Principles. In accordance with these requirements, the baseline studies of biodiversity resources provide a reference point against which any future changes associated with a project can be assessed and offer information for subsequent monitoring of biodiversity performance. The baseline study identified (both in the immediate and wider area around a project site) habitats that will be affected, the range and status of the main species groups that live in the area, the potential presence and status of protected areas or other important areas for biodiversity, and any potential impacts to ecosystem services that might have local, regional or global impacts.

3 SCOPE OF WORK

In order to reach the objectives outlined in section 2, the scope of work for the wetland ecology assessment included the following:

- An extensive literature review in order to determine the expected bioregions, vegetation types and wetland fauna and flora associated with the study area;
- Three field surveys, conducted during April 2017, from 11–25 October 2017 and augmented by data collected during a study conducted from the 12th to the 18th of April 2018, in order to determine:
  - The local study area, i.e. the area to be affected by the proposed Project (including the Project footprint and surrounding areas likely to be impacted by the Project);
  - The current ecological status of the receiving environment, with reference to wetland ecological systems, associated with the study area;
  - The species of flora and fauna extant within the wetlands;
  - Present Ecological Status (PES) and Ecological Importance and Sensitivity (EIS) of the wetlands likely to be affected by the development
  - The presence or absence of species of conservation importance within the wetlands, likely to be affected by the proposed Project;

4 DATA AND INFORMATION SOURCES

4.1 Information sources

A number of books, peer-reviewed scientific journal articles, field guides, official databases, previous studies and official internet sources were used as information sources for the purposes of this study. Furthermore, information was obtained from discussions with local inhabitants of the area.

4.2 Primary Data

Primary data for the purposes of this study were collected during the field surveys conducted during April 2017. Data were collected using accepted scientific methodologies and due care was taken during the collection of said data in order to ensure repeatability of the data collection. The Precautionary Principle (COMEST, 2005) was considered during the analysis and interpretation of the data collected.

4.3 Secondary Data

Secondary data were obtained from previous studies conducted in the area. These data were not utilised for the purposes of the report as such, but as a precautionary measure to assure the accuracy of the data collected and well as the accuracy of species identifications.

5 APPROACH

The approach followed to undertake this baseline assessment was as follows:

Step 1: Thoroughly review relevant literature in order to obtain a theoretical understanding of the receiving environment in which the Project is envisaged to take place.

Step 2: Confirm relevant national and international regulatory requirements, and World Bank and IFC best practice standards to be addressed during the ecological studies (IFC Performance Standard 6).

Step 3: Using knowledge of the Project and information obtained through the literature review, and scoping assessment to provide a detailed description of the study area.

Step 4: Conduct a wetland biodiversity baseline level assessment of the study area, in order to confirm information obtained through the literature review and scoping report and collect primary data regarding the study area as defined in step 3.

Step 5: Prepare a wetland baseline biodiversity report outlining the results of the literature review and field surveys conducted in step 4, with regards to:

- Mapping: Ground-truthing and mapping the study area. Based on the final mapping of the study area and data obtained during the field assessments, the study area was refined and mapped based on habitat types (vegetation communities).
- Biodiversity: A baseline level description of fauna and flora associated with each of the wetland habitat types (vegetation communities), for purposes of determining the sensitivity of the habitat types to possible impacts by the proposed development.

6 POLICY, LEGISLATIVE AND ADMINISTRATIVE FRAMEWORK

6.1 ESIA Compliance

Sovereign is committed to conduct its activities in full compliance to the requirements of national regulations, its obligations under international conventions and treaties and giving due consideration to international best practices and policies. For this reason, this scoping report, as part of the ESIA process, has been developed so as to comply with the laws and decrees of the Republic of Malawi and international conventions and treaties, and additionally to comply with international best practice standards.

6.1.1 Malawi Regulatory Framework

The Constitution of the Republic of Malawi, 1994 and as amended, and further national laws and regulations, form the basis of requirements for development of projects such as the proposed Malingunde Flake Graphite Project. The ESIA process in Malawi is based on the principles in the 1992 Rio Declaration on Environment and Development and the legislative requirements of the Environment Management Act, 2017 as well as the guidelines of 1996. By signing the Rio Declaration on

Environment and Development, Malawi has committed, among other things, to Principle 17: 'Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment and are subject to a decision of a competent national authority'. The Environment Management Act outlines an ESIA process for Malawi and requires project developers to comply with that process. The process is managed by the Director of Environmental Affairs (DEA) in the Environmental Affairs Department (EAD). The Act specifies that the types and sizes of projects subject to ESIA be prescribed and gazetted. Accordingly, the Project activities are subject to approval under the terms of the Environment Management Act. As such, the ESIA will be undertaken in strict accordance with this regulatory framework, as well as the Environmental Affairs Department's ESIA Guidelines.

6.1.2 International Standards and Guidelines

The Project will comply with the standards of the World Bank and the International Finance Corporation (IFC). Policies and guidelines related to these organisations provide additional environmental and social safeguards and an opportunity to maximise the project benefits to the people of Malawi, while minimising any adverse impact, through compliance with these international best practice standards. The World Bank provides guidance on ESIA requirements through the Environmental Assessment Sourcebook (World Bank, 1991) which includes sectoral guidelines. The World Bank process is implemented through a set of Operational Policies/Procedures. The primary objective is to ensure that Bank operations do not cause adverse impacts and that they "do no harm". The IFC is a member of the World Bank Group, providing finance and development advice for private sector ventures and projects in developing countries. Their Performance Standards on Environmental and Social Sustainability (IFC, 2012) and Environmental, Health and Safety (EHS) Guidelines (IFC, 2007) provide further guidance as a framework when implementing the practical Malawi national legislative and regulatory provisions, and the World Bank Operational Policies.

6.1.3 International Agreements

Malawi is party to a number of internationally acceptable policies, conventions, treaties and protocols, which are relevant to the Project. These agreements serve as the principal framework for international co-operation and collaboration between members of the international community in their efforts to protect the local, regional and global environment. Malawi is bound to the provisions of an international agreement/law only if it signs and submits instruments of ratification in respect of a particular agreement.

6.2 Summary of EIA Regulatory Requirements

A listing of Malawi regulatory and policy requirements, as well as International provisions, relevant to the ecological studies, is provided in Table 1. Details are provided in the subsequent sections.

Table 1: A listing of Malawi regulatory and, policy requirements and International provisions

MALAWI LEGISLATION AND POLICIES	
Legislation	
▪ Constitution of the Republic of Malawi (1994) ▪ Environment Management Act (2017) ▪ Land Act (2016)	▪ Fisheries Conservation & Management Act (1997) ▪ Forestry Act (1997) ▪ National Parks and Wildlife Act (2004)
Policies & Guidelines	
▪ National Environmental Policy (2004) ▪ Guidelines for Environmental Impact Assessment (1997) ▪ National Land Policy (2002) ▪ National Water Policy (2005)	▪ National Environmental Action Plan (2002) ▪ National State of Environment Report (2010) ▪ Malawi National Forest Policy (1996) ▪ Other Relevant Malawi Standards
WORLD BANK	
Environmental Assessment Sourcebook (1991)	
Operational Procedures	
▪ OP 4.01: Environmental Assessment ▪ OP 4.36: Forests	▪ OP 4.04: Natural Habitats
IFC PERFORMANCE STANDARDS	
▪ PS1: Assessment and Management of Environmental and Social Risks and Impacts ▪ PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	
INTERNATIONAL AGREEMENTS	

- African Convention on the Conservation of Nature and Natural Resources
- Convention on Wetlands of International Importance (RAMSAR), especially as Waterfowl Habitat
- South African Development Community (SADC) revised Protocol on Shared Watercourses
- SADC Protocol on Forestry
- Zambezi Watercourse Commission (ZAMCOM)
- Other:
  - Rio Declaration, the Convention on Climate Change, the Montreal Protocol, the Convention to Combat Desertification, the Convention on Biodiversity and the Convention on International Trade in Endangered Species of wild fauna and flora (CITES)
  - The Convention on International Plant Protection, The Convention concerning the Protection of World Cultural and Natural Heritage, The Convention on the Conservation of Migratory species of Wild Animals, The FAO International Undertaking on Plant and Genetic Resources, and The Convention on Biological Diversity

6.2.1 The Constitution of the Republic of Malawi, 1995

6.2.1.1 Accountable and Transparent Decision Making

In line with the Constitutional principles set out in section 12 of the Constitution, public participation and consultation is encouraged for projects such as the Malingunde Project. This principle is based on the presumption that, while organised society delegates its affairs to public institutions, the public retain the right to have an input in decision making and enforcement processes, and to expect, as a minimum, transparency in government decision making.

In that way institutions will not assume they are exclusive custodians of power and will ensure accountability in their actions. As in principle (1)(c): "*the authority to exercise power of State is conditional upon the sustained trust of the people of Malawi and that trust can only be maintained through open, accountable and transparent Government and informed democratic choice*".

Further, the Constitution in section 146 establishes local government authorities to represent the people over whom they have authority, and to be responsible for their welfare, and gives them the responsibility of, among other things, promoting infrastructural and economic development through the formulation and execution of local government plans. Consultation at local government level will be required as part of the ESIA process.

6.2.1.2 Sustainable Environmental Management

The Constitution provides a framework for the integration of environmental considerations into development programs. The implication of this provision is that Government, its cooperating partners and the private sector have a responsibility to ensure that development programs and projects are undertaken in an environmentally responsible manner. The State has a constitutional responsibility to ensure that all programs and projects are undertaken in an environmentally sustainable manner.

The Constitution contains principles of national policy in section 13, including that of sustainable environmental management. The section sets out a broad framework for sustainable environmental management at various levels in Malawi. Section 13 provides that the State shall actively promote the welfare and development of the people of Malawi by progressively adopting and implementing policies and legislation aimed at managing the environment responsibly in order to, under section 13(d):

a) Prevent the degradation of the environment;
b) Provide a healthy living and working environment for the people of Malawi;
c) Accord full recognition to the rights of future generations by means of environmental protection and the sustainable development of natural resources; and
d) Conserve and enhance the biological diversity of Malawi.

The goal for rural life under section 13 (e) is: '*To enhance the quality of life in rural communities and to recognize rural standards of living as a key indicator of the success of Government policies*'.

Table 2: Key Constitutional Principles and Relevant Project Objectives

Summary of Key Constitutional Principles and Relevant Project Objectives	
Accountable and transparent decision making	Public consultation and participation
	Public communication strategies
	Local government level consultation
Sustainable environmental management	Maintain or improve healthy living environments
	Conserve or enhance biodiversity
	Protect or improve environmental sustainability
	Enhance rural quality of life as a key indicator of project success

6.2.2 Republic of Malawi National Legislative Framework

6.2.2.1 Environment Management Act (2017)

The Environment Management Act (EMA) (2017) is described as a framework piece of legislation on environmental management, protection and conservation. The Act contains general provisions on protection, management, conservation and sustainable utilisation for almost all forms of environmental media.

31. (1) The Minister may, on the recommendation of the Authority, specify, by notice published in the Gazette, the type and size of a project which shall not be implemented unless an Environmental and Social Impact Assessment is carried out.
    (2) A person shall not undertake any project for which an Environmental and Social Impact Assessment is required without the written approval of the Authority, and except in accordance with any conditions imposed in that approval.
    (3) Any other licensing authority shall not grant a permit or licence for the execution of a project referred to in subsection (1) unless an approval for the project is granted by the Authority, or the grant of the permit or licence is made conditional upon the approval of the Authority being granted.
    (4) The Minister may, on the advice of the Authority, make regulations for the effective administration of Strategic Environmental Assessment, Environmental and Social Impact Assessment and Environmental Audit.
32. (1) The Authority shall, in consultation with such lead agency as it may consider appropriate, carry out or cause to be carried out periodic environmental audits of any project for purposes of enforcing the provisions of this Act.
    (2) The owner of the premises or operator of a project for which an Environmental and Social Impact Assessment has been made shall keep records and make annual reports to the authority describing how far the project conforms in operation with the statements made, in the Environmental and Social Impact Assessment.
    (3) A developer shall take all reasonable measures for mitigating any undesirable effects on the environment arising from the implementation of a project which could not reasonably be foreseen in the process of conducting an Environmental and Social Impact Assessment and shall, within a reasonable time, report to the Authority on the effects and measures taken.
    (4) An inspector may enter any land or premises for the purpose of determining how far the activities carried out on that land or premises conform to the statements made in the Environmental and Social Impact Assessment.
33. (1) The Authority shall, in consultation with any lead agency, monitor-
        (a) all environmental phenomena with a view to making an assessment of any possible changes in the environment and their possible impacts; and
        (b) the operation of any industry, project or activity with a view to determining its immediate and long-term effects on the environment.
    (2) The Authority shall require a developer whose project requires an Environmental and Social Impact Assessment licence to prepare and submit to the Authority, environmental management plans in a form and manner prescribed by the Authority.
    (3) An inspector may enter upon any land or premises for the purpose of monitoring the effects on the environment of any activities carried out on that land or premises and to enforce compliance with the environmental mitigation and management plans prescribed under subsection (2).
34. The Authority shall, by notice published in the Gazette, prescribe fees necessary for conducting environmental and social impact studies and for covering reasonable costs for scrutinizing Environmental and Social Impact Assessment Reports and for the subsequent monitoring of a project which has been approved for implementation under this Act.

A prescribed list of projects for which ESIA is mandatory is given in Malawi's Guidelines for Environmental Impact Assessment, 1997. Figure 1 sets out the ESIA process that is required.

Figure 1: EIA process that is required by Malawi's Guidelines for EIA, 1997

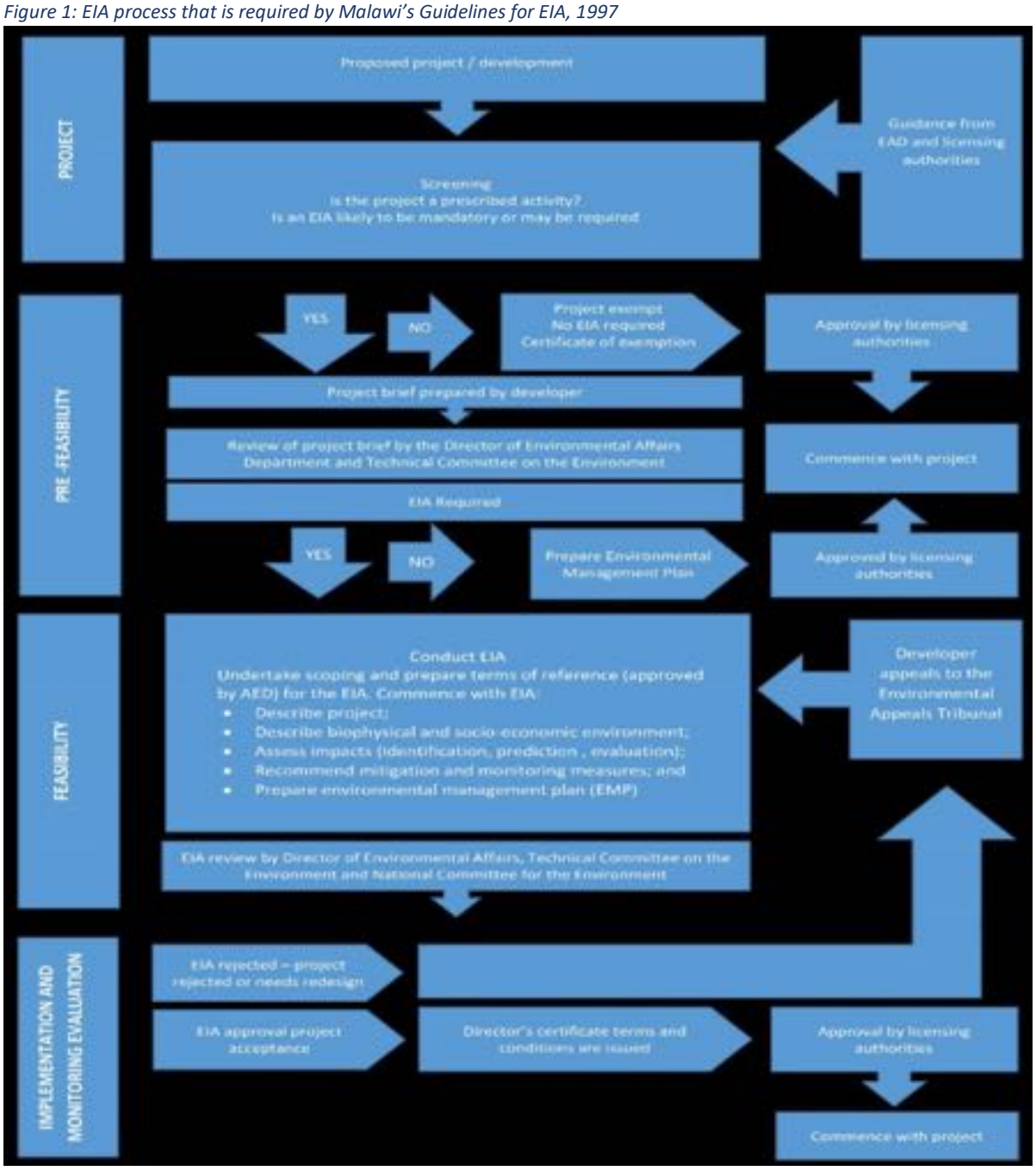

Table 3: Environment Management Act Provisions and Relevant Project Objectives

Summary of Key Environment Management Act Provisions and Relevant Project Objectives	
Ministerial assessment of developments for environmental impact:	Ensure EIA is conducted and presented within Director Requirements.
Manage adverse impacts on environment:	Develop environmental management plan for construction and operation of the Project.
	Mitigate, monitor and audit environmental and social impacts during construction and operation of the Dam.

6.2.2.2 Water Resources Act (2013) CAP 72.03 & Waterworks Act (1995) CAP 72.01

The management of water resources involves two related issues: (1) Provision of a wholesome supply and (2) The removal and disposal of contaminated liquid wastes from the water supply. The Water Resources Act, 2013 is the primary legislation dealing with management of water resources.

The Act specifically deals with control, conservation, apportionment and use of water resources of Malawi. The Act prohibits any person to divert, dam, store, abstract or use public water for any other purpose except in accordance with the provisions of this Act.

Under Section 16 (i): It is an offence for any person to interfere with, alter the flow of or pollute or foul any public water. The Act defines pollution or fouling of public water to mean the discharge into or in the vicinity of public water or in a place where public water is likely to flow, of any matter or substance likely to cause injury whether directly to public health, livestock, animal life, fish, crops, orchards or gardens which such water is used or which occasions, or which is likely to occasion, a nuisance. Further, under the Regulations, persons are not allowed to discharge into public water any water of less purity or any matter that might affect the river or fish. Section 24: No offence is committed if a discharge is, *inter alia*, under the authority of the Act or any other written law as under the Water Resources (Water Pollution Control) Regulations made pursuant to Section 24 of the Act, the Board is given powers to consider applications for a Ministerial consent to discharge waste or effluent into public water.

Section 6: The right to use public water may be limited if the use may cause damage to natural resources of the area or in the vicinity.

The Water Resources Act operates in conjunction with the Waterworks Act (1995), which also provides for the establishment of Water Resources Boards and water-areas and for the administration of such water-areas and for the development, operation and maintenance of waterworks and waterborne sewerage sanitation systems in Malawi and for matters incidental thereto. The Water Resources Act gives the said Water Boards various powers and duties in connection with water supplies and waterborne sewerage sanitation in their respective water areas.

Firstly, the Act imposes a duty on the Water Boards to provide a supply of portable water sufficient for the domestic purposes of the inhabitants within their respective water-areas. This presupposes a supply of fresh and clean water, free of pollutants because only clean water can be safely used for household purposes. The Act also empowers Water Boards to make by-laws for the regulation of the use and the prevention of pollution and the prevention of pollution of gathering grounds, waterworks and water therein.

The Act prohibits people from throwing or emptying into public sewers any:

a) Matter likely to injure the sewer or drain, or to interfere with free flow of its contents, or to affect prejudicially the treatment and disposal of its contents; or
b) Chemical refuse or waste steam; and
c) Petroleum spirit or carbide of calcium.

In the construction, operation and decommissioning phases of the Project, the proponent will be required to ensure that the existing water supply is not polluted or that any noxious matter is carried into the river and surrounding water systems. Pollution will need to be mitigate during the life of the Project to comply with section 16 of the Water Resources Act and the Regulations.

Table 4: Water Resources Act & Waterworks Act Provisions and Relevant Project Objectives

Summary of Key Water Resources Act & Waterworks Act Provisions and Relevant Project Objectives	
Duties to safeguard safe water supply	Mitigate pollutants that may enter the river system during construction

6.2.2.3 National Parks and Wildlife Act (2004) CAP 66.07

The purposes of the National Parks and Wildlife Act (2004) are to conserve selected examples of wildlife communities, and to protect '*rare, endangered and endemic species of wild plants and animals*'. In addition, conflict is to be minimised between people and animals.

Table 5: Key National parks & Wildlife Act Provisions and Relevant Project Objectives

Summary of Key National parks & Wildlife Act Provisions and Relevant Project Objectives	
Protection of flora and fauna	Determine and assess threatened species
Manage impact on fauna and flora	Mitigate adverse impact on local flora and fauna
	Reduce opportunity for conflict with local animal species during construction, operation and decommissioning activities
Promotion of local participation in protection objectives	Collaborate with local communities to plan ongoing conservation measures

6.2.2.4 Forestry Act (1997) CAP 63.01

The Forestry Act (1997) deals with the management of indigenous forests on customary and private land; forest reserves and protected forest areas; woodlots and plantation forestry and also crosscutting issues including law enforcement and fire management. The Act, among other things seeks to:

- Protect trees and other resources in forest reserves, conserve and enhance biodiversity;
- Protect and facilitate management of trees on customary land, promote community involvement in the conservation of trees, promote sustainable utilisation of timber and other forest produce; and
- Protect fragile areas such as river banks and water catchment areas.

Diverse use of forest areas is encouraged under the provisions of the Act, so as to empower local communities' active management of their forest areas.

Forestry Rules set out protected species of trees, and outline permissions required before felling of any protected forest areas may be carried out.

Rehabilitation measures are to be conducted in a manner consistent with the provisions for coordinating forestry development and implementing the Forestry Programme of Action in the SADC region, as in section 5 of the Forestry Act.

Table 6: Forestry Act Provisions and Relevant Project Objectives

Summary of Key Forestry Act Provisions and Relevant Project Objectives	
Manage and protect natural forest resources	Document biodiversity
	Document impact of the project
	Obtain necessary permits before felling forest areas
	Rehabilitate species
Forestry Programme of Action	Liaise with Forestry Programme to plan rehabilitation of forest areas
	Liaise with Forestry Programme to initiate planning for development of recreational forest areas

6.2.3 Relevant Policies and Other Instruments

The National Environmental Policy (NEP), 2004, aims to manage the degradation of the environment and depletion of the natural resources on one hand and development on the other. The Policy promotes sustainable social and economic development through sound management of the environment and natural resources. The policy seeks, among other things to:

a) Secure for all persons now and in the future an environment suitable for their health and wellbeing;
b) Promote efficient utilisation and management of the country's natural resources and encourage, where appropriate long-term self-sufficiency in food, fuel wood and other energy requirements;
c) Facilitate the restoration, maintenance and enhancement of the ecosystems and ecological processes essential for the functioning of the biosphere and prudent use of renewable resources;
d) Integrate sustainable environment and natural resources management into the decentralised governance systems and ensure that the institutional framework for the management of the environment and natural resources supports environmental governance in local government authorities;
e) Enhance public education and awareness of various environmental issues and public participation in addressing them; and
f) Promote local community, NGO and private sector participation in environment and natural resources management.

The NEP's overall objective is to manage and use water resources efficiently and effectively so as to promote its conservation and availability in sufficient quality and acceptable quality. In order to realise this objective, the NEP lays down a number of guiding principles. The NEP states that the precautionary approach to water quality management shall be pursued with a focus on pollution minimisation and prevention. Further, the NEP advocates the incorporation of the '*polluter pays*' principle in water policy and legislation so as to ensure that costs of unsustainable water utilisation and management are borne by the party responsible for such conduct. The NEP includes strategies on environmental planning and environmental impact assessment, audits and monitoring, among others. On environmental planning, the objective is to ensure that national and district development plans integrate environmental concerns, in order to improve environmental management and ensure sensitivity to local concerns and needs. The guidelines for ESIAs, audits, monitoring and evaluation are regularly reviewed so that adverse environmental impacts can be eliminated or mitigated and environmental benefits enhanced. In line with the environmental policy (on planning and ESIAs, among others), the developers must integrate environmental concerns during the whole cycle of the project i.e. planning, design, and implementation. The implication of the policy is that the project has to put in place measures to reduce adverse impacts arising from the activities of the project and that implementation of the activities of this project must accommodate sustainability issues.

Table 7: National Environmental Policy Provisions and Project Objectives

Summary of National Environmental Policy Provisions and Project Objectives	
Minimise impact on natural environment	Confine necessary construction and associated facilities impact footprint
Encourage self-sufficiency	Manage resources for construction process efficiently
	Aim for local resources being used only for local needs
	Construction needs to be brought in
	Waste management independent of local resources
Restore environment	Assist with advice on rehabilitation plans of the Dam surrounds

6.2.3.1 Guidelines for Environmental Impact Assessment (1997)

The Guidelines for Environmental Impact Assessment outline the process for conducting ESIAs and facilitate compliance to the process by developers as provided for in the Environment Management Act. The guidelines provide a list of prescribed projects for which ESIA is mandatory. They act as a tool for integrating environmental concerns into development plans at all levels.

It is a requirement under section 29 of the EMA that developers submit ESIA Reports to the Environmental Affairs Department for review and approval. The proposed Project falls under the list of projects for which ESIA is mandatory.

Table 8: Guidelines for Environmental Impact Assessment Provisions and Project Objectives

Summary of Guidelines for Environmental Impact Assessment Provisions and Project Objectives	
Guidelines for undertaking EISA to ensure compliance with Environment Management Act, 1996	Ensure general ESIA guidelines are appropriately adhered to.

6.2.3.2 National Water Policy (2005)

Malawi's policy on water resources management requires that:

a) Water should be managed and used efficiently and effectively in order to promote its conservation and future availability in sufficient quantity and acceptable quality; and
b) All programs related to water should be implemented in a manner that mitigates environmental degradation and at the same time promotes the enjoyment of the asset by all.

For a long time rivers have been used as a cheap and convenient repository for human and industrial waste. Recently they have come to be recognised as the basis of unique ecosystems worthy of protection in their own right. If the water is to continue to perform this and other many important roles in a sustainable manner then unrestrained disposal of materials into the aqueous environment poses an unacceptable threat.

Table 9: National Water Policy Provisions and Project Objectives

Summary of National Water Policy Provisions and Project Objectives	
Comprehensive water resources management	Prevent or mitigate pollution during construction, operation and decommissioning activities
	Mitigate environmental degradation during construction, operation and decommissioning activities

6.2.3.3 Malawi National Forest Policy (1996)

The policy promotes sustainable contribution of national forests, woodlands and trees towards the improvement of the quality of life in the country by conserving the resources for the benefit of the nation and to the satisfaction of diverse and changing needs of Malawi population, particularly rural smallholders. The policy prevents unnecessary changes in land-use that promote deforestation, or endanger the protection of the forests which have cultural, biodiversity or water catchment values. It also discourages development activities in gazetted forests unless proven to be environmentally friendly for which suitable inter-sectoral and local consultations will be conducted.

Above all, the policy advocates the carrying out of an ESIA where actions are likely to have significant adverse impacts on important forests and other resources.

Table 10: Malawi National Forest Policy Provisions and Project Objectives

Summary of Malawi National Forest Policy Provisions and Project Objectives	
Sustainable forestry	Consider original forest policy objectives of forestry protection
	Foster options for community use of forest areas

6.2.3.4 National Environmental Action Plan (NEAP), 2004

The NEAP was prepared in 1994 in response to Agenda 21 that required signatories to the 1992 Rio Declaration to prepare an action plan for integrating environmental issues into socio-economic development programs. The NEAP was updated in 2004. The objectives of the NEAP are to:

a) Document and analyse all major environmental issues and measures in order to alleviate them;
b) Promote sustainable use of natural resources in Malawi; and
c) Develop an environmental protection and management plan.

Key issues relevant to this project include:

- Soil erosion;
- Water resources degradation;
- Threat to natural resources; and
- Threat to biodiversity.

In order to protect the environment from further degradation; the NEAP outlines actions that need to be considered to ensure adequate environmental protection. The actions relevant to the establishment of the project in question include:

- ESIAs will be required for any development that may affect fragile ecosystems; and
- Government will ensure that workers in hazardous workplaces are supplied with the appropriate protective equipment and undergo pre-employment medical examinations and regular check-ups.

The environmental objectives are reflected in the Environment Management Act (2017). The policy recognises the integration of social issues with environmental issues, so requiring an integrated environmental and social assessment.

Table 11: National Environmental Action Plan Provisions and Project objectives

Summary of National Environmental Action Plan Provisions and Project Objectives	
Action plan for environmental assessment in development programs	Integrate environmental and social assessment
	Develop environmental protection and management plan

6.2.3.5 National State of Environment Report (2010)

The objective of the National State of Environment Report (NSoER) is to provide the status of the environment at national level. The NSoER for Malawi analyses key environmental issues of concern in Malawi including issues related to natural resources

management. It presents the relationship between external pressures, status and responses to the problems facing natural resources. The NSoER therefore provides a basis for environmental planning and development of the proposed project.

Table 12: National State of the Environment Report and Project objectives

Summary of National Environmental Action Plan Provisions and Project Objectives	
Key issues of environmental concern for the water sector	Ensure ESIA and ESMP appropriately address key natural resources issues related to poor natural resource management.

6.2.4 International Standards

6.2.4.1 World Bank

The World Bank provides guidance on ESIA requirements through the World Bank Group Environmental, Health, and Safety Guidelines, which includes sectoral guidelines. It addresses environmental monitoring and management issues, and identifies typical mitigation measures. The World Bank process is implemented through a set of Operational Policies/Procedures whose primary objective is to ensure that Bank operations do not cause adverse impacts and they "do no harm". Specific safeguard policies address natural habitats, pest management, cultural property, involuntary resettlement, indigenous peoples, and safety of dams, projects on international waterways and projects in disputed areas. The safeguard policies can be broadly grouped into Environment, Rural Development and Social Development. The World Bank Pollution and Abatement Handbook (1998a) and Environmental Assessment Handbook (1999a) will be considered during the EIA process. World Bank Operational Policies, and their applicability to the Project are summarised in Table 13 below.

Table 13

Table 13: World Bank Operational Policies

APPLICABLE WORLD BANK OPERATIONAL POLICIES	
OP/BP 4.01: Environmental Assessment (January 1999 and as revised April 2013)	
Ensures that appropriate levels of environmental and social assessment are carried out as part of project design. It also deals with the public consultation process, and ensures that the views of project-affected persons/groups and local NGOs are taken into account. It outlines the contents of environmental assessment reports and environmental management plans for Category A projects. This Policy requires proper Information Disclosure as a prerequisite for meaningful consultation for Category A projects. Public participation is a requirement where a project involves involuntary resettlement or affects indigenous people. Category A projects also requires consultation with affected groups and other stakeholders during at least two stages of the EA process; shortly after categorisation of the project and during preparation of the EA.	This safeguard Policy is relevant because of the size and nature of the Project and its potential to cause adverse impacts including the need for involuntary resettlement. The Project is designated as a Category A project and therefore requires information disclosure and two stages of consultation. Involuntary resettlement is also likely, thereby requiring public participation.
OP/BP 4.04: Natural Habitats (June 2001)	
Supports the conservation of natural habitats and the maintenance of ecological functions as a basis for sustainable development. The Bank does not support projects that involve the significant conversion or degradation of critical natural habitats.	The Project site contains a range of habitats that support a variety of terrestrial and aquatic animals, as well as providing ecological resources to local peoples. It is not anticipated that the Project would result in significant conversion or degradation of critical natural habitats.
OP 4.36: Forests (November 2002)	
This Policy aims to reduce deforestation and enhance, through sustainable economic development, the environmental and social contribution of forests. The Bank does not support projects which involve significant conversion or degradation of critical forest areas or related critical natural habitats.	Small areas of remnant forest within the Project footprint may be directly impacted, however it is not anticipated these areas are critical natural habitat from a biodiversity point of view.

6.2.4.2 International Finance Corporation (IFC) Standards and Guidelines

The IFC is a member of the World Bank Group, providing finance and development advice for private sector ventures and projects in developing countries. Their Performance Standards provide benchmarks for identifying and managing environmental and social risks. The ESIA will take cognisance of the eight IFC Performance Standards and associated guidance notes on Environmental and Social Sustainability (January 2012 edition), which together define the optimal environmental, social and health standards to be upheld throughout the life of a project. Also relevant are World Bank Guidelines and Handbooks for specific issues such as cumulative impact assessment and resettlement. Specifically, they provide guidance to:

- Identify environmental and social impacts, risks and opportunities of projects, with effective community engagement and consultation.
- Identify and minimise impacts on workers, affected communities and the environment, and prioritise active management of impacts.
- Identify specific objectives, such as avoidance of damage of areas of cultural significance. A demonstration of an awareness of these standards is expected as part of an environmental and social due diligence process to be undertaken by the financing institution.

IFC Performance Standards (PSs) and their applicability to the ecology section of the Project are summarised in Table 14 below.

Table 14: Applicable IFC Performance Standards

APPLICABLE IFC PERFORMANCE STANDARDS	
PS1: Assessment and Management of Environmental and Social Risks and Impacts	
This PS promotes the importance of managing environmental and social performance throughout the life of a project through identification and management of risks, and implementation of an effective Environmental and Social Management System (ESMS).	The Project has potential to cause significant adverse impacts including the need for involuntary resettlement. The EIA will therefore identify potential risks and mitigation measures, and incorporate environmental & social measures to manage any residual risks.
PS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	
This PS addresses sustainable development by biodiversity conservation, maintaining ecosystem services, and sustainably managing living natural resources.	The Project site contains a range of habitats that support a variety of terrestrial and aquatic animals, as well as providing ecological resources to local peoples. However the Project is unlikely to affect critical habitat and most of the areas affected will be cleared agricultural land. Mitigation may include re-establishing riparian vegetation around the dam perimeter as well as establishing new graveyard vegetation sites in suitable vegetation.

6.2.4.3 African Development Bank

The African Development Bank (AFDB) has a set of environmental/social policies, requirements and recommendations that apply to its projects, similar to those developed by the World Bank. A number of documents are of relevance:

The Bank's policies provide general orientations to mainstream crosscutting themes in Bank projects, as in:

- Involuntary Resettlement Policy (November 2003); and
- African Development Bank Group's Policy on the Environment (April 2004).

The Bank's procedures delineate how to proceed to integrate environmental/social issues in the project cycle, including the development of a resettlement plan when/if appropriate:

- Environmental and Social Assessment Procedures for African Development Bank's Public Sector Operations (June 2001).

The Bank's guidelines details requirements for any specific project, and when delineating potential beneficial/adverse impacts and corresponding enhancement/mitigation measures, outlines a component on migration and resettlement:

- Integrated Environmental and Social Impact Assessment Guidelines (October 2003).

6.2.5 International Agreements

Malawi is party to a number of internationally acceptable policies, conventions, treaties and protocols in order to augment the national policies and laws. International laws and their institutions serve as the principal framework for international co-operation and collaboration between members of the international community in their efforts to protect the local, regional and global environment. Many environmental problems have a trans-boundary effect hence require a concerted effort to manage them. International environmental laws assist in capturing and building consensus between nations on goals for environmental protection, resource conservation and sustainable use. Malawi is bound to the provisions of an international agreement/law, only if it signs and submits instruments of ratification in respect of a particular agreement.

Malawi is signatory to a number of Agreements as summarised below:

- As noted in the Malawi National Forest Policy (1996): 'The Government of Malawi is also a signatory to numerous bilateral and international agreements and conventions linked to the environment and forestry; including the Rio Declaration, the

Convention on Climate Change, the Montreal Protocol, the Convention to Combat Desertification, the Convention on Biodiversity and the Convention on International Trade in Endangered Species of wild fauna and flora (CITES).'

- Malawi was an early signatory, in 1973, to the African Convention on the Conservation of Nature and Natural Resources. Malawi has additionally ratified, in 2001, the SADC revised Protocol on Shared Watercourses, in 2002, the SADC Protocol on Fisheries, and in 2003, the SADC Protocol on Forestry.
- As noted by the Malawi Sustainable Development Network Programme (SNDP), it is also a signatory to: The Convention on International Plant Protection, The Convention on Wetland of Significant Importance, The Convention concerning the Protection of World Cultural and Natural Heritage, The Convention on the Conservation of Migratory Species of Wild Animals, The Food and Agriculture Organization (FAO) of the United Nations International Undertaking on Plant and Genetic Resources, and The Convention on Biological Diversity.
- The Convention on Biological Diversity (1992) recognises that protecting biological diversity includes concerns relating to people, food security, medicine, fresh air, water, shelter and a clean and healthy environment.
- In addition, gender equality is a basic human right and development issue, as affirmed in a number of international and regional instruments to which Malawi is signatory, including the Millennium Development Goals (MDGs), and the Protocol on Gender and Development (2008). As noted in the Gender Policy (2008), instruments to which Malawi is committed include: 1987 UN Convention on the Elimination of all Forms of Discrimination Against Women (CEDAW); the 1993 Vienna Conference on Human Rights; the Southern African Development Cooperation (SADC) Declaration on Gender and Development, 1997, and the Protocol to the African Charter on Human and People's Rights on the Rights of Women in Africa. Malawi's commitment to gender equality has now been reflected in its Gender Equality Act (2013).
- In respect of social aspects of development, a commitment to labour rights and health is reflected in Malawi's signatory status on the International Covenant on Economic, Social and Cultural Rights (1993) and the Convention on the Rights of the Child (1989).

Details of Agreements with specific relevance to the Project are provided in Table 15 below:

Table 15: International Agreements and Objectives

Summary of Important International Agreement Provisions and Project Objectives		
African Convention on the Conservation of Nature and Natural Resources	Ratified in 1973	The Convention requires the contracting States to undertake and adopt measures necessary to ensure conservation, utilisation and development of soil, water, flora and fauna resources in accordance with scientific principles and with due regard to the best interests of the people.
		The Convention has implications for the Project due to the potential effects on soil, water, flora and fauna resources.
Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar)	Ratified in 1997	The Ramsar treaty provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
		Malawi has only one wetland listed under Ramsar (Lake Chilwa) however this wetland is not affected by the Project.
Convention concerning the Protection of the World Cultural and Natural Heritage	Ratified in 1972	Acknowledge cultural identity related to the natural environment of each district.
Convention on Biological Diversity	Ratified in 1994	Mitigate impact on people, food security, medicine, fresh air, water, shelter and a clean and healthy environment.
SADC revised Protocol on Shared Watercourses	Ratified in 2001	The Protocol is aimed at fostering closer cooperation for judicious, sustainable and coordinated management, protection and utilisation of shared watercourses and advances the SADC agenda of regional integration and poverty alleviation.
		The Protocol is relevant as the Project is on a tributary that ultimately flows into Lake Malawi, a shared water body which forms a boundary between Malawi, Mozambique and Tanzania.
SADC Protocol on Forestry	Ratified in 2003	The Protocol applies to all activities relating to development, conservation, sustainable management and utilisation of all types of forests and trees, and trade in forest products throughout the SADC Region.

Summary of Important International Agreement Provisions and Project Objectives		
		The Project potentially impacts on riparian and remnant graveyard forests.
Zambezi Watercourse Commission (ZAMCOM)	Ratified in 2005	The objective of the Commission "is to promote the equitable and reasonable utilisation of the water resources of the Zambezi Watercourse as well as the efficient management and sustainable development thereof."
		The Protocol is relevant to the Project since the Lilongwe River ultimately flows into Lake Malawi and then the Zambezi River.

7 STUDY AREA

The proposed development area (local study area) is situated approximately 22km, at a bearing of 215 degrees (south east) of the Malawian capital of Lilongwe. The local study area covers an area of approximately 1885ha (Figure 2) and is situated to the north and adjacent to the Kamuzu Dam. For the purposes of this study a regional study area covering a total of approximately 9100ha was investigated to a lesser extent. No alternative development footprint was investigated as part of this study.

The "Ramsar Convention" has defined wetlands as: "*areas of marsh, fen, peatland, or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6 meters"* (Davis & Hirji, 2003; Roggeri, 1995).

According to the Ramsar Convention and scientific literature, wetlands can be classified into three main types (World Bank, 2002):

- Inland wetlands, including permanent and seasonal rivers, inland deltas and floodplains, permanent and seasonal lakes and ponds, marshes, freshwater swamp forests and peatlands.
- Marine/coastal wetlands, including open coast, coral reefs, estuaries, tidal flats, mangrove forests and coastal lagoons. These wetlands occupy about 8.6 million km2, or 6.4 percent of the world's land surface (World Bank, 1991). About 56 percent of these wetlands are located in the tropics and subtropics.
- Artificial or human-made wetlands, including reservoirs, aquaculture ponds, excavations and borrow pits, wastewater treatment ponds and irrigation canals, ditches and rice fields.

Wetlands in Malawi, are "*characterised by hydromorphic soils with grass and sedge growth throughout the year*", and called dambos. Topographically dambos are usually broad, gentle sloping valleys occurring in the catchment area of Malawi's main rivers. Dambo soils are waterlogged at or near the surface for a large part of the year. These hydromorphic soils have a high-water table and are poorly drained resulting in poor aeration. They vary from coarse sands to heavy clays with a soil reaction ranging from acid to alkaline. Large variations also occur in the nutrient status and the structural stability of dambo soils. Vegetation, grass and sedge, sometimes shrubs or trees, grow even during the driest months of the year (Mzembe, 1990). The World Bank (1987) estimates that dambos form about 12% (259,000 hectares) of the total land area available for cultivation in Malawi. The dambo area comprises about 31,000 hectares (ha) used for grazing (Mzembe, 1990), 50,000 ha under rice production (Mzembe, 1990), 700 small dams (Mzembe, 1990) and an unknown area used for vegetable growing. Most of the wetland area is uncultivated (approximately 178,000 ha) and possibly surplus land. These areas are too wet to grow crops or graze, and as a result are left to natural vegetation. However, with proper drainage and flood control facilities, wetlands could contribute positively towards national crop and livestock production goals (Mzembe, 1990)

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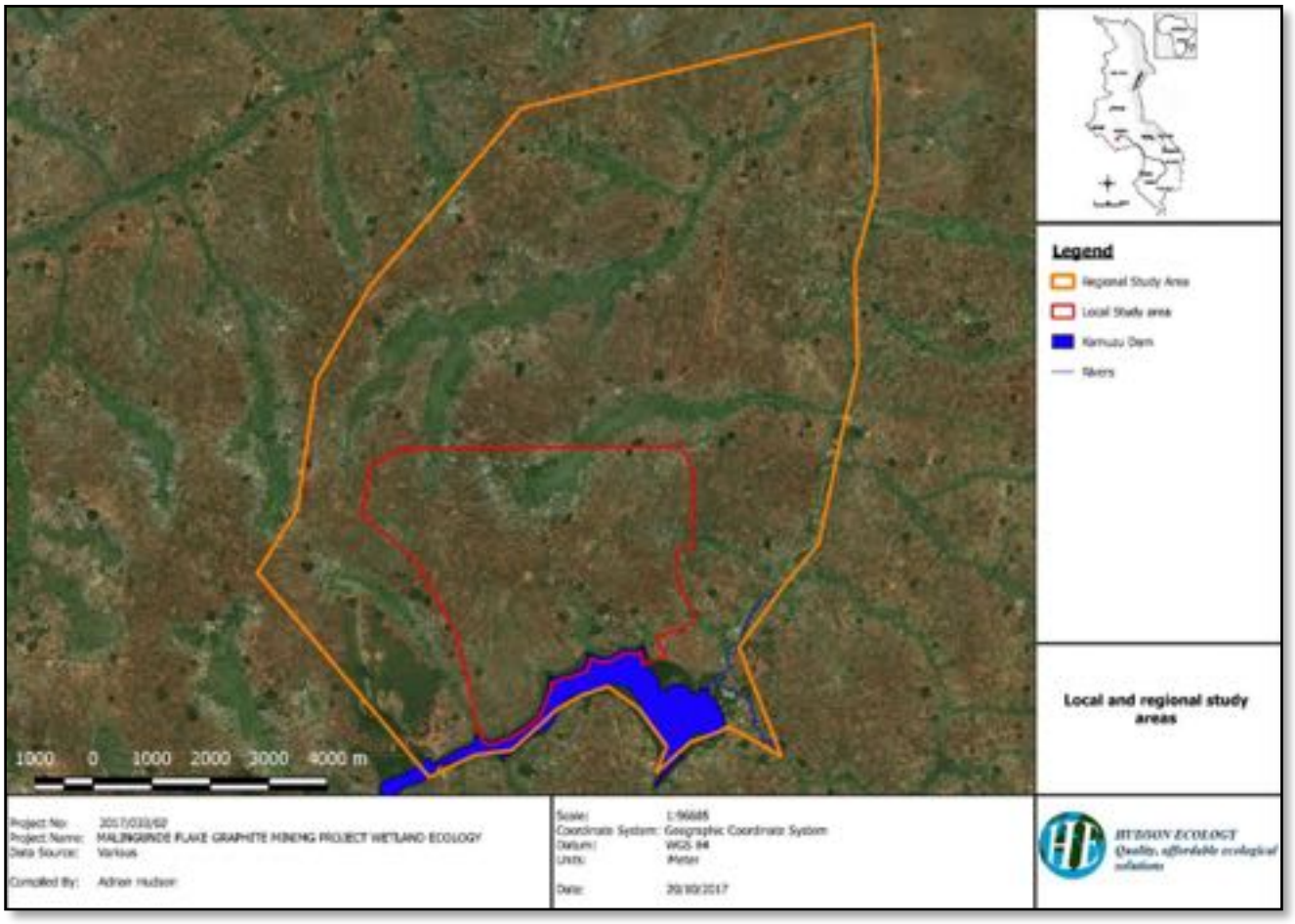


Figure 2: Local and regional study areas investigated

8 METHODOLOGY

8.1 Desktop review of relevant documentation

A number of literature sources were reviewed for the purposes of this report. These include, *inter alia*, vegetation descriptions, field guides and atlases for the various flora and fauna taxa, and scientific articles in order to determine species lists for the area. Previous studies conducted in the area and scientific online literature were also consulted where necessary.

8.2 Methodologies

Based on the RAMSAR and Malawi definitions of wetlands and these types of wetlands occurring in the study areas, eight sites were investigated in order to collect primary data. These sites are shown in Figure 3. In order to enable a characterisation of the environment, as well as floral and faunal species that may be present at the monitoring sites, faunal and floral groups were investigated. These factors were then used in order to determine the current ecological state of the wetlands. The following taxa were investigated:

- Vegetation;
- Avifauna;
- Mammals;
- Herpetofauna (Reptiles); and
- Amphibia.

Furthermore, an indication of the hydrology and other abiotic factors were determined. All methods implemented during this investigation are based on accepted scientific investigative techniques and principles, and were performed to accepted

standards and norms, whilst taking the limitations of this investigation into consideration. The Precautionary Principle (COMEST, 2005) was applied throughout the assessments.

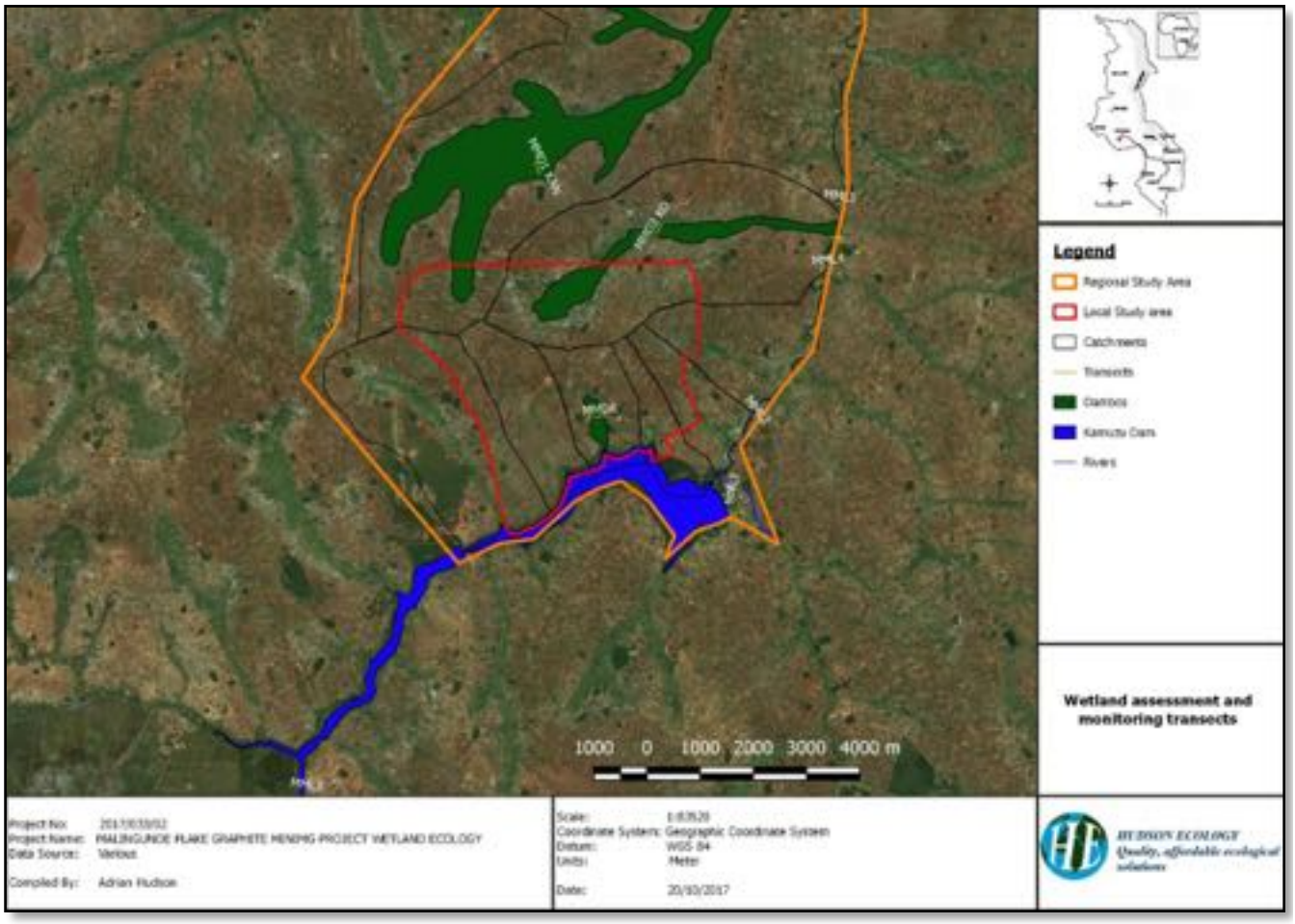


Figure 3: Wetland Monitoring Assessment Sites

8.2.1 General Floristic Attributes

The vegetation assessment was based on a variation of the Braun-Blanquet method (Mueller-Dombois & Ellenberg, 1974; Westhoff & Van der Maarel, 1978) whereby vegetation is stratified, by means of aerial or satellite imagery with physiognomic characteristics as a first approximation. Representative areas within these stratifications are then surveyed by means of line-point transects for grasses, sedges and forbs, as well as belt transects for shrubs and trees (this was unnecessary in this case). Results and species lists provided should be interpreted with the survey limitations in mind.

During the floral surveys conducted in April 2017, October 2017 and February 2018, cognisance was taken of the following environmental attributes and general information:

- Biophysical environment (geology, topography, aspect, hydrology slope etc.);
- Regional vegetation;
- Current status of habitats;
- Red Data habitat suitability;

Phytosociological data collected include the following:

- Plant species and growth forms;
- Dominant plant species; and
- Samples or digital images of unidentified plant species.

8.2.2 Red Data Floral Assessment

Data collected during the surveys were compared with the IUCN Red Data plant species list and Malawi threatened species list to compile a list of plant species of concern that may potentially occur within the study area and that were recorded in the study area.

A survey of this kind (instantaneous sampling bout or "snapshot" investigations) poses limitations to the identification of Red Data plant species. Therefore, emphasis was placed on the identification of habitat that would be suitable for sustaining Red Data plant species, by associating available habitat to known habitat requirements of Red Data plant species.

8.3 General Faunal Attributes

8.3.1 Reptilia

Anecdotal search and capture methods were used for the presence of snakes and other reptiles. Snakes and other reptiles are identified visually and only captured if visual identification is hampered by swift-moving snakes or if the snake is obscured from view. Branch (1996) and Broadley (1971) were used as identification guides, where necessary.

8.3.2 Amphibia

Suitable areas for frogs were sampled or identified by means of anecdotal searches and acoustic identification methods, especially at night when highest amphibian activity is expected. Areas were also netted for tadpoles and amphibian species identified by means of tadpoles. Du Preez and Carruthers (2009) was used to confirm identification where necessary.

8.3.3 Aves

Avifauna were surveyed by means of point counts (Bibby, et al., 1993) and visual identification and the calls of bird species were used to identify species. Wherever possible, visual identification was used to confirm call identifications. Bird ranges were confirmed using Harrison *et al* (1997). Other guides were also utilised (Hockey, et al., 2005) (BirdLife International, 2000) (Sinclair & Ryan, 2003)

8.3.4 Mammalia

Visual sightings and ecological indications were used to identify the small mammal inhabitants of the study area. Scats were also used for identification of nocturnal small mammals. A number of reference sources *inter alia* Stuart and Stuart (2007) and Smithers (1983) were used for identification purposes.

8.3.5 Red Data Faunal Assessment

The following parameters were used to assess the Probability of Occurrence of each Red Data species:

- Habitat requirements (HR) – Most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics in the study area was evaluated;
- Habitat status (HS) – The status or ecological condition of available habitat in the area is assessed. Often a high level of habitat degradation prevalent in a specific habitat will negate the potential presence of Red Data species (this is especially evident in wetland habitats); and
- Habitat linkage (HL) – Movement between areas for breeding and feeding forms an essential part of the existence of many species. Connectivity of the study area to surrounding habitat and the adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area.

Probability of occurrence is presented in four categories, namely:

- Low;
- Medium;
- High; and
- Recorded.

In order to assess the status of fauna species of concern in the study area, the following sources were used:

- IUCN Red List Categories and Criteria (IUCN, 2001);
- IUCN Red List of Threatened Species (IUCN, 2017); and
- Malawi Threatened and Protected species list.

8.4 Wetland assessment methodology

8.4.1 Wetland delineation

The field procedure for the wetland delineation was conducted according to the Guidelines for delineating the boundaries of a wetland set out by the South African Department of Water Affairs (DWAF, 2005) in the absence of Malawi guidelines on this aspect. Due to the transitional nature of wetland boundaries, these are often not clearly apparent and the delineations should therefore be regarded as a human construct. The delineations are based on scientifically defensible criteria and are aimed at providing a tool to facilitate the decision-making process regarding the assessment of the significance of impacts that may be associated with the proposed developments.

The wetlands were delineated by considering the following wetland indicators (DWAF, 2005):

- Terrain unit indicators help identify those parts of the landscape where wetlands are most likely to occur. Wetlands occupy characteristic positions in the landscape and can occur on the following terrain units: crest, midslope, footslope, and valley bottoms;
- Soil wetness indicator identifies the morphological signatures developed in the soil profile as a result of prolonged and frequent saturation; and
- The vegetation indicator identifies hydrophytic vegetation associated with frequently saturated soils.

The following procedure was followed during the delineation of the wetland boundaries and zones:

- Desktop delineations were undertaken using satellite imagery of the study sites;
- Areas for verification were identified; and
- Areas were then assessed in the field during the April 2017 survey with boundaries being recorded using a GPS.

According to the wetland definition used in the South African National Water Act (1998), soils and vegetation are the primary indicators, which must be present under normal circumstances. This coincides with the Malawian definition of a wetland, mentioned earlier, thus the DWA guidelines seem consistent with Malawian standards and were therefore used in the absence of Malawian guidelines. Table 16 describes the criteria for wetland zones according to Kotze, Breen & Klug (1994).

Table 16: Criteria for distinguishing different soil saturation zones and hydrophytic vegetation within a wetland (from Kotze, Breen & Klug, 1994)

Soil	Degree of wetness		
	Temporary	Seasonal	Permanent/Semi-permanent
Soil depth 0 – 20 cm	Matrix brown to greyish brown (chroma 0 - 3, usually 1 or 2). Few/no mottles. Non-sulphidic.	Matrix brownish grey to grey (chroma 0 - 2). Many mottles. Sometimes sulphidic.	Matrix grey (chroma 0 - 1). Few/no mottles. Often sulphidic.
Soil depth 20 – 40 cm	Matrix greyish brown (chroma 0 - 2, usually 1). Few/many mottles.	Matrix brownish grey to grey (chroma 0 - 1). Many mottles.	Matrix grey (chroma 0 - 1). No/few mottles.
VEGETATION			
If herbaceous:	Predominantly grass species; mixture of species, which occur extensively in non-wetland areas, and hydrophytic plant species, which are restricted largely to wetland areas.	Hydrophytic sedge and grass species which are restricted to wetland areas, usually <1 m tall.	Dominated by: (1) emergent plants, including reeds (*Phragmites* sp.), sedges and bulrushes (*Typha* sp.), usually >1m tall (marsh); or (2) floating or submerged aquatic plants.

The wetlands boundaries are a mental construct of those delineating them based on certain scientifically defensible criteria.

8.4.2 Wetland classification

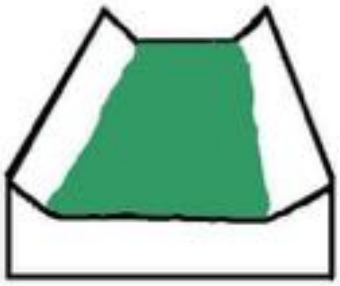
Due to the lack of a further classification system for wetlands in Malawi, and the similarity in the Malawian and South African definitions of wetlands, SANBI's "Further development of a proposed National Classification System for South Africa" was used to classify the wetlands within the study area (SANBI, 2009). The wetlands were classified up to level four, which includes the system, regional setting, landscape unit and hydrogeomorphic unit.

Table 17: Wetland classification level 1 - 4

Level 1: System	Level 2: Regional setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit			
Connectivity to open ocean	Ecoregion	Landscape setting	HGM type	Longitudinal zonation / landform	Drainage - outflow	Drainage - inflow
			A	B	C	D
INLAND	DWA Level 1 Ecoregions	LOPE	Channel (river)	Mountain headwater stream	Not applicable	Not applicable
				Mountain stream	Not applicable	Not applicable
				Transitional river	Not applicable	Not applicable
				Rejuvenated bedrock fall	Not applicable	Not applicable
			Hillslope seep	Not applicable	With channel inflow	Not applicable
					Without channel inflow	Not applicable
			Depression	Not applicable	Exorheic	With channel inflow
						Without channel inflow
					Endorheic	With channel inflow
						Without channel inflow
					dammed	With channel inflow
						Without channel inflow
		VALLEY FLOOR	Channel (river)	Mountain stream	Not applicable	Not applicable
				Transitional river	Not applicable	Not applicable
				Rejuvenated bedrock fall	Not applicable	Not applicable
				Upper foothill river	Not applicable	Not applicable
				Lower foothill river	Not applicable	Not applicable
				Lowland river	Not applicable	Not applicable
				Rejuvenated foothill river	Not applicable	Not applicable
				Upland floodplain river	Not applicable	Not applicable
			Channelled valley-bottom wetland	Valley-bottom depression	Not applicable	Not applicable
				Valley-bottom flat	Not applicable	Not applicable
			Unchannelled valley-bottom wetland	Valley-bottom depression	Not applicable	Not applicable
				Valley-bottom flat	Not applicable	Not applicable
			Floodplain wetland	Floodplain depression	Not applicable	Not applicable
				Floodplain flat	Not applicable	Not applicable

Level 1: System	Level 2: Regional setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit			
Connectivity to open ocean	Ecoregion	Landscape setting	HGM type	Longitudinal zonation / landform	Drainage - outflow	Drainage - inflow
			A	B	C	D
			Depression	Not applicable	Exorheic	With channel inflow
						Without channel inflow
					Endorheic	With channel inflow
						Without channel inflow
					dammed	With channel inflow
						Without channel inflow
			Valley head seep	Not applicable	Not applicable	Not applicable
		PLAIN	Channel (river)	Lowland river	Not applicable	Not applicable
				Upland floodplain river	Not applicable	Not applicable
			Floodplain wetland	Floodplain depression	Not applicable	Not applicable
				Floodplain flat	Not applicable	Not applicable
			Unchannelled valley-bottom wetland	Valley-bottom depression	Not applicable	Not applicable
				Valley-bottom flat	Not applicable	Not applicable
			Depression	Not applicable	Exorheic	With channel inflow
						Without channel inflow
					Endorheic	With channel inflow
						Without channel inflow
			Flat	Not applicable	Not applicable	Not applicable
		BENCH (Hilltop/saddle/shelf)	Depression	Not applicable	Exorheic	With channel inflow
						Without channel inflow
					Endorheic	With channel inflow
						Without channel inflow
			Flat	Not applicable	Not applicable	Not applicable

Table 18: Schematic illustration of wetland types (DWA, 2008)

Hydro-geomorphic type	Illustration	Description
Flood Plain		Valley bottom areas with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley Bottom with a Channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley Bottom Without a Channel		Valley bottom areas with no clearly defined stream channel usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.
Channeled Hillslope Seepage Feeding a Watercourse		Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a watercourse.

Hydro-geomorphic type	Illustration	Description
Hillslope Seepage Feeding a Watercourse		Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow connecting the area directly to a watercourse.
Hillslope Seepage Not Feeding a Watercourse		Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a watercourse.
Depression		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent.

8.4.3 WET-Health (Present Ecological Status)

For the WET-health component a level 2 assessment was conducted of the wetlands within the project area. A level 2 assessment includes a field survey where the hydrology and the vegetation of a wetland are assessed.

A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments. The three modules used during this assessment were:

- Hydrology;
- Geomorphology; and
- Vegetation

During the assessment wetlands were divided into hydrogeomorphic (HGM) units, which were then assessed separately in terms of hydrological, geomorphological and vegetation health, based on the extent, intensity and magnitude of impact. Once the HGM units were identified, the results for each assessment unit were then combined to obtain an indication of the health of the wetland as a whole.

A single present state score was produced for each module at the end of each assessment using Table 19 to Table 21.

Table 19: Health categories used by WET-Health for describing the hydrological integrity of wetlands

Description	Impact score range	Health category
No discernible modifications or the modifications are of such a nature that they have no impact on the hydrological integrity.	0 - 0.9	A
Although identifiable the impact of the modifications on the hydrological integrity are small.	1 - 1.9	B
The impact of the modifications on the hydrological integrity is clearly identifiable, but limited.	2 - 3.9	C
The impact of the modifications is clearly detrimental to the hydrological integrity. Approximately 50% of the hydrological integrity has been lost.	4 - 5.9	D
Modifications clearly have an adverse effect on the hydrological integrity. 51% to 79% of the hydrological integrity has been lost.	6 - 7.9	E
Modifications are so great that the hydrological functioning has been drastically altered. 80% or more of the hydrological integrity has been lost.	8 - 10	F

Table 20: Present Geomorphic State categories used by WET-Health for describing the geomorphic integrity of wetlands

Description	Impact score	Present geomorphic state category
Unmodified, natural.	0 - 0.9	A
Largely natural with few modifications. A slight change in geomorphic processes is discernable but the system remains largely intact	1 - 1.9	B
Moderately modified. A moderate change in geomorphic processes has taken place but the system remains predominantly intact	2 - 3.9	C
Largely modified. A large change in geomorphic processes has occurred and the system is appreciably altered.	4 - 5.9	D
Greatly modified. The change in geomorphic processes is great but some features are still recognisable.	6 - 7.9	E
Modifications have reached a critical level as geomorphic processes have been modified completely	8 - 10	F

Table 21: Present Vegetation State categories used to define health of wetland vegetation

Description	Overall Impact Score	Present Vegetation State Category
Vegetation composition appears natural.	0 - 0.9	A
A very minor change to vegetation composition is evident at the site.	1 - 1.9	B
Vegetation composition has been moderately altered but introduced; alien and/or increased ruderal species are still clearly less abundant than characteristic indigenous wetland species.	2 - 3.9	C
Vegetation composition has been largely altered and introduced; alien and/or increased ruderal species occur in approximately equal abundance to the characteristic indigenous wetland species.	4 - 5.9	D
Vegetation composition has been substantially altered but some characteristic species remain, although the vegetation consists mainly of introduced, alien and/or ruderal species.	6 - 7.9	E
Vegetation composition has been totally or almost totally altered, and if any characteristic species still remain, their extent is very low.	8 - 10	F

8.4.3.1 Assessing the anticipated trajectory of change

This wetland was assessed to determine whether, by how much and in which direction the current state is likely to change in the future (Table 22). Each HGM is assigned a change score to determine the change symbol (i.e., trajectory of change).

Table 22: Potential changes in trajectory in each of the hydrogeomorphic (HGM) units

Change class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

8.4.4 Wetland ecological importance and sensitivity (EIS)

The ecological importance and sensitivity assessment were conducted according to the guidelines provided by DWA (1999). "Ecological importance" of a water resource is defined as an expression of its importance to the maintenance of ecological diversity and function on local and wider scales. "Ecological sensitivity", according to DWA (1999), refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and Sensitivity (EIS) provide a guideline for the determination of the Ecological Management Class (EMC).

In the method outlined by DWA a series of determinants for EIS are assessed for the wetlands on a scale of 0 to 4 (Table 23), where 0 indicates no importance and 4 indicates very high importance. The median of the determinants is used to determine the EIS and EMC of the wetland units.

Table 23: Score sheet for the determination of ecological importance and sensitivity (DWA, 1999)

Determinant	Score	Confidence
Primary determinants		
Rare and endangered species		
Species/taxon richness		
Diversity of Habitat types or features		
Migration route/breeding and feeding site for wetland species		
Sensitivity to changes in the natural hydrological regime		
Sensitivity to water quality changes		
Flood storage, energy dissipation and particulate/element removal		
Modifying determinants		
Protected status		
Ecological integrity		

Score guideline: 4 = Very High; 3 = High; 2 = Moderate; 1 = Marginal/Low; 0 = None. Confidence rating: 4 = Very High Confidence; 3 = High Confidence; 2 = Moderate Confidence; 1 = Marginal/Low Confidence.

Table 24: Ecological Importance and Sensitivity (EIS) categories and the interpretation of median scores for biotic and habitat determinants (DWA, 1999)

Range of Median	EIS Category	Category Description	Recommended Ecological Management Class
>3 and <=4	Very High	Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	A
>2 and <=3	High	Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water in major rivers.	B
>1 and <=2	Moderate	Wetlands that are to be considered ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	C
>0 and <=1	Low/ Marginal	Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	D

8.5 Quantification of Impacts

The spatial extent of impact of individual activities were assessed, and then the intensity of the impact on each activity in the affected wetland area. The extent and intensity were then combined to determine the overall magnitude of the impact:

Magnitude = Extent / 100 x Intensity

Once the magnitudes for each module were calculated, they were measured on a scale of 1-10, which then categorises the impact in one of six categories (Table 25 to Table 27).

Table 25: Guideline for interpreting the magnitude of impact on the hydrological integrity of an HGM unit

Impact category	Description	Impact Score
None	No discernible modification or the modification is such that it has no impact on hydrological integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on hydrological integrity is small.	1 – 1.9
Moderate	The impact of this modification on hydrological integrity is clearly identifiable, but limited.	2 – 3.9
Large	The modification has a clearly detrimental impact on hydrological integrity. Approximately 50% of hydrological integrity has been lost.	4 – 5.9
Serious	The modification has a clearly adverse effect on hydrological integrity. Well in excess of 50% of the hydrological integrity has been lost.	6 – 7.9
Critical	The modification is so great that the ecosystem processes of this component of hydrological health are drastically altered. 80% or more of the hydrological integrity has been lost.	8 – 10

Table 26: Description of Present Geomorphic State in relation to Impact Scores for each HGM

Impact category	Description	Impact Score
None	Unmodified, natural.	0-0.9
Small	Largely natural. A slight change in geomorphic processes is discernable but the system remains largely intact.	1-1.9
Moderate	Moderately modified. A moderate change in geomorphic processes has taken place but the system remains predominantly intact.	2-3.9
Large	Largely modified. A large change in geomorphic processes has occurred and the system is appreciably altered.	4-5.9
Serious	Greatly modified. The change in geomorphic processes is great but some features are still recognisable.	6-7.9
Critical	Modifications have reached a critical level as geomorphic processes have been modified completely.	8-10

Table 27: Impact categories for assessing the intensity of impacts on vegetation integrity within disturbance classes

Impact category	Description	Intensity of impact score
None	Vegetation composition appears entirely natural.	0.5
Small	A very minor change to vegetation composition is evident at the site (e.g. abundance of ruderal, indigenous invasive slightly higher than would be the case naturally)	1.5
Moderate	Vegetation composition has been moderately altered but introduced; alien and/or increased ruderal species are still clearly less abundant than characteristic indigenous wetland species.	3
Large	Vegetation composition has been largely altered and introduced; alien and/or increased ruderal species occur in approximately equal abundance to the characteristic indigenous wetland species.	5
Serious	Vegetation composition has been substantially altered but some characteristic species remain, although the vegetation consists mainly of introduced, alien and/or ruderal species.	7
Critical	Vegetation composition has been almost totally altered, and in the worst case all indigenous vegetation has been lost (e.g. as a result of a parking lot)	9

8.5.1 Ecosystem services supplied by wetlands

The assessment of the ecosystem services supplied by the identified wetland units was conducted according to the guidelines as described by Kotze, et al. (2007). A Level 2 assessment was undertaken which examines and rates natural and human services.

8.5.1.1 Indirect Services

The following natural services were assessed:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;

- Carbon storage; and
- Maintenance of biodiversity.

Scores for each of the above natural service assessments were allocated a class based on those shown in Table 28. These scores were then added to determine the overall level of natural services for the wetland system using the classes shown in Table 29.

Table 28: Classes for service scores

Class Boundary	Class Score
0 - 0.99	1
1 - 1.99	2
2 - 2.99	3
3 - 4	4

Table 29: Classes for the overall level of natural services provided by a wetland unit

Natural Services and Functions		
Class Boundaries	**Class**	**Class Description**
Within acceptable range		
30 - 36	Very High	Unmodified or approximated natural condition.
24 - 29.9	High	Largely natural with few modifications, but with some loss of natural habitats.
18 - 23.9	Moderate	Moderately modified, but with some loss of natural habitats.
12 - 17.9	Low	Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
Outside acceptable range		
6 - 11.9	Very Low	Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
0 - 5.9	Non Existent	Critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

8.5.1.2 Direct Services

The following potential human services that wetland can deliver were assessed:

- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

Scores for each of the above human service assessments were allocated a class based on those shown in Table 28. These scores were then added to determine the overall level of human services for the wetland system using the classes shown in

Table **30**.

Table 30: Classes for the overall level of human services provided by a wetland unit

Human Services and Functions		
Class Boundaries	**Class**	**Class Description**
Within acceptable range		
20 - 24	Very High	Local people are extremely dependent on the wetland and benefit from it greatly.
16 - 19.9	High	Local people have a high level of dependence on the wetland and benefit from it considerably.
12 - 15.9	Moderate	Local people are moderately dependent on the wetland and benefit from it from occasionally.
8 - 11.9	Low	Local people have a low dependency on the wetland and seldom benefit from it.
Outside acceptable range		
4 - 7.9	Very Low	Local people rarely rely on the wetland and almost never benefit from it.
0 - 3.9	Non Existent	Local people have no interaction with the wetland and never receive any benefits from it.

8.6 Riparian Assessment Methodology (VEGRAI)

The riparian assessments were conducted according to the Riparian Vegetation Response Assessment Index (VEGRAI) methodology as described by Kleynhans et al (2007).

The products of VEGRAI are more than a measure of Ecological Category (EC) as the process and data are valuable in and of themselves. VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results. Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and converts multiple ratings into an EC).

The mechanism of the VEGRAI 4 assessment is given in Figure 4.

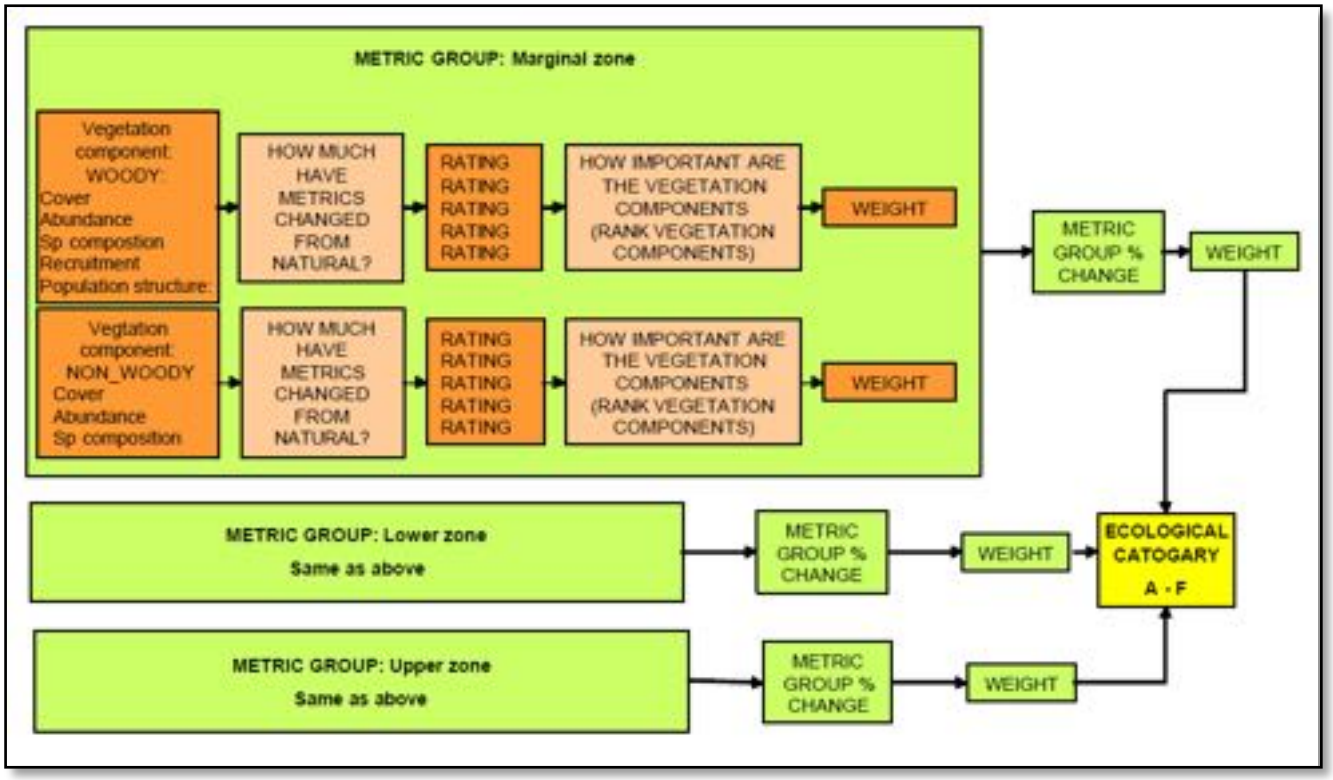


Figure 4: VEGRAI 4 mechanism of assessment

This proportional weight is multiplied by the percentage of the metric group in a natural condition and summed for all metric groups. This provides an integrated value that relates to the Ecological Category for the riparian vegetation that ranges from A to F. These ecological categories and their descriptions are given in Table 31.

Table 31: Ecological categories for EcoStatus components (reproduced from Kleynhans et al., 2007)

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the biotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0-19

9 SURVEY ASSUMPTIONS AND LIMITATIONS

- Accuracy of the maps, ecosystems, routes and desktop assessments were made using Google earth and converting the .kml files to .shp files and are subject to the accuracy of Google Earth imagery with some loss of accuracy during the conversion process;
- GPS co-ordinates are accurate to within 10m and lines drawn on maps can only be assumed to be accurate to within a distance of 50m;
- Data obtained from published articles, reference books, field guides, official databases or any other official published or electronic sources are assumed to be correct and no review of such data was undertaken by Hudson Ecology Pty Ltd;
- Satellite imagery obtained was limited to imagery on Google Earth, thus the ability to accurately map vegetation communities was limited;
- Time and budget constraints do not allow for an intensive survey of the entire study area during the scoping phase surveys, and as with any survey of this kind, rare and cryptic species may be overlooked during the study;
- Every possible precaution was taken to reduce the effect of the above-mentioned limitations on the data collected for this study;
- The fact that a species or Red Data species is not recorded during a survey cannot support the assumption that the species in question does not occur in the area, it can only indicate a decreased probability of the species occurring in the area. This is particularly pertinent if the species has been recently or historically recorded in the area; and
- Ecological studies should be undertaken over a number of seasons in order to obtain long term ecological data. Studies are usually conducted in this way in order to eliminate the effects of unusual climatic conditions or other unusual conditions prevailing at the study area during the time of study. The results of this study are based on a literature review and three field surveys conducted on the 18th to the 27th of April 2017, the 11th to the 21st of October 2017 and the 12th to the 18th of February 2018.

The wet season study conducted in April 2017 did not represent ideal conditions for a wet season study as it was conducted in the latter part of the wet season and many annual plant species were not emergent, and thus no longer visible or identifiable for study. Many migratory bird species were also no longer present in the area, for this reason a follow up survey was conducted in October 2017, at the beginning of the wet season. Due to changes in the conceptual mine footprint a further study was undertaken in order to collect baseline data further downstream along the Lilongwe River, this study resulted in the addition of sites MML4 and MML5.

10 RESULTS

10.1 Flora Assessment

10.1.1 General floristic attributes

A total of 109 species of plants, associated with wetland and riparian systems, were recorded in the study area, during the 2017 and 2018 surveys. These are given in APPENDIX B.

Generally the most common species across all three the wetlands surveyed are *Cyperus esculentus, Cyperus tenax, Kylinga erecta, Typha domingensis, Aristida junciformis, Andropogon eucomus, Arundinella nepalensis, Cynodon dactylon, Echinochloa pyramidalis, Heteropogon contortus , Hyparrhenia filipendula, Hyparrhenia nyassae, Hyperthelia dissoluta, Melinis repens, Pogonarthria squarrosa, Sporobolus pyramidalis, Bidens biternata, Bidens pilosa, Conyza albida, Euphorbia tirucalli, Oldenlandia corymbosa, Oldenlandia herbacea, Senecio strictifolius, Solanum delagoense, Tagetes minuta, Verbena bonariensis, Dichrostachys cinerea, Gmelina arborea, Senna alata* and *Piliostigma thonningii*.

The most common species recorded in the riparian vegetation communities are *Acacia polyacantha, Acacia sieberiana, Burkea africana, Combretum molle, Piliostigma thonningii, Dichrostachys cinerea, Trichilia emetica, Psidium guajava, Bauhinia thonningii, Gmelina arborea, Blumea alata, Senna alata, Eriosema ellipticum, Euclea crispa, Helichrysum kraussii, Lippia javanica, Maytenus heterophylla, Flueggea virosa, Diospiros heterophylla, Bidens biternata, Bidens pilosa, Conyza welwitschii, Helichrysum species, Oldenlandia corymbosa, Ranunculus multifidus, Senecio strictifolius, Solanum delagoense, Tagetes minuta, Verbena bonariensis, Aristida junciformis, Cynodon dactylon, Heteropogon contortus, Hyparrhenia filipendula, Pogonarthria squarrosa, Sporobolus pyramidalis* and *Phragmites mauritianus*.

Wetlands can generally be divided into four zones namely the Terrestrial Zone, Temporary Zone, Seasonal Zone and Permanent Zone. Common species in the Terrestrial Zone include *Cosmos bipinnatus, Conyza bonariense, Eragrostis lehmanniana,*

Hyparrhenia hirta, Themeda triandra, Cirsium vulgare, Tagetes minuta, Eragrostis curvula and, in more disturbed areas, *Pennisetum clandestinum.* In the temporary zone common species include *Cosmos bipinnatus, Conyza bonariense, Cynodon dactylon, Imperata cylindrica, Tagetes minuta, Eragrostis plana, Leersia hexandra, Cyperus marginatus, Cyperus esculentus, Cyperus rupestris* and *Schoenoplectus paludicola*, while the Seasonal Zone is dominated by *Cynodon dactylon, Imperata cylindrica, Panicum maximum, Berkheya radula, Leersia hexandra, Cyperus marginatus, Cyperus esculentus* and *Cyperus rupestris.* Finally the Permanent Zones are dominated by *Kyllinga erecta, Schoenoplectus paludicola, Leersia hexandra, Cyperus marginatus, Cyperus esculentus, Cyperus rupestris* and *Typha capensis.*

Species diversity varies considerably across the eight monitoring sites (Figure 5) with Kankoma Dambo and riparian monitoring site 3 (MML3) showing the highest species diversity with 58 and 70 species respectively, while the sites with the lowest species diversity being MML4 and Dambo 1 (MMD) with 33 and 37 species, respectively

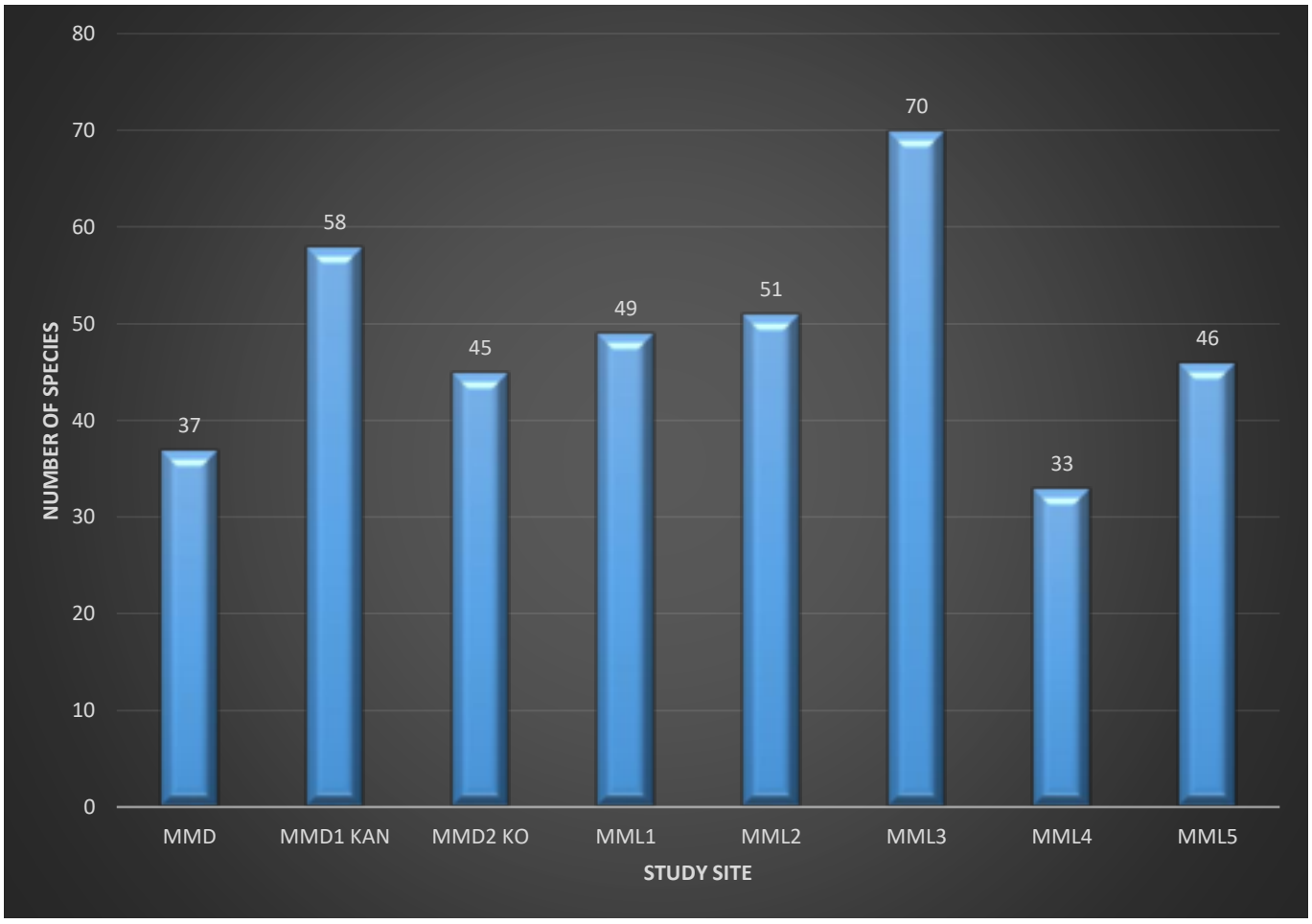


Figure 5: Plant species richness across the six monitoring sites

10.1.2 Species of conservation importance

The plant species of conservation importance that could occur in the area are given in

Table 32. One species is currently listed as Least Concern, two species are listed as Near Threatened, two species are listed as Vulnerable while one species is listed as Critically Endangered. Only one species was recorded in the wetland vegetation community, namely *Burkea africana*.

Table 32: Species of conservation importance that may occur in the study area

Scientific Name	Common Name	Growth Form	IUCN Status	Malawi National Status	Probability of occurrence
Aerangis distincta	Distinct Aerangis	Arboreal orchid	Not Listed	Protected	Low
Afzelia quanzensis	Mahogany Bean	Tree	Not Listed	Protected	High
Aloe bulbicaulis		Succulent	Not Listed	Protected	Low
Aloe cannellii		Succulent	Not Listed	Protected	Low
Aloe chabaudii var. chabaudii	Grey Aloe	Succulent	Not Listed	Protected	Low
Aloe cryptopoda		Succulent	Not Listed	Protected	Low
Aloe myriacantha		Succulent	Not Listed	Protected	Low
Aloe swynnertonii		Succulent	Not Listed	Protected	Low
Borassus aethiopum	Deleb Palm	Palm	Least Concern	Protected	Low
Breonadia microcephala	Redwood	Tree	Not Listed	Protected	High
Bridelia micrantha	Coast Gold leaf	Tree	Not Listed	Protected	High
Burkea africana	Ash	Tree	Not Listed	Protected	Recorded
Colophospermum mopane	Mopane	Tree	Not Listed	Protected	Low
Cordyla africana	Wild Mango	Tree	Not Listed	Protected	High
Dalbergia melanoxylon	African Blackwood	Tree	Near Threatened	Protected	High
Humularia descampsii		Tree	Not Listed	Protected	Low
Hyphaene crinata	Doum Palm	Palm	Not Listed	Protected	Low
Khaya anthotheca	Mahogany	Tree	Vulnerable	Protected	High
Milicia excels	Iroko	Tree	Not Listed	Protected	Moderate
Morinda asteroscepa		Forb	Vulnerable	Protected	Low
Morus mesozygia	African mulberry	Tree	Critically Endangered	Protected	Low
Prunus africana	African cherry	Tree	Vulnerable	Protected	Moderate
Pterocarpus angolensis	African Teak	Tree	Near Threatened	Protected	High
Rytigynia adenodonta		Forb	Not Listed	Protected	Low
Terminalia sericea	Silver cluster leaf	Tree	Not Listed	Protected	High

The probability of occurrence of the species of conservation importance are shown graphically in Figure 6. Fourteen species have a low probability of occurrence while two and seven species have a moderate and high probability of occurrence respectively. As mentioned above one species of conservation importance was recorded.

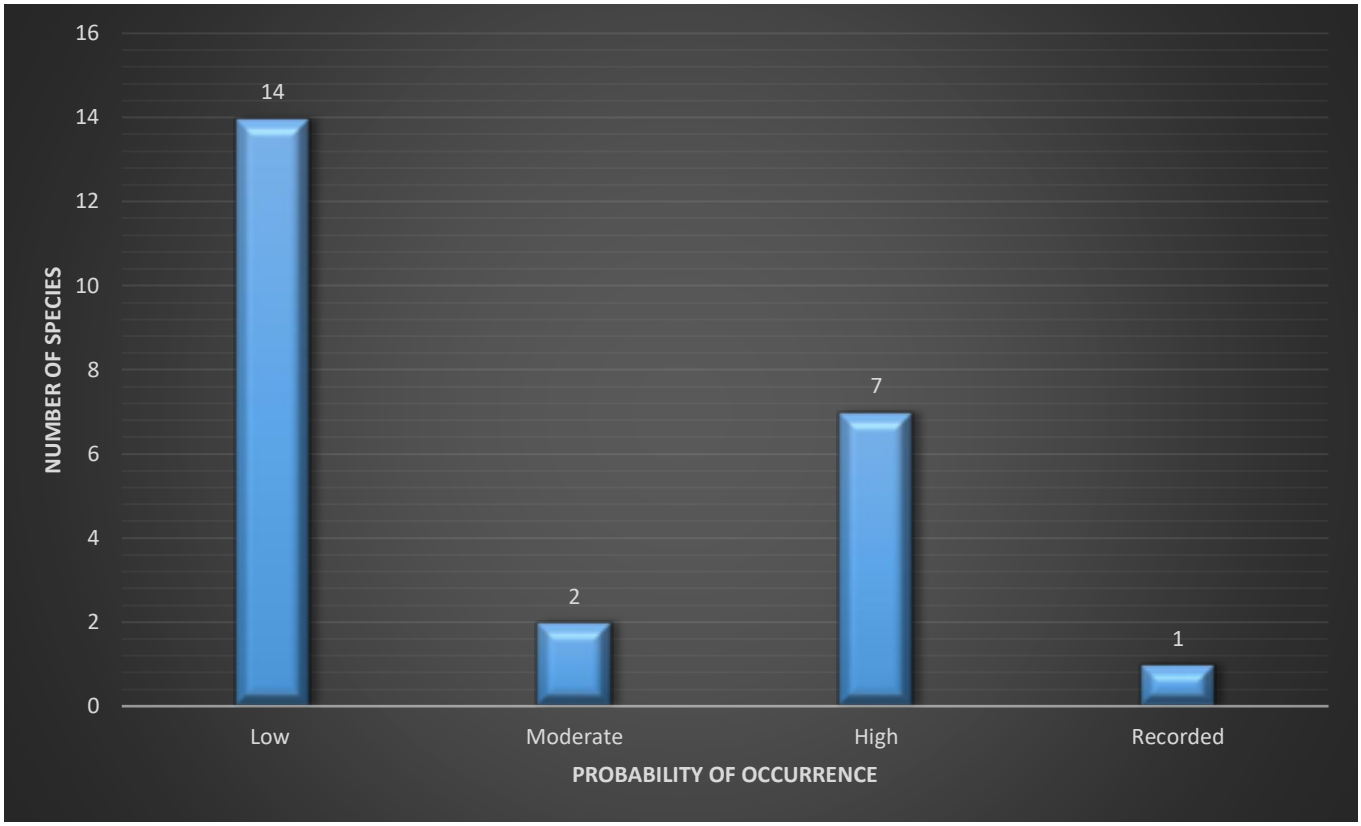


Figure 6: A graphic representation of the probability of occurrence of species of conservation importance

10.2 Fauna Assessment

10.2.1 Recorded Faunal Species

10.2.1.1 Herpetofauna

There are 140 species of reptiles recorded in Malawi, represented in 22 families. Species likely to occur in the area as well as Malawian species of conservation importance were determined, using relevant literature, and these species are given in *APPENDIX B*. As expected, species diversity, for the wetland areas, was relatively low, with only 3 species being recorded during the surveys (

Table 33). There are numerous explanations for the low species diversity, and these can be split into explanations for temporary reduction in species richness and permanent reduction in species richness. These explanations are summarised as follows:

Temporary reduction in species richness:

- Weather – with colder winters and more moderate days, reptile species richness declines due to lower levels of activity in exothermic species such as reptiles; and
- Higher rainfall – during times of higher rainfall reptile prey species (small mammals birds insects and other species are often more dispersed thus dispersing the reptile predators often making recording of these species more difficult due to reduced density in highly favourable areas.

Permanent reduction in species richness:

- Habitat destruction – much of this area has been denuded of natural habitat thus greatly reducing the number of species, and abundance of individuals of the species, historically occurring in the area;
- Persecution – reptiles, particularly snakes, are one of the most severely persecuted taxa in the world and are usually killed due to fear or superstition;
- Food – many reptile species, particularly terrapins and tortoises, are utilised as a food source and in areas with high population density, such as the study area, these species and the abundances of individuals are greatly reduced.

Table 33: Reptile species recorded at wetlands during the April 2017, October 2017 and February 2018 field surveys.

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	April 2017	October 2017	February 2018
AGAMIDAE	*Agama mossambica*	Mozambique Agama	Not Listed	Recorded	Recorded	Recorded
CROCODYLIDAE	*Crocodylus niloticus*	Nile Crocodile	Not Listed	Recorded	Not recorded	Recorded
LAMPROPHIIDAE	*Amblyodipsas polylepis*	Common Purple-glossed Snake	Not Listed	Recorded	Recorded	Not recorded
SCINCIDAE	*Trachylepis margaritifera*	Rainbow skink	Not Listed	Recorded	Recorded	Recorded
	Trachylepis varia	Variable Skink	Not Listed	Recorded	Recorded	Recorded

None of the species recorded are restricted in number or distribution and none of the species are regarded as protected species by Malawi Legislation or listed on the IUCN Red Data list. The species of conservation importance are further discussed in section 10.2.2.

10.2.1.2 Amphibia

Anura (frogs and toads) are by far the largest group of amphibians (3,500 species) worldwide, and occupy a vast range of habitats. There are 91 species of anurans recorded in Malawi these species are given in *APPENDIX C*. Only four species of anurans were recorded in the wetland areas during the April 2017, October 2017 and February 2018 field surveys, and these are listed in Table 34. This is considerably lower than the expected number of species, although a number of factors influenced the number of species recorded in the study area, namely:

- No night surveys were conducted. The majority of frog species in a water body are identified through acoustic surveys of waterbodies at night;
- Amphibians are particularly threatened due to habitat destruction. As wetlands are drained and transformed for agriculture their breeding sites disappear and those left are often affected by pollution or other anthropogenic impacts;
- With other prey species such as small mammals being reduced in number, through anthropogenic impacts, predators (particularly snakes and birds) will increasingly target anurans as a food source; and
- The removal of insects and other prey species from the food chain affects amphibians and, regrettably, very few amphibian species are protected.

Table 34: Amphibian species recorded during the April 2017, October 2017 and February 2018 field surveys.

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	April 2017	October 2017	February 2018
BREVICIPITIDAE	*Breviceps mossambicus*	Mozambique Rain Frog	Not Listed	Recorded	Not recorded	Recorded
BUFONIDAE	*Amietophrynus gutturalis*	African Common Toad	Not Listed	Recorded	Recorded	Recorded
HYPEROLIIDAE	*Hyperolius pusillus*	Water Lily Reed Frog	Not Listed	Recorded	Not recorded	Not recorded
HYPEROLIIDAE	*Kassina senegalensis*	Senegal Kassina	Not Listed	Recorded	Recorded	Recorded

None of the species recorded are classified as being restricted in abundance or distribution, although Malawi does host a number of endemic species, and none of the species recorded are listed under the IUCN Red Data list. Amphibian species of conservation importance are further discussed in section 10.3.2.

10.2.1.3 Avifauna

About 646 species from 78 families, comprising 456 residents, 94 intra-African migrants of regular occurrence (most of which probably breed in Malawi), 77 regular and 12 vagrant Palaearctic species have been documented in Malawi. Over a third of all bird species in Malawi are considered to be uncommon or rare, and of at least limited conservation concern. Ninety-four birds in Malawi are restricted range species, found in only one or a few biomes, but there are no true national endemic bird species. Only twenty-seven (27) species of avifauna were recorded during the April 2017, October 2017 and February 2018 field surveys, and these species are listed in Table 35. This is far lower than the expected number of species for this area. The reduction in number of species recorded in the area, can be attributed to a number of factors namely:

- Destruction of habitat;

- Overutilisation of avifauna as a food source (this is particularly pertinent in dambo areas which are highly populated);
- The survey was conducted late in the wet season and some migratory bird species may have begun their migrations; and
- Reduction of prey species (particular prey species for larger raptors, which compete with humans in rural Africa).

Table 35: Avifauna species recorded during the April 2017, October 2017 and February 2018 field surveys

BIOLOGICAL NAME	COMMON NAME	STATUS	April 2017	October 2017	February 2018
Acrocephalus schoenobaenus	Sedge Warbler	Not Listed	Recorded	Not recorded	Recorded
Corythornis cristatus	Malachite Kingfisher	Not Listed	Recorded	Recorded	Recorded
Dendrocygna bicolor	Fulvous Whistling-Duck	Not Listed	Recorded	Not recorded	Recorded
Alopochen aegyptiaca	Egyptian Goose	Not Listed	Recorded	Recorded	Not recorded
Apus affinis	Little Swift	Not Listed	Recorded	Not recorded	Recorded
Ardea cinerea	Grey Heron	Not Listed	Recorded	Recorded	Recorded
Burhinus capensis	Spotted Thick-knee	Not Listed	Recorded	Recorded	Recorded
Vanellus coronatus	Crowned Lapwing	Not Listed	Recorded	Recorded	Recorded
Anastomus lamelligerus	African Openbill	Not Listed	Recorded	Not recorded	Not recorded
Streptopelia capicola	Ring-necked Dove	Not Listed	Recorded	Recorded	Not recorded
Streptopelia semitorquata	Red-eyed Dove	Not Listed	Recorded	Recorded	Recorded
Estrilda astrild	Common Waxbill	Not Listed	Recorded	Recorded	Recorded
Uraeginthus angolensis	Southern Cordonbleu	Not Listed	Recorded	Not recorded	Recorded
Serinus mennelli	Black-eared Seedeater	Not Listed	Recorded	Recorded	Recorded
Motacilla aguimp	African Pied Wagtail	Not Listed	Recorded	Recorded	Recorded
Nectarinia famosa	Malachite Sunbird	Not Listed	Recorded	Recorded	
Passer griseus	Northern Grey-headed Sparrow	Not Listed	Recorded	Recorded	Recorded
Petronia superciliaris	Yellow-throated Petronia	Not Listed	Recorded	Not recorded	Recorded
Ploceus ocularis	Spectacled Weaver	Not Listed	Recorded	Not recorded	Not recorded
Ploceus cucullatus	Village Weaver	Not Listed	Recorded	Recorded	Recorded
Euplectes orix	Southern Red Bishop	Not Listed	Recorded	Recorded	Recorded
Euplectes albonotatus	White-winged Widowbird	Not Listed	Recorded	Not recorded	Recorded
Gallinula chloropus	Eurasian Moorhen	Not Listed	Recorded	Recorded	Not recorded
Crecopsis egregia	African Crake	Not Listed	Recorded	Not recorded	Recorded
Bostrychia hagedash	Hadada Ibis	Not Listed	Recorded	Recorded	Recorded
Upupa epops africana	African Hoopoe	Not Listed	Recorded	Recorded	Recorded
Zosterops senegalensis	African Yellow White-eye	Not Listed	Recorded	Recorded	Recorded

None of the species recorded during the surveys are restricted in range or abundance, and none of the species recorded are currently listed on the IUCN Red Data list. A large number of species in Malawi are, however, listed on the IUCN Red Data lists, and a number of them are likely to occur in this area. The species of conservation importance further discussed in section 10.3.2.

10.2.1.4 Mammalia

About 195 mammal species from 37 families have been recorded in Malawi. Only twelve (12) species of mammals were recorded in the wetland areas during the April 2017, October 2017 and February 2018 field surveys, and these species are listed in Table 36. This is far lower than the expected number of species for this area. The reduction in number of species recorded in the area, can be attributed to a number of factors namely:

- Destruction of habitat;

- Introduction of domestic animals which outcompete and predate indigenous species;
- Overutilisation of mammal species as a food source; and
- Reduction of prey species (particular prey species for larger mammalian predators, which would compete with humans in rural Africa).

Table 36: Mammal species recorded during the April 2017, October 2017 and February 2018 field surveys

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	April 2017	October 2017	February 2018
HYSTRICIDAE	*Hystrix africaeaustralis*	Cape porcupine	Not Listed	Recorded	Not recorded	Not recorded
THRYONOMYIDAE	*Thryonomys gregorianus*	Lesser cane rat	Not Listed	Recorded	Not recorded	Not recorded
NESOMYIDAE	*Steatomys pratensis*	Fat mouse	Not Listed	Recorded	Not recorded	Not recorded
	Otomys angoniensis	Angoni vlei rat	Not Listed	Recorded	Not recorded	Not recorded
	Dasymys incomtus	African marsh rat	Not Listed	Not recorded	Not recorded	Recorded
	Mastomys natalensis	Natal multimammate mouse	Not Listed	Recorded	Not recorded	Recorded
	Pelomys fallax	Creek groove-toothed swamp rat	Not Listed	Recorded	Not recorded	Not recorded
	Rhabdomys pumilio	Four-striped grass mouse	Not Listed	Recorded	Not recorded	Recorded
SORICIDAE	*Crocidura cyanea*	Reddish-gray musk shrew	Not Listed	Recorded	Recorded	Not recorded
	Crocidura hirta	Lesser red musk shrew	Not Listed	Recorded	Not recorded	Not recorded
HERPESTIDAE	*Galerella sanguinea*	Slender mongoose	Not Listed	Recorded	Recorded	Not recorded
	Helogale parvula	Common dwarf mongoose	Not Listed	Recorded	Recorded	Not recorded

Of the mammal species recorded in Malawi, 16 are listed in the IUCN Red Data List. Most of these animals are found in protected areas and their long-term survival outside protected areas could be problematic due to human activities. A number of these species may however occur outside of protected areas and possibly in the study area. These species are further discussed in section 10.2.2.

10.2.2 Fauna Species of conservation importance

A total of sixty seven (67) animal species (Table 37), currently considered as species of conservation importance, thus either endemic to Malawi or listed as Red Data List species according to the IUCN Red List (IUCN, 2016), occur in Malawi. Of these species:

- Reptile species constitute 10 of the species of concern (Table 37), of which two are listed as just Red Data list species, six are listed as endemics and two are listed as both Red Data list species and endemic species;
- Anuran species (frogs and toads) constitute nine of the species of concern (Table 37), of which seven are listed as just Red Data list species, two are listed as endemics and three are listed as both Red Data list species and endemic species;
- Avifauna species constitute 32 of the species of concern (Table 28), of which 32 are listed as just Red Data list species, none are listed as endemics and none are listed as both Red Data list species and endemic species; and
- Mammal species constitute 16 of the species of concern (Table 37), of which 15 are listed as just Red Data list species, none are listed as just endemics and one is listed as both Red Data list species and endemic species.

Of the ten reptile species of concern:

- One is listed as critically endangered, 3 are listed as endangered and 8 are listed as endemic; and
- Nine species have a low probability of occurrence in the study area and one has a high probability of occurrence.

Of the nine amphibian (anuran) species of concern:

- Three are listed as vulnerable, 1 is listed as Near threatened, 3 are listed as Data deficient and 5 are listed as endemic; and
- Eight species have a low probability of occurrence in the study area and one has a high probability of occurrence.

Of the thirty-two avian species of concern:

- Three are listed as critically endangered, 7 are listed as endangered, 6 are listed as vulnerable, 15 are listed as Near threatened and 1 is listed as Data deficient. No avian species are listed as endemic; and
- Twelve species have a low probability of occurrence in the study area, 2 have a moderate probability of occurrence and 18 have a high probability of occurrence.

Of the sixteen mammal species of concern:

- One is listed as critically endangered, 2 are listed as endangered, 4 are listed as vulnerable, 4 are listed as Near threatened and 5 are listed as Data deficient. One species is listed as endemic; and
- Eleven species have a low probability of occurrence in the study area, 2 have a moderate probability of occurrence and 3 have a high probability of occurrence.

Table 37: Species of conservation importance known to occur in Malawi

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM	DISTRIBUTION/HABITAT	PROBABILITY OF OCCURRENCE
CHAMAELEONIDAE	*Nadzikambia mlanjensis*	Mlanje Mountain Chameleon	EN	Malawi Endemic	This species is endemic to Mount Mulanje, Malawi and is found in the remaining evergreen forest fragments on moist southern and eastern facing slopes at mid altitude, and in the forest at high altitude on the Lichenya plateau. A population may exist on the immediately adjacent small inselberg Mt. Mchese (< 5km to the north of Mulanje), but this has not been confirmed. It is also suggested that neighbouring large Mozambican inselbergs might contain additional populations of *N. mlanjensis*, but most of these mountains have not been surveyed.	Low
	Rhampholeon chapmanorum	Malawi Hill Pygmy Chameleon	CR	Malawi Endemic	This species is only found at Malawi Hill (more specifically, in the Natundu Hills range), near Nsanje, Malawi. It was described from a tiny remnant of lowland seasonal rainforest on the upper south east facing slope within the Matandwe Forest Reserve. The indigenous forest of the Malawi Hill has essentially been destroyed due to human encroachment.	Low
CHAMAELEONIDAE	*Rhampholeon platyceps*	Mount Mulanje Pygmy Chameleon	EN		*Rhampholeon platyceps* is endemic to the mid and high-altitude evergreen forest fragments of Mount Mulanje and the adjacent Mchese Mountain (and essentially part of the same massif), Malawi. It is found only on the moist southern and eastern-facing slopes where forest occurs in remnant fragmented patches, totalling ca. 61 km^2.	Low
CORDYLIDAE	*Platysaurus mitchelli*	Mitchell's Flat Lizard		Malawi Endemic	Not known to occur in the area	Low
	Cordylus nyikae	Nyika Girdled Lizard		Malawi Endemic	Not known to occur in the area	Low
GEKKONIDAE	*Lygodactylus rex*	King Dwarf Gecko		Malawi Endemic	Not known to occur in the area	Low
SCINCIDAE	*Eumecia johnstoni*	Nyika Serpentiform Skink		Malawi Endemic	Not known to occur in the area	Low
	Trachylepis hildae	Nyika Three-striped Skink		Malawi Endemic	Not known to occur in the area	Low
	Trachylepis mlanjensis	Mlanje Skink		Malawi Endemic	Not known to occur in the area	Low

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM	DISTRIBUTION/HABITAT	PROBABILITY OF OCCURRENCE
TRIONYCHIDAE	*Cycloderma frenatum*	Zambezi Flapshell Turtle	EN		*Cycloderma frenatum* inhabits rivers and lakes in eastern Africa, from the Rufiji River basin in Tanzania in the north through Lake Malawi and the Rufiji, Rovuma, and Lower Zambezi river basins, extending south to the lower Save (Sabi) river of southeastern Zimbabwe and central Mozambique (Iverson 1992, Boycott and Bourquin 2000, Branch 2008, Gramentz 2008). It has also been recorded in Zambia.	High
ARTHROLEPTIDAE	*Arthroleptis francei*	Ruo River Screeching Frog	VU	Malawi Endemic	This species is known from three threat-defined locations: Mount Mulanje in southern Malawi and Mounts Namuli and Mabu in northern Mozambique, where it occurs as low as 700 m asl in the Ruo Basin and up to the plateau up to at least 2,500 m asl. As the region is poorly surveyed, it is unknown whether this species could occur more widely. Records from the Zomba Mountains (north of Mulanje) still need to be confirmed as the region requires extensive surveying. Records from Mounts Namuli and Mabu in northern Mozambique may not actually belong to this species, but are retained until formally described as a separate species. The extent of occurrence (EOO) is 7,959 km^2, excluding the Zomba records.	Low
BUFONIDAE	*Mertensophryne nyikae*	Nyika Dwarf Toad	NT	Malawi Endemic	This species is likely to be endemic to the Nyika Plateau in northern Malawi and north-eastern Zambia. It is a high-altitude species known from 2,500 m asl, although its precise altitudinal range is not known. Its approximate EOO is 1,431 km^2.	Low
HYPEROLIIDAE	*Hyperolius friedemanni*	Friedmans Long Reed Frog	DD	Malawi Endemic	This species is only known from two sites - Karonga and Monkey Bay - on the shores of Lake Malawi. However, the limits of its range and that of its congeners remains highly uncertain. As such, its rangemap has been limited to the lakeside sites where it has been recorded. Further research into this species' relationship with others in the *Hyperolius nasutus* group is likely to amend its distribution, with possible expansion along the lakeshore and further west into Malawi.	Low

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM	DISTRIBUTION/HABITAT	PROBABILITY OF OCCURRENCE
HYPEROLIIDAE	*Hyperolius inyangae*	Nyanga Long Reed Frog	VU		This species is known from the Eastern Highlands of Zimbabwe where it was collected in the Nyanga National Park, and also from Kaningina Forest Reserve in northern Malawi. There have been no records of the species in the intervening areas or in Mozambique thus far and the limits of its distribution remain largely uncertain. Its EOO is 16,195 km^2.	Low
HYPEROLIIDAE	*Hyperolius spinigularis*	Spiny Reed Frog	VU		This species is restricted to the Mulanje Massif (but not recorded on Mount Mulanje) in southern Malawi and the Namuli Massif in Mozambique. It could occur in other isolated massifs in Mozambique, but the region is poorly surveyed (S. Loader pers. comm. December 2014). Its elevational range is 690-1,250 m asl and its EOO is 5,488 km^2.	Low
PHRYNOBATRACHIDAE	*Phrynobatrachus stewartae*	Stewart's River Frog	DD		This very poorly known species is so far known only from three localities: Rumpi, in northern Malawi; Mulenge Forest, in south-central Tanzania, and Katavi National Park, in western Tanzania. It presumably occurs in intervening locations, and perhaps more widely. Its altitudinal range is unclear, though it has been reported from a site at about 800 m asl and probably occurs above 1,200 m asl.	Low
PHRYNOBATRACHIDAE	*Phrynobatrachus ukingensis*	Ukinga River Frog	DD		This species occurs in the Ukinga and Rungwe Mountains of southern Tanzania, in the Misuku Mountains and at Nchenachena in northern Malawi, and at Maroka (in the highlands south-west of Zomba) in southern Malawi. It has recently been found much further to the north in the Uluguru Mountains of eastern Tanzania. It presumably occurs more widely, in particular between the currently known sites. It is a montane species, probably occurring above 1,000 m asl, and perhaps ranging to over 2,000 m asl in places.	Low
PTYCHADENIDAE	*Ptychadena broadleyi*	Broadley's Ridged Frog		Malawi Endemic	Not known to occur in the area	Low
PYXICEPHALIDAE	*Amietia johnstoni*	Johnston's river frog		Malawi Endemic	Not known to occur in the area	Low
ACCIPITRIDAE	*Aquila nipalensis*	Steppe Eagle	EN		Migratory - Known from the area	High

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM	DISTRIBUTION/HABITAT	PROBABILITY OF OCCURRENCE
	Circus macrourus	Pallid Harrier	NT		Migrate to the Afrotropics (Sudan, South Sudan, Eritrea, Djibouti, Ethiopia, Somalia, Kenya, Uganda, Rwanda, Burundi, Tanzania, Malawi, Zambia, Zimbabwe, Mozambique, Chad, Niger, Mali, Senegal, Gambia, Sierra Leone, Guinea-Bissau, Liberia, Ivory Coast, Ghana, Togo, Benin, Burkina Faso, Nigeria, Cameroon, Central African Republic, Democratic Republic of Congo, Angola, Namibia, Botswana, Swaziland and South Africa)	High
	Buteo oreophilus	Mountain Buzzard	NT		*Buteo oreophilus* is distributed from Ethiopia, west through Kenya, Uganda, South Sudan and Rwanda to eastern Democratic Republic of Congo, and south to Tanzania, Burundi and Malawi.	Low
	Terathopius ecaudatus	Bateleur	NT		Known to occur in the area	High
	Stephanoaetus coronatus	Crowned Eagle	NT		Known to occur in the area	High
	Polemaetus bellicosus	Martial Eagle	VU		Known to occur in the area	High
	Gyps africanus	White-backed Vulture	CR		This species is the most widespread and common vulture in Africa, although it is now undergoing rapid declines.	High
	Trigonoceps occipitalis	White-headed Vulture	CR		Locally extinct	Low
	Torgos tracheliotos	Lappet-faced Vulture	EN		Locally extinct	Low
	Necrosyrtes monachus	Hooded Vulture	CR		This species is widespread in sub-Saharan Africa; from Senegal (with higher densities in the west, for at least the southern part of the country, with possibly 2,350-2,700 pairs in the Ziguinchor Département) and southern Mauritania east through southern Niger and Chad, to southern Sudan, South Sudan, Ethiopia and western Somalia, southwards to northern Namibia and Botswana, and through Zimbabwe to southern Mozambique and north-eastern South Africa	High

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM	DISTRIBUTION/HABITAT	PROBABILITY OF OCCURRENCE
ACROCEPHALIDAE	*Acrocephalus griseldis*	Basra Reed Warbler	EN		The highest populations of breeding individuals between 2005 and 2011 were found in Central Marshes, West Hammar Marshes, Hawizeh and Dalmaj, with these populations amounting to c.90% of the total breeding population (Nature Iraq in press). It winters in Sudan, South Sudan, Ethiopia, south Somalia, southeast Kenya (Urban et al. 1997), east Tanzania, south Malawi (few records) and Mozambique.	LOW
ARDEIDAE	*Ardeola idae*	Madagascar Pond-Heron	EN		It has a large non-breeding range in Central and East Africa including the Comoro Islands, Mozambique, Zimbabwe, Zambia, Malawi, Tanzania, Kenya, Uganda, Burundi, Rwanda and Democratic Republic of Congo. It is present almost throughout Madagascar, but is always uncommon	High
BUCORVIDAE	*Bucorvus leadbeateri*	Southern Ground-Hornbill	VU		Known to occur in the area	High
CISTICOLIDAE	*Apalis chariessa*	White-winged Apalis	VU		*Apalis chariessa* has a disjunct range in Kenya (possibly extinct), Tanzania, Malawi and Mozambique. In Kenya, the nominate subspecies is known only from the lower Tana river, but has not been seen since 1961	Low
CISTICOLIDAE	*Apalis flavigularis*	Yellow-throated Apalis	EN		*Apalis flavigularis* is restricted to three massifs (Mt Mulanje, Mt Zomba, Mt Malosa) in southeast Malawi, east of the Nyasa-Shire Rift	Low
FAONIDAE	*Fao fasciinucha*	Taita Faon	VU		It is recorded from southern Ethiopia, eastern South Sudan, eastern Uganda, Kenya (probably occurring at low densities throughout the country), Tanzania (scattered records), eastern Zambia (a few sites), Malawi (two recent records), Zimbabwe (20-50 pairs), but recently reported to be in decline	Moderate
FAONIDAE	*Fao vespertinus*	Western Red-footed Faon	NT		Migratory species - known to occur in the area	High
GRUIDAE	*Bugeranus carunculatus*	Wattled Crane	VU		Not known to occur in the region	Low
	Balearica regulorum	Grey Crowned-Crane	EN		Known to be resident in the area	High
HIRUNDINIDAE	*Hirundo atrocaerulea*	Blue Swallow	VU		Occurs only in northern and southern Malawi	Low
LARIDAE	*Rynchops flavirostris*	African Skimmer	NT		Widely distributed through central Africa and known to occur in the area	High
MUSCICAPIDAE	*Sheppardia gunningi*	East Coast Akalat	NT		Not known to occur in the area	Low

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM	DISTRIBUTION/HABITAT	PROBABILITY OF OCCURRENCE
OTIDIDAE	*Neotis denhami*	Denham's Bustard	NT		Although very widely distributed, it has suffered population declines through much of its range. The Rift Valley in Kenya was formerly regarded as its stronghold, but there are now probably fewer than 300 in all, and its range has contracted. It is now regarded as the most endangered of its family in Kenya.	High
PHOENICOPTERIDAE	*Phoeniconaias minor*	Lesser Flamingo	NT		Not known to occur in the area	Low
PICIDAE	*Dendropicos stierlingi*	Stierling's Woodpecker	NT		Occurs in southern Tanzania, northern Mozambique and adjacent southern Malawi	Low
PLOCEIDAE	*Ploceus olivaceiceps*	Olive-headed Weaver	NT		Known to occur in the area	High
PSITTACULIDAE	*Agapornis lilianae*	Lilian's Lovebird	NT		*Agapornis lilianae* occurs along the Zambezi Valley in Mozambique and into Zimbabwe, northwards along the Luangwa River into Zambia and southern Tanzania, and along the Shire River into Malawi, where it occurs throughout Liwonde National Park	Moderate
SAGITTARIIDAE	*Sagittarius serpentarius*	Secretarybird	VU		Widespread throughout southern Africa - known to occur in the area	High
SCOLOPACIDAE	*Calidris ferruginea*	Curlew Sandpiper	NT		Migratory species - known to occur in the area	High
	Numenius arquata	Eurasian Curlew	NT		Known to occur in the area	High
	Gallinago media	Great Snipe	NT		From early August, it migrates through central Asia, central and southeastern Europe (notably Turkey and Cyprus) Tunisia and Egypt, with birds gathering in wet high-plateau grasslands in Ethiopia. When these dry out in October, birds follow the rains south and west to Sudan, South Sudan, Chad, Burkina Faso, Mali, Mauritania, Senegal, Sierra Leone, Liberia, Côte d'Ivoire, Ghana, Togo, Benin, Nigeria, Cameroon, Gabon, Congo, Democratic Republic of Congo, Kenya, Uganda, Rwanda, Burundi, Tanzania, Malawi, Zambia, Zimbabwe, Mozambique, South Africa, Angola and Namibia.	High
TURDIDAE	*Geokichla guttata*	Spotted Ground-Thrush	EN		Resident subspecies in southern Malawi	Low

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM	DISTRIBUTION/HABITAT	PROBABILITY OF OCCURRENCE
MACROSCELIDIDAE	*Elephantulus fuscus*	Dusky elephant shrew	DD		There are 22 documented locations (some may have more than one specimens) - nine from southern Malawi, 12 from southern Mozambique, and one from southern Zimbabwe. One specimen dates from about 2005, the rest pre-date 1968. Habitat seems to be savanna or woodland, but nothing else is known. The locations fall within a polygon that is about 146,000 km^2. Based only on the size of this area, one could guess that it is not Near Threatened, and perhaps Least Concern. However, Malawi and much of Zimbabwe are densely populated by people, and it may be that suitable habitat has been greatly reduced given the lack of recent records.	Low
SCIURIDAE	*Paraxerus lucifer*	Black and red bush squirrel	DD		This species is limited to northern Malawi (Misuku Hills and Nyika Plateau region at around 2,000 m asl) and southwestern Tanzania (in the Poroto Mountains and Mount Rungwe).	Low
GLIRIDAE	*Graphiurus johnstoni*	Johnston's African dormouse	DD	Malawi Endemic	This species appears to be limited to southern Malawi. The range limits are not well known.	Low
SORICIDAE	*Myosorex gnoskei*	Nyika Burrowing Shrew	EN		This species is endemic to the Nyika Plateau in Nyika National Park, Malawi, and has been found from 2,100 to 2,300 m asl.	Low
PTEROPODIDAE	*Epomophorus anselli*	Ansell's epauletted fruit bat	DD		This species is currently only known from Malawi, where it has been collected in the Kasungu National Park and (most probably) the Karonga area.	Low
VESPERTILIONIDAE	*Neoromicia flavescens*	Yellow Pipistrelle	DD		This poorly known species appears to have been recorded from Angola (type locality at Galanga), Burundi, and Cameroon, Malawi (including the Shire Highlands, Mozambique, Uganda (Kampala) and Somalia (Shonto Forest). The distribution is uncertain and further studies are needed to clarify the species range.	Low
MANIDAE	*Manis temminckii*	Ground pangolin	VU		The most widespread African pangolin species, recorded from southeastern Chad, through South Sudan, much of East Africa and southern Africa as far south as the Northern Cape and North West Provinces of South Africa and northeast KwaZulu-Natal Province	High
FELIDAE (CATS)	*Acinonyx jubatus jubatus*	South African cheetah	VU		Restricted to nature reserves	Low
	Panthera leo	Lion	VU		Restricted to nature reserves	Low

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM	DISTRIBUTION/HABITAT	PROBABILITY OF OCCURRENCE
	Panthera pardus pardus	African leopard	VU		Leopards are widely distributed across Africa and Asia, but populations have become reduced and isolated, and they are now extirpated from large portions of their historic range. Due to their wide geographic range, secretive nature and habitat tolerance,	Moderate
CANIDAE	*Lycaon pictus lupinus*	East African wild dog	EN		Restricted to Nature reserves	Low
MUSTELIDAE	*Lutra maculicollis*	Speckle-throated otter	NT		Although this species has a large distribution they are restricted to areas of permanent fresh water, offering good shoreline cover and an abundant prey base. Thus while the distribution range is large, the spatial size of their occupied habitats is much smaller and unknown, particularly due to the widespread habitat destruction and pollution problems reported for much of the African continent.	High
MUSTELIDAE	*Aonyx capensis*	African clawless otter	NT		The African clawless otter is the most widely distributed otter species in Africa, with a range stretching from Senegal and Mali throughout most of West Africa to Sudan and Ethiopia, and then southwards throughout East Africa to the Western Cape of South Africa. They are absent from the Congo basin, where they are replaced by the Congo clawless otter (*Aonyx congicus*), the two species being sympatric in Uganda and Rwanda.	High
EQUIDAE	*Equus quagga crawshayi*	Crawshay's zebra	NT		Restricted to nature reserves	Low
RHINOCEROTIDAE	*Diceros bicornis minor*	South-central black rhinoceros	CR		Restricted to nature reserves	Low
BOVIDAE	*Kobus vardonii*	Puku	NT		The Puku (*Kobus vardonii*) formerly occurred widely in grasslands near permanent water within the savannah woodlands and floodplains of south-central Africa. It has been eliminated from large parts of its former range and reduced to fragmented, isolated populations, but some of these are still numerous. Large numbers now occur in only two countries, Tanzania and Zambia	Low

10.3 Wetland Assessment

Based on the conceptual mining footprint and an assessment of the watersheds in the area, three functional dambos are likely to be impacted upon by the mining development in the area, one falls within the local study area (Dambo 1) and two (Kankoma Dambo and Kovuma Dambo) occur to the north of the study area (Figure 7).

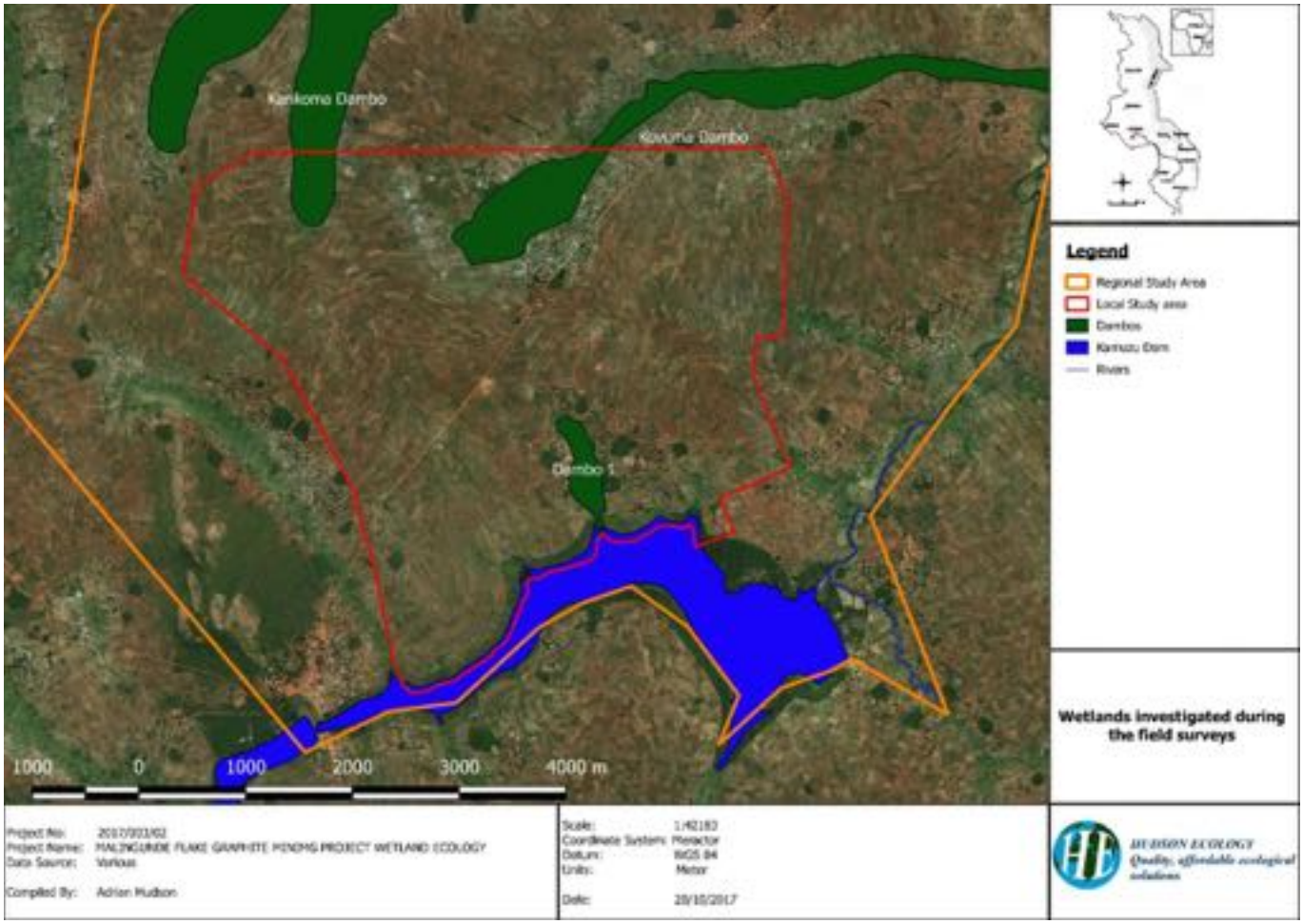


Figure 7: Wetlands investigated during the study

Assessments and classifications of the wetlands according to Present Ecological Status (PES), Ecological Importance and Sensitivity (EIS) and Wetland Function Assessment are outlined in Figure 8 and Figure 9, respectively, and are described in sections 10.3.1 to 10.3.3 below. Comprehensive studies of the wetland areas were conducted during the April 2017 and October 2017 surveys. The February 2018 surveys were however conducted of additional areas, and observations in the original study area were considered incidental and used only to augment existing data. PES and EIS studies of the wetlands, as well as VEGRAI studies on riparian vegetation were conducted during both the April 2017 and October 2017 surveys, however, due to the short timeframe between the studies and the fact that the April 2017 study was conducted in a wetter season, the results of the April 2017 surveys were used if there was any discrepancy in the results between the two seasonal surveys.

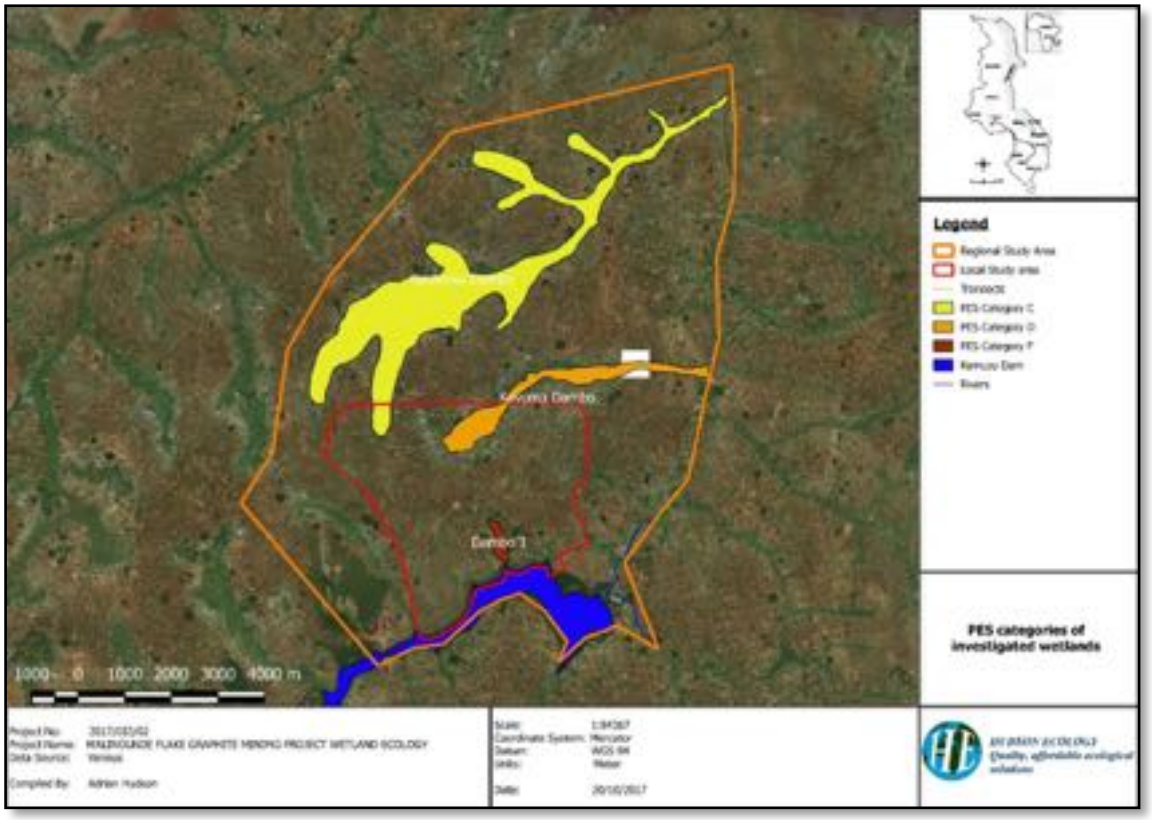


Figure 8: Present Ecological Status of investigated wetlands

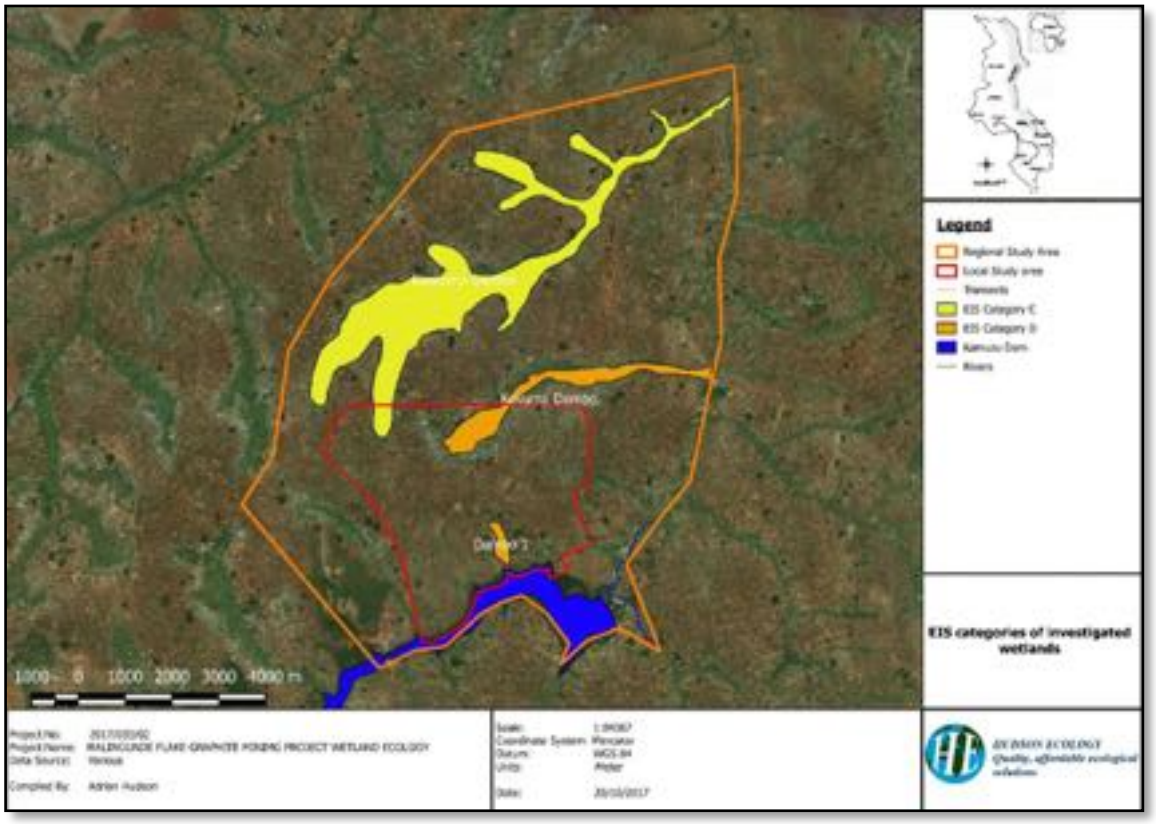


Figure 9 Ecological Importance and Sensitivity of investigated wetlands:

10.3.1 Kankoma Dambo (Study site MMD1)

The Kankoma Dambo is situated to the north of the study area and flows in a west-east direction. As with the vast majority of the dambos in the area, the Kankoma Dambo has been impacted upon to a significant degree through anthropogenic impacts such as impoundments, cropping, grazing and overutilisation of natural resources, as can be seen in Figure 10. This dambo has, however, not been completely transformed as is the case with other dambos in the area.

Figure 10: Kankoma Dambo cross section view from north to south

10.3.1.1 Present Ecological Status (PES)

Similar to the other wetlands (dambos) within the study area, Kankoma Dambo has been severely impacted. This wetland has been canalised to a lesser extent than the other wetlands in the area, furthermore the wetland has been impounded to allow for vehicle and pedestrian traffic. Although many of the graminoid and cyperoid species expected still occur in the area, some woody species such as *Senna alata* have encroached upon the canal. Many exotic species such as, *inter alia*, *Bidens biternata, Bidens pilosa, Helichrysum* sp.*, Sesbania microphylla, Solanum delagoense, Tagetes minuta* and *Verbena bonariensis* are present at this site. Cyperoid species include *Cyperus digitatus, Cyperus esculentus, Cyperus tenax, Kylinga erecta* and *Pycreus aethiops.* While *Typha latifolius* and *Typha domingensis* are also present in areas where water persists. The majority of wetlands in the area are severely degraded and grass species occurring in these wetlands include *Andropogon gayanus, Aristida junciformis, Arundinella nepalensis, Brachiaria deflexa, Cynodon dactylon, Eragrostis capensis, Eragrostis chapelieri, Hyparrhenia filipendula, Melinis repens, Pogonarthria squarrosa, Setaria pumila, Sporobolus pyramidalis, Sporobolus subtilis* and *Themeda triandra*. This wetland is severely overgrazed and canalisation and erosion both occur frequently in this wetland.

Table 38: Present Ecological Status

Criteria and attributes	Score	Confidence
Hydrologic		
Flow modification	3	4
Permanent Inundation	5	4
Water Quality		
Water Quality Modification	6	4
Sediment load modification	2	4
Hydraulic/Geomorphic		
Canalisation	2	4
Topographic Alteration	4	4
Biota		
Terrestrial Encroachment	3	4
Indigenous Vegetation Removal	6	4
Invasive plant encroachment	4	4
Alien fauna	1	4
Overutilisation of biota	2	4
TOTAL	**38**	
MEAN	**3**	
PES Category	**C**	

The current trajectory of this wetland is ↓

10.3.1.2 Ecological Importance and Sensitivity (EIS)

The EIS for Kankoma Dambo, determined during the April 2017 assessment, is given in Table 39 below, the October 2017 assessment showed similar results, however the scores were lower due to the very dry conditions prevailing at the time of the October 2017 surveys.

Table 39: EIS scores for Kankoma Dambo

Determinant	Kankoma Dambo	
	Score	Confidence
PRIMARY DETERMINANTS		
1. Rare & Endangered Species	1	3
2. Populations of Unique Species	1	3
3. Species/taxon Richness	2	3
4. Diversity of Habitat Types or Features	2	4
5. Migration route/breeding and feeding site for wetland species	3	4
6. PES as determined by Wet-Health assessment	3	5
7. Importance in terms of function and service provision	1	3
MODIFYING DETERMINANTS		
8. Protected Status	4	5
9. Ecological Integrity	2	5
TOTAL	**18**	
MEAN	**2.0**	
OVERALL EIS (Recommended Ecological Management Class)	**C**	

10.3.1.3 Wetland Services Assessment

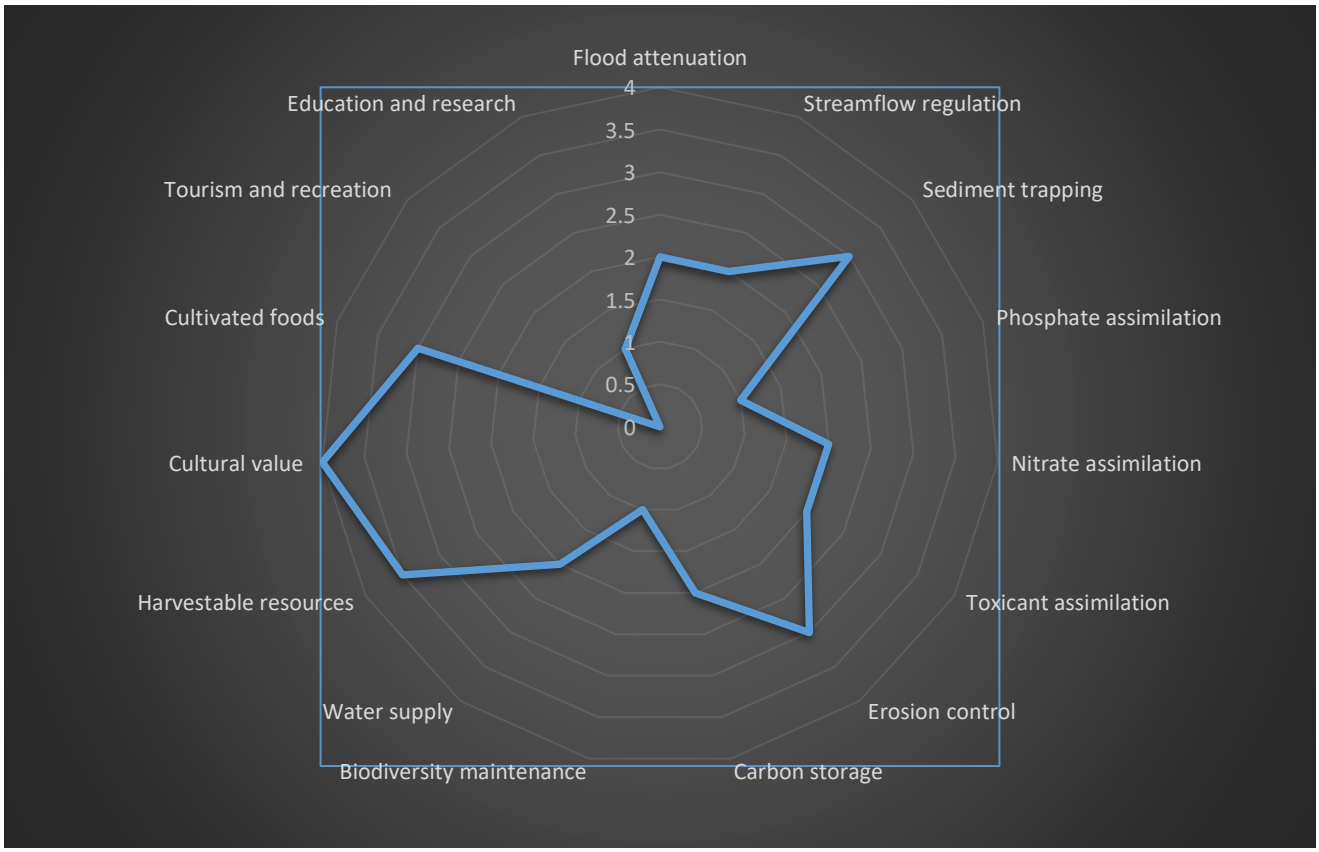


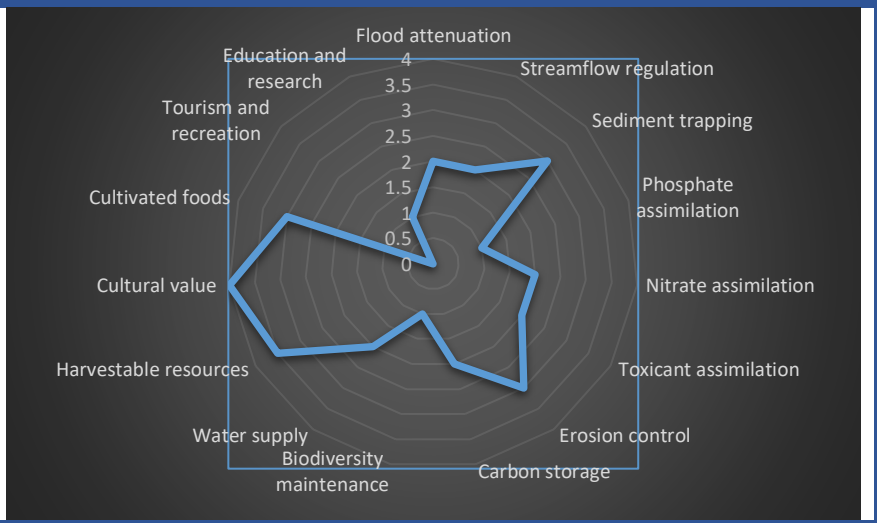
Figure 11: Kankoma Dambo Wetland Services Assessment

10.3.1.4 Summary

Table 40 provides a summary for the Kankoma Dambo investigation.

Table 40: Summary of the Kankoma Dambo ecological status scores

WETLAND TYPE		
Valley Bottom with a Channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.

PES AND EIS			WETLANDS ECOSYSTEM SERVICES
PES	**Hydrology**	**D**	
	Geomorphology	**C**	
	Vegetation	**C**	
EIS		**Moderate (C)**	

The reasons for the scores during the surveys are as follows:

- Hydrology – the hydrology at Kankoma Dambo has been severely impacted by impoundments and agricultural practices in the area;
- Geomorphology – similarly to the hydrology, the geomorphology of the wetland has been altered through a variety of anthropogenic impacts; and
- Vegetation – although a large number of indigenous species are still present on site, a large number of exotic species have invaded the wetland areas. These likely originate from surrounding agricultural areas and seed dispersal through means of vehicles.
- The current trajectory of this wetland is ↓

10.3.2 Kovuma Dambo (Study site MMD2 KO)

The Kovuma Dambo is situated to the north of the study area and flows in a west-east direction. As with the vast majority of the dambos in the area the Kankoma Dambo has been impacted upon to a significant degree through anthropogenic impacts such as cropping, impoundments, grazing and overutilisation of natural resources, as can be seen in Figure 12. This dambo has, however, not been completely transformed as is the case with other dambos in the area, although it is considerably impacted.

Figure 12: Kovuma Wetland cross section from south-east to north-west

10.3.2.1 Present Ecological Status (PES)

Similar to the other wetlands (dambos) within the study area, Kovuma Dambo has been severely impacted. This wetland has been considerably canalised causing the desiccation of the outer edges of the wetland causing the encroachment of terrestrial grass species, such as *Themeda triandra*, and woody species. Although many of the graminoid and cyperoid species expected still occur in the area, the number of these species has been greatly reduced from the number of expected species in the area. There is encroachment of some woody species, such as *Senna alata,* in the channel, and the dambo is also being impacted on by the cultivation of water intensive species such as *Eucalyptus* spp in the adjacent areas. Many exotic species such as, *inter alia, Bidens pilosa, Blumea alata, Conyza albida, Eucalyptus saligna, Psidium guajava, Sesbania microphylla, Solanum delagoense, Tagetes minuta, Verbena bonariensis* and *Lantana camara* are present at this site. Cyperoid species include *Cyperus digitatus, Cyperus esculentus* and *Cyperus tenax.* While *Typha domingensis* is present and in certain areas dominates where water persists. The majority of wetlands in the area are severely degraded and grass species occurring in these wetlands include *Andropogon gayanus, Aristida junciformis, Brachiaria deflexa, Cynodon dactylon, Eragrostis capensis, Eragrostis chapelieri, Melinis repens, Pogonarthria squarrosa, Sporobolus pyramidalis* and *Themeda triandra* is present in areas where the dambo has been desiccated through the canalisation of the valley. The present ecological status at the Kovuma Dambo monitoring site is given in Table 41.

Table 41: PES scores for Kovuma Dambo

Criteria and attributes	Score	Confidence
Hydrologic		
Flow modification	6	4
Permanent Inundation	6	4
Water Quality		
Water Quality Modification	6	4
Sediment load modification	4	4
Hydraulic/Geomorphic		
Canalisation	6	4
Topographic Alteration	2	4
Biota		
Terrestrial Encroachment	6	4
Indigenous Vegetation Removal	4	4
Invasive plant encroachment	6	4
Alien fauna	2	4
Overutilisation of biota	6	4
TOTAL	54	
MEAN	5	
PES Category	D	

10.3.2.1 Ecological Importance and Sensitivity (EIS)

The EIS for the Kovuma Dambo, determined during the April 2017 assessment, is given in Table 42, below, the October 2017 assessment showed similar results, however the scores were lower due to the very dry conditions prevailing at the time of the October 2017 surveys.

Table 42: EIS scores for Kovuma Dambo

Determinant	Kovuma Dambo	
	Score	Confidence
PRIMARY DETERMINANTS		
1. Rare & Endangered Species	1	3
2. Populations of Unique Species	1	3
3. Species/taxon Richness	2	3
4. Diversity of Habitat Types or Features	3	3
5. Migration route/breeding and feeding site for wetland species	2	2
6. PES as determined by Wet-Health assessment	1	4
7. Importance in terms of function and service provision	1	4
MODIFYING DETERMINANTS		
8. Protected Status according to NFEPA WetVeg	1	4
9. Ecological Integrity	1	3
TOTAL	**13**	
MEAN	**1**	
OVERALL EIS (Recommended Ecological Management Class)	**D**	

10.3.2.1 Wetland Services Assessment

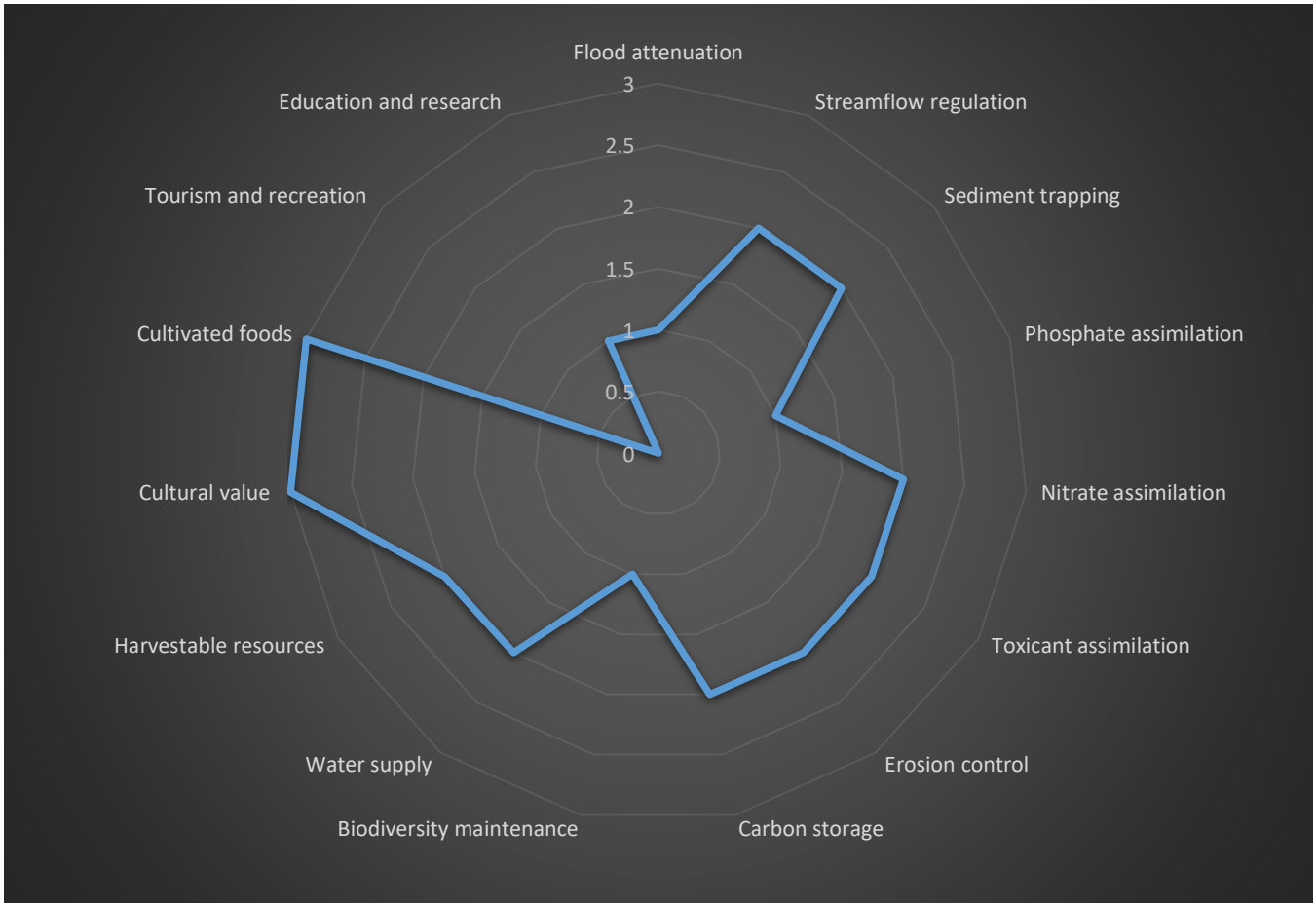


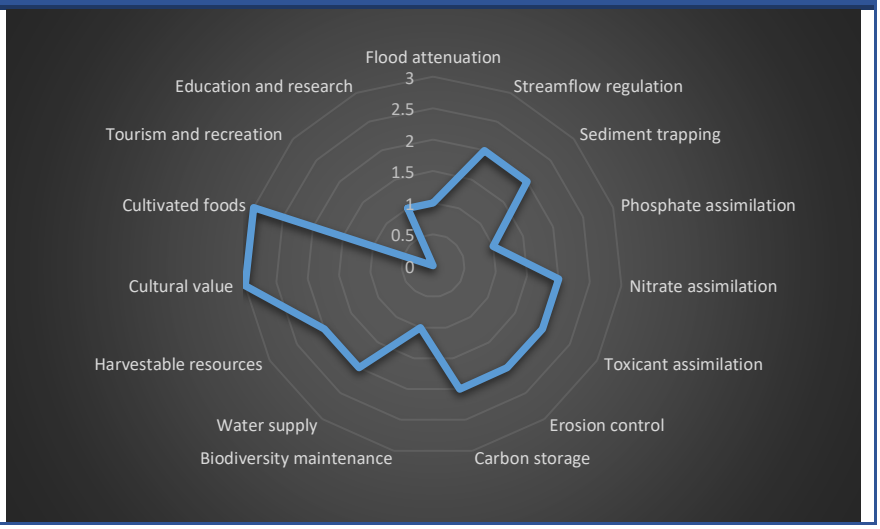
Figure 13: Kovuma Dambo Wetland Services Assessment

10.3.2.2 Summary

Table 43 provides a summary for the Kovuma Dambo investigation.

Table 43 Summary of the Kovuma Dambo ecological status scores

WETLAND TYPE		
Valley Bottom with a Channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.

PES AND EIS			WETLANDS ECOSYSTEM SERVICES
PES	Hydrology	D	
	Geomorphology	D	
	Vegetation	E	
EIS		Low (D)	

The reasons for the scores during the surveys are as follows:

- Hydrology – the hydrology at Kovuma Dambo has been severely impacted by impoundments and agricultural practices in the area;
- Geomorphology – similarly to the hydrology, the geomorphology of the wetland has been altered through a variety of anthropogenic impacts; and
- Vegetation – although a large number of indigenous species are still present on site, a large number of exotic species have invaded the wetland areas. These likely originate from surrounding agricultural areas and seed dispersal through means of vehicles.
- The current trajectory of this wetland is ↓

10.3.3 Dambo 1 (Study site MMDR)

Dambo 1 is an unnamed dambo occurring in the southern part of the study area draining southwards into the Kazumu Dam. This dambo has, however been completely transformed and performs very little, or no, functionality usually associated with wetlands. Transformation has occurred through the natural vegetation being removed throughout the wetland in order to be replaced by agriculture. Mainly in the form of maize (*Zea mays*) and groundnuts (*Arachis villosulicarpa*). Almost all aspects of this dambo have been severely impacted or transformed through anthropogenic impacts such as cropping, impoundments, grazing and overutilisation of natural resources, as can be seen in Figure 14 and this dambo can be characterised as transformed.

Figure 14: An example of cultivation pervading Dambo 1, which runs in a north-south direction in the south of the study area.

10.3.3.1 Present Ecological Status (PES)

Dambo 1 can only be described as completely transformed and from an ecological point of view this means that very little, if any of the ecological function of the wetland still remains. This are is also colonised by exotic species in many areas, the infestation by exotic species ranges from mild to severe in various areas of the dambo. Small areas (<1ha) of natural vegetation occur very sparsely within this dambo, tree species recorded in this dambo area include mainly *Senna alata*, with the odd *Kigellia africana* and *Piliostigma thonningii*, individuals being recorded on the edge of cultivated lands. The grass and sedge layers of this dambo have been virtually eradicated and are limited to regrowth in fallow lands where species such as *Aristida junciformis, Arundinella nepalensis, Cynodon dactylon, Hyparrhenia filipendula, Pogonarthria squarrosa* and *Sporobolus pyramidalis* are emergent. Forb species are dominated by alien invasive species such *Bidens biternata, Bidens pilosa, Solanum delagoense, Tagetes minuta, Agave* sp. *Opuntia* sp. and *Verbena bonariensis*. The present ecological status of Dambo 1 is given in Table 44.

Table 44: PES scores for Dambo 1

Criteria and attributes	Score	Confidence
Hydrologic		
Flow modification	8	4
Permanent Inundation	9	4
Water Quality		
Water Quality Modification	9	4
Sediment load modification	9	4
Hydraulic/Geomorphic		
Canalisation	9	4
Topographic Alteration	8	4
Biota		
Terrestrial Encroachment	10	4
Indigenous Vegetation Removal	10	4
Invasive plant encroachment	10	4
Alien fauna	10	4
Overutilisation of biota	10	4
TOTAL	102	
MEAN	9	
PES	F	

10.3.3.2 Ecological Importance and Sensitivity (EIS)

The EIS for the Dambo 1, determined during the April 2017 assessment, is given in Table 45, below, the October 2017 assessment showed similar results, however the scores were lower due to the very dry conditions prevailing at the time of the October 2017 surveys.

Table 45: EIS scores for Dambo 1

Determinant	Dambo1	
	Score	Confidence
PRIMARY DETERMINANTS		
1. Rare & Endangered Species	1	4
2. Populations of Unique Species	1	4
3. Species/taxon Richness	2	4
4. Diversity of Habitat Types or Features	1	4
5. Migration route/breeding and feeding site for wetland species	1	3
6. PES as determined by Wet-Health assessment	1	4
7. Importance in terms of function and service provision	1	4
MODIFYING DETERMINANTS		
8. Protected Status according to NFEPA WetVeg	1	4
9. Ecological Integrity	1	3
TOTAL	10	
MEAN	1	
OVERALL EIS (Recommended Ecological Management Class)	D	

10.3.3.3 Wetland Services Assessment

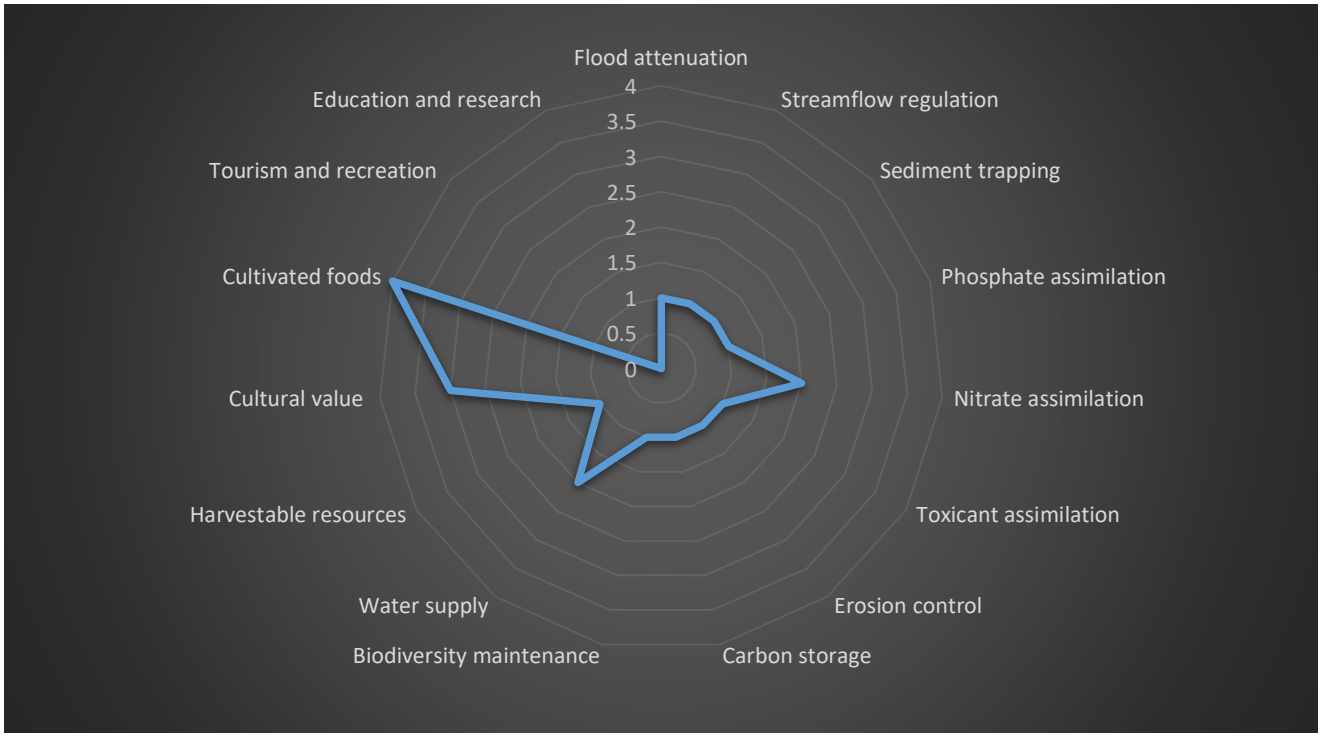


Figure 15: Dambo 1 Wetland Services Assessment

10.3.3.4 Summary

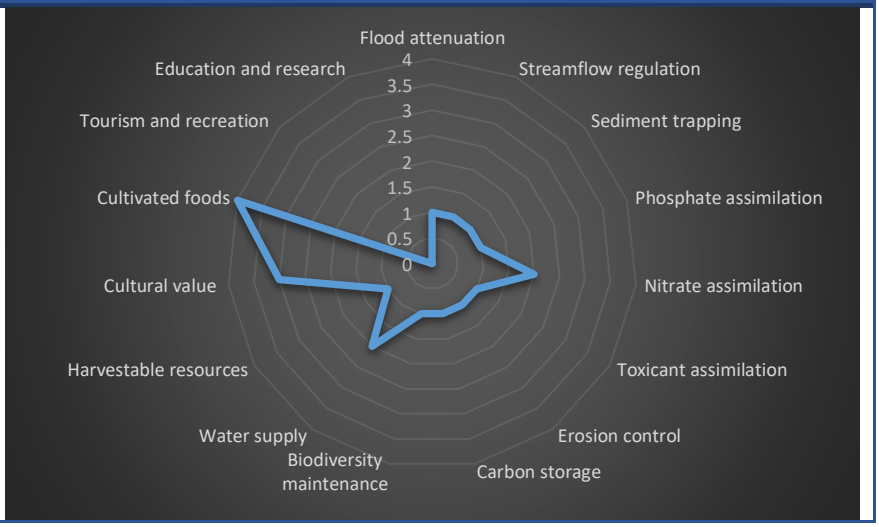
Table 46 provides a summary for the Dambo 1 investigation.

Table 46 Summary of the Dambo 1 ecological status scores

WETLAND TYPE		
Valley Bottom with a Channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.

PES AND EIS		
PES	**Hydrology**	**F**
	Geomorphology	**E**
	Vegetation	**F**
EIS		**Low (D)**

WETLANDS ECOSYSTEM SERVICES



The reasons for the scores during the 2017 survey are as follows:

- Hydrology – the hydrology at Dambo 1 has been transformed by impoundments and agricultural practices in the area;
- Geomorphology – similarly to the hydrology, the geomorphology of the wetland has been transformed through a variety of anthropogenic impacts; and
- Vegetation – few small areas of indigenous vegetation are still present on site; a large number of exotic species have invaded the dambo. These likely originate from agricultural practices that have completely transformed the wetlands.
- The current trajectory of this wetland is ↓

10.4 Riparian Assessment

10.4.1 Monitoring site MML 1

10.4.1.1 General description

The site at Monitoring site 1 (MML1) consists of a relatively narrow area of flow with moderately sloping banks (Figure 16), on which vegetation would easily colonise and recruit. For this reason, the vegetation surveyed for the purposes of this study was the vegetation at the transect site itself as well as vegetation further upstream of the site. Land use in the area is predominantly agricultural and pastoral farming. This site was chosen as a monitoring site due to its location up stream of the Kamuzu Dam outlet into the Lilongwe River, as runoff from the site could affect water quality in the Kamuzu Dam. The vegetation of the site showed little variation between the two surveys conducted in the study area, although the second survey showed less vegetation growth and lower water levels in the river due to the drier weather at the time of the year of the second season.

Figure 16: Monitoring site 1

10.4.1.2 VEGRAI Results

Table **47** indicates the results of the VEGRAI assessment for Monitoring site 1.

Current status: The area is currently somewhat degraded due to the introduction of a number of exotic species and agriculture being practiced on the banks of the river. The exotic species in the area, in fact, contribute to a total of approximately 10% of the total number of species identified during the surveys. Furthermore, previous impacts, erosion and removal of riparian vegetation compound the impacts on this area.

Trajectory of change: Due to the factors mentioned above under the section "Current Status" and the fact that these factors are not being remedied or arrested it must be assumed, in order to comply with cautionary principles, that the trajectory of change is negative.

LEVEL 4 VEGRAI EC : **D**

Table 47: Monitoring site 1 VEGRAI

LEVEL 4 ASSESSMENT						
RIPARIAN VEGETATION EC METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**WEIGHT**	**Reasons**
MARGINAL	54.0	18.0	3.0	1.0	100.0	Marginal vegetation very low species diversity. This may be due to the recent heavy rains and will need to be monitored in order to determine whether this is a natural state.
LOWER ZONE	56.0	18.7	3.0	2.0	100.0	Lower vegetation has been moderately impacted by denudation, erosion and introduction of exotic species
UPPER ZONE	55.3	21.8	3.0	3.0	100.0	Upper zone has been moderately impacted by the introduction of exotic species and cultivation of crops
	3.0				300.0	
LEVEL 4 VEGRAI (%)				55.1		
VEGRAI EC				**D**		
AVERAGE CONFIDENCE				3.0		

	Zone		
	Marginal	**Lower**	**Upper**
VEGRAI % (Zone)	54.0	56.0	55.3
EC (Zone)	**D**	**D**	**D**
Confidence (Zone)	3.0	3.0	3.0

REASONS FOR PES

The river system is somewhat degraded, due to the introduction of exotic species and other anthropogenic impacts such as agriculture and grazing, a hypothetical reference position was determined, as well as the data collected from all the sites within the study area. Reductions in exotic species diversity and abundance, as well as exotic species cover, were utilised in order to obtain a hypothetical reference site. Many of the decisions made in order to determine the hypothetical reference site were subjective decisions based on existing literature and field experience.

Due to the factors mentioned above under the section “Current Status” and the fact that these factors are not being remedied or arrested it must be assumed, in order to comply with cautionary principles, that the trajectory of change is negative.

Causes and sources

PES	CAUSES	SOURCES	F[1]/NF[2]	Conf[3]
D	Terrestrial exotic invasive species	Anthropogenic	N	4
	Low marginal and instream species diversity	Anthropogenic	F	

1: Flow related 2: Non Flow related 3: Confidence

Trend

PES	TREND	TREND PES	TIME	REASONS	Conf
D	Negative	D Negative	10 years	According to the data collected as well as the literature and satellite imagery consulted a negative trend in the PES has been identified.	4

10.4.2 Monitoring site MML2

10.4.2.1 General description

Monitoring site 2 (MML2) is situated downstream of the Kamuzu Dam outlet into the Lilongwe River and has been somewhat transformed through the introduction of exotic species, changes in hydrology, agriculture and construction (Figure 17). The marginal zone shows very low species diversity, and the lower and upper zones of the banks show considerable impacts due to removal of natural vegetation, agriculture and the introduction of exotic species.

Figure 17: Monitoring site 2

10.4.2.2 VEGRAI Results

Table 48 indicates the results of the VEGRAI assessment for Monitoring site 2.

Current status: The area is currently considerably degraded due to the introduction of a number of exotic species, historical construction of a bridge and an upstream weir and other anthropogenic impacts, mainly agriculture and the effect of water releases from the Kamuzu Dam. The exotic species in the area, contribute to a total of almost 20% of the total number of species identified during the surveys. Furthermore, the lack of stochastic events, such as fire and regular flooding from releases from the Kamuzu dam, are causing homogenisation of the riparian vegetation at site Monitoring site 2.

Trajectory of change: Due to the factors mentioned above under the section "Current Status" and the fact that these factors are not being remedied or arrested it must be assumed, in order to comply with cautionary principles, that the trajectory of change is negative.

LEVEL 4 VEGRAI EC : **E**

Table 48: Monitoring site 2 VEGRAI

LEVEL 4 ASSESSMENT						
RIPARIAN VEGETATION EC METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**WEIGHT**	**Reasons**
MARGINAL	36.3	3.3	4.0	1.0	100.0	Marginal Vegetation shows very low species diversity
LOWER ZONE	45.0	3.0	4.0	2.0	100.0	Lower vegetation has been moderately impacted by vegetation removal, exotic species and agriculture
UPPER ZONE	32.4	7.3	4.0	3.0	100.0	Upper zone has been moderately impacted by the introduction of exotic species
	3.0				300.0	
LEVEL 4 VEGRAI (%)				37.9		
VEGRAI EC				**E**		
AVERAGE CONFIDENCE				4.0		

	Zone		
	Marginal	**Lower**	**Upper**
VEGRAI % (Zone)	36.3	45.0	32.4
EC (Zone)	**E**	**D**	**E**
Confidence (Zone)	4.0	4.0	4.0

REASONS FOR PES

The area is currently considerably degraded due to the introduction of a number of exotic species and transformation due to agriculture. The exotic species in the area, contribute to a total of almost 20% of the total number of species identified during the surveys.

Due to the factors mentioned above under the section "Current Status" and the fact that these factors are not being remedied or arrested it must be assumed, in order to comply with cautionary principles, that the trajectory of change is negative.

Causes and sources

PES	CAUSES	SOURCES	F[1]/NF[2]	Conf[3]
E	Terrestrial exotic invasive species mechanical impacts	Anthropogenic	N	4
	Pollution	Anthropogenic	F	

1: Flow related 2: Non Flow related 3: Confidence

Trend

PES	TREND	TREND PES	TIME	REASONS	Conf
E	Negative	Negative	10 years	According to the data collected as well as the literature and satellite imagery consulted a negative trend in the PES has been identified.	4

10.4.3 Monitoring site MML3

10.4.3.1 General description

The site at Monitoring site 3 (MML3) consists of a relatively broad area of flow with moderately sloping banks, on which vegetation would easily colonise and recruit. All zones were well developed and recruitment was moderate to good (Figure 18). Land use in the area is predominantly agricultural and pastoral farming, however it does not affect the riparian zone as in other areas.

Figure 18: Monitoring site 3

10.4.3.2 VEGRAI Results

Table 49 indicates the results of the VEGRAI assessment for Monitoring site 3.

Current status: The area is not severely degraded, the marginal Lower and upper zones are well colonised with few exotic species.

Trajectory of change: The trajectory of change is Stable.

LEVEL 4 VEGRAI EC : **B**

Table 49: Monitoring site 3 VEGRAI

LEVEL 4 ASSESSMENT						
RIPARIAN VEGETATION EC METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**WEIGHT**	**Reasons**
MARGINAL	88.0	22.3	4.0	1.0	100.0	Marginal Vegetation shows high diversity and includes a number of sensitive species
LOWER ZONE	82.0	25.3	4.0	2.0	100.0	Lower Zone Vegetation is well developed and few exotic species are present
UPPER ZONE	85.0	28.3	4.0	3.0	100.0	Upper Zone Vegetation is well developed and few exotic species are present
	3.0				300.0	
LEVEL 4 VEGRAI (%)				85		
VEGRAI EC				**B**		
AVERAGE CONFIDENCE				4.0		

	Zone		
	Marginal	**Lower**	**Upper**
VEGRAI % (Zone)	88.0	82.0	85.0
EC (Zone)	**B**	**B**	**B**
Confidence (Zone)	4.0	4.0	4.0

REASONS FOR PES

The area is not severely degraded, the marginal Lower and upper zones are well colonised with few exotic species. Indigenous species diversity is moderate and recruitment is good.

Due to the factors mentioned above under the section "Current Status" and the fact that these factors are not being remedied or arrested it must be assumed, in order to comply with cautionary principles, that the trajectory of change is negative.

Causes and sources

PES	CAUSES	SOURCES	F[1]/NF[2]	Conf[3]
C	Terrestrial exotic invasive species	Anthropogenic	N	4
			F	

1: Flow related 2: Non Flow related 3: Confidence

Trend

PES	TREND	TREND PES	TIME	REASONS	Conf
C	Stable	C Stable	10 years	According to the data collected as well as the literature (covering approximately the last ten years) consulted a stable trend in the PES has been identified.	4

10.4.4 Monitoring site MML4

10.4.4.1 General description

The site at Monitoring site 4 (MML4) consists of a relatively narrow area of flow with steeply sloping banks and a very incised almost canal-like channel (Figure 19). This incising of the channel is caused by the release of water by the Kamuzu Dam, which has completely altered the hydrology of the river downstream of the release point of the dam. Because of the sloping of the bank and the incised canal, the marginal zone is poorly developed, and erosion is a serious issue on the banks of this part of the river. These issues are further exacerbated by the sand-mining occurring in the area. All zones were well developed and recruitment was low to moderate, greatly affected by the anthropogenic impacts and erosion in the area. Land use in the area is predominantly agricultural and pastoral farming.

Figure 19: Monitoring site 4

10.4.4.2 VEGRAI Results

Table 50 indicates the results of the VEGRAI assessment for Monitoring site 4.

Current status: The area is quite severely degraded; the marginal zone has been depleted due to the incision of the channel, the lower zone has been severely affected by sand mining and changes in hydrological regime and the upper zones have been utilised for agriculture resulting in the invasion of exotic species and erosion.

Trajectory of change: The trajectory of change is Stable.

LEVEL 4 VEGRAI EC : **E**

Table 50: Monitoring site 4 VEGRAI

LEVEL 4 ASSESSMENT						
RIPARIAN VEGETATION EC METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**WEIGHT**	**Reasons**
MARGINAL	28.4	9.8	3.8	1.0	100.0	Marginal zone most important for year-round refuge habitat, overhanging vegetation important for habitat creation / variability. This vegetation community has been severely impacted by the changes in hydrology as well as anthropogenic impacts such as sand mining
LOWER ZONE	32.6	11.2	4.0	2.0	100.0	Lower zone has high seasonal importance for breeding habitat, also shading of aquatic habitats. Anthropogenic impacts such as overutilisation and the effect of releases from the Kamuzu dam have resulted in severe erosion and loss of habitat in this area
UPPER ZONE	29.2	9.1	4.0	3.0	90.0	Not directly important for instream habitat, but bank stability indirectly important, possibly some shading and litter input. Overitilisation has resulted in denudation of large areas of this habitat and this is also evident in the high level of erosion in this area.
	3.0				290.0	
LEVEL 4 VEGRAI (%)				30.1		
VEGRAI EC				E		
AVERAGE CONFIDENCE				3.9		

	Zone		
	Marginal	**Lower**	**Upper**
VEGRAI % (Zone)	28.4	32.6	29.2
EC (Zone)	**E**	**E**	**E**
Confidence (Zone)	4.0	4.0	4.0

REASONS FOR PES

The area is currently considerably degraded due to the introduction of a number of exotic species and transformation due to agriculture, sand mining and the change in hydrology caused by the Kamuzu Dam. The exotic species in the area, contribute to a total of almost 15% of the total number of species identified during the surveys.

Due to the factors mentioned above under the section “Current Status” and the fact that these factors are not being remedied or arrested it must be assumed, in order to comply with cautionary principles, that the trajectory of change is negative.

Causes and sources

PES	CAUSES	SOURCES	F[1]/NF[2]	Conf[3]
E	Terrestrial exotic invasive species mechanical impacts	Anthropogenic	N	4
	Sand mining	Anthropogenic	N	
	Hydrological changes	Anthropogenic	F	

1: Flow related 2: Non Flow related 3: Confidence

Trend

PES	TREND	TREND PES	TIME	REASONS	Conf
E	Negative	Negative	10 years	According to the data collected as well as the literature and satellite imagery consulted a negative trend in the PES has been identified.	4

10.4.5 Monitoring site MML5

10.4.5.1 General description

The site at Monitoring site 5 (MML5) consists of a relatively narrow area of flow with steeply sloping banks and a very incised almost canal-like channel (Figure 20). This incising of the channel is caused by the release of water by the Kamuzu Dam, which has completely altered the hydrology of the river downstream of the release point of the dam. In addition to the incising of the channel the increased flow results in reduced growth of marginal vegetation. Because of the sloping of the bank and the incised channel, the marginal zone is poorly developed, and erosion is a serious issue on the banks of this part of the river as it is at site 4. Although zones showed high individual numbers, species richness was low with large areas of monoculture. Land use in the area is predominantly agricultural and pastoral farming. All these issues compound the impact caused by the hydrological changes from the construction of the Kamuzu Dam.

Figure 20: Monitoring site 5

10.4.5.2 VEGRAI Results

Table 51 indicates the results of the VEGRAI assessment for Monitoring site 5.

Current status: The area is quite severely degraded; the marginal zone has become a monoculture due to the incision of the channel allowing only larger species, such as in this case *Phragmites* sp., to flourish. The lower zone has been severely affected by the invasion by exotic species and changes in hydrological regime and the upper zones have been utilised for agriculture resulting in the invasion of exotic species and erosion. The incision of the channel has resulted in the desiccation of the upper and lower zones causing the colonisation of these zones by a number of non- riparian species.

Trajectory of change: The trajectory of change is negative.

LEVEL 4 VEGRAI EC : **E**

Table 51: Monitoring site 5 VEGRAI

LEVEL 4 ASSESSMENT						
RIPARIAN VEGETATION EC METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**WEIGHT**	**Reasons**
MARGINAL	30.1	10.4	3.8	1.0	100.0	Marginal zone most important for year-round refuge habitat, overhanging vegetation important for habitat creation / variability. This vegetation community has been severely impacted by the changes in hydrology as well as anthropogenic impacts such as sand mining
LOWER ZONE	30.6	10.6	4.0	2.0	100.0	Lower zone has high seasonal importance for breeding habitat, also shading of aquatic habitats. Anthropogenic impacts such as overutilisation and the effected of releases from the Kamuzu dam have resulted in severe erosion and loss of habitat in this area
UPPER ZONE	32.4	10.1	4.0	3.0	90.0	Not directly important for instream habitat, but bank stability indirectly important, possibly some shading and litter input. Overitilisation have resulted in denudation of large areas of this habitat and this is also evident in the high level of erosion in this area
	3.0				290.0	
LEVEL 4 VEGRAI (%)				31.0		
VEGRAI EC				**E**		
AVERAGE CONFIDENCE				3.9		

	Zone		
	Marginal	**Lower**	**Upper**
VEGRAI % (Zone)	30.1	30.6	32.4
EC (Zone)	**E**	**E**	**E**
Confidence (Zone)	3.8	4.0	4.0

REASONS FOR PES

The area is moderately degraded, the marginal zone is a monoculture of species that survive in deeper water. The lower and upper zones are colonised with exotic species and non-riparian species due to the incision of the channel and resultant desiccation of these zones. Indigenous species diversity is low, however, recruitment is moderate to good.

Due to the factors mentioned above under the section "Current Status" and the fact that these factors are not being remedied or arrested it must be assumed, in order to comply with cautionary principles, that the trajectory of change is negative.

Causes and sources

PES	CAUSES	SOURCES	F[1]/NF[2]	Conf[3]
E	Terrestrial exotic invasive species mechanical impacts	Anthropogenic	N	4
	Over-utilistion and overgrazing of indigenous species and clearing for agriculture	Anthropogenic	N	
	Hydrological changes	Anthropogenic	F	

1: Flow related 2: Non Flow related 3: Confidence

Trend

PES	TREND	TREND PES	TIME	REASONS	Conf
E	Negative	Negative	10 years	According to the data collected as well as the literature and satellite imagery consulted a negative trend in the PES has been identified.	4

11 DISCUSSION AND CONCLUSIONS

Three wetlands (dambos) could potentially be impacted by the proposed development. Only one of these falls within the Project area in proximity to the disturbance footprint, and two are located outside of the development footprint. All of the dambos investigated show moderate to extreme degradation, with the dambo inside the proposed development area being characterised as completely transformed.

The main causes of disturbance within the study area are soil disturbance, grazing, agriculture and the presence of alien vegetation. The mechanisms through which these disturbances impact upon the wetlands, in the study area, are numerous and can be described as follows.

Transformation through agricultural practices, most notably through the loss of natural vegetation, results in a loss of habitats and connectivity within wetlands and obstructs or reduces the functionality of wetland systems.

Increase in surface runoff due to a reduction in the basal cover and increase in hardened surfaces adjacent to, and within the wetlands causes an increase in erosion and changes the run-off characteristics in wetland systems.

The use of temporary zones of wetland areas as cultivated land for commercial crop species removes all indigenous vegetation associated with the wetlands in these areas and decreases the surface roughness and basal cover within the wetlands. All these factors result in a large change in ecosystem processes and loss of natural habitat and biota.

The hydrology of the wetlands has been mainly impacted by the presence of impoundments which alter the drainage pattern within the wetlands. In addition, these dams are used for irrigation purposes which then leads to water abstraction. The presence of roads located adjacent to the wetlands, as well as those traversing the wetlands, has resulted in increased water input within the wetlands. The presence of roads has resulted in moderate modification of the sediment regime of the wetland features. In addition, the wetlands have been subjected to high sediment load deposition from the surrounding agricultural activities. As a result of this activity, the soil profile along the wetland boundaries has been altered.

The monitoring sites along the Lilongwe River adjacent to the study area show varying degrees of impacts, with the sites further upstream showing lower degrees of degradation. The main impacts recorded at the study sites are vegetation removal for the purposes of agriculture, introduction of exotic species and impoundments due to the construction of bridges and weirs. The construction of the Kamuzu Dam has also influenced the flow regime of the Lilongwe River downstream of the dam.

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APPENDIX A

Plant species recorded in the regional study area

Trees	Shrubs	Forbs	Grasses	Cyperoids/Sedges
Acacia polyacantha	*Blumea alata*	*Azolla nilotica*	*Aristida junciformis*	*Cyperus digitatus*
Acacia sieberiana	*Eriosema ellipticum*	*Bidens biternata*	*Andropogon eucomus*	*Cyperus esculentus*
Albizia antunesiana	*Eriosema engleranum*	*Bidens pilosa*	*Andropogon gayanus*	*Cyperus tenax*
Burkea africana	*Euclea crispa*	*C. albida*	*Aristida junciformis*	*Kylinga erecta*
Combretum molle	*Gnidia kraussiana*	*Ceratotheca triloba*	*Arundinella nepalensis*	*Pycreus aethiops*
Cussonia arborea	*Helichrysum kraussii*	*Conyza albida*	*Brachiaria deflexa*	*Typha latifolius*
Ekebergia benguelensis	*Indigofera arrecta*	*Conyza welwitschii*	*Brachiaria humidicola*	*Typha domingensis*
Faurea speciosa	*Lippia javanica*	*Euphorbia cyparissoides*	*Cynodon dactylon*	*Phragmites mauritianus*
Ozoroa insignis	*Lopholaena coriifolia*	*Euphorbia tirucalli*	*Dactyloctenium aegyptium*	
Strychnos spinosa	*Maytenus heterophylla*	*Haumaniastrum sericeum*	*Digitaria scalarum*	
Vangueria infausta	*Maytenus senegalensis*	*Helichrysum species*	*Echinochloa pyramidalis*	
Piliostigma thonningii	*Pavetta schumanniana*	*Kniphofia linearifolia*	*Eleusine indica*	
Dichrostachys cinerea	*Rhynchosia resinosa*	*Nymphaea lotus*	*Entolasia imbricata*	
Antidesma venosum	*Flueggea virosa*	*Nymphaea nouchali*	*Eragrostis capensis*	
Afzelia quanzensis	*Diospiros heterophylla*	*Oldenlandia corymbosa*	*Eragrostis chapelieri*	
Trichilia emetica	*Asparagus terrisfolias*	*Oldenlandia herbacea*	*Eragrostis spp.*	
Psidium guajava	*Gnidia kraussiana*	*Persicaria lapathifolia*	*Hemarthria altissima*	
Bauhinia thonningii	*Blumea alata*	*Pistia stratiotes*	*Heteropogon contortus*	
Gmelina arborea	*Eriosema engleranum*	*Polygonum senegalense*	*Hyparrhenia filipendula*	
Eucalyptus saligna		*Ranunculus multifidus*	*Hyparrhenia nyassae*	
Senna alata		*Rorippa nasturtium-aquaticum*	*Hyperthelia dissoluta*	
Kigellia africana		*Senecio strictifolius*	*Ischaemum afrum*	
Piliostigma thonningii		*Senecio strictifolius,*	*Melinis repens*	
Faldebia albida		*Sesbania microphylla*	*Monocymbium ceresiiforme*	
		Solanum delagoense	*Oryza barthii*	
		Tagetes minuta	*Paspalum urvillei*	
		Utricularia cf. intermedia	*Perotis patens*	

		Verbena bonariensis	*Pogonarthria squarrosa* *Setaria pumila* *Sporobolus pyramidalis* *Sporobolus subtilis* *Themeda triandra*	

APPENDIX B

Reptile species historically recorded in Malawi

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM
Agamidae	*Acanthocercus atricollis*	Black-necked Agama		
Agamidae	*Agama mossambica*	Mozambique Agama		
Agamidae	*Agama kirkii*	Kirk's Rock Agama		
Chamaeleonidae	*Trioceros incornutus*	Poroto Mountain Chameleon		
Chamaeleonidae	*Trioceros goetzei*	Ilolo Chameleon		
Chamaeleonidae	*Trioceros melleri*	Meller's Chameleon		
Chamaeleonidae	*Chamaeleo dilepis*	Flap-necked Chameleon		
Chamaeleonidae	*Nadzikambia mlanjensis*	Mlanje Mountain Chameleon	EN	Malawi Endemic
Chamaeleonidae	*Rhampholeon chapmanorum*	Malawi Hill Pygmy Chameleon	CR	Malawi Endemic
Chamaeleonidae	*Rhampholeon platyceps*	Mount Mulanje Pygmy Chameleon	EN	
Colubridae	*Dasypeltis scabra*	Egg-eating Snake		
Colubridae	*Natriciteres olivacea*	Olive Marsh Snake		
Colubridae	*Dasypeltis medici*	East African Egg Eater		
Colubridae	*Philothamnus punctatus*	Spotted Green Snake		
Colubridae	*Philothamnus semivariegatus*	Spotted Bush Snake		
Colubridae	*Philothamnus hoplogaster*	Green Water Snake		
Cordylidae	*Platysaurus torquatus*	Striped Flat Lizard		
Cordylidae	*Platysaurus intermedius nyasae*			
Cordylidae	*Platysaurus mitchelli*	Mitchell's Flat Lizard		Malawi Endemic
Cordylidae	*Cordylus nyikae*	Nyika Girdled Lizard		Malawi Endemic
Crocodylidae	*Crocodylus niloticus*	Nile Crocodile		
Elapidae	*Dendroaspis polylepis*	Black Mamba		
Elapidae	*Naja annulifera*	Snouted Cobra		
Elapidae	*Dendroaspis angusticeps*	Eastern Green Mamba		
Elapidae	*Elapsoidea semiannulata*	Angolan Garter Snake		
Gekkonidae	*Hemidactylus mabouia*	Tropical House Gecko		
Gekkonidae	*Hemidactylus platycephalus*	Flathead Leaf-toed Gecko		
Gekkonidae	*Lygodactylus capensis*	Cape Dwarf Gecko		
Gekkonidae	*Lygodactylus rex*	King Dwarf Gecko		Malawi Endemic
Gerrhosauridae	*Matobosaurus validus*	Giant Plated Lizard		
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard		
Lacertidae	*Nucras ornata*	Ornate Scrub Lizard		
Lacertidae	*Nucras taeniolata*	Striped Scrub Lizard		
Lamprophiidae	*Psammophis subtaeniatus*	Stripe-bellied Sand Snake		
Lamprophiidae	*Prosymna ambigua*	Angolan Shovel-snout		
Lamprophiidae	*Gonionotophis nyassae*	Black File Snake		
Lamprophiidae	*Lycophidion acutirostre*	Eastern Wolf Snake		
Lamprophiidae	*Lycodonomorphus whytii*	Whyte's Water Snake		
Lamprophiidae	*Duberria lutrix*	Common Slug-eater		
Lamprophiidae	*Hemirhagerrhis hildebrandtii*	Eastern Bark Snake		
Lamprophiidae	*Lycodonomorphus leleupi*	Mulanje Water Snake		
Lamprophiidae	*Psammophylax variabilis*	Grey-bellied Grass Snake		
Lamprophiidae	*Amblyodipsas polylepis*	Common Purple-glossed Snake		
Lamprophiidae	*Lycophidion capense*	Cape Wolf Snake		
Pelomedusidae	*Pelusios nanus*	African Dwarf Mud Turtle		
Pythonidae	*Python natalensis*	Southern African Python		
Scincidae	*Trachylepis bocagii*	Bocage's Skink		
Scincidae	*Mochlus sundevalli*	Sundevall's Writhing Skink		

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM
Scincidae	*Melanoseps ater*	Longtail Limbless Skink		
Scincidae	*Trachylepis lacertiformis*	Bronze Rock Skink		
Scincidae	*Trachylepis punctatissima*	Montane Speckled Skink		
Scincidae	*Trachylepis margaritifera*	Rainbow skink		
Scincidae	*Trachylepis maculilabris*	Speckle-lipped Mabuya		
Scincidae	*Trachylepis mlanjensis*	Mulanje Skink		
Scincidae	*Trachylepis varia*	Variable Skink		
Scincidae	*Trachylepis maculilabris*	Speckle-lipped Mabuya		
Scincidae	*Eumecia johnstoni*	Nyika Serpentiform Skink		Malawi Endemic
Scincidae	*Trachylepis hildae*	Nyika Three-striped Skink		Malawi Endemic
Scincidae	*Trachylepis mlanjensis*	Mlanje Skink		Malawi Endemic
Testudinidae	*Kinixys zombensis*	Eastern Hinged-Back Tortoise		
Trionychidae	*Cycloderma frenatum*	Zambezi Flapshell Turtle	EN	
Varanidae	*Varanus niloticus*	Nile Monitor		
Viperidae	*Causus rhombeatus*	Rhombic Night Adder		
Viperidae	*Bitis arietans*	Puff Adder		
Viperidae	*Causus defilippii*	Snouted Night Adder		

APPENDIX C

Amphibian species historically recorded in Malawi

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM
ARTHROLEPTIDAE	*Leptopelis parbocagii*	Lake Upemba Forest Tree Frog		
ARTHROLEPTIDAE	*Leptopelis mossambicus*	Mozambique Forest Tree Frog		
ARTHROLEPTIDAE	*Leptopelis argenteus*	Silvery Tree Frog		
ARTHROLEPTIDAE	*Leptopelis bocagii*	Bocage's Tree Frog		
ARTHROLEPTIDAE	*Leptopelis flavomaculatus*	Yellow-spotted Tree Frog		
ARTHROLEPTIDAE	*Arthroleptis stenodactylus*	Common Squeaker		
ARTHROLEPTIDAE	*Arthroleptis francei*	Ruo River Screeching Frog	VU	
ARTHROLEPTIDAE	*Arthroleptis reichei*	Poroto Screeching Frog		
ARTHROLEPTIDAE	*Arthroleptis xenochirus*	Plain Squeaker		
ARTHROLEPTIDAE	*Arthroleptis xenodactyloides*	Dwarf Squeaker		
BREVICIPITIDAE	*Breviceps poweri*	Power's Rain Frog		
BREVICIPITIDAE	*Breviceps mossambicus*	Mozambique Rain Frog		
BUFONIDAE	*Amietophrynus gutturalis*	African Common Toad		
BUFONIDAE	*Schismaderma carens*	African Split-skin Toad		
BUFONIDAE	*Amietophrynus kisoloensis*	Kisolo Toad		
BUFONIDAE	*Amietophrynus maculatus*	Flat-backed Toad		
BUFONIDAE	*Mertensophryne lindneri*			
BUFONIDAE	*Mertensophryne nyikae*	Nyika Dwarf Toad	NT	
BUFONIDAE	*Mertensophryne taitana*	Taita Toad		
BUFONIDAE	*Poyntonophrynus beiranus*	Beira Toad		
BUFONIDAE	*Amietophrynus garmani*	Garman's Toad		
CAECILIIDAE	*Boulengerula changamwensis*			
CAECILIIDAE	*Scolecomorphus kirkii*	Kirk's Caecilian		
HEMISOTIDAE	*Hemisus guineensis*	Guinea Snout-burrower		
HEMISOTIDAE	*Hemisus marmoratus*	Shovel-nosed frog		
HYPEROLIIDAE	*Hyperolius kachalolae*	Kachalola Reed Frog		
HYPEROLIIDAE	*Hyperolius spinigularis*	Spiny-throated Reed Frog		
HYPEROLIIDAE	*Hyperolius pusillus*	Water Lily Reed Frog		
HYPEROLIIDAE	*Hyperolius argus*			
HYPEROLIIDAE	*Hyperolius marmoratus*	Painted Reed Frog		
HYPEROLIIDAE	*Hyperolius quinquevittatus*	Five-striped Reed Frog		
HYPEROLIIDAE	*Hyperolius mitchelli*	Mitchell's Reed Frog		
HYPEROLIIDAE	*Hyperolius tuberilinguis*	Tinker Reed Frog		
HYPEROLIIDAE	*Hyperolius marginatus*			
HYPEROLIIDAE	*Hyperolius acuticeps*			
HYPEROLIIDAE	*Hyperolius pictus*	Variable Reed Frog		
HYPEROLIIDAE	*Hyperolius glandicolor*	Gong Rock Frog		
HYPEROLIIDAE	*Hyperolius kivuensis*	Kivu Reed Frog		
HYPEROLIIDAE	*Afrixalus delicatus*	Delicate Spiny Reed Frog		
HYPEROLIIDAE	*Afrixalus fornasini*	Fornasini's Spiny Reed Frog		
HYPEROLIIDAE	*Kassina maculata*	Red-legged kassina		
HYPEROLIIDAE	*Kassina senegalensis*	Senegal Kassina		
HYPEROLIIDAE	*Hyperolius substriatus*			
HYPEROLIIDAE	*Afrixalus crotalus*			
HYPEROLIIDAE	*Afrixalus quadrivittatus*			
HYPEROLIIDAE	*Afrixalus brachycnemis*			
HYPEROLIIDAE	*Afrixalus aureus*	Golden Dwarf Reed Frog		
HYPEROLIIDAE	*Hyperolius friedemanni*	Friedmans Long Reed Frog	DD	Malawi Endemic
HYPEROLIIDAE	*Hyperolius inyangae*	Nyanga Long Reed Frog	VU	
HYPEROLIIDAE	*Hyperolius viridis*			
HYPEROLIIDAE	*Hyperolius spinigularis*	Spiny Reed Frog	VU	
MICROHYLIDAE	*Phrynomantis bifasciatus*	Red-Banded Rubber Frog		
PHRYNOBATRACHIDAE	*Phrynobatrachus stewartae*	Stewart's River Frog	DD	

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN STATUS	ENDEMISM
PHRYNOBATRACHIDAE	*Phrynobatrachus acridoides*	Eastern puddle frog		
PHRYNOBATRACHIDAE	*Phrynobatrachus parvulus*			
PHRYNOBATRACHIDAE	*Phrynobatrachus mababiensis*	Mababe puddle frog		
PHRYNOBATRACHIDAE	*Phrynobatrachus natalensis*	Natal puddle frog		
PHRYNOBATRACHIDAE	*Phrynobatrachus ukingensis*	Ukinga River Frog	DD	
PHRYNOBATRACHIDAE	*Phrynobatrachus rungwensis*	Rungwe puddle frog		
PHRYNOBATRACHIDAE	*Phrynobatrachus perpalmatus*			
PIPIDAE	*Xenopus laevis*	African Clawed Frog		
PIPIDAE	*Xenopus muelleri*	Muller's Platanna		
PTYCHADENIDAE	*Ptychadena schillukorum*	Schilluk ridged frog		
PTYCHADENIDAE	*Ptychadena oxyrhynchus*	Sharp-nosed ridged frog		
PTYCHADENIDAE	*Ptychadena broadleyi*	Broadleyas Ridged Frog		
PTYCHADENIDAE	*Ptychadena upembae*	Upemba ridged frog		
PTYCHADENIDAE	*Ptychadena mossambica*	Mozambique ridged frog		
PTYCHADENIDAE	*Ptychadena taenioscelis*	Small ridged frog		
PTYCHADENIDAE	*Ptychadena guibei*	Guibe's ridged frog		
PTYCHADENIDAE	*Ptychadena ansorgii*	Ansorge's Ridged Frog		
PTYCHADENIDAE	*Ptychadena uzungwensis*	Udzungwa ridged frog		
PTYCHADENIDAE	*Ptychadena mascareniensis*	Mascarene Ridged Frog		
PTYCHADENIDAE	*Ptychadena porosissima*	Grassland ridged frog		
PTYCHADENIDAE	*Hildebrandtia ornata*	Ornate frog		
PTYCHADENIDAE	*Ptychadena broadleyi*	Broadley's Ridged Frog		Malawi Endemic
PYXICEPHALIDAE	*Nothophryne broadleyi*	Mongrel frog		
PYXICEPHALIDAE	*Tomopterna marmorata*	Marbled sand frog		
PYXICEPHALIDAE	*Tomopterna cryptotis*	Cryptic sand frog		
PYXICEPHALIDAE	*Pyxicephalus adspersus*	African Bullfrog		
PYXICEPHALIDAE	*Pyxicephalus edulis*	Edible bullfrog		
PYXICEPHALIDAE	*Amietia angolensis*	Common River Frog		
PYXICEPHALIDAE	*Amietia johnstoni*	Johnston's river frog		Malawi Endemic
PYXICEPHALIDAE	*Amietia viridireticulata*			
PYXICEPHALIDAE	*Strongylopus fuelleborni*	Fulleborn's Stream Frog		
PYXICEPHALIDAE	*Tomopterna cryptotis*	common sand frog		
PYXICEPHALIDAE	*Tomopterna tandyi*	Tandy's sand frog		
PYXICEPHALIDAE	*Tomopterna tuberculosa*	Rough sand frog		
PYXICEPHALIDAE	*Strongylopus merumontanus*			
RANIDAE	*Amnirana darlingi*	Darling's white-lipped frog		
RANIDAE	*Amnirana galamensis*	Galam white-lipped frog		
RHACOPHORIDAE	*Chiromantis xerampelina*	Grey Foam-nest Treefrog		

APPENDIX D

Avifauna species historically recorded in Malawi

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
ACCIPITRIDAE	*Kaupifao monogrammicus*	Lizard Buzzard	
	Clanga pomarina	Lesser Spotted Eagle	
	Aquila verreauxii	Verreaux's Eagle	
	Aquila rapax	Tawny Eagle	
	Aquila nipalensis	Steppe Eagle	EN
	Accipiter minullus	Little Sparrowhawk	
	Accipiter tachiro	African Goshawk	
	Accipiter ovampensis	Ovampo Sparrowhawk	
	Accipiter melanoleucus	Black Goshawk	
	Accipiter rufiventris	Rufous-chested Sparrowhawk	
	Accipiter badius	Shikra	
	Hieraaetus ayresii	Ayres's Hawk-Eagle	
	Circus ranivorus	African Marsh-Harrier	
	Circus pygargus	Montagu's Harrier	
	Circus aeruginosus	Western Marsh-Harrier	
	Circus macrourus	Pallid Harrier	NT
	Buteo augur	Augur Buzzard	
	Buteo oreophilus	Mountain Buzzard	NT
	Buteo buteo	Common Buzzard	
	Terathopius ecaudatus	Bateleur	NT
	Circaetus pectoralis	Black-breasted Snake-Eagle	
	Circaetus cinereus	Brown Snake-Eagle	
	Circaetus cinerascens	Banded Snake-Eagle	
	Polyboroides typus	African Harrier-Hawk	
	Aviceda cuculoides	African Cuckoo-Hawk	
	Milvus migrans	Black Kite	
	Elanus caeruleus	Black-winged Kite	
	Haliaeetus vocifer	African Fish-Eagle	
	Stephanoaetus coronatus	Crowned Eagle	NT
	Pernis apivorus	European Honey-buzzard	
	Lophaetus occipitalis	Long-crested Eagle	
	Melierax metabates	Dark Chanting-Goshawk	
	Polemaetus bellicosus	Martial Eagle	VU
	Gyps africanus	White-backed Vulture	CR
	Trigonoceps occipitalis	White-headed Vulture	CR
	Torgos tracheliotos	Lappet-faced Vulture	EN
	Macheiramphus ainus	Bat Hawk	
	Gypohierax angolensis	Palm-nut Vulture	
	Necrosyrtes monachus	Hooded Vulture	CR
	Aquila spilogaster	African Hawk-Eagle	
	Hieraaetus wahlbergi	Wahlberg's Eagle	
	Micronisus gabar	Gabar Goshawk	
ACROCEPHALIDAE	*Acrocephalus griseldis*	Basra Reed Warbler	EN
	Acrocephalus arundinaceus	Great Reed Warbler	
	Acrocephalus gracilirostris	Lesser Swamp Warbler	
	Acrocephalus palustris	Marsh Warbler	
	Acrocephalus schoenobaenus	Sedge Warbler	
	Acrocephalus scirpaceus		
	Iduna natalensis	African Yellow-Warbler	
	Iduna similis	Mountain Yellow-Warbler	
	Hippolais icterina	Icterine Warbler	
	Hippolais olivetorum	Olive-tree Warbler	
ALAUDIDAE	*Mirafra africana*	Rufous-naped Lark	
	Mirafra rufocinnamomea	Flappet Lark	
	Eremopterix leucopareia	Fischer's Sparrow-Lark	
	Eremopterix leucotis	Chestnut-backed Sparrow-Lark	
	Calandrella cinerea	Red-capped Lark	
AEDINIDAE	*Hayon albiventris*	Brown-hooded Kingfisher	
	Hayon leucocephala	Gray-headed Kingfisher	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
	Hayon chelicuti	Striped Kingfisher	
	Hayon senegalensis	Woodland Kingfisher	
	Aedo semitorquata	Half-collared Kingfisher	
	Ceryle rudis	Pied Kingfisher	
	Corythornis cristatus	Malachite Kingfisher	
	Ispidina picta	African Pygmy-Kingfisher	
	Megaceryle maxima	Giant Kingfisher	
ANATIDAE	*Dendrocygna viduata*	White-faced Whistling Duck	
	Dendrocygna bicolor	Fulvous Whistling-Duck	
	Thalassornis leuconotus	White-backed Duck	
	Anas undulata	Yellow-billed Duck	
	Anas hottentota	Hottentot Teal	
	Anas sparsa	African Black Duck	
	Anas querquedula	Garganey	
	Anas erythrorhyncha	Red-billed Teal	
	Anas capensis	Cape Teal	
	Netta erythrophthalma	Southern Pochard	
	Nettapus auritus	African Pygmy-Goose	
	Plectropterus gambensis	Spur-winged Goose	
	Sarkidiornis melanotos	Comb Duck	
	Alopochen aegyptiaca	Egyptian Goose	
ANHINGIDAE	*Anhinga rufa*	African Darter	
APODIDAE	*Apus affinis*	Little Swift	
	Apus caffer	White-rumped Swift	
	Apus barbatus	African Swift	
	Apus	Common Swift	
	Cypsiurus parvus	African Palm-Swift	
	Neafrapus boehmi	Bat-like Spinetail	
	Schoutedenapus myoptilus	Scarce Swift	
	Telacanthura ussheri	Mottled Spinetail	
	Apus aequatorialis	Mottled Swift	
	Apus melba	Alpine Swift	
ARDEIDAE	*Egretta ardesiaca*	Black Heron	
	Egretta garzetta	Little Egret	
	Ardea purpurea	Purple Heron	
	Ardea cinerea	Grey Heron	
	Ardea alba	Great Egret	
	Ardea goliath	Goliath Heron	
	Ardea melanocephala	Black-headed Heron	
	Ardeola idae	Madagascar Pond-Heron	EN
	Ardeola ralloides	Squacco Heron	
	Ardeola rufiventris	Rufous-bellied Heron	
	Ixobrychus sturmii	Dwarf Bittern	
	Ixobrychus minutus	Little Bittern	
	Bubuus ibis	Cattle Egret	
	Botaurus stellaris	Eurasian Bittern	
	Mesophoyx intermedia	Intermediate Egret	
	Gorsachius leuconotus	White-backed Night-heron	
	Butorides striata	Striated Heron	
	Nycticorax	Black-crowned Night-Heron	
	Ardea alba melanorhynchos	African Great Egret	
BUCEROTIDAE	*Lophoceros nasutus*	African Grey Hornbill	
	Lophoceros alboterminatus	Crowned Hornbill	
	Lophoceros pallidirostris	Pale-billed Hornbill	
	Tockus leucomelas	Southern Yellow-billed Hornbill	
	Tockus erythrorhynchus	Red-billed Hornbill	
	Bycanistes brevis	Silvery-cheeked Hornbill	
	Bycanistes bucinator	Trumpeter Hornbill	
	Tockus rufirostris	Southern Red-billed Hornbill	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
BUCORVIDAE	*Bucorvus leadbeateri*	Southern Ground-Hornbill	VU
BUPHAGIDAE	*Buphagus africanus*	Yellow-billed Oxpecker	
	Buphagus erythrorhynchus	Red-billed Oxpecker	
BURHINIDAE	*Burhinus capensis*	Spotted Thick-knee	
	Burhinus vermiculatus	Water Thick-knee	
CALYPTOMENIDAE	*Smithornis capensis*	African Broadbill	
CAMPEPHAGIDAE	*Coracina caesia*	Gray Cuckoo-shrike	
	Coracina pectoralis	White-breasted Cuckoo-shrike	
	Campephaga flava	Black Cuckoo-shrike	
CAPRIMULGIDAE	*Caprimulgus pectoralis*	Fiery-necked Nightjar	
	Caprimulgus europaeus	European Nightjar	
	Caprimulgus fossii	Square-tailed Nightjar	
	Caprimulgus tristigma	Freckled Nightjar	
	Caprimulgus vexillarius	Pennant-winged Nightjar	
	Caprimulgus ruwenzorii guttifer		
CERTHIIDAE	*Salpornis spilonotus*	Indian Spotted-Creeper	
	Salpornis salvadori	African Spotted-Creeper	
CETTIIDAE	*Erythrocercus livingstonei*	Livingstone's Flycatcher	
CHARADRIIDAE	*Vanellus crassirostris*	Long-toed Lapwing	
	Charadrius hiaticula	Common Ringed Plover	
	Charadrius tricollaris	Three-banded Plover	
	Charadrius marginatus	White-fronted Plover	
	Charadrius asiaticus	Caspian Plover	
	Charadrius pecuarius	Kittlitz's Plover	
	Vanellus albiceps	White-headed Lapwing	
	Vanellus lugubris	Senegal Lapwing	
	Vanellus senegallus	African Wattled Lapwing	
	Vanellus armatus	Blacksmith Lapwing	
	Vanellus coronatus	Crowned Lapwing	
	Vanellus spinosus	Spur-winged Lapwing	
CICONIIDAE	*Anastomus lamelligerus*	African Openbill	
	Ciconia abdimii	Abdim's Stork	
	Ciconia	White Stork	
	Ciconia nigra	Black Stork	
	Ciconia episcopus	Woolly-necked Stork	
	Mycteria ibis	Yellow-billed Stork	
	Leptoptilos crumenifer	Marabou Stork	
	Ephippiorhynchus senegalensis	Saddle-billed Stork	
CISTICOLIDAE	*Cisticola erythrops*	Red-faced Cisticola	
	Cisticola robustus	Stout Cisticola	
	Cisticola lais	Wailing Cisticola	
	Cisticola brachypterus	Siffling Cisticola	
	Cisticola ayresii	Wing-snapping Cisticola	
	Cisticola cantans	Singing Cisticola	
	Cisticola rufilatus	Gray Cisticola	
	Cisticola woosnami	Trilling Cisticola	
	Cisticola aberrans	Rock-loving Cisticola	
	Cisticola natalensis	Croaking Cisticola	
	Cisticola pipiens	Chirping Cisticola	
	Cisticola njombe	Churring Cisticola	
	Cisticola nigriloris	Black-lored Cisticola	
	Cisticola juncidis	Zitting Cisticola	
	Cisticola galactotes	Winding Cisticola	
	Prinia subflava	Tawny-flanked Prinia	
	Camaroptera brachyura	Green-backed Camaroptera	
	Apalis melanocephala	Black-headed Apalis	
	Apalis thoracica	Bar-throated Apalis	
	Apalis chariessa	White-winged Apalis	VU
	Apalis flavida	Yellow-breasted Apalis	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
	Apalis chapini	Chapin's Apalis	
	Apalis flavigularis	Yellow-throated Apalis	EN
	Apalis ruddi	Rudd's Apalis	
	Eremomela icteropygialis	Yellow-bellied Eremomela	
	Eremomela usticollis	Burnt-neck Eremomela	
	Eremomela scotops	Greencap Eremomela	
	Artisornis metopias	African Tailorbird	
	Cisticola chiniana	Rattling Cisticola	
	Cisticola fulvicapilla	Piping Cisticola	
	Heliolais erythropterus	Red-winged Prinia	
	Apalis flavigularis	Yellow-throated Apalis	
	Calamonastes undosus	Miombo Wren-Warbler	
	Apalis thoracica flavigularis	Yellow-throated apalis	
COLIIDAE	*Urocolius indicus*	Red-faced Mousebird	
	Colius striatus	Speckled Mousebird	
COLUMBIDAE	*Streptopelia senegalensis*	Laughing Dove	
	Streptopelia decipiens	Mourning Collared-Dove	
	Streptopelia capicola	Ring-necked Dove	
	Streptopelia semitorquata	Red-eyed Dove	
	Streptopelia lugens	Dusky Turtle-Dove	
	Columba arquatrix	Rameron Pigeon	
	Columba guinea	Speckled Pigeon	
	Columba larvata	Lemon Dove	
	Turtur afer	Blue-spotted Wood-Dove	
	Turtur chaospilos	Emerald-spotted Wood-Dove	
	Turtur tympanistria	Tambourine Dove	
	Treron calvus	African Green Pigeon	
	Oena capensis	Namaqua Dove	
CORACIIDAE	*Coracias garrulus*	European Roller	
	Coracias caudatus	Lilac-breasted Roller	
	Coracias naevius	Rufous-crowned Roller	
	Coracias spatulatus	Raquet-tailed Roller	
	Eurystomus glaucurus	Broad-billed Roller	
CORVIDAE	*Corvus albicollis*	White-necked Raven	
	Corvus albus	Pied Crow	
CUCULIDAE	*Centropus superciliosus*	White-browed Coucal	
	Centropus senegalensis	Senegal Coucal	
	Centropus grillii	Black Coucal	
	Centropus cupreicaudus	Coppery-tailed Coucal	
	Chrysococcyx klaas	Klaas's Cuckoo	
	Chrysococcyx cupreus	African Emerald Cuckoo	
	Chrysococcyx caprius	Dideric Cuckoo	
	Clamator glandarius	Great Spotted Cuckoo	
	Clamator jacobinus	Jacobin Cuckoo	
	Clamator levaillantii	Levaillant's Cuckoo	
	Cuculus poliocephalus	Lesser Cuckoo	
	Cuculus solitarius	Red-chested Cuckoo	
	Cuculus canorus	Common Cuckoo	
	Cuculus clamosus	Black Cuckoo	
	Cuculus gularis	African Cuckoo	
	Cuculus rochii	Madagascar Cuckoo	
	Cercococcyx montanus	Barred Long-tailed Cuckoo	
	Pachycoccyx audeberti	Thick-billed Cuckoo	
	Ceuthmochares aereus	Yellowbill	
DICRURIDAE	*Dicrurus adsimilis*	Fork-tailed Drongo	
	Dicrurus ludwigii	Square-tailed Drongo	
EMBERIZIDAE	*Emberiza capensis*	Cape Bunting	
	Emberiza flaviventris	Golden-breasted Bunting	
	Emberiza cabanisi	Cabanis's Bunting	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
	Emberiza tahapisi	Cinnamon-breasted Bunting	
ESTRILDIDAE	*Estrilda rhodopyga*	Crimson-rumped Waxbill	
	Estrilda astrild	Common Waxbill	
	Estrilda perreini	Black-tailed Waxbill	
	Pyrenestes minor	Lesser Seedcracker	
	Pytilia melba	Green-winged Pytilia	
	Pytilia afra	Orange-winged Pytilia	
	Uraeginthus angolensis	Southern Cordonbleu	
	Hypargos niveoguttatus	Peters's Twinspot	
	Lagonosticta senegala	Red-billed Firefinch	
	Lagonosticta rubricata	African Firefinch	
	Lagonosticta rhodopareia	Jameson's Firefinch	
	Amadina fasciata	Cut-throat	
	Cryptospiza reichenovii	Red-faced Crimson-wing	
	Mandingoa nitidula	Green-backed Twinspot	
	Ortygospiza atricollis	Black-faced Quailfinch	
	Coccopygia melanotis	Swee Waxbill	
	Paludipasser locustella	Locustfinch	
	Spermestes cucullata	Bronze Mannikin	
	Spermestes fringilloides	Magpie Mannikin	
	Sporaeginthus subflavus	Zebra Waxbill	
	Lonchura nigriceps	Red-backed Mannikin	
	Spermestes bicolor	Black-and-white Mannikin	
FAONIDAE	*Fao cuvierii*	African Hobby	
	Fao vespertinus	Red-footed Faon	
	Fao subbuteo	Eurasian Hobby	
	Fao peregrinus	Peregrine Faon	
	Fao tinnunculus	Eurasian Kestrel	
	Fao dickinsoni	Dickinson's Kestrel	
	Fao chicquera	Red-necked Faon	
	Fao biarmicus	Lanner Faon	
	Fao amurensis	Amur Faon	
	Fao fasciinucha	Taita Faon	VU
	Fao ardosiaceus	Grey Kestrel	
	Fao vespertinus	Western Red-footed Faon	NT
	Fao naumanni	Lesser Kestrel	
FRINGILLIDAE	*Serinus mozambicus*	Yellow-fronted Canary	
	Serinus sulphuratus	Brimstone Canary	
	Serinus mennelli	Black-eared Seedeater	
	Serinus reichardi	Reichard's Seedeater	
	Serinus hypostictus	Southern Citril	
	Serinus striolatus	Streaky Seedeater	
	Serinus melanochrous	Tanzania Seedeater	
	Serinus citrinipectus	Lemon-breasted Seedeater	
	Linurgus olivaceus	Oriole Finch	
	Serinus flavivertex	Yellow-crowned Canary	
GLAREOLIDAE	*Cursorius temminckii*	Temminck's Courser	
	Glareola nuchalis	Rock Pratincole	
	Glareola pratincola	Collared Pratincole	
	Rhinoptilus cinctus	Three-banded Courser	
	Rhinoptilus chaopterus	Bronze-winged Courser	
GRUIDAE	*Bugeranus carunculatus*	Wattled Crane	VU
	Balearica regulorum	Grey Crowned-Crane	EN
HELIORNITHIDAE	*Podica senegalensis*	African Finfoot	
HIRUNDINIDAE	*Hirundo smithii*	Wire-tailed Swallow	
	Hirundo atrocaerulea	Blue Swallow	VU
	Hirundo rustica	Barn Swallow	
	Hirundo dimidiata	Pearl-breasted Swallow	
	Hirundo angolensis	Angola Swallow	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
	Hirundo albigularis	White-throated Swallow	
	Riparia	Bank Swallow	
	Riparia paludicola	Plain Martin	
	Riparia cincta	Banded Martin	
	Psalidoprocne albiceps	White-headed Sawwing	
	Psalidoprocne pristoptera	Black Sawwing	
	Phedina borbonica	Mascarene Martin	
	Delichon urbicum	Common House-Martin	
	Hirundo daurica	Striated Swallow	
	Cecropis semirufa	Rufous-chested Swallow	
	Cecropis senegalensis	Mosque Swallow	
	Pseudhirundo griseopyga	Gray-rumped Swallow	
	Ptyonoprogne fuligula	Rock Martin	
	Cecropis abyssinica	Lesser Striped-Swallow	
	Cecropis cucullata	Greater Striped-Swallow	
	Cecropis daurica	Red-rumped Swallow	
HYLIOTIDAE	*Hyliota australis*	Southern Hyliota	
	Hyliota flavigaster	Yellow-bellied Hyliota	
INDICATORIDAE	*Indicator variegatus*	Scaly-throated Honeyguide	
	Indicator	Greater Honeyguide	
	Indicator minor	Lesser Honeyguide	
	Indicator meliphilus	Pallid Honeyguide	
	Prodotiscus zambesiae	Green-backed Honeyguide	
	Prodotiscus regulus	Wahlberg's Honeyguide	
JACANIDAE	*Microparra capensis*	Lesser Jacana	
	Actophilornis africanus	African Jacana	
LANIIDAE	*Lanius collaris*	Common Fiscal	
	Lanius collurio	Red-backed Shrike	
	Lanius souzae	Sousa's Shrike	
	Lanius excubitoroides	Gray-backed Fiscal	
	Corvinella melanoleuca	Magpie Shrike	
	Lanius humeralis	Northern Fiscal	
LARIDAE	*Rynchops flavirostris*	African Skimmer	NT
	Chlidonias leucopterus	White-winged Tern	
	Chlidonias hybrida	Whiskered Tern	
	Chroicocephalus cirrocephalus	Gray-hooded Gull	
	Gelochelidon nilotica	Gull-billed Tern	
	Hydroprogne caspia	Caspian Tern	
	Onychoprion fuscatus	Sooty Tern	
	Thalasseus bengalensis	Lesser Crested Tern	
LEIOTHRICHIDAE	*Turdoides jardineii*	Arrow-marked Babbler	
LOCUSTELLIDAE	*Bradypterus baboecala*	Little Rush-Warbler	
	Bradypterus cinnamomeus	Cinnamon Bracken-Warbler	
	Bradypterus lopezi	Evergreen-forest Warbler	
	Locustella fluviatilis	Eurasian River Warbler	
	Schoenicola brevirostris	Fan-tailed Grassbird	
LYBIIDAE	*Lybius melanopterus*	Brown-breasted Barbet	
	Lybius minor	Black-backed Barbet	
	Lybius torquatus	Black-collared Barbet	
	Pogoniulus bilineatus	Yellow-rumped Tinkerbird	
	Pogoniulus chrysoconus	Yellow-fronted Tinkerbird	
	Pogoniulus leucomystax	Moustached Tinkerbird	
	Pogoniulus simplex	Green Tinkerbird	
	Stactolaema leucotis	White-eared Barbet	
	Stactolaema olivacea	Green Barbet	
	Stactolaema whytii	Whyte's Barbet	
	Trachyphonus vaillantii	Crested Barbet	
	Tricholaema frontata	Miombo Pied Barbet	
	Tricholaema lacrymosa	Spot-flanked Barbet	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
MACROSPHENIDAE	*Sylvietta ruficapilla*	Red-capped Crombec	
	Sylvietta whytii	Red-faced Crombec	
	Sylvietta rufescens	Cape Crombec	
	Melocichla mentalis	Moustached Grass-Warbler	
	Melocichla mentalis	Moustached Grass-Warbler	
MALACONOTIDAE	*Telophorus sulfureopectus*	Orange-breasted Bush-Shrike	
	Telophorus nigrifrons	Black-fronted Bushshrike	
	Telophorus olivaceus	Olive Bushshrike	
	Laniarius funebris	Slate-colored Boubou	
	Laniarius fuelleborni	Fuelleborn's Boubou	
	Laniarius aethiopicus	Tropical Boubou	
	Malaconotus blanchoti	Gray-headed Bushshrike	
	Dryoscopus cubla	Black-backed Puffback	
	Tchagra australis	Brown-crowned Tchagra	
	Nilaus afer	Brubru	
	Tchagra minutus	Marsh Tchagra	
	Tchagra senegalus	Black-crowned Tchagra	
	Telophorus quadricolor	Four-coloured bushshrike	
MEROPIDAE	*Merops pusillus*	Little Bee-eater	
	Merops hirundineus	Swallow-tailed Bee-eater	
	Merops superciliosus	Olive Bee-eater	
	Merops boehmi	Boehm's Bee-eater	
	Merops persicus	Blue-cheeked Bee-eater	
	Merops bullockoides	White-fronted Bee-eater	
	Merops nubicoides	Southern Carmine Bee-eater	
MONARCHIDAE	*Terpsiphone viridis*	African Paradise-Flycatcher	
	Trochocercus cyanomelas	African Crested-Flycatcher	
MOTACILLIDAE	*Motacilla cinerea*	Grey Wagtail	
	Motacilla flava	yellow wagtail (inactive)	
	Motacilla aguimp	African Pied Wagtail	
	Motacilla clara	Mountain Wagtail	
	Anthus leucophrys	Plain-backed Pipit	
	Anthus trivialis	Tree Pipit	
	Anthus caffer	Bush Pipit	
	Anthus lineiventris	Striped Pipit	
	Anthus richardi	Richard's Pipit	
	Anthus similis	Long-billed Pipit	
	Anthus vaalensis	Buffy Pipit	
	Macronyx ameliae	Rosy-throated Longclaw	
	Macronyx croceus	Yellow-throated Longclaw	
	Macronyx fuelleborni	Fuelleborn's Longclaw	
	Anthus cinnamomeus	Grassveld Pipit	
	Motacilla flava lutea	Yellow-headed Wagtail	
	Motacilla flava	Western Yellow Wagtail	
MUSCICAPIDAE	*Saxicola torquatus*	African Stonechat	
	Fraseria caerulescens	Ashy Flycatcher	
	Cichladusa arquata	Collared Palm-Thrush	
	Oenanthe	Northern Wheatear	
	Cossypha natalensis	Red-capped Robin-Chat	
	Cossypha caffra	Cape Robin-Chat	
	Cossypha anomala	Olive-flanked Robin-Chat	
	Cossypha heuglini	White-browed Robin-Chat	
	Agricola pallidus	Pale Flycatcher	
	Pseudalethe fuelleborni	White-chested Alethe	
	Pseudalethe choloensis	Cholo Alethe	
	Oenanthe pileata	Capped Wheatear	
	Myrmecocichla arnoti	White-headed Black-Chat	
	Myrmecocichla nigra	Sooty Chat	
	Saxicola rubetra	Whinchat	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
	Muscicapa striata	Spotted Flycatcher	
	Bradornis boehmi	BÃ¶hm's Flycatcher	
	Muscicapa adusta	Dusky-brown Flycatcher	
	Cercotrichas barbata	Miombo Scrub-Robin	
	Cercotrichas quadrivirgata	Bearded Scrub-Robin	
	Cercotrichas leucophrys	Red-backed Scrub-Robin	
	Luscinia luscinia	Thrush Nightingale	
	Ficedula semitorquata	Semicollared Flycatcher	
	Ficedula albicollis	Collared Flycatcher	
	Monticola angolensis	Miombo Rock-Thrush	
	Melaenornis pammelaina	Southern Black Flycatcher	
	Fraseria plumbea	Grey Tit-Flycatcher	
	Cercomela familiaris	Familiar Chat	
	Sheppardia sharpei	Sharpe's Akalat	
	Sheppardia gunningi	East Coast Akalat	NT
	Pinarornis plumosus	Boulder Chat	
	Pogonocichla stellata	White-starred Robin	
	Melaenornis fischeri	White-eyed Slaty-flycatcher	
	Thamnolaea cinnamomeiventris	Mocking Cliff-Chat	
MUSOPHAGIDAE	*Corythaixoides personatus*	Bare-faced Go-away Bird	
	Tauraco livingstonii	Livingstone's Turaco	
	Tauraco porphyreolophus	Purple-crested Turaco	
	Tauraco schalowi	Schalow's Turaco	
	Corythaixoides concolor	Gray Go-away-bird	
NECTARINIIDAE	*Nectarinia famosa*	Malachite Sunbird	
	Nectarinia kilimensis	Bronze Sunbird	
	Nectarinia johnstoni	Red-tufted Sunbird	
	Anthreptes longuemarei	Violet-backed Sunbird	
	Anthreptes anchietae	Anchieta's Sunbird	
	Nectarinia afra	Greater Double-collared Sunbird	
	Chaomitra senegalensis	Scarlet-chested Sunbird	
	Cinnyris venustus	Variable Sunbird	
	Chaomitra amethystina	Amethyst Sunbird	
	Cinnyris bifasciatus	Purple-banded Sunbird	
	Cinnyris cupreus	Copper Sunbird	
	Cinnyris oustaleti	Oustalet's Sunbird	
	Cinnyris shelleyi	Shelley's Sunbird	
	Cinnyris talatala	White-breasted Sunbird	
	Cyanomitra verticalis	Green-headed Sunbird	
	Hedydipna collaris	Collared Sunbird	
	Nectarinia fuelleborni	Eastern Double-collared Sunbird	
	Cinnyris manoensis	Miombo Sunbird	
	Cyanomitra olivacea	Olive Sunbird	
	Nectarinia veroxii	Grey Sunbird	
NICATORIDAE	*Nicator gularis*	Eastern Nicator	
NUMIDIDAE	*Numida meleagris*	Helmeted Guineafowl	
	Guttera pucherani	Crested Guineafowl	
ORIOLIDAE	*Oriolus auratus*	African Golden Oriole	
	Oriolus oriolus	Eurasian Golden Oriole	
	Oriolus larvatus	Black-headed Oriole	
	Oriolus chlorocephalus	Green-headed Oriole	
OTIDIDAE	*Neotis denhami*	Denham's Bustard	NT
	Lissotis melanogaster	Black-bellied Bustard	
PANDIONIDAE	*Pandion haliaetus*	Osprey	
PARIDAE	*Melaniparus griseiventris*	Miombo Tit	
	Melaniparus niger	Southern Black Tit	
	Melaniparus rufiventris	Rufous-bellied Tit	
PASSERIDAE	*Passer griseus*	Northern Grey-headed Sparrow	
	Petronia superciliaris	Yellow-throated Petronia	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
	Passer diffusus	Southern Gray-headed Sparrow	
	Passer suahelicus	Swahili Sparrow	
PELECANIDAE	*Pelecanus onocrotalus*	Great White Pelican	
	Pelecanus rufescens	Pink-backed Pelican	
PELLORNEIDAE	*Illadopsis pyrrhoptera*	Mountain Illadopsis	
PHALACROCORACIDAE	*Phalacrocorax carbo*	Great Cormorant	
	Microcarbo africanus	Long-tailed Cormorant	
	Phalacrocorax carbo lucidus	White-breasted Cormorant	
PHASIANIDAE	*Francolinus coqui*	Coqui Francolin	
	Pternistis hildebrandti	Hildebrandt's Francolin	
	Francolinus shelleyi	Shelley's Francolin	
	Pternistis squamatus	Scaly Francolin	
	Pternistis afer	Red-necked Francolin	
	Francolinus levaillantii	Red-wing Francolin	
	Pternistis swainsonii	Swainson's Francolin	
	Francolinus sephaena	Crested Francolin	
	Coturnix coturnix	Common Quail	
	Synoicus adansonii	Blue Quail	
	Coturnix delegorguei	Harlequin Quail	
	Pternistis afer melanogaster		
PHOENICOPTERIDAE	*Phoeniconaias minor*	Lesser Flamingo	NT
	Phoenicopterus roseus	Greater Flamingo	
	Phoeniculus purpureus	Green Woodhoopoe	
	Rhinopomastus cyanomelas	Common Scimitarbill	
PHYLLOSCOPIDAE	*Phylloscopus ruficapilla*	Yellow-throated Wood-Warbler	
	Phylloscopus trochilus	Willow Warbler	
PICIDAE	*Campethera cailliautii*	Green-backed Woodpecker	
	Campethera abingoni	Golden-tailed Woodpecker	
	Campethera bennettii	Bennett's Woodpecker	
	Dendropicos namaquus	Bearded Woodpecker	
	Dendropicos stierlingi	Stierling's Woodpecker	NT
	Dendropicos fuscescens	Cardinal Woodpecker	
	Dendropicos griseocephalus	Olive Woodpecker	
PITTIDAE	*Pitta angolensis*	African Pitta	
PLATYSTEIRIDAE	*Batis capensis*	Cape Batis	
	Batis molitor	Chinspot Batis	
	Batis fratrum	Woodward's Batis	
	Batis soror	Pale Batis	
	Platysteira peltata	Black-throated Wattle-eye	
	Batis crypta	Dark Batis	
PLOCEIDAE	*Ploceus bicolor*	Forest Weaver	
	Ploceus baglafecht	Baglafecht Weaver	
	Ploceus subaureus	African Golden-weaver	
	Ploceus ocularis	Spectacled Weaver	
	Ploceus cucullatus	Village Weaver	
	Ploceus bertrandi	Bertram's Weaver	
	Ploceus velatus	Southern Masked Weaver	
	Ploceus xanthopterus	Southern Brown-throated Weaver	
	Ploceus xanthops	Holub's Golden-Weaver	
	Ploceus olivaceiceps	Olive-headed Weaver	NT
	Ploceus intermedius	Lesser Masked-Weaver	
	Euplectes orix	Southern Red Bishop	
	Euplectes hordeaceus	Black-winged Bishop	
	Euplectes capensis	Yellow-rumped Widowbird	
	Euplectes albonotatus	White-winged Widowbird	
	Euplectes psammocromius	Buff-shouldered Widowbird	
	Euplectes axillaris	Fan-tailed Widowbird	
	Euplectes ardens	Red-collared Widowbird	
	Quelea quelea	Red-billed Quelea	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
	Quelea erythrops	Red-headed Quelea	
	Quelea cardinalis	Cardinal Quelea	
	Amblyospiza albifrons	Grosbeak Weaver	
	Plocepasser rufoscapulatus	Chestnut-backed Sparrow-Weaver	
	Plocepasser mahali	White-browed Sparrow-weaver	
	Bubalornis niger	Red-billed Buffalo-Weaver	
	Anaplectes rubriceps	Red-headed Weaver	
	Euplectes macroura	Yellow-shouldered Widowbird	
PODICIPEDIDAE	*Tachybaptus ruficollis*	Little Grebe	
PROMEROPIDAE	*Modulatrix stictigula*	Spot-throat	
PSITTACIDAE	*Poicephalus cryptoxanthus*	Brown-headed Parrot	
	Poicephalus meyeri	Meyer's Parrot	
	Poicephalus robustus robustus	Cape Parrot	
PSITTACULIDAE	*Agapornis lilianae*	Lilian's Lovebird	NT
PYCNONOTIDAE	*Phyllastrephus terrestris*	Terrestrial Brownbul	
	Phyllastrephus cerviniventris	Gray-olive Greenbul	
	Phyllastrephus cabanisi	Cabanis's Greenbul	
	Phyllastrephus flavostriatus	Yellow-streaked Bulbul	
	Pycnonotus barbatus	Common Bulbul	
	Chlorocichla flaviventris	Yellow-bellied Greenbul	
	Eurillas virens	Little Greenbul	
	Arizelocichla nigriceps	Eastern Mountain-Greenbul	
	Arizelocichla milanjensis	Stripe-cheeked Greenbul	
	Arizelocichla masukuensis	Shelley's Greenbul	
	Andropadus importunus	Sombre Greenbul	
RALLIDAE	*Zapornia pusilla*	Baillon's Crake	
	Porzana porzana	Spotted Crake	
	Zapornia flavirostra	Black Crake	
	Rallus caerulescens	African Rail	
	Gallinula angulata	Lesser Moorhen	
	Gallinula chloropus	Eurasian Moorhen	
	Crex crex	Corn Crake	
	Fulica cristata	Red-knobbed Coot	
	Porphyrio porphyrio	Purple Swamphen	
	Porphyrio alleni	Allen's Gallinule	
	Amaurornis marginalis	Striped Crake	
	Crecopsis egregia	African Crake	
RECURVIROSTRIDAE	*Himantopus himantopus*	Black-winged Stilt	
	Recurvirostra avosetta	Pied Avocet	
REMIZIDAE	*Anthoscopus caroli*	African Penduline-Tit	
ROSTRATULIDAE	*Rostratula benghalensis*	Greater Painted-snipe	
SAGITTARIIDAE	*Sagittarius serpentarius*	Secretarybird	VU
SAROTHRURIDAE	*Sarothrura affinis*	Striped Flufftail	
	Sarothrura boehmi	Streaky-breasted Flufftail	
	Sarothrura elegans	Buff-spotted Flufftail	
	Sarothrura rufa	Red-chested Flufftail	
SCOLOPACIDAE	*Calidris minuta*	Little Stint	
	Calidris ferruginea	Curlew Sandpiper	NT
	Tringa nebularia	Common Greenshank	
	Tringa stagnatilis	Marsh Sandpiper	
	Tringa ochropus	Green Sandpiper	
	Numenius arquata	Eurasian Curlew	NT
	Gallinago media	Great Snipe	NT
	Gallinago nigripennis	African Snipe	
	Actitis hypoleucos	Common Sandpiper	
	Tringa glareola	Wood Sandpiper	
SCOPIDAE	*Scopus umbretta*	Hamerkop	
STENOSTIRIDAE	*Elminia albicauda*	White-tailed Blue-Flycatcher	
	Elminia albonotata	White-tailed Crested-Flycatcher	

FAMILY	BIOLOGICAL NAME	COMMON NAME	STATUS
STRIGIDAE	*Bubo capensis*	Cape Eagle-Owl	
	Glaucidium capense	African Barred Owlet	
	Glaucidium perlatum	Pearl-spotted Owlet	
	Strix woodfordii	African Wood-Owl	
	Scotopelia peli	Pel's Fishing-Owl	
	Bubo lacteus	Verreaux's Eagle-Owl	
	Bubo africanus	Spotted Eagle-owl	
	Otus senegalensis	African Scops-Owl	
	Asio capensis	Marsh Owl	
	Ptilopsis leucotis	Northern White-faced Owl	
	Bubo africanus	Spotted Eagle-Owl	
STURNIDAE	*Lamprotornis mevesii*	Meves's Glossy-starling	
	Lamprotornis chloropterus	Lesser Blue-eared Glossy-starling	
	Poeoptera kenricki	Kenrick's Starling	
	Lamprotornis chalybaeus	Greater Blue-eared Starling	
	Onychognathus walleri	Waller's Starling	
	Onychognathus morio	Red-winged Starling	
	Onychognathus tenuirostris	Slender-billed Starling	
	Neocichla gutturalis	Babbling Starling	
	Cinnyricinclus leucogaster	Violet-backed Starling	
	Creatophora cinerea	Wattled Starling	
	Lamprotornis elisabeth	Miombo Blue-eared Starling	
	Onychognathus morio	Red-winged Starling	
SYLVIIDAE	*Sylvia communis*	Greater Whitethroat	
	Sylvia atricapilla	Eurasian Blackcap	
	Sylvia borin	Garden Warbler	
	Sylvia lugens	Brown Warbler	
	Sylvia abyssinica	African Hill Babbler	
THRESKIORNITHIDAE	*Platalea alba*	African Spoonbill	
	Threskiornis aethiopicus aethiopicus	African Sacred Ibis	
	Bostrychia hagedash	Hadada Ibis	
	Plegadis fainellus	Glossy Ibis	
TROGONIDAE	*Apaloderma narina*	Narina Trogon	
	Apaloderma vittatum	Bar-tailed Trogon	
TURDIDAE	*Turdus libonyana*	Kurrichane Thrush	
	Turdus olivaceus	Olive Thrush	
	Geokichla guttata	Spotted Ground-Thrush	EN
	Geokichla gurneyi	Orange Ground-Thrush	
	Psophocichla litsitsirupa	Groundscraper Thrush	
TURNICIDAE	*Turnix sylvaticus*	Common Buttonquail	
TYTONIDAE	*Tyto capensis*	African Grass-Owl	
	Tyto alba	Barn Owl	
UPUPIDAE	*Upupa epops*	Common Hoopoe	
	Upupa epops africana	African Hoopoe	
VANGIDAE	*Bias musicus*	Black-and-white Shrike-flycatcher	
	Prionops plumatus	White-crested Helmetshrike	
	Prionops retzii	Retz's Helmetshrike	
VIDUIDAE	*Vidua paradisaea*	Eastern Paradise-Whydah	
	Vidua chalybeata	Village Indigobird	
	Vidua macroura	Pin-tailed Whydah	
	Vidua purpurascens	Purple Indigobird	
	Vidua obtusa	Broad-tailed Paradise-Whydah	
	Vidua codringtoni	Green Indigobird	
	Vidua funerea	Black Widowfinch	
	Anomalospiza imberbis	Cuckoo Finch	
ZOSTEROPIDAE	*Zosterops senegalensis*	African Yellow White-eye	

APPENDIX E

Mammal species historically recorded in Malawi

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN
MACROSCELIDIDAE (Elephant-shrews)	*Elephantulus brachyrhynchus*	Short-snouted elephant	
	Elephantulus fuscus	Dusky elephant shrew	DD
	Petrodromus tetradactylus	Four-toed elephant shrew	
	Rhynchocyon cirnei	Checkered elephant shrew	NT
ORYCTEROPODIDAE	*Orycteropus afer*	Aardvark	
PROCAVIIDAE (Hylaxes)	*Heterohyrax brucei*	Yellow-spotted rock hyrax	
ELEPHANTIDAE (Elephants)	*Loxodonta africana*	African bush elephant	VU
GALAGIDAE	*Galago moholi*	Mohol bushbaby	
	Galagoides demidovii	Prince Demidoff's	
	Galagoides granti	Grant's bushbaby	DD
	Galagoides nyasae	Malawi bushbaby	DD
	Galagoides thomasi	Thomas's bushbaby	
	Galagoides zanzibaricus	Zanzibar bushbaby	NT
	Otolemur crassicaudatus	Brown greater galago	
CERCOPITHECIDAE (Old World monkeys)	*Chlorocebus pygerythrus*	Vervet monkey	
	Cercopithecus mitis	Blue monkey	
	Papio cynocephalus	Yellow baboon	
	Papio ursinus	Chacma baboon	
	Colobus angolensis	Angola colobus	
BATHYERGIDAE	*Cryptomys hottentotus*	Common mole-rat	
	Cryptomys mechowi	Mechow's mole-rat	
	Heliophobius	Silvery mole-rat	
HYSTRICIDAE (Old World	*Hystrix africaeaustralis*	Cape porcupine	
THRYONOMYIDAE (Cane rats)	*Thryonomys gregorianus*	Lesser cane rat	
ANOMALURIDAE	*Anomalurus derbianus*	Lord Derby's scaly-tailed	
SCIURIDAE (Squirrels)	*Heliosciurus mutabilis*	Mutable sun squirrel	
	Paraxerus cepapi	Smith's bush squirrel	
	Paraxerus flavovittis	Striped bush squirrel	DD
	Paraxerus lucifer	Black and red bush squirrel	DD
	Paraxerus palliatus	Red bush squirrel	
GLIRIDAE (Dormice)	*Graphiurus johnstoni*	Johnston's African	DD
	Graphiurus microtis	Small-eared dormouse	
NESOMYIDAE	*Dendromus melanotis*	Gray climbing mouse	
	Dendromus mesomelas	Brant's climbing mouse	
	Dendromus mystacalis	Chestnut climbing mouse	
	Dendromus nyikae	Nyika climbing mouse	
	Steatomys pratensis	Fat mouse	
	Beamys major	Greater hamster-rat	NT
	Cricetomys gambianus	Gambian pouched rat	
	Saccostomus campestris	South African pouched	
MURIDAE (Mice, rats, voles, gerbils, hamsters, etc)	*Acomys spinosissimus*	Spiny mouse	
	Lophuromys flavopunctatus	Yellow-spotted brush-	
	Uranomys ruddi	Rudd's mouse	
	Otomys angoniensis	Angoni vlei rat	
	Otomys denti	Dent's vlei rat	NT
	Otomys lacustris	Tanzanian vlei rat	NT
	Otomys uzungwensis	Uzungwe vlei rat	EN
	Tatera boehmi	Boehm's gerbil	
	Tatera leucogaster	Bushveld gerbil	
	Aethomys chrysophilus	Red rock rat	
	Aethomys kaiseri	Kaiser's rock rat	
	Aethomys namaquensis	Namaqua rock rat	

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN
	Aethomys nyikae	Nyika rock rat	
	Arvicanthis niloticus	African grass rat	
	Dasymys incomtus	African marsh rat	
	Grammomys dolichurus	Woodland thicket rat	
	Grammomys ibeanus	Ruwenzori thicket rat	
	Hylomyscus denniae	Montane wood mouse	
	Lemniscomys rosalia	Single-striped grass mouse	
	Lemniscomys striatus	Typical striped grass	
	Mastomys natalensis	Natal multimammate	
	Mus minutoides	African pygmy mouse	
	Mus triton	Gray-bellied pygmy mouse	
	Mylomys dybowskii	African groove-toothed rat	
	Pelomys fallax	Creek groove-toothed	
	Praomys delectorum	Delectable soft-furred	NT
	Rhabdomys pumilio	Four-striped grass mouse	
	Thallomys paeduus	Acacia rat	
	Zelotomys hildegardeae	Hildegarde's broad-headed	
LEPORIDAE (Rabbits, hares)	*Pronolagus rupestris*	Smith's red rock hare	
ERINACEIDAE (Hedgehogs)	*Atelerix albiventris*	Four-toed hedgehog	
SORICIDAE (Shrews)	*Crocidura cyanea*	Reddish-gray musk shrew	
	Crocidura fuscomurina	Bicolored musk shrew	
	Crocidura hirta	Lesser red musk shrew	
	Crocidura luna	Moonshine shrew	
	Crocidura silacea	Lesser gray-brown musk	
	Crocidura turba	Turbo shrew	
	Suncus lixus	Greater dwarf shrew	
	Suncus varilla	Lesser dwarf shrew	
	Sylvisorex megalura	Climbing shrew	
PTEROPODIDAE (Flying foxes, Old World fruit bats)	*Eidolon helvum*	Straw-coloured fruit bat	
	Epomophorus crypturus	Peters's epauletted fruit	
	Epomophorus labiatus	Ethiopian epauletted fruit	
	Epomophorus wahlbergi	Wahlberg's epauletted	
	Epomops dobsoni	Dobson's epauletted fruit	
	Plerotes anchietae	D'Anchieta's fruit bat	DD
	Rousettus aegyptiacus	Egyptian fruit bat	
	Rousettus lanosus	Long-haired rousette	
VESPERTILIONIDAE	*Kerivoula argentata*	Damara woolly bat	
	Kerivoula lanosa	Lesser woolly bat	
	Myotis bocagii	Rufous mouse-eared bat	
	Myotis tricolor	Cape hairy bat	
	Myotis welwitschii	Welwitsch's bat	
	Eptesicus hottentotus	Long-tailed house bat	
	Glauconycteris argentata	Silvered bat	
	Glauconycteris variegata	Butterfly bat	
	Laephotis botswanae	Botswanan long-eared bat	
	Neoromicia capensis	Cape serotine	
	Neoromicia flavescens	Yellow serotine	DD
	Neoromicia mekorum	Mek's house bat	DD
	Neoromicia nanus	Banana pipistrelle	
	Neoromicia rendalli	Rendall's serotine	
	Neoromicia somalicus	Somali serotine	
	Zulu serotine	Neoromicia zuluensis	

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN
	Nycticeinops schlieffeni	Schlieffen's bat	
	Pipistrellus rueppelli	Rüppell's pipistrelle	
	Pipistrellus rusticus	Rusty pipistrelle	
	Scotoecus albigula	White-bellied lesser house	DD
	Scotoecus albofuscus	Light-winged lesser house	DD
	Scotoecus hindei	Hinde's lesser house bat	DD
	Scotoecus hirundo	Dark-winged lesser house	DD
	Scotophilus dinganii	African yellow bat	
	Scotophilus nigrita	Schreber's yellow bat	NT
	Scotophilus viridis	Greenish yellow bat	
	Miniopterus fraterculus	Lesser long-fingered bat	
	Miniopterus natalensis	Natal long-fingered bat	NT
MOLOSSIDAE	*Chaerephon nigeriae*	Nigerian free-tailed bat	
	Chaerephon pumila	Little free-tailed bat	
	Mops condylurus	Angolan free-tailed bat	
	Mops midas	Midas free-tailed bat	
	Otomops martiensseni	Large-eared free-tailed bat	NT
	Tadarida fulminans	Madagascan large free-	
	Tadarida ventralis	African giant free-tailed	NT
EMBALLONURIDAE	*Taphozous mauritianus*	Mauritian tomb bat	
NYCTERIDAE	*Nycteris grandis*	Large slit-faced bat	
	Nycteris hispida	Hairy slit-faced bat	
	Nycteris macrotis	Large-eared slit-faced bat	
	Nycteris thebaica	Egyptian slit-faced bat	
	Nycteris woodi	Wood's slit-faced bat	NT
MEGADERMATIDAE	*Lavia frons*	Yellow-winged bat	
RHINOLOPHIDAE	*Rhinolophus blasii*	Blasius's horseshoe bat	NT
	Rhinolophus clivosus	Geoffroy's horseshoe bat	
	Rhinolophus darlingi	Darling's horseshoe bat	
	Rhinolophus fumigatus	Rüppell's horseshoe bat	
	Rhinolophus landeri	Lander's horseshoe bat	
	Rhinolophus simulator	Bushveld horseshoe bat	
	Hipposideros caffer	Sundevall's roundleaf bat	
	Hipposideros ruber	Noack's roundleaf bat	
	Triaenops persicus	Persian trident bat	
MANIDAE	*Manis temminckii*	Ground pangolin	NT
FELIDAE (Cats)	*Acinonyx jubatus jubatus*	South African cheetah	VU
	Caracal caracal	Caracal	
	Felis silvestris	Wildcat	
	Leptailurus serval	Serval	
	Panthera leo	Llion	VU
	Panthera pardus pardus	African leopard	NT
VIVERRIDAE (Civets, mongooses, etc)	*Civettictis civetta*	African civet	
	Genetta angolensis	Angolan genet	
	Genetta maculata	Rusty-spotted genet	
NANDINIIDAE	*Nandinia binotata*	African palm civet	
HERPESTIDAE (Mongooses)	*Atilax paludinosus*	Marsh mongoose	
	Bdeogale crassicauda	Bushy-tailed mongoose	
	Galerella sanguinea	Slender mongoose	
	Helogale parvula	Common dwarf mongoose	
	Herpestes ichneumon	Egyptian mongoose	
	Mungos mungo	Banded mongoose	

FAMILY	BIOLOGICAL NAME	COMMON NAME	IUCN
	Paracynictis selousi	Selous' mongoose	
	Rhynchogale melleri	Meller's mongoose	
HYAENIDAE (Hyaenas)	*Crocuta crocuta*	Spotted hyena	
	Hyaena brunnea	Brown hyena	NT
CANIDAE (Dogs, foxes)	*Canis adustus*	Side-striped jackal	
	Lycaon pictus lupinus	East African wild dog	EN
MUSTELIDAE (Mustelids)	*Ictonyx striatus*	Striped polecat	
	Poecilogale albinucha	African striped weasel	
	Mellivora capensis	Ratel	
	Lutra maculicollis	Speckle-throated otter	
	Aonyx capensis	African clawless otter	
EQUIDAE (Horses etc)	*Equus quagga crawshayi*	Crawshay's zebra	
RHINOCEROTIDAE	*Diceros bicornis minor*	South-central black	CR
SUIDAE (Pigs)	*Phacochoerus africanus*	Common warthog	
	Potamochoerus larvatus	Bushpig	
HIPPOPOTAMIDAE	*Hippopotamus amphibius*	Hippopotamus	VU
BOVIDAE (Antelope, sheep and goats)	*Aelaphus lichtensteinii*	Lichtenstein's hartebeest	
	Connochaetes taurinus	Blue wildebeest	
	Neotragus moschatus	Suni	
	Oreotragus oreotragus	Klipspringer	
	Ourebia ourebi	Oribi	
	Raphicerus sharpei	Sharpe's grysbok	
	Syncerus caffer	African buffalo	
	Tragelaphus angasii	Nyala	
	Tragelaphus oryx	Common eland	
	Tragelaphus scriptus	Bushbuck	
	Tragelaphus strepsiceros	Greater kudu	
	Cephalophus monticola	Blue duiker	
	Cephalophus natalensis	Red forest duiker	
	Sylvicapra grimmia	Common duiker	
	Hippotragus equinus	Roan antelope	
	Hippotragus niger	Sable antelope	
	Aepyceros melampus	Impala	
	Kobus ellipsiprymnus	Waterbuck	
	Kobus vardonii	Puku	
	Redunca arundinum	Southern reedbuck	

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