Irrigation Development Support Project (IDSP)
Ministry of Agriculture
Government of the Republic of Zambia

Environmental and Social Management Plan

Irrigation Development Support Project (IDSP) Remedial Works

Remedial Works on Kanyika Dam

2 December 2021

Prepared by UNOPS for the Government of the Republic of Zambia

Names of Authors

This ESMP was prepared by Titus Chilongo (Environmental Specialist), Tanja Chopra (Social Specialist), and Pilila Chongo (Environmental Specialist) from UNOPS. The Biodiversity Assessment and Management Plan was prepared by Dr Concillia Monde (Terrestrial and Aquatic Ecologist), with Pilila Chongo and Titus Chilongo (Environmental Experts)

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AF	Additional Financing
AR	Activity Rate
BMP	Biodiversity Management Plan
CoC	Code of Conduct
COVID-19	Corona Virus Disease 2019
CpUE	Catch per Unit Effort
Dbh	Diameter at breast height
DMC	Dam Management Committee
DMMU	Disaster Management and Mitigation Unit
DWRD	Department of Water Resources Development, previously Department of Water Affairs, WRDP implementer
E&S	Environmental and Social
EIA	Environmental Impact Assessment
EPB	Environmental Project Brief
EPP	Emergency Preparedness Plan
ESA	Environmental and Social Audit
ESMP	Environmental and Social Management Plan
ESSAT	Environmental and Social Standards Advisory Team
EPBs	Environmental Project Briefs
FAO	Food and Agriculture Organization of the United Nations
fsl	Full Surface Level
GBV	Gender Based Violence
GPS	Geographical Positioning System
GRM	Grievance Redress Mechanism
GRZ	Government of the Republic of Zambia
HSSE	Health Safety Social and Environmental
IBAT	Integrated Biodiversity Assessment Tool
ICOLD	International Commission on Large Dams
IDA	International Development Agency
IDSP	Irrigation Development Support Project
IDSP AF	Irrigation Development Support Project Additional Financing
ILO	International Labor Organization
ISDS	Integrated Safeguard Data Sheet (World Bank)
IUCN	International Union for Conservation of Nature
IVI	Importance Value Index
KBA	Key Biodiversity Area
LMP	Labor Management Plan
MAMSL	Height above sea level

MAR	mean annual runoff
MoA	Ministry of Agriculture
MWDSEP	Ministry of Water Development Sanitation and Environmental Protection
msl	mean sea level
NGO	Non-governmental Organization
ODI	Overseas Development Institute
OP	Operational Policy (World Bank)
OPCS	Operational Policy and Country Services (World Bank)
PAD	Project Appraisal Document (World Bank)
PAP	Project Affected Person
PDO	Project Development Objective
PGA	Peak Ground Acceleration
PIU	Project Implementing Unit
PSU	Primary Sampling Unit
SEF	Safety Evaluation Flood
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
SF	Sampled fishers
SI	Shannon Diversity Index
SMN	Sampled Catch
SP	Sampling Points
Spp	Species
TEVETA	Technical Education, Vocational and Entrepreneurship Training Authority
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UNOPS	United Nations Office for Project Services
USD	United States Dollar
VIP	Ventilated Improved Pit
VSU	Victim Support Unit
WARMA	Water Resources Management Authority
WRDP	Water Resources Development Project
YWCA	Young Women Christian Associates
ZABS	Zambia Bureau of Standards
ZEMA	Zambia Environmental Management Agency
ZMD	Zambia Meteorological Department

Executive Summary

Kanyika Dam is located in Kasempa District in the North Western Province of Zambia. It is one of ten dams that have been selected for remedial works under the World Bank funded Irrigation Development Support Project (IDSP). The IDSP is implemented by the Ministry of Agriculture and has been effective since 2011. The Dam was first constructed in 2018, under the Water Resources Development Programme (WRDP), to provide water for irrigation and aquaculture.

The Zambia Water Resources Development Project (WRDP) was classified as a 'Category B' project under the World Bank safeguards policies, and it triggered several operational policies (OPs) in relation to the dam construction. However, the World Bank's mid-term review of the WRDP identified non-compliance issues with safeguards policies and poor quality of the construction works at the dam. Despite efforts to bring the project back on track, the project continued to remain out of safeguards compliance. The WDRP was closed in 2018.

The World Bank has provided Additional Financing (AF) to the IDSP, to support remedial works on 10 of the dams constructed or rehabilitated by the WRDP, including Kanyika Dam. The United Nations Office for Project Services (UNOPS) is tasked with overseeing the works and with the preparation of this Environmental and Social Management Plan (ESMP) on behalf of the Government of the Republic of Zambia. The objectives of this ESMP are to guide the remedial works on the dam, mitigate imminent identified risks to the environment, safety of communities and their associated livelihoods, and to bring the dam in compliance with World Bank safeguards policies.

The key structural legacy issues of the Kanyika Dam include spillway risks as the spillway training walls are not in good shape and no emergency spillway is present; return channel drop structures and training walls risks as there is gullying and erosion in the return channel; embankment and slope stability risks due to erosion hazards and lack of embankment stability, as well as rip raps that are not in good shape, crest narrowing as a result of erosion and shoulder erosions on the crest. Furthermore, there are rock toe risks due to the lack of toe drains or filters for seepage control.

UNOPS has developed detailed designs for the remedial works on Kanyika Dam. These include the establishment of a downstream slope of 1:2.5, which will be associated with an offset of the centerline downstream to accommodate a 1:2.5 notational slope on the upstream; the establishment of a rock toe and chimney drain with associated reverse filters; and stone pitching for 10m upstream and 15m downstream of the sill structure abutments to prevent wash aways. The works will not change the nature and scope of the existing dam operation activities. The works will be implemented in two ways: a) construction and demobilization activities and b) the existing sites' remediation activities.

Institutional Arrangements: The sub-project works on Kanyika Dam will be managed and implemented by the Ministry of Agriculture of Zambia, under the IDSP. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the IDSP-PIU will manage and implement the broader AF activities, it has contracted UNOPS to oversee and implement the remediation works on ten dams, including the Kanyika Dam. UNOPS will procure and oversee a contractor for the remedial works on the dam.

The dam community is expected to own this project and report any grievance or misconduct by the contractor or contractor personnel to the IDSP-PIU through the AF Grievance Redress Mechanism (GRM). Upon completion of the works, the management, operation and maintenance of the dam will therefore be handed over to the Kanyika dam committee. In order to successfully operate the dam, and limit its negative impacts on people and environment, the dam committee and community members will receive capacity building and training.

The ESMP addresses the environmental and social risks and impacts, which were identified through extensive field assessments. It includes a construction works management plan with mitigation measures and performance indicators for non-hazardous waste; hazardous waste; soil; land use and aesthetics; surface and groundwater pollution; air quality and noise; sanitation; traffic; biodiversity; community health and safety; gender equality and Gender Based Violence (GBV); Protection Against Sexual Exploitation & Abuse (PSEA); labor and working conditions; decommissioning and rehabilitation measures; maintenance and monitoring. The results of a Biodiversity Assessment and a Biodiversity Management Plan (BMP) are annexed to this ESMP.

A separate rehabilitation and remediation plan is included in this ESMP in order to identify, rehabilitate and remediate the existing previous dam construction area, which has environmental and safety issues, as well as to enable completion of existing incomplete dam construction works and sites; and to outline the requirements to return previously disturbed sites to a state which is similar to the state prior to construction.

Health and safety and non-structural risks related to legacy issues of the dam include unrehabilitated borrow pits posing health and safety issues for the community; the inability to monitor and assess downstream ecological effects of dam operation leading to a poor development of the aquatic ecosystem; stagnant water ponds within the spillway that can be vector breeding areas and may cause drowning risks; a lack of access across the stream on the downstream side of the dam; as well as several injury and drowning risks for community members related to lack of awareness.

Social concerns include risks of food insecurity caused by the failure to stock the dam with fish and a lack of capacity development / training for community members to benefit fully from irrigation water supply.

The ESMP further includes a capacity building and training plan that lays out the necessary training for dam committee members, community members, and other stakeholders in relation to the construction and operation phase of the planned works at Kanyika Dam. Similarly, a stakeholder engagement plan lays out the detailed modes of engagement with a variety of stakeholders in order to ensure appropriate dissemination of all information regarding the works; and to allow for consultation of stakeholders on dam-related environmental and social issues. A Grievance Redress Mechanism (GRM) has been designed specifically for the AF, to allow stakeholders to file any feedback or grievances and receive appropriate responses from the IDSP.

1. Introduction

Kanyika Dam is located in Kasempa District in the North Western Province of Zambia. It is one of ten dams that have been selected for remedial works under the World Bank funded IDSP. The current structural integrity of Kanyika Dam has been compromised by the initial construction works. This has become a threat to the safety of the local community and downstream users. UNOPS has been tasked to prepare this ESMP on behalf of the Government of the Republic of Zambia. The ESMP guides the remedial works on the dam, mitigates imminent identified risks to the environment and the safety of communities and their associated livelihoods, and brings the dam into compliance with World Bank safeguards policies.

UNOPS has conducted environmental, social and dam engineering studies based on desk reviews, interviews and consultations with key sub-project stakeholders, and collection of field data at the dam site using field specific equipment. Initial field screening visits by the team revealed that an in-depth biodiversity assessment of the dam site was required. The biodiversity assessment was undertaken, the data analysed and a Biodiversity Management Plan (BMP) developed. The results and the BMP are annexed to this ESMP

Dam rehabilitation works will commence after ESMP approval and disclosure. The ESMP will then be communicated to the stakeholders prior to the remedial works. Dam construction is anticipated to take 6 months.

1.1. Project Background and Description

The Kanyika Dam is a new dam, which was constructed in 2018 under the WRDP. It was built exclusively for irrigation and aquaculture purposes. To mitigate structural legacy issues, only minor measures were put in place, including sand bags to channel the overflows in the correct places. The proposed remedial works will help complete the dam.

The Water Resources Development Project (WRDP)

The WRDP became effective in 2013 and was closed in 2018. The PDO of the project was 'to support the implementation of an integrated framework for development and management of water resources in Zambia'. The WRDP had three components: Component A: Water Resource Management; Component B: Water Resources Development; and Component C: Institutional Support. Component B included the support for the design, rehabilitation and construction of 100 small dams. Of these, only 12 dam sites were procured for construction or rehabilitation. Kanyika Dam was one of them.

***WRDP E&S Safeguards*:** The project was classified as a 'Category B' project under the World Bank safeguards policies, and several World Bank safeguards policies were triggered. As a result, the following instruments were prepared, consulted and agreed upon: i) Environmental and Social Management Framework with provision for cultural resources management and protection; ii) Pest Management Plan; and iii) Resettlement Policy Framework. The World Bank Integrated Safeguard Data Sheet (ISDS) indicated that the project would not finance the construction of large dams and required only the generic dam safety measures contained in existing operational procedures and the application of the 2010 Food and

Agricultural Organization (FAO) Technical Guide for Small Earth Dams for compliance with safeguards on dam safety.

The World Bank's mid-term review of the WRDP, however, identified non-compliance issues with safeguards policies and poor quality of construction of the Kanyika and other dams. As a result, the Project Management Unit prepared Environmental Project Briefs (EPBs) for the dams, which were finalized between March and June 2016 and approved by Zambian Environmental Management Agency (ZEMA) between January and May 2017. However, these EPBs were not compliant with World Bank safeguards policies and despite efforts to rectify the issues, the non-compliance persisted. As a consequence, on March 26, 2018, the World Bank issued a Partial Suspension of the Project. The suspension limited project expenditure to addressing safeguards issues and remediating the dams that had already been built or rehabilitated under the WRDP. Although EPBs and an ESMP for 8 dams were in place, remedial works at the ten dam sites had not taken place at the time of closure in 2018. Since project closure, the World Bank and GRZ have worked to address the outstanding issues, given the responsibilities and obligations of the parties set out in the WRDP's Financing Agreement. On October 10, 2019, the World Bank and the GRZ agreed on remedial actions to ensure the safety of the 10 dams that were constructed/ rehabilitated under the WRDP. To address the shortfalls, remedial works would be financed under the IDSP.

Irrigation Development Support Project (IDSP)

The IDSP (P102459) was approved and became effective in 2011. Two restructurings of the original project changed the Project Development Objective (PDO), the number of components and the closing date. The current PDO of the IDSP is to 'provide improved access to irrigation services in selected sites in the Recipient's territory'. The project consists of three components:

Component 1: Public infrastructure investment;
Component 2: Development of irrigation management capacity; and
Component 3: Project management and coordination

As part of the 2019 agreement, it was decided that the remedial work of these dams will be carried out through the IDSP, based on a two phased approach. The first phase is financed by the IDSP parent project, the second phase by the AF.

Phase 1 covers preparatory activities that will facilitate the works to remediate dam safety and integrity and to realize its original intent (which was to the benefit of the local community and the department of agriculture). The scope of Phase 1 consists of a) undertaking the necessary investigations for remediation, including in regards to dam safety and environmental and social safeguards; b) prepare an ESMP and Biodiversity Assessment and Management Plan; c) undertake immediate, limited, structural and non-structural interventions to minimize immediate risks to communities caused by the dam.

IDSP Additional Financing (AF)

The AF extends the original deadline of the IDSP to 30 November 2022. It consists of three distinct sets of activities: Activity 1: Completion of ongoing works under the IDSP and cost replenishment; Activity 2: Remedial works for the 10 WRDP dams; Activity 3: Drought Emergency Response. The remediation of Kanyika Dam and nine other dams will be implemented under activity 2.

Phase 2 of the 2019 agreement and activity 2 of the AF provide remedial activities to reduce the risks/impacts related to construction and operation of the Kanyika Dam and provide support through training and capacity building, which is required to safely operate the dams and reduce the downstream

environmental impacts. It is envisaged that the activities associated with the works will not change the nature and scope of the existing scheme and will not increase the dam's existing capacity. With this, it is projected that the remedial measures will not adversely change the quality or quantity of water flows downstream to other areas.

The scope of Phase 2 for Kanyika Dam consists of:

a) Civil works on the dam to ensure the safety of dam and downstream communities;
b) Establishment of operation and maintenance arrangements;
c) Continuation of surveillance;
d) Upon completion of the works, hand-over of the management, operation and maintenance of the dam to a dam committee comprising of members of the beneficiary communities;
e) Implementation of the ESMP, including remediation of environmental legacy areas such as borrow pits, excavation pits, spoil areas, hazardous wastes areas, etc.; and
f) Training of communities on how to operate the dam and conserve the catchment.

1.2. Objectives of the ESMP

This ESMP has been prepared to guide all the works on Kanyika Dam during Phase 2 of the IDSP AF. The main objectives of this ESMP are to mitigate imminent identified risks to the environment, safety of communities, and their associated livelihoods, and to bring the dam construction and operational management into compliance with World Bank safeguards policies.

1.3. Methodology

This ESMP is based on a desk review of available information and field data collection, which included consultations with members of the Kanyika dam community, the local government authorities, representatives of the GRZ, and members of the World Bank and IDSP teams. Field visits were conducted to the Kanyika dam site for detailed on-site assessments of the environmental and social impacts of the sub-project. This ESMP has been guided by the Zambian Environmental Management Act EIA Regulations (1997), as well as by the World Bank's OPs. Reference is made to the Remedial ESMP for 8 dams (COWI 2018), the Environmental and Social Audit (April 2020), and recent dam assessments in order to determine environmental and social requirements for rehabilitation and restoration measures. The EMSP follows the format, which is laid out in the Environmental and Social Audit (April 2020).

In summary the following activities were undertaken by UNOPS:

- Literature review, including data and documentation provided by the IDSP to UNOPS:
    - Remedial Environmental and Social Management Plans of Eight (8) Dams Under the Water Resource Development Programme (2018)
    - Approval Decision letters by Zambia Environmental Management Authority (2017)
    - Environmental Project Briefs (EPB) prepared under WRDP (2017)
    - Environmental and Social Audit (ESA) of 10 Dams (IDSP, 2020)

- Field studies by the UNOPS environmental and social (E&S) safeguards and engineering teams in July 2020, accompanied by IDSP team members:
    - Site environmental and social assessments.

    - Site and analytical geotechnical studies
    - Site surveying
    - Site and desk terrestrial and aquatic biodiversity studies
    - Site and desk hydrological studies
- Public participatory interviews, Focus Group Discussions and community consultations.
- Environmental quality monitoring – water quality sampling and analysis.
- Ad hoc filling in of matrix and checklists based on impact assessment.

The ESMP has included the preparation of the following plans and reports:

- Policy, legal and institutional framework
- Baseline conditions
- Remedial design with
    - Geotechnical information
    - Survey information
    - Hydrology information
- Safety reports-operations and maintenance/ emergency preparedness plan
- Biodiversity management plan
- General construction works management plan
- Rehabilitation plan
- Training plan and stakeholder engagement
- Grievance redress mechanism
- ESMP implementation process

2. Policy, Legal and Institutional Framework

Environmental and social sustainability is vested in international and national policies, laws, regulations, guidelines and standards that guide the implementation of this sub-project. The below table outlines key legislation that regulates the environmental and social aspects during dam rehabilitation through to the operational phases. The sub-project activities must fully comply with the relevant legislation of the Republic of Zambia as well as with the World Bank safeguards policies.

2.1. National Policy and Legislative Framework

These policies and others are actively implemented through compliance with the legislative frameworks described below. Table 1 outlines the various laws of the Republic of Zambia that are relevant to the proposed works.

Table 1 Laws relevant to the sub-project

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Environmental and Natural Resource Management			
Environmental Management Act No.12, 2011 **Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997**	To protect the environment and control pollution, so as to provide for the health and welfare of persons, animals, plants and the environment. This Act provides for the management of effluent discharge, air and noise pollution, the parameters which are relevant to this sub-project. Under these regulations, a developer will not implement a project for which a project brief or an environmental impact statement is required, unless the project brief or an environmental impact assessment has been concluded in accordance with these Regulations and the Council has issued a decision letter.	UNOPS to ensure the relevant regulations are mainstreamed in the ESMP and enforced. IDSP to monitor compliance throughout sub-project lifespan.	Activities to be undertaken as remedial measures to dam's safety and integrity are likely to have environmental impacts. Provisions for mitigation measures for identified sub-project impacts are in place in order to eliminate or reduce the effects of these impacts. The measures are consistent with the requirements in the Environmental Management Act of 2011. As an example, some of the works to be undertaken may result in environmental discharges that will require ZEMA licenses for compliance and monitoring. Relevant pieces of regulations have been included in this ESMP and contractor's compliance with the regulations during the rehabilitation of the dam will be ensured. At the national level, the Environmental Impact Assessment (EIA) regulation of 1997 gives guidance, schedules and categories for the various project types and the relevant EIA studies to be undertaken. It further gives provision on post- EIA approval management of projects and guidelines for developing ESMPs. This has been followed.

Solid Waste Management Act of 2018	To ensure disposal of generated solid waste to designated sites	UNOPS to ensure the regulation is enforced through the ESMP. IDSP to monitor compliance throughout the sub-project lifespan; local municipal authority	The ESMP has taken into consideration solid waste management at work sites by introducing a parameter that will compel the contractor to take care of all the generated solid waste at its worksites and appropriately dispose of the same.
Natural Resources Conservation Act, Cap 315, 1970	To conserve and protect both natural and cultural heritage, e.g. waterfalls, in perpetuity and other resources within the boundaries of the site for the benefit of the present and future generations.	UNOPS to ensure enforcement during preparation and construction phase IDSP to monitor compliance throughout sub-project lifespan	The ESMP takes into consideration the results of a biodiversity assessment and a BMP, which includes detailed specific conservation and mitigation measures to ensure sub-project activities promote the conservation and protection of both natural and cultural heritage in the sub-project affected areas, in compliance with the regulation.
Fisheries Resources Management			
Fisheries Act, Cap 200, 1974	Provides for development of commercial fishing and the registration of fishermen and their boats and the protection of endangered fish species.	IDSP Monitoring: Ministry of Agriculture and Livestock	The proposed dam will be used for fishing; commercial fishing may be eventually developed by communities. The provisions of this Act will be complied with in the management of these fish resources. Fishing will be conducted according to the regulations and the Department of Fisheries will be involved to train the community on relevant activities. UNOPS, on behalf of the GRZ, has included actions to ensure species are protected with the involvement of the Department of Fisheries in the District.
Lands Management			
The Lands Act, 1995 (CAP 292, CAP 289, CAP 288)	The Department of Lands administers the Land Act, 1995 (CAP 292, CAP 289, CAP 288) and the Lands Acquisition Act, 1995 for the allocation and alienation of land under statutory leaseholds. The Department is also responsible	UNOPS to ensure enforcement during preparation and construction phase. Monitoring: Ministry of Lands, Natural Resources and Environment Protection.	No additional land is expected to be required for this sub-project. If any land acquisition be required, UNOPS/ IDSP will comply with this regulation which governs the acquisition of the land to be used for various developmental activities.

	for the administration of lands and deeds registration and land surveys and mapping.		
Urban and Regional Planning Act, No. 3 of 2015	Provides for the appointment of planning authorities, the preparation approval and revocation of development plans, and the control of development and subdivision of land.	UNOPS to ensure enforcement during preparation and construction phase. Monitoring: Ministry of Local Government and Housing; local authorities	The land around the dam falls within traditional tenure. UNOPS, on behalf of the GRZ, will comply with this regulation for the approvals of construction and development plans within a locality if required.
Local Government Act, 1990	Provides for the establishment of councils in districts, the functions of local authorities and the local government system.	Ministry of Local Government and Housing Local Authorities	The function of the municipalities is guided by the provision of the Local Government Act. UNOPS will, on behalf of the GRZ, comply with the requirements of this Act for measures related to pollution control and environmental protection functions which are handled by the local council. It will ensure that the council and stakeholders are involved in the planning, rehabilitation and operation activities.
Agricultural Lands Act No 13 of 1994 (Cap. 187)	The Act establishes the Agricultural Land Board and provides for its functions which inter alia includes; keeping under review the use that is being made of state land, outside urban and peri-urban areas and to make recommendation to the Minister responsible for agriculture. The Act provides for tenant farming schemes.	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Agriculture	The sub-project construction work and dam operation activities may be carried out on agricultural lands and thus assessment of the impacts of these activities on the agricultural areas in the sub-project area was undertaken. UNOPS, the contractor and stakeholders will comply with this law in relation to rehabilitation and operation of the dam.
Traffic Management			
The Road Traffic Act No. 11 of 2002	Establishment of the Road Transport and Safety Agency (RTSA). It also provides for a system of road safety and traffic management in Zambia.	Contractor Monitoring: UNOPS	The transportation of construction materials has the potential to cause accidents, hence traffic control measures must be employed and their development must comply with provisions of the Act. UNOPS and contractors will comply with all the regulations under this Act, traffic safety rules for communities, and traffic management. This ESMP includes a traffic management plan.

Tourism Management			
Zambia Wildlife Act No. 14 of 2015	Management and Protection of National Parks and Wildlife respectively	UNOPS to ensure enforcement during preparation and construction phase. Monitoring: Ministry of Tourism	The dam is located in a remote rural area, hence all activities by UNOPS, on behalf of the GRZ, will comply with the requirements of this regulation, if the protection of wildlife is required. The ESMP determines appropriate actions to ensure preservation of national parks and protected areas, wildlife, and protected and endangered species by including an ecologist on the team. A biodiversity assessment was conducted and a BMP prepared, which is annexed to this ESMP
Employment and Labor			
Workers' Compensation Act No. 10 of 1999 Employment Act	All employment regulations and laws.	Contractor, UNOPS Monitoring: Ministry of Labour	UNOPS will, on behalf of the GRZ, ensure that the contractor comply with provisions of these regulations during the course of employment.
Occupational Health and Safety Act	Provides for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery.	Contractor, UNOPS Monitoring: Ministry of Labour	UNOPS will, on behalf of the GRZ, ensure that the contractor complies with the occupational health and safety requirements of the Act, promotes safety by putting in place all measures required to ensure the well-being of the workers.
Worker's Compensation Act No. 10 of 1999	Establishment and administration of a Fund for the compensation of workers disabled by accidents to, or diseases contracted by such workers in the course of their employment, and for the payment of compensation to dependants of workers who die as a result of such accidents or diseases.	Contractor, UNOPS Monitoring: Ministry of Labour	This Act is relevant to the sub-project because workers are at higher risk of suffering from injuries that could lead to disabilities or contracting diseases due to the nature of their work environment. In the event of work-related accidents, the provisions of this Act will be triggered. UNOPS and its contractors will comply with regulations under this Act by registering with the workers compensation Board and by providing safe working sites.
Community Health and Safety			
The Public Health Act of 1995	Prevention and suppression of diseases and regulation of all matters connected with public	Contractor, UNOPS Monitoring:	The sub-project is likely to cause pathogens due to human activities. Measures to prevent diseases and pollution particularly during the rehabilitation and operation phases will be instituted.

	health. This law may be read together with the Local Government Act, Cap 281 of the laws of Zambia. The Act empowers the Ministry of Health and the Councils to prevent diseases and pollution dangerous to human health, as well as prevention of pollution to any water supply for domestic use.	Ministry of Health	UNOPS will, on behalf of the GRZ, take measures to prevent diseases and pollution dangerous to human health by ensuring that there are good sanitation and waste disposal systems on the working premise (prevention of vectors etc.). COVID-19 prevention and management measures are included in this ESMP.
The Gender Equity and Equality Act, 2015	Taking of measures and strategic decisions to ensure gender equity, equality and integration of both sexes in society; promotes gender equity and equality as a cross cutting issue in all spheres of life and stimulate productive resources and development opportunities for both sexes; prohibits harassment, victimization and harmful social, cultural and religious practices; provides for public awareness and training on issues of gender equity and equality; provides for the elimination of all forms of discrimination against women, empowers women and achieve gender equity and equality	Contractor, UNOPS Monitoring: Ministry of Gender Ministry of Community Development and Social Services	Sub-project works and operation will require gender mainstreaming and prevention and mitigation measures for GBV UNOPS and its contractors will comply with all the regulations under this Act. This ESMP includes a gender equality and GBV action plan.
The Anti-gender-based Violence Act, 2011	The Act provides for the protection of victims of gender-based violence; constitutes the Anti-Gender-Based Violence Committee.	Contractor, UNOPS Monitoring: Ministry of Gender	Worker influx bears risks of GBV cases. UNOPS and its contractors will comply with all the regulations under this Act. Sensitization, reporting and referral pathways will be put in place.

		Ministry of Community Development and Social services	
Disaster Management			
Disaster Management Act, 2010	Establishes and provides for the maintenance and operation of a system for the anticipation, preparedness, prevention, coordination, mitigation and management of disaster situations and establishes the Disaster Management and Mitigation Unit (DMMU).	UNOPS to ensure enforcement during preparation and construction phase. Monitoring: Office of the Vice President District Commissioner Office	Dam safety risk and emergency response measures need to be in concordance with the Act and should involve the necessary stakeholders. UNOPS engineering and safeguards teams will work together for remedial actions that promote safety. The UNOPS and IDSP will involve the DMMU in implementing safety and emergency measures.
Zambia Coronavirus Disease (COVID-19) Statutory Instruments Public Health (Infected Areas) (Coronavirus Disease 2019) Regulations, No. 22 of 2020; Public Health (Notifiable Infectious Disease) (Declaration) Notice, No. 21 of 2020; The Employment Code (Exemption) Regulations, 2020; The	Construction and operational activities will involve workers and the community on site. Zambia is currently experiencing the COVID-19 pandemic according to the national notifiable infectious disease declaration notice of March 2020.	UNOPS to ensure enforcement during preparation and construction phase	COVID-19 prevention and management measures are included in this ESMP.

Public Health (Infected Areas) (Coronavirus Disease 2019) (Amendment) Regulations, 2020			

2.2. World Bank Operational Policies

This sub-project will fully comply with the World Bank OPs. In addition, it will be guided by the WBG Environmental, Health and Safety Guidelines (EHS Guidelines); The World Bank's Good Practice Note on 'Addressing Gender Based Violence in Investment Project Financing Involving Major Civil Works'[1]; as well as World Bank guidance on 'Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx[2].

Table 2 describes the applicable triggered policies and actions to be followed by the IDSP AF/UNOPS and the contractor. The ESA indicated 6 triggered policies for the project, but the Kanyika dam subproject has not triggered the OP 4.12 **(**Involuntary Resettlement), because there is no anticipated resettlement for the subproject; it has not triggered OP 4.09 (Pest Management) because it is a livestock dam; and has not triggered OP 7.5 (Project on International Waterways) because the surface water bodies that Kanyika stream feeds into, such as Nkenyauna River, and subsequently Lunga River, which feeds into Kafue River, are all local water bodies.

Table 2 Relevant World Bank operational policies

OP	Name	Actions to be followed by the IDSP AF / UNOPS
OP 4.01	Environmental Assessment:	The project was classified EA Category B and an Environmental and Social Audit (ESA) was prepared to comply with OP 4.01. The policy is triggered because of the potential impacts the remediation works on Kanyika Dam could have on the environment and people. Some of the potential impacts include: soil excavations, borrow pits, construction waste, clearing of vegetation, noise, sedimentation, downstream flow restrictions, etc. For the remediation works at Kanyika Dam, UNOPS has prepared this ESMP, following the requirements defined in the ESA. The sub-project will implement all measures described in both instruments to mitigate all identified negative impacts.
OP 4.04	Natural Habitats:	This policy is triggered because the construction of the dam has caused impacts in natural and modified habitats. Also, the impact of the operation of the dam on the downstream flow and the induced impacts of increasing human

[1] World Bank, Good Practice Note. Addressing Gender Based Violence in Investment Project Financing involving Major Civil Works, September 2018

[2] World Bank, Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx, OPCS and ESSAT, December 2016.

		populations on both aquatic and terrestrial ecosystems were identified in the ESA as an area of weakness in the previous safeguard instruments that must be rectified. The previous ESMP prepared for 8 dams (including Kanyika) listed some of the ecological impacts associated with dam and flow regulation but argued in favor of the dam as a means of guaranteeing flow in the downstream system in the dry season and during times of drought. This presupposes that flows will be managed to benefit downstream ecology, which, given capacity limitations and cost, is far from certain; and while there may be benefit in supplementing ecological base flows in dry periods, this does not necessarily outweigh other negative considerations. Cumulative changes brought about by the dam may negatively affect the downstream aquatic and wetland environment, including creating a barrier to the movement of aquatic species. The opportunity to properly address these issues, as required by OP 4.01, has to some extent passed. The dam is already built. There are, however, some options for impact minimization, as well as actions to make the most of the potential benefits of flow regulation. It should be noted however that Kanyika Dam was constructed on a seasonal stream and therefore the downstream ecology is cut off from the overflow via the spillway in the dry season. The downstream ecology survives on the water springs existing in the area. This ESMP has provided measures to mitigate negative impacts on terrestrial and aquatic ecosystems in the area of influence of the dam, which include impacts that will be caused by the current construction teams in their day to day activities and those caused by the previous construction works (see remediation plan in this ESMP). UNOPS has further conducted a biodiversity assessment and prepared a BMP, which is annexed to this ESMP to enhance conservation of flora and fauna during and after the remedial works.
OP 4.37	Safety of the dam	This policy is triggered because the remediation works at the dam are necessary to ensure dam safety. The dam is considered a small dam because it has a height less than 15m. UNOPS and its contractors will follow Good International Industry Practice (GIIP) to determine and implement corrective actions that mitigate dam safety issues. For the sub-project a *Plan for construction supervision and quality assurance*, *Operation and Maintenance (O&M) Plan*, and an *Emergency Preparedness Plan (EPP)* have been prepared.

2.3. World Bank Group Environment Health and Safety Guidelines

The WBG EHS Guidelines contain the following guidelines included in the ESMP to be applied on the subproject:

- Environment- air emissions and quality; energy conservation; wastewater and ambient water quality; water conservation; hazardous materials management; waste management; noise and contaminated land.

- Occupational health and safety- facility design and operation; communication and training; hazards; PPE and monitoring.
- Community health and safety- water quality and availability; infrastructure structural safety; life and fire safety; traffic safety; transport of hazardous materials; disease prevention and emergency preparedness and safety.
- Construction with decommissioning –environment, occupational health and safety and community health and safety.

3. Institutional Arrangements for E&S Management of the Sub-Project

The Kanyika Dam remedial works will be managed and implemented by the Ministry of Agriculture (MoA) of Zambia. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the PIU of the IDSP will manage and implement the broader AF activities, it has contracted UNOPS to oversee and implement the remediation works of the ten dams, including Kanyika Dam. The IDSP-PIU Environmental and Social (E&S) Team is responsible for all E&S aspects of the IDSP. It will supervise and monitor all E&S aspects of all activities implemented by the UNOPS Sub-PIU and UNOPS contractor at the Kanyika dam site. The UNOPS Sub-PIU E&S Team is responsible for the implementation of the E&S mitigation measures laid out in this ESMP. Where implementation is conducted by contractors, the UNOPS Sub-PIU E&S Team supervises and monitors all E&S related aspects of the contractor's works. The institutional arrangements are summarized in Figure 1.

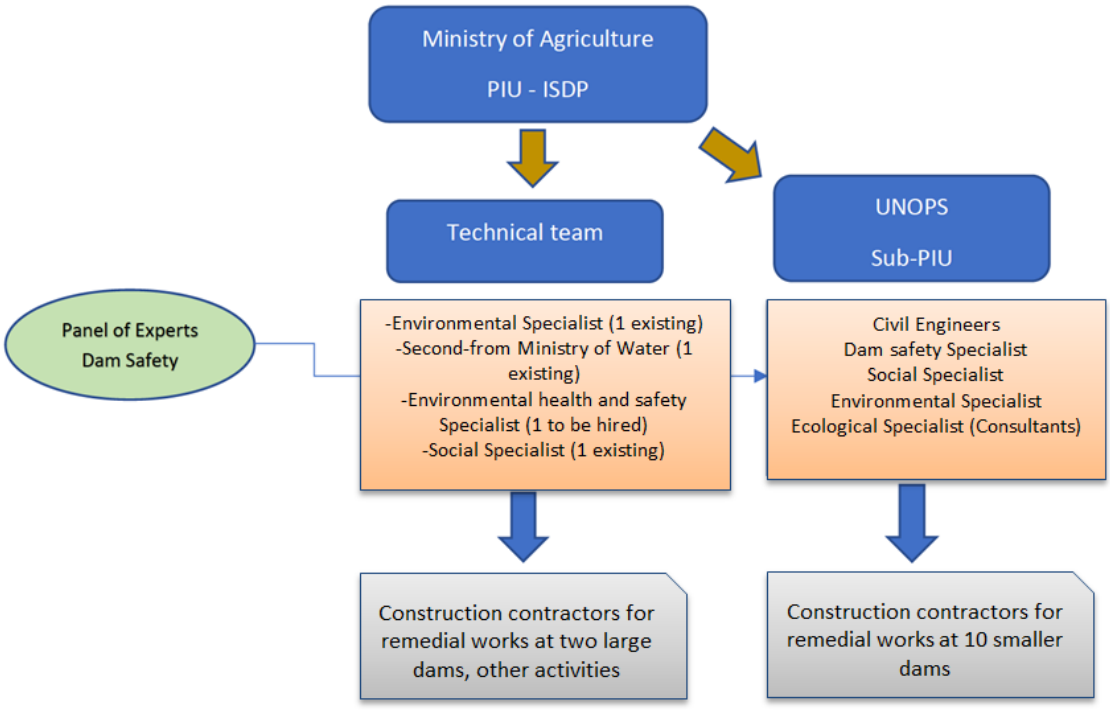


Figure 1 Institutional arrangement for sub-project implementation

3.1. Ministries / IDSP-PIU

The IDSP-PIU is situated within the Ministry of Agriculture and will have overall oversight of the dam remediation works and the implementation of this EMSP.

The IDSP-PIU will include one environmental specialist, one environmental health and safety specialist, and one social specialist to support the overall supervision of the remedial works.

The IDSP-PIU will further provide support to the dam remediation activities through a dam safety panel of experts, which will have oversight over the works, remediation plans, safety plans, etc…

The IDSP-PIU will retain the primary responsibility for ensuring that environmental and social commitments for the Kanyika Dam are met throughout the sub-project lifespan vis-à-vis the World Bank.

The IDSP-PIU will establish a schedule of supervision and monitoring for the environmental and social management of the Kanyika dam site. Environmental and social issues are the responsibility of all personnel, from the management to the operator. However, day-to-day supervision and monitoring for the planning and implementation of the whole sub-project lies specifically with the environmental specialist, the environmental health and safety specialist and the social specialist (Figure 1). Furthermore, at least one additional MoA field staff member with health, safety and environmental responsibilities will be located at Kanyika dam site for continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP.

The three specialists will supervise all E&S related matters for the works under the AF. This includes supervision of UNOPS and the UNOPS contractor at the Kanyika dam site. This E&S supervision includes the operationalization of the dam, during which period the IDSP staff will be working with the respective local authorities, dam committee and local communities, in preparation for smooth handover when IDSP ceases to exist as a project.

The IDSP-PIU will implement capacity building and training of local stakeholders to ensure their informed cooperation in E&S matters during the remedial works and during the operational phase of the dam as well as advising the dam committee.

3.2. United Nations Office for Project Services (UNOPS)

The IDSP-PIU has contracted UNOPS to implement the remediation sub-project of Kanyika Dam under the AF, including the day-to-day environmental and social management and implementation of the measures described in this ESMP. UNOPS has been tasked with the design of the remedial works and the preparation of this ESMP. UNOPS will further be responsible for the preparation of the tender document and supervision of the contractor for the remedial construction works including the implementation of E&S mitigation measures. Supervision will involve the management of the contractor and liaison with and reporting to the IDSP-PIU throughout the contract period.

The UNOPS technical team will include civil engineers and a dam safety specialist. Environmental and social issues will be the responsibility of one environmental specialist, one social specialist and one ecologist. This technical team will be located at the UNOPS Sub-PIU in Lusaka, with frequent travel to the Kanyika dam site.

The environmental specialist, ecologist and the social specialist will be involved in the environmental and social management of Kanyika Dam. In addition, the team will supervise and monitor the implementation of environmental and social mitigation measures by the contractor. The team will establish a regular supervision and monitoring schedule, including site visits, and will prepare and submit quarterly environmental and social monitoring reports to the IDSP-PIU.

3.3. The Contractor and Sub-Contractors

The contractor will be responsible for carrying out the work at the site in compliance with this ESMP, in accordance with applicable Zambian laws and regulations governing environmental and social impact management, pollution control, waste management, occupational health and safety, and the World Bank OPs.

The contractor will appoint one full time Health, Safety, Security and Environmental (HSSE) Officer to serve at the construction site throughout the entire period and ensure implementation of the ESMP. Among other obligations, the contractor will comply with all labor and gender equality requirements on site, as specified in the ESMP, and will brief the Kanyika dam management committee (DMC) and relevant government officials through regular meetings.

The contractor is required to prepare method statements for the implementation of sub-project aspects, and to operationalize all action and management plans as defined in this ESMP (including non-hazardous waste, hazardous materials and waste, surface and groundwater pollution, protection measures for terrestrial and aquatic fauna and flora, air quality and noise, labor and working conditions, sanitation, gender equality, gender based violence (GBV), Protection Against Sexual Exploitation & Abuse (PSEA), stakeholder engagement, provision of flow during construction, environmental remediation and rehabilitation, maintenance and monitoring). This will be outlined in the procurement documentation provided to the contractor. The Contractor's method statements will be submitted to UNOPS for approval prior to commencement of work.

3.4. The Dam Community

As owners of the dams, the dam community (see baseline section 4.2.) will be encouraged to be active partners during the construction and operational period. It will be regularly consulted on a variety of issues (see stakeholder engagement section). They will further be asked to report any misconduct by the contractor or contractor's personnel to the IDSP-PIU, through the Grievance Redress Mechanism (GRM), which has been designed for the AF activities. The DMC and community representatives, such as the headmen, will verify to ensure that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the Stakeholder Engagement Plan (SEP) below, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the environmental and social mitigation measures undertaken. Stakeholder engagement ensures that dam community members are consulted throughout the construction and operational phases.

The dam is operated by an active DMC, which consists of 4 women and 6 men. The Kanyika DMC composition is shown in Appendix G. The dam management committee is a locally developed, decentralized organization where user communities have been ceded rights and have responsibilities for managing their own resources, typically using a mix of traditional or more formalized mechanisms of contract and enforcement to define, access, exploit, maintain and share dam resources or benefits. Due to the complexity of managing dams, the management structure is extended to include public agencies such as agriculture, water resources, fisheries and forestry departments as advisors and trainers. The committee has been/will be involved during planning, construction and operation phases. Its role will include involvement in stakeholder engagement, auxiliary sites selection, employment, ESMP implementation, operation guidelines and monitoring, operation maintenance and dam safety. The level of involvement in the maintenance and management will depend on the type of technology, the range of maintenance activities and capacity building offered to the committee. Therefore, UNOPS and IDSP have and will further inform communities of their expected obligations and contributions during consultations and training.

The DMC has not yet organized itself to commence the execution of dam monitoring activities. The few members who have been active have been informing the community about the dangers of cultivating close to the dam. The committee is yet to set rules, which will be communicated to the users. These should include tree and vegetation conservation rules around the dam (the agricultural activities around the dam have contributed to tree cutting - which may have a negative effect on quality of water in the dam). The dam has no security measures in place and the DMC should be encouraged to establish rules and regulations when monitoring activities at the dam.

Upon completion of the remedial works, there will be a hand-over of the management, operation and maintenance of the dam to the Kanyika DMC. In order to successfully operate the dam, and limit impacts on people and environment, the DMC members require further capacity building and training. Training will include issues such as dam safety management/ structural deterioration; gender equality; health and safety issues, erosion control and conservation (see training plan below).

MoA has representatives at the dam site who will continuously monitor the remedial works and report to IDSP.

4. Environment and Social Baseline Conditions

4.1. Physical Conditions

4.1.1. Geology

Kasempa District has a sedimentary geology dominated by consolidated shale-silt-sandstone. This geological unit covers about 75 % of the district especially in the northern and eastern areas. Other significant geological formations include undifferentiated upper karoo; alluvium, colluvium and laterite; fossil seif dunes; and some granitic outcrops (figure 2 below).

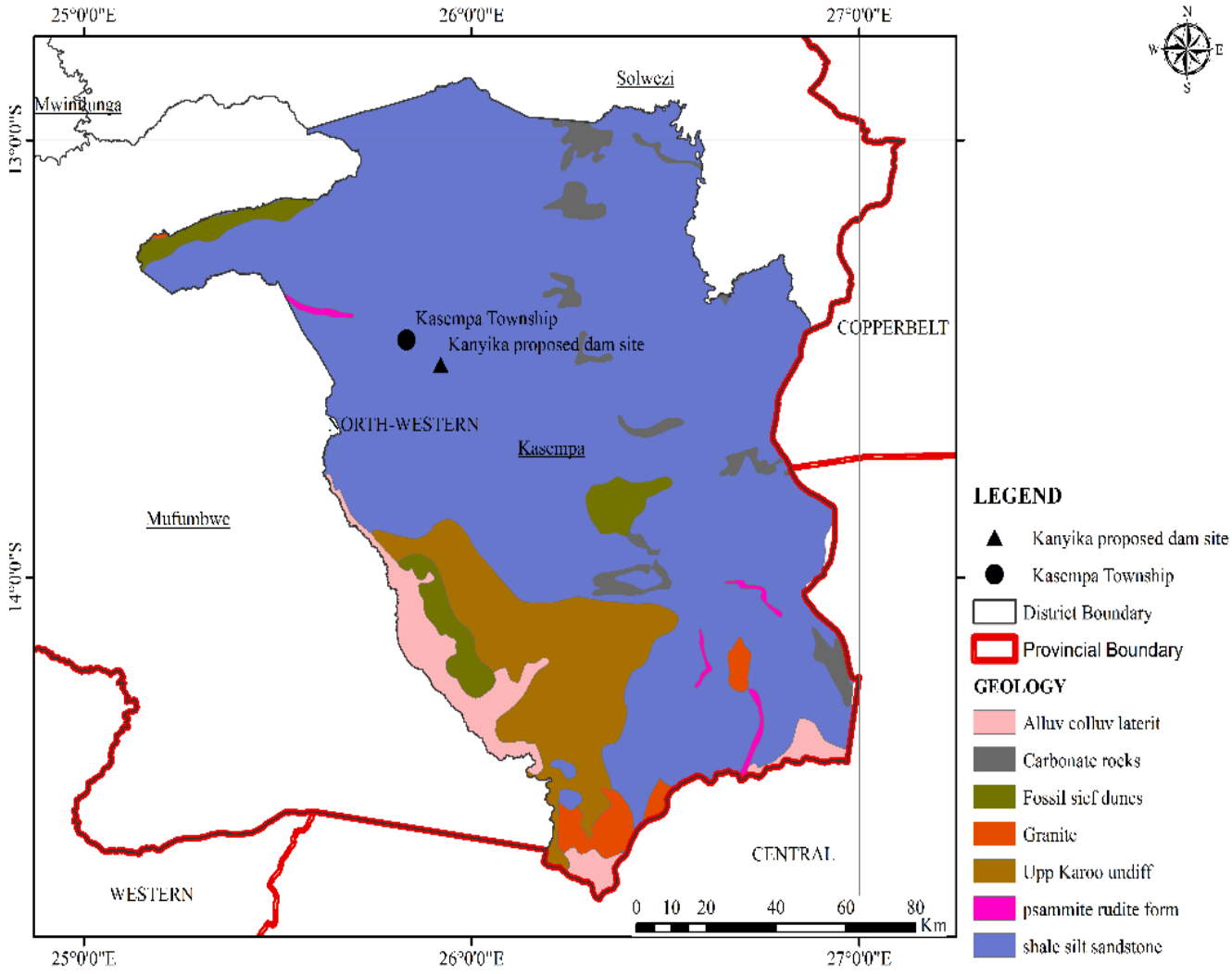


Figure 2 Geology of Kasempa District and around Kanyika Dam

4.1.2. Topography

The topography of Kasempa District can be described as a hilly plateau incised by numerous river valleys. The highest elevations occur in the central northern areas at about 1,685 mamsl, whereas the lowest elevations of around 1,021 mamsl occur mostly in the southern central areas.

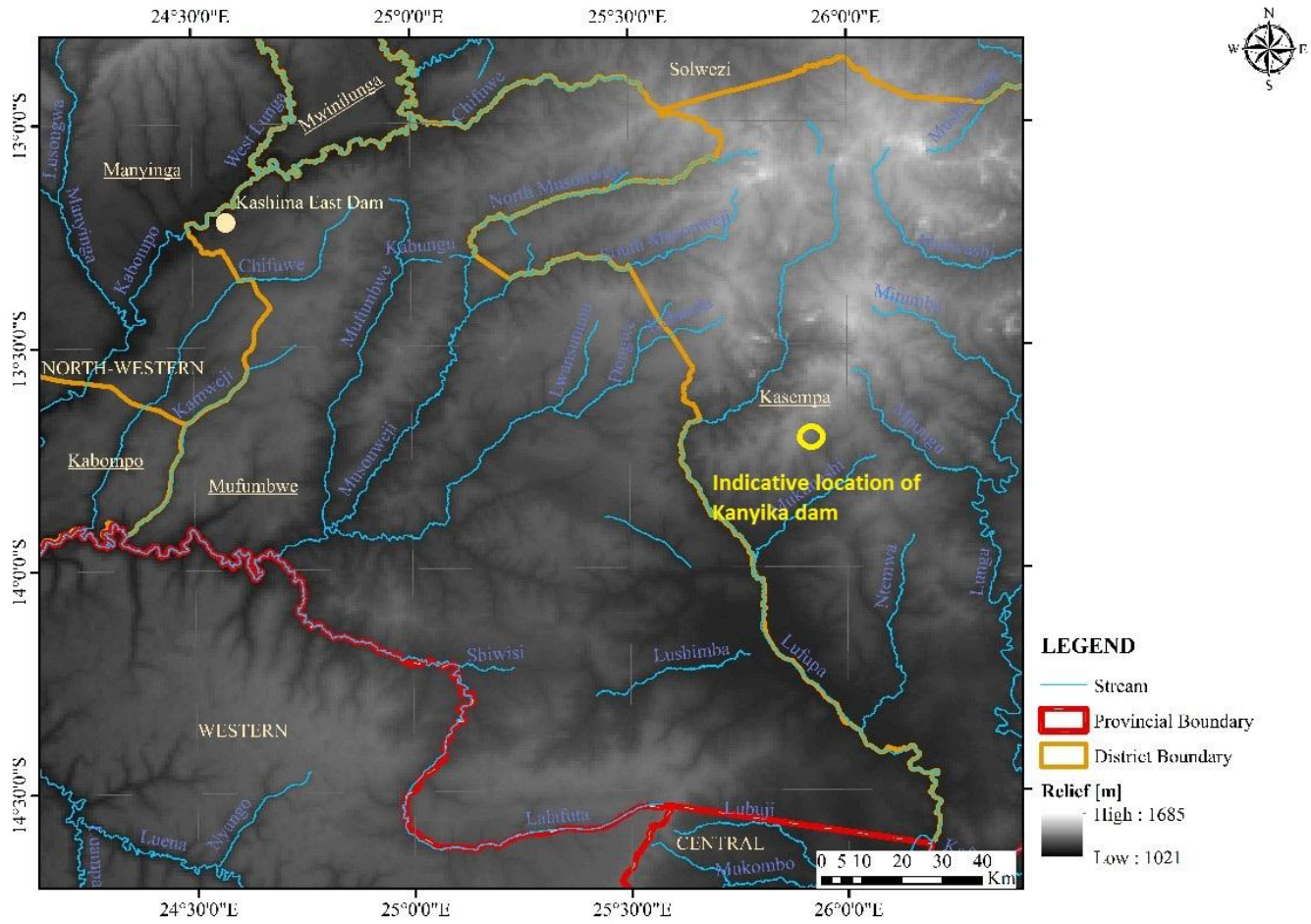


Figure 3 Map showing topography of project area and the surface drainage

4.1.3. Surface Hydrology

The North-Western Province is located on the Central African Plateau at an elevation of approximately 1,300m above sea level. It has an area of approximately 125,826 km^2. Kasempa is located on 13^o 27′ 18″S, 25^o 50′ 06″ E within the Lufupa River drainage pattern (see figure above). The Province's surface water is drained by the dendritic pattern of the Kabompo River and its tributaries into the Zambezi River. The gently undulating topography of the Zambian North-Western Province has elevations from 1250 to 1400 m. The Kanyika Dam is located on the Kanyika perennial stream, which drains into the Nkenyauna River. Nkenyauna River flows into Lufupa River, which is a tributary of the Kafue River.

The next map shows probable flood areas downstream of the Kanyika Dam.

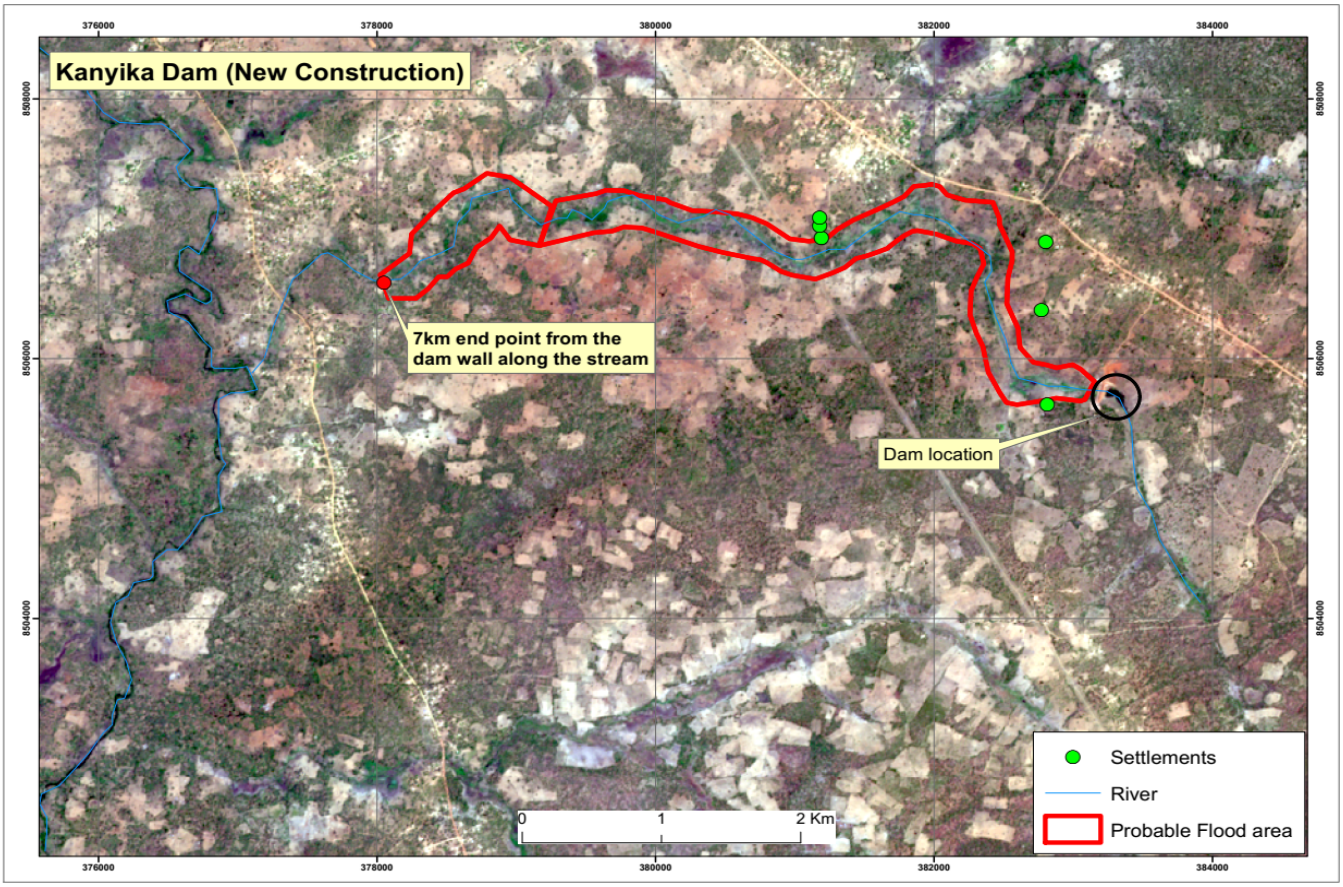


Figure 4 Kanyika Dam flood area

The land slopes in the north western direction, where the local community grows vegetables, such as cabbage and grape. It is suspected that the downstream area of the dam is a wetland with pockets of small springs from the ground water. It therefore remains a wet area throughout the year, even when the dam itself is not overflowing. The community members in the area indicated that three months into dry season, there is no overflow to the downstream areas of the dam, specifically beyond the month of June - until the next rainy season. The community accesses water mostly from the wetlands in dry the season and uses buckets to water their vegetable gardens. The total catchment area is 6km^2. The catchment area is shown below, the figure also indicates the dam elevations.

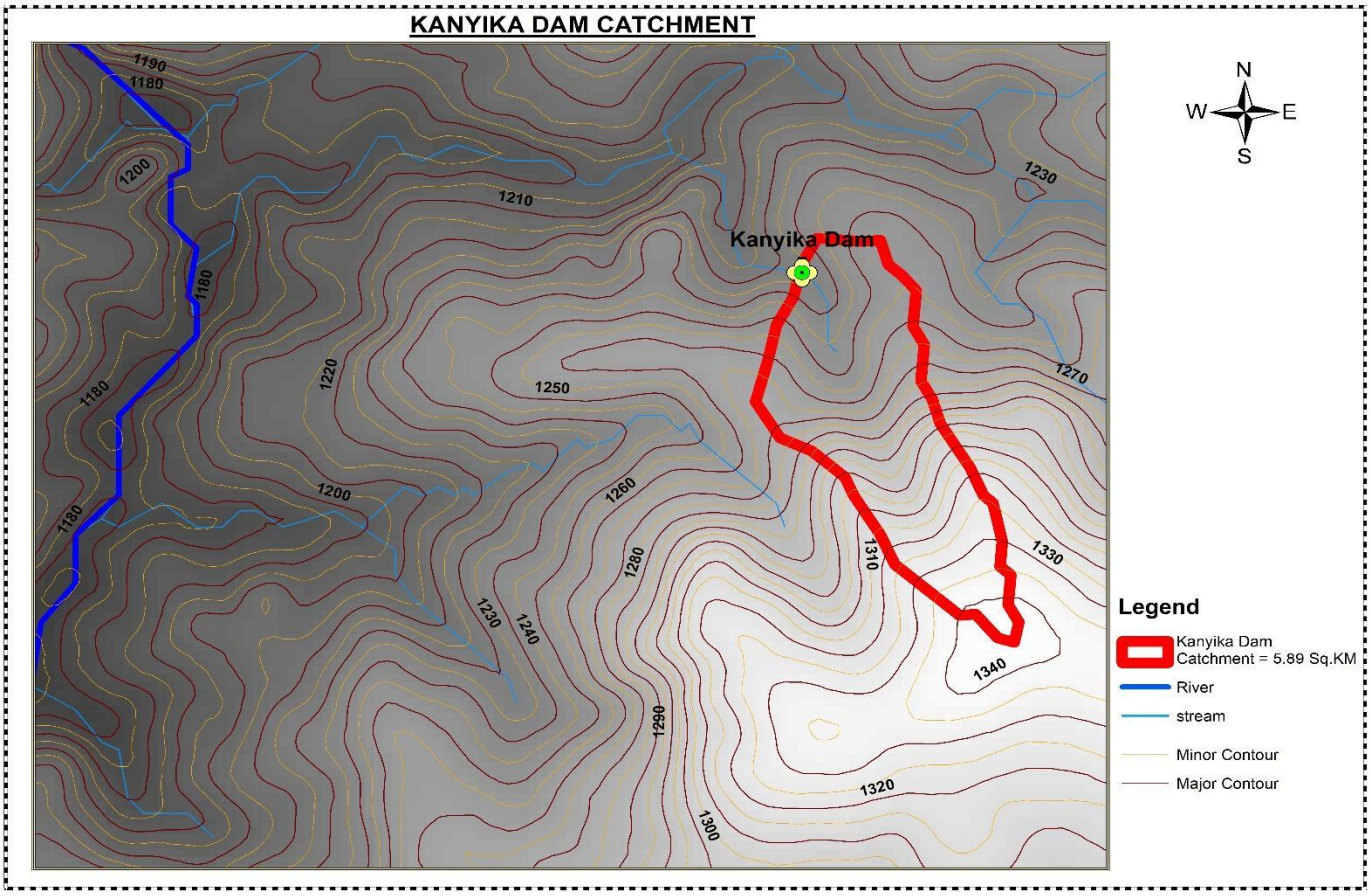


Figure 5 Kanyika Dam catchment area.

4.1.4. Surface Water Quality

Kasempa District is largely rural and serviced by pit latrines, boreholes, streams and willow well water supply. The urban and peri-urban population (less than 6% of the total population of the district), is serviced by the North Western Water Supply & Sewerage Company (NWWSC) of Kasempa District. Many village settlements, however, are located near streams where there is easy access to water. Villages largely depend on water from willow wells, streams and rivers in the area. This water is used for drinking and other domestic uses, such as cooking, washing, bathing and watering of gardens along the riverbanks. Despite the abundance of water, accessibility to safe water still remains a challenge. A number of houses have pit latrines and bathing shelters that are constructed of local materials with a thatch. Use of open bush is common in villages without pit latrines.

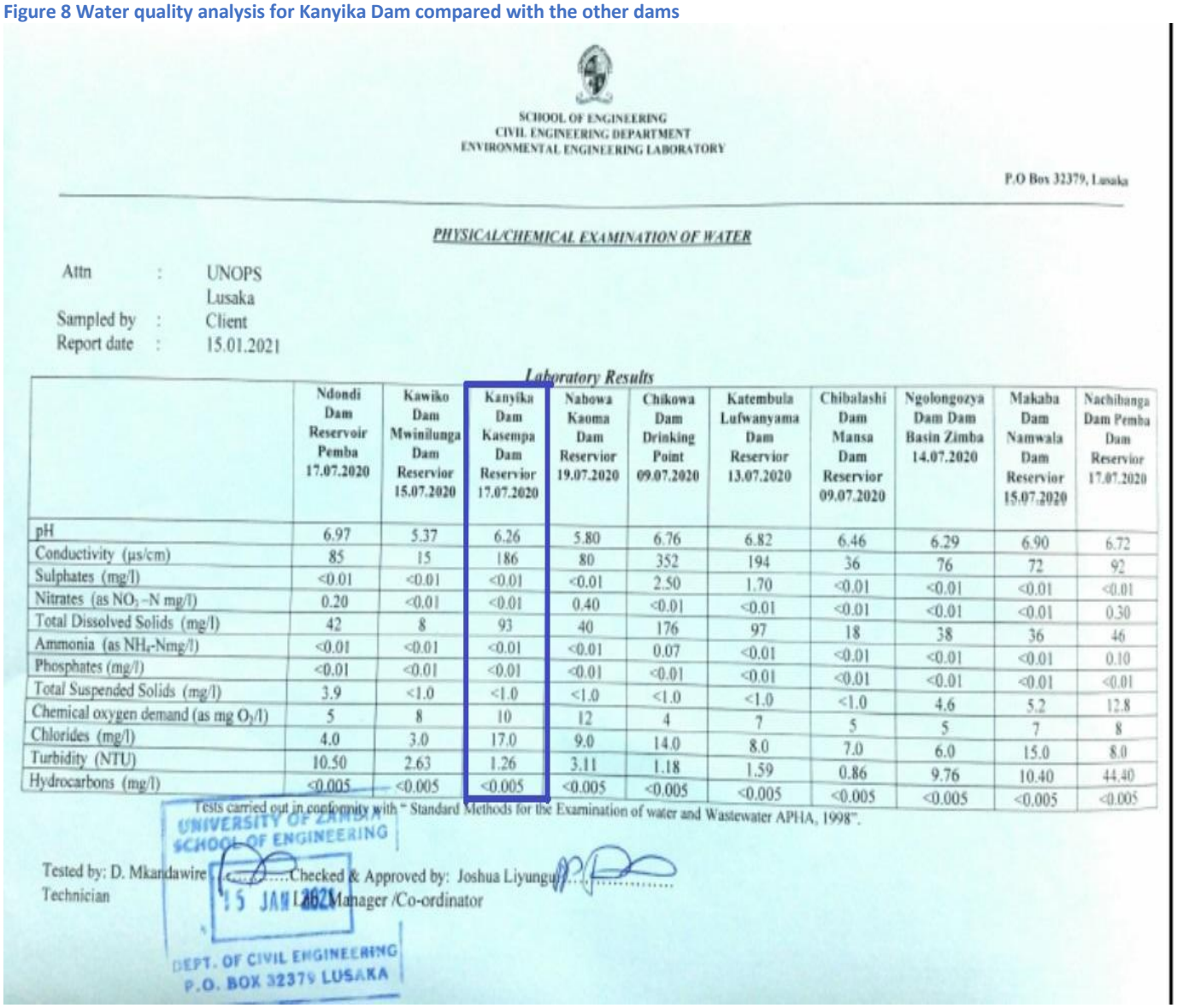
To assess the quality of water in the dam, water samples were collected at the eastern end of the dam at coordinates 13°30'50.80"S; 25°55'18.25"E and analyzed at the University of Zambia. There are subsistence farming activities (growing of maize upstream in the east and south of the dam), which have the potential to increase the total suspended solids in water.

Figure 6 Reservoir water (Kanyika Dam)

Figure 7 Farming activities upstream of the dam

Table 3 show the results of the 2020 water quality sample taken in Kanyika Dam, compared with other dams of the project. None of the water quality parameters exceeded the WHO guidelines' maximum permissible level for drinking water limit. A comparison to the water quality results obtained in 2016 (shown below) shows that the basin water's quality has been good for many years. Care should be taken, however, to ensure that trees are preserved in the area to avoid the transfer of sediment from the extensively deforested and cultivated upstream catchment. The levels of phosphates, sulphates and Chemical Oxygen Demand are within the statutory limit, which implies that generally the water quality in the reservoir is currently within the regulatory framework.

Figure 8 Water quality analysis for Kanyika Dam compared with the other dams



SCHOOL OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
ENVIRONMENTAL ENGINEERING LABORATORY

P.O Box 32379, Lusaka

PHYSICAL/CHEMICAL EXAMINATION OF WATER

Attn : UNOPS
Lusaka
Sampled by : Client
Report date : 15.01.2021

Laboratory Results

	Ndondi Dam Reservoir Pemba 17.07.2020	Kawiko Dam Mwinilunga Dam Reservior 15.07.2020	Kanyika Dam Kasempa Dam Reservior 17.07.2020	Nabowa Kaoma Dam Reservior 19.07.2020	Chikowa Dam Drinking Point 09.07.2020	Katembula Lufwanyama Dam Reservior 13.07.2020	Chibalashi Dam Mansa Dam Reservior 09.07.2020	Ngolongozya Dam Dam Basin Zimba 14.07.2020	Makaba Dam Namwala Dam Reservior 15.07.2020	Nachibanga Dam Pemba Dam Reservior 17.07.2020
pH	6.97	5.37	6.26	5.80	6.76	6.82	6.46	6.29	6.90	6.72
Conductivity (µs/cm)	85	15	186	80	352	194	36	76	72	92
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01	2.50	1.70	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3-N mg/l)	0.20	<0.01	<0.01	0.40	<0.01	<0.01	<0.01	<0.01	<0.01	0.30
Total Dissolved Solids (mg/l)	42	8	93	40	176	97	18	38	36	46
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	0.10
Phosphates (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids (mg/l)	3.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	4.6	5.2	12.8
Chemical oxygen demand (as mg O_2/l)	5	8	10	12	4	7	5	5	7	8
Chlorides (mg/l)	4.0	3.0	17.0	9.0	14.0	8.0	7.0	6.0	15.0	8.0
Turbidity (NTU)	10.50	2.63	1.26	3.11	1.18	1.59	0.86	9.76	10.40	44.40
Hydrocarbons (mg/l)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Tests carried out in conformity with " Standard Methods for the Examination of water and Wastewater APHA, 1998".

UNIVERSITY OF ZAMBIA
SCHOOL OF ENGINEERING
15 JAN 2021
DEPT. OF CIVIL ENGINEERING
P.O. BOX 32379 LUSAKA

Tested by: D. Mkandawire ..... Checked & Approved by: Joshua Liyungu .....
Technician Laboratory Manager /Co-ordinator

Table 3 Table showing results extracted from the table above for Kanyika Dam.

Element	Kanyika Dam	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard[34]
pH	6.26	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	186	1500	
Sulphates (mg/l)	< 0.01	250	
Nitrates (as NO_3-N mg/l)	< 0.01	500	

[3] The World Bank, Water Resources and Environment. Technical Note D1, Water Quality Assessment and Protection, 2003, p. 32, accessed at: http://documents1.worldbank.org/curated/en/514141468768597679/pdf/multi0page.pdf.

[4] The World Bank, General Environmental Guidelines, Pollution Prevention and Abatement Handbook, 1998, p. 438; accessed at: https://www.ifc.org/wps/wcm/connect/77a4c571-c743-48a8-9c6d-21d6ce77d017/genenv_PPAH.pdf?MOD=AJPERES&CVID=jqeDiLg.

Total Dissolved Solids (mg/l)	93.00	1000	
Ammonia (as NH4-Nmg/l)	< 0.01	1.5	10
Phosphates (mg/l)	< 0.01	-	
Total Suspended Solids (mg/l)	< 1.0	-	50
Chemical Oxygen Demand (as mg O2/l	10.00	-	250
Chlorides (mg/l)	17.00	250	
Turbidity (NTU)	1.26	5	
Hydrocarbons (mg/l)	< 0.005	-	10

Table 4 Water quality results for Kanyika Dam, Sampled 29th March 2016

Parameter	Unit	Value	WHO Guidelines for Drinking water
Conductivity	µS/cm	475	N/A
pH	-	7.49	6.5 - 8.0 (No health based guideline)
Temperature	°C	26.7	No guideline
TDS	mg/l	237	600 (No health based guideline)
TSS	mg/L	206	
Turbidity	NTU	< 1	0.1 (No health based guideline)
D.O	mg/L	7.2	No health based guideline
Ca^{2+}	mg/l	37.6	100 - 300 combined Ca^{2+}& Mg^{2+} hardness threshold. No health based threshold
Alkalinity	mg/L	56.1	-
HCO_3^{-1}	mg/L	68.4	
Cl^-	mg/L	48	300 (No health based guideline)
Fe	mg/L	0.626	0.3
$N\text{-}NO_3$	mg/L	-	50 (short term exposure)
$P\text{-}PO_4$	mg/L	-	No health based guidelines
Mg^{2+}	mg/L	18.96	100 - 300 combined Ca^{2+}& Mg^{2+} hardness threshold. No health based threshold
SO_4	mg/L	47.5	250 (No health based guideline)
Na	mg/L	32.99	50
K	mg/L	10.5	No health based threshold

4.1.5. Seismology

Earthquakes can result in damage to and failure of man-made structures, such as dams. When constructed in areas of high seismicity, dams may pose a significant risk to downstream life and property. Seismic waves may cause deformation of dam embankments, a loss of foundation strength and instability of the dam.

For Zambia, previously conducted studies on seismic hazard assessments estimate the Peak Ground Acceleration (PGA - which is the maximum ground acceleration during an earthquake shaking at a location), between 0.3 to 0.9g[5] (equal to magnitudes 2.943 to 8.829m/s^2). This poses a very low risk. Only three major occurrences have been recorded in Southern Zambia between 1910 and 2016. Two of them took place around Lake Kariba and one in Southern Province (Table 5).

[5] g= Gram force 1g=9.81m/s^2

Table 5 Major earthquakes in Zambia (Zambian Seismic Network Country Report, 2017)

DATE	TIME	LAT	LONG	MAGNITUDE	REGION
13/12/1910	11:34	8	31	7.1	South Of Tanganyika
13/12/1942	13:40	11.4	34.5	6.7	Western
25/09/1963	07:03	16.73	28.4	6.4	Lake kariba
18/07/1986	15:07	16.36	28.48	5.4	Lake kariba
10/05/1991	01:12	17.35	24.98	4.8	sw of Mulobezi
13/02/2010	16:00	13.4	30.84	5.3	Serenje
18/01/2011	16:31	8.6	31.74	5.7	Mbala
21/07/2011	15:55	15.96	25.98	5.2	Itezhi-tezhi
02/10/2013	14:23	13.4	31.8	4.5	West of Chipata
3/11/2014	18:25	10.97	29.69	5.3	Lubwe, Luapula
19/08/2015	00:15	9.66	28.61	5.1	Luapula Province
09/01/2016	03:05	16.046	28.55	4.6	Lusaka & southern Provinces

According to the Seismic Hazard Map of Africa[6] there is a 10% probability of a peak ground acceleration of between 0.4 and 0.8 m/s2 being exceeded every 50 years.

The study[7] highlighted seismic hazard in Zambia. Zambia lies in the interior of the African plate , which is considered relatively aseismic. However, the presence of the East Africa Rift System, with its various sectors, influences seismic activity in the region. It is evident from the study that there is sufficient level of earthquake activity to warrant consideration of earthquake effects in the design of structures in Zambia. Even with the limited history of earthquake event documentation, there are a number of events that should compel engineers to consider seismic loading in the design of structures. According to EN 1998-1, the design seismic action is generally expressed in terms of the seismic action associated with a 10% probability of excedance in 50 years or a reference return period of 475 years. The existing records of only around 100 years in Zambia cannot be relied upon to dismiss the occurrence of destructive earthquakes anywhere within Zambia.

In the North-Western Province of Zambia, seismic events of magnitude 4.9 on the Richter Scale have been recorded in the Province[8]. Therefore, the sub- project area is considered to be in an area of low to medium seismic activity. It may be recommended that seismic hazard be given due consideration in the design of structures in Zambia, especially in regions which the study has identified as high earthquake risk regions, such as the Upper region of Luapula Province, which has rift valley influence. However, consideration can also be extended to other parts of Zambia, including the project area in Kasempa. The study particularly recommends that all lifeline and critical

[6] G. Grünthal, C. Bosse, Seismic Hazard Map of Africa, Geoforschungszentrum, 1999, Potsdam, Germany.

[7] Factoring Seismic Hazard in Structural Design of Infrastructure in Zambia, 2020

[8] Turyamurugyendo - Seismic Hazard Assessment in Eastern and Southern Africa, 1996

installations and infrastructure, such as hospitals, bridges, dams and electrical power plants should be designed and built to withstand significant levels of seismic action.

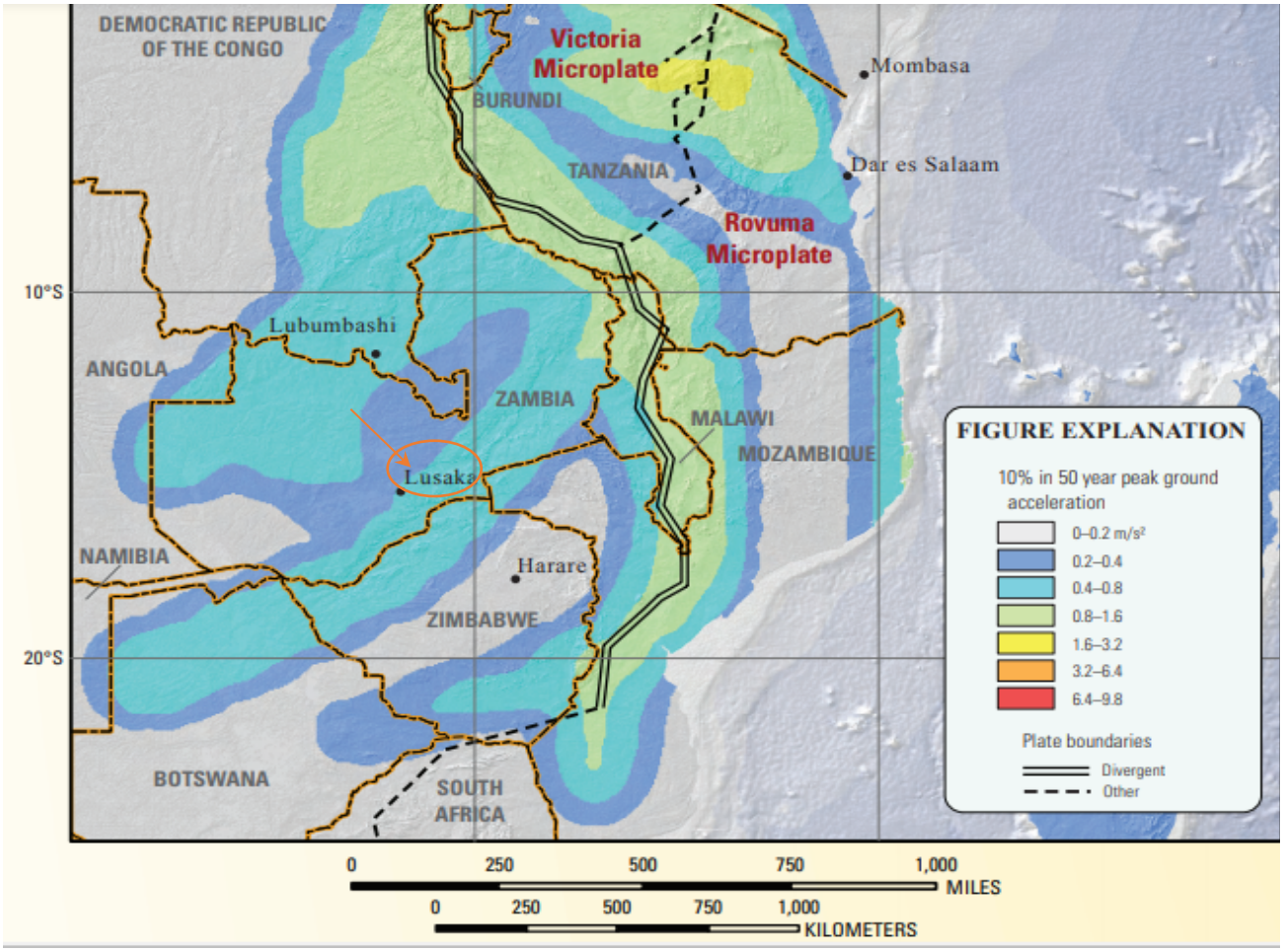


Figure 9 Seismic Hazard, US Geological Survey 2013

4.1.6. Climate and Climate Change

Climate: The project area has a tropical climate with three distinct seasons: a) the warm-wet season, stretching from November to April with mean temperatures of 26°C; b) cold dry season from May to August with mean temperatures varying between 14°C and 24°C; and c) the hot dry season, experienced during the months of September and October with mean temperature of 32°C. The temperatures are at their lowest in June and July, averaging between 5°C and 8°C degrees, and they show a fairly rapid rise into October. They continue to rise until December and January, when they are maintained at about 17°C degrees until the end of the rains.

Rainfall Pattern: The district is characterized by high rainfall and a relatively high-water table, ranging from 10–30 m depending on the time of the year. Rainfall averages 1,000 to 1,100 millimeters annually, although in the past seven years the rainfall has been below average, between 850 and 1,000 millimeters annually.

Temperatures: Temperatures range between the extremes of 5 and 33 degrees Celsius. May, June and July are normally the coldest months; September, October and November are the hottest months.

Climate Change: According to the World Bank[9], Zambia's climate is highly variable and over the last few decades has experienced a series of climatic extremes, e.g. droughts, seasonal floods and flash floods, extreme temperatures and dry spells, many of these with increased frequency, intensity and magnitude. Their impacts on the country are evident in climate-induced changes to physical and biological systems, which increasingly exert considerable stress on the country's vulnerable sectors. Climate change has been having adverse impacts on food and water security, water quality, energy and the sustainable livelihoods of rural communities. Coupled with poverty they also limit economic development.

According to a UNDP study[10], 2008, climate change is set to increase food insecurity in agro-ecological zones I and II in Zambia. Agro-ecological zone I, which stretches along the southern border, has the least rainfall. Within these regions, since the late 1980s, there has been a tendency for the later onset and earlier withdrawal of rains, as well as more frequent droughts. In the last seven years of this decade, Zambia has had droughts in the rainy seasons of 2000/01, 2001/02 and 2004/5. Floods are becoming more widespread too: over half of Zambia's districts were affected in the last few years – 2005/6, 2006/7 and 2007/8 - some for the first time. With very little infrastructure for water collection, Zambia is overwhelmingly dependent on rainfall. Water needs are met through boreholes and wells where available, or through rivers.

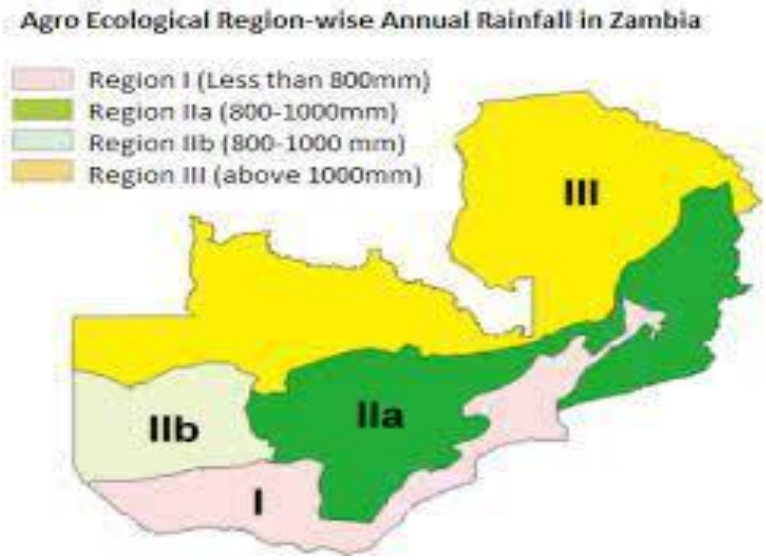


Figure 10 Ecological zones in Zambia

The Kanyika Dam may become an important adaptation infrastructure for the near and far communities' water storage and use in a time when climate change is experienced. Climate change projections point to an increase in temperature and a change in patterns of rainfall, leading to prolonged droughts and localized flooding. Zone III has rainfall patterns exceeding 1000mm, which implies that the area can be suitable for agriculture land. The area is characterized by high rainfall and a relatively high-water table. Like in many districts of Zone 3, the water table ranges from 10 – 30m, depending on the time of the year.

Climate change is super-imposed on unsustainable land-use practices, such as forest clearing for agriculture and charcoal production, and combined with poor livestock management systems has caused severe land degradation. The practices affect the dam sustainability. The communities in North-Western Province depend mostly on goats and growing of farm produce, such as maize cabbage and other types of crops at small scale. Cultivation in the upstream of the dam opens up the area which then becomes vulnerable to erosion and eventually may cause siltation of the dam in the long run. The local community is growing maize, tomatoes and various types of vegetable in the upstream of the dam.

[9] World Bank Climate Change Knowledge Portal, Country: Zambia, accessed at: https://climateknowledgeportal.worldbank.org/country/zambia

[10] UNDP Climate Change Adaptation, Adaptation to the Effects of Drought and Climate Change, accessed at: https://www.adaptation-undp.org/projects/ldcf-drought-zambia

Climate projections for Zambia[11] are shown in the figures below. The World Bank has used the Coupled Model Inter Comparison Project, Phase 5 (CMIP5) models, included in the IPCC's Fifth Assessment Report (AR5). Key projected climate trends are summarized below:

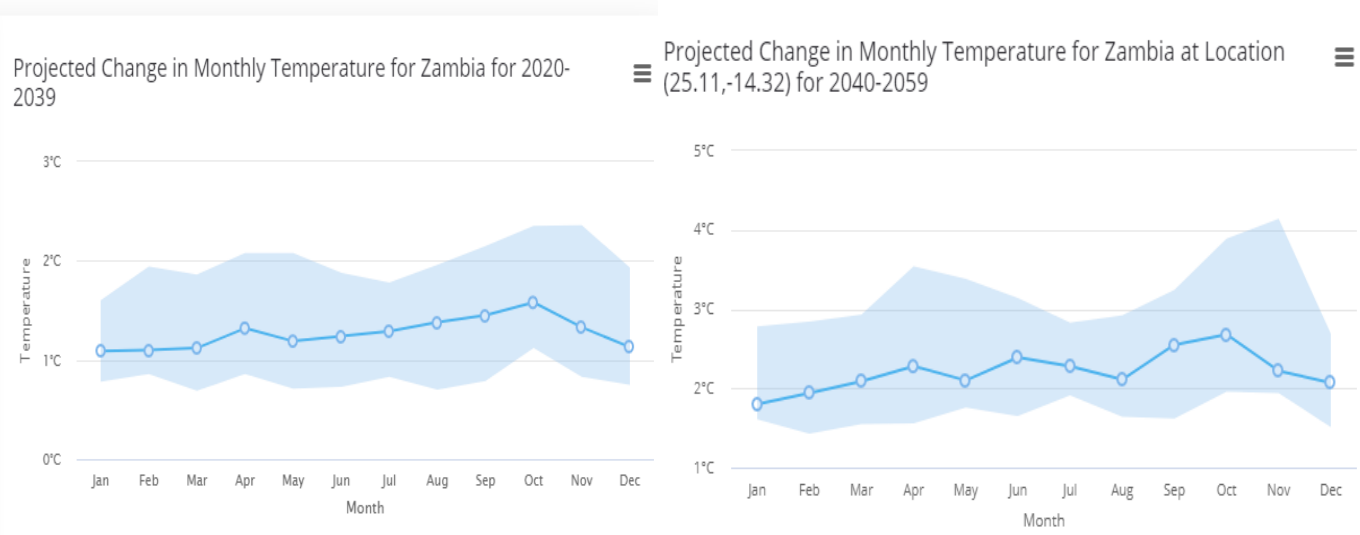
Temperature

- Mean annual temperature is projected to increase by 1.2-3.4°C by 2060.
- Hot days are projected to increase by 15-29%. Hot nights are projected to increase by 26-54%.

Precipitation

- Projections of mean rainfall do not indicate large changes in annual rainfall. Seasonally, the range of projections from different models is large, but indicates decreases in September-November and increases in December-February rainfall respectively.
- The proportion of rainfall from heavy events is expected to increase.

Continued changes in climate may mean continuous impacts on biological, social and physical environments around the dam.



[11] World Bank Climate Change Knowledge Portal, Country: Zambia, accessed at: https://climateknowledgeportal.worldbank.org/country/zambia

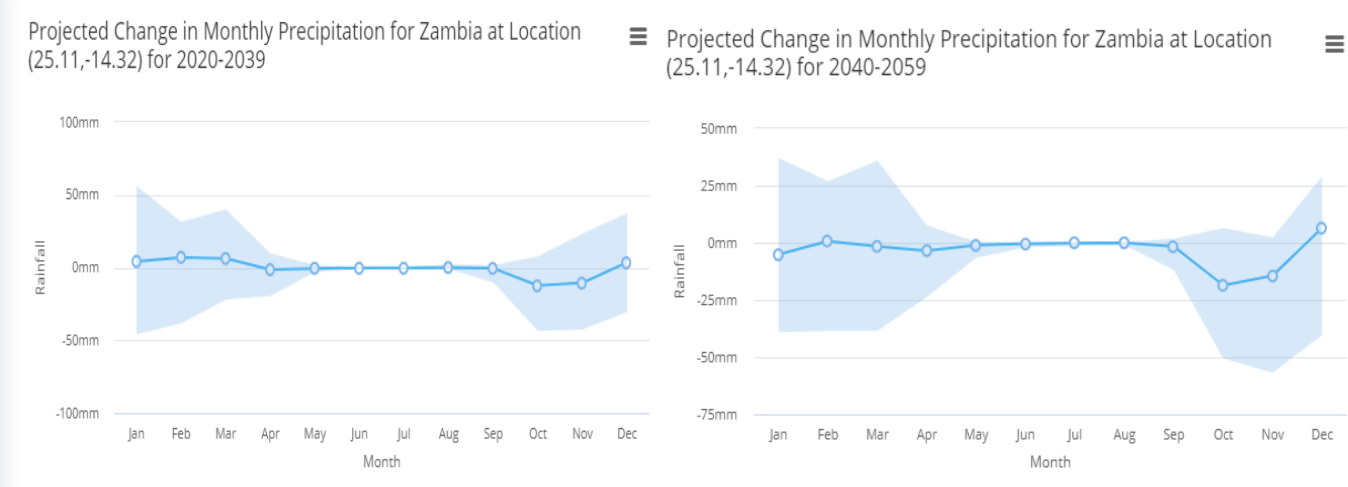


Figure 11 Projected changes in monthly temperatures for Zambia 2020-2059

4.1.7. Land Use

Much of the catchment area of the dam has undergone human influence due to maize and dambo vegetable production. Cultivation and other activities take place in all transects, from the aquatic to the upper transect. This practice was more prominent in the downstream part of the Kanyika Dam. Generally, the availability of large tracts of fertile red clay soils and good rainfall patterns have been the main drivers of farming activities in Kasempa. The areas close to the drainage are covered with rich soils and therefore more suitable for farming and as a result the perennial availability of water and the relatively fertile soil makes the riverine zone a valuable natural resource[12].

The infrastructure does not, however, allow water to flow downstream during the dry season. The communities in the area rely on spring water from around the dam to water their gardens. In the wet season, the infrastructure allows too much water downstream, to the extent that garden crops are affected. The picture below shows the community growing vegetables for sale in the dry season. The wetland has some groundwater sources, such as springs, from which water is channeled through some man made canals to water gardens. Communities use buckets as well, as seen in the picture.

Figure 12 Vegetables grown downstream in dry season.

[12] https://pure.uva.nl/ws/files/1687602/176905_Fifty_years_Kasempa_District.pdf

The area that has not been disturbed in terms of land cover is the one surrounding the graveyard on the left fringe of the dam. The graveyard is about 50metres from the centre of the Kanyika stream.

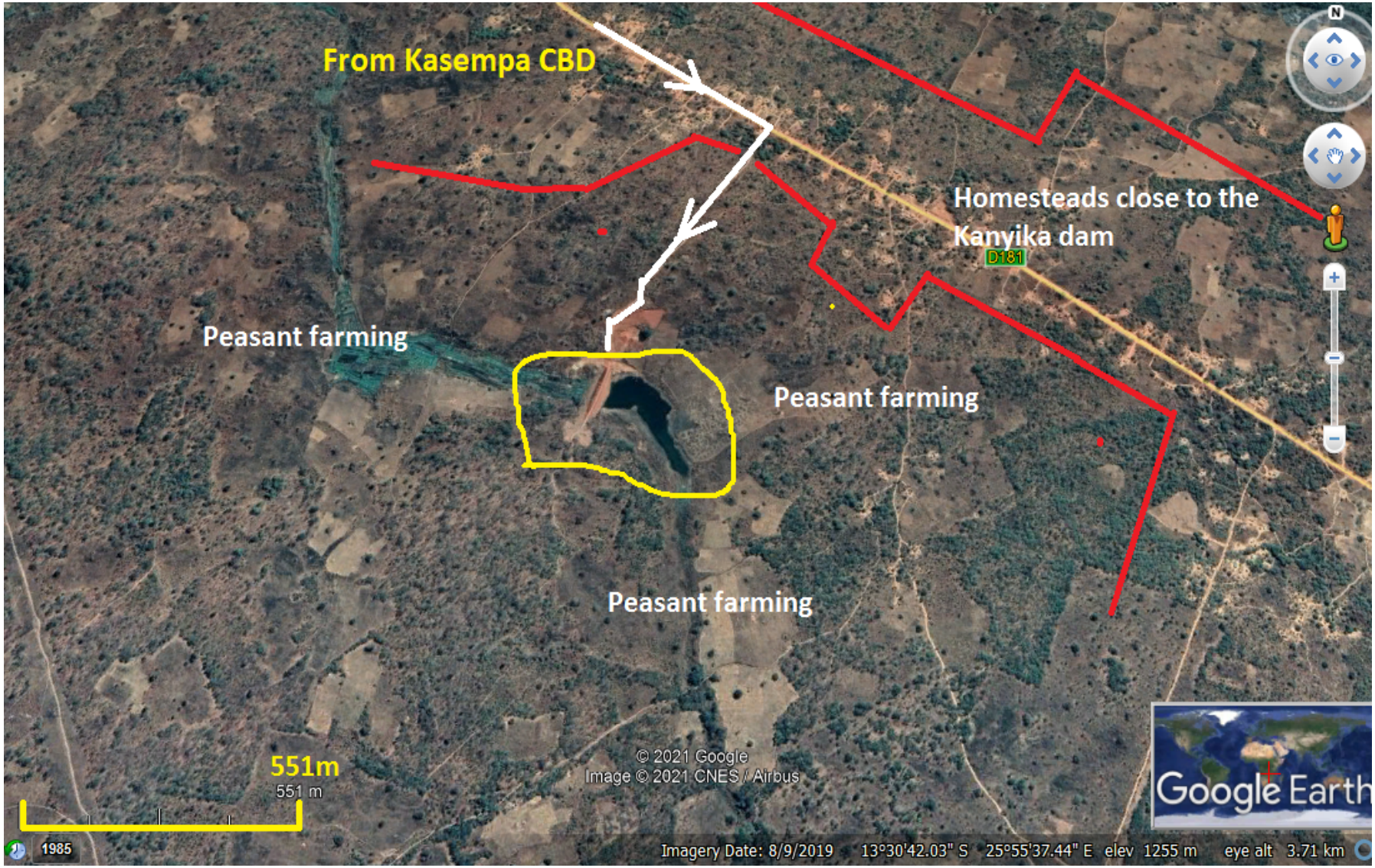


Figure 13 Google map showing location of the Kanyika Dam and surrounding subsistence farming activities

4.2. Biological Conditions

Traditionally, the people of North-Western Province have been hunters of wildlife. Furthermore, in the areas where they have settled, they have practiced charcoal burning. Coupled with subsistence farming activities, the human settlements have scanty vegetation with barely any wild animals, except those animals that would stray into the settlements from game management areas. The biodiversity assessment report annexed to this ESMP provides a more detailed review of the current ecosystem at Kanyika Dam.

4.2.1. Habitats

The area around Kanyika Dam is situated in modified habitats that have been significantly transformed by cultivation and bush clearing for charcoal and firewood. Under normal circumstances, Kasempa lies in the eco region of the Central Zambezian miombo woodlands, with Brachystegia and Julbernardia species as predominant trees. Around the dam, vegetation occurs in an agricultural mosaic - approximately 70 per cent of the vegetation cover has been cleared in the recent past for subsistence farming, extending from the town of Kasempa. Along the Kanyika River, farmers cultivate the entire area including the dambo (wetland) areas down to the stream edge, with the most noticeable effect downstream of the dam, although the upper reaches of the river have also been affected.

Figure 14 Google map showing vegetation around the dam

Dividing the area into zones, the following is evident:

- Part 1-Upstream of the dam basin; habitats consist of highly disturbed forest habitat, extensively modified by maize fields. Most of the woodland has been lost to cultivation. Habitat integrity is low and the area is a potential source of sediment in the basin.

- Part 2-In the dam basin area; depleted Miombo woodland in the dam and grass cover seems to be typical for the disturbed habitats in the area, which were affected by the dam construction. Overall habitat integrity in the dam has regenerated over time to form part of the aquatic ecosystem.

- Part 3-Downstream of the dam basin, most of the vegetation cover has been cleared for vegetable gardens downstream, an area which seems to be a wetland with continuous supply of ground water even when there is no downstream flow from the dam, especially in the dry season.

Some of the vulnerable tree species identified in the DWA EPB (2016) and the COWI ESMP (2018c) include Mubanga *(Pericopsis angolensis)* and Mukwa/Mulombwa *(Pterocarpus angolensis).* These trees are heavily exploited for timber and most of the large tree specimens have been lost. The most common larger trees left in the dam area are *Acacia* species.

4.2.2. Protected Areas

A third of Kasempa District's land area is covered by the Kafue National Park and two game management areas, i.e. Kasonso Busanga and Lunga–Luswishi. The nearest protected forest area to the dam is the Kamona Forest Reserve, 8 km north of the dam and north-east of Kasempa town. It has an area of roughly 221 km^2, and is well conserved in some parts. However, there is evidence on the satellite imagery of habitat impact due to rural settlement and cultivation, expanding from Kasempa.

4.2.3. Terrestrial Fauna

The area around the dam has been disturbed by human activities, such as growing of vegetables and maize, and therefore has reduced important habitats for various animals. Additionally, the local community – known for their hunting– has depleted the wildlife and no animals can be seen around the dam or project area unless those that stray from the Lunga National Park - exposing themselves as easy prey to humans. Local communities reported to have spotted most of the animals presented in the table below.

Table 6 Animal species spotted in the Kanyika dam environment

No	Scientific name	Common name
1.	Xerus inauris	Bush Squirrel
2.	Paraxerus Cepapi	Tree Squirrel
3.	Sylvicapra Grimmia	Common duiker
4.	Lepus saxatilis	Scrub hare
5.	Thryonomys swinderianus	Greater Cane Rat
6.	Aepyceros melampus	Impala
7.	Proteles cristatus	Aardvark
8.	Cercopithecus aethiops	Vervet Monkey
9.	Ourebia ourebi	Oribi
10.	Redunca arundinum	Reedbuck
11.	Potamochoerus porcus	Bush Pig

12.	Rattus rattus	Black Rat

Many bird species inhabit the reservoir area and the riparian and wetland areas downstream of the dam. Most of these birds are found in the willow waters of the dam, embankment, river bank, on bare or poorly vegetated mud habitats, often at the water's edge. The trees along the dam and the remains of drowned trees in the dam also provide perches for birds, most of which are occasional visitors or are migratory. At the dam, more bird species likely to be present include those shown in the table below;

Table 7 Type of birds found in the project area

No.	Common Name1	Scientific Name
1.	Racket-tailed Roller	*Coracias spatulatus*
2.	Common Quail	*Cotumix Cotumix*
3.	Golden-tailed Woodpecker	*Campethera abingoni*
4.	African Pied Wagtail	*Motacilla aguimp*
5.	Spur-winged Goose	*Plectropterus gambensis*
6.	Bronze Sunbird	*Nectarinia kilimensis*
7.	White-necked Raven	*Corvus albicollis*
8.	African Reed Warbler	*Acrocephalus baeticatus*
9.	Common Snipe	*Gallinago gallinago*
10.	Greater Honey Guide	*Indicator indicator*
11.	African Grey Hornbill	*Tockus nasutus*
12.	Woodland Kingfisher	*Halcyon senegalensis*
13.	Red-colored Widowbird	*Euplectes ardens*
14.	Square-tailed Drongo	*Dicrurus ludwigii*
15.	Brown Falcon	*Falco berigora*
16.	African Marsh Harrier	*Circus ranivorus*
17.	Barn Swallow	*Hirundo rustica*
20	Pied Crow	*Corvus albus*
21	Laughing Dove	*Streptopelia senegalensis*
22	African Grass Owl	*Tyto capensis*
23	Bateleur Eagle	*Terathopius ecaudatus*
24	Black-eyed Bulbul	*Pycnonotus barbatus*
25	Streaky Seedeater	*Serinus striolatus*
26	White-fronted Bee-eater	*Merops bullockoides*
27	Helmetted Guineafowl	*Guttera pucherani*

Source Community Consultative meeting

Overall, the occurrence of terrestrial fauna around the dam has been heavily impacted by habitat loss, and by intensive hunting and (in the case of reptiles) persecution. The initial assessment indicated that it is unlikely that there are any threatened species in the project area. However, the use of the Integrated Biodiversity Assessment Tool (IBAT) shows 28 potentially occurring Red Data species - 8 mammal, 13 bird, 2 fish and 5 plants - within a 50 km radius of the dam site. Most of the terrestrial species are likely to be found in the protected areas, the game management areas and forest reserves. There are no Key Biodiversity Areas (KBAs) recorded within the 50 km buffer - Kafue National Park is outside of the buffer to the south. However, the detailed Biodiversity Assessment and the BMP (annexed to this ESMP) provide guidance on fauna classified for conservation.

Table 8 Red Data species (mammals) recorded in IBAT within a 50km radius of the Kanyika dam site

Species (common name)	Scientific name	IUCN Status
Mammals		
Black rhinoceros	*Diceros bicornis*	CR
African wild dog	*Lycaon pictus*	EN
Cheetah	*Acinonyx jubatus*	VU
Hippopotamus	*Hippopotamusamphibius*	VU
African elephant	*Loxodonta africana*	VU
Lion	*Panthera leo*	VU
Leopard	*Panthera pardus*	VU
Temminck's pangolin	*Smutsiatemminckii*	VU

Table 9 Red Data species (birds) recorded in IBAT within a 50km radius of the Kanyika dam site

Species (common name)	*Scientific name*	IUCN Status
White-backed vulture	*Gyps africanus*	CR
Hooded vulture	*Necrosyrtes monachus*	CR
White-headed vulture	*Trigonoceps occipitalis*	CR
Steppe eagle	*Aquila nipalensis*	EN
Madagascar pond-heron	*Ardeola idea*	EN
Grey crowned crane	*Balearica regulorum*	EN
Lappet-faced vulture	*Torgostracheliotos*	EN
Tawny eagle	*Aquila rapax*	VU
Southern ground-hornbill	*Bucorvus leadbeateri*	VU
Wattled crane	*Bugeranus carunculatus*	VU
Slaty egret	*Egretta vinaceigula*	VU
Martial eagle	*Polemaetus bellicosus*	VU
Secretarybird	*Sagittarius serpentarius*	VU

Table 10 Red Data species (plants) recorded in IBAT within a 50km radius of the Kanyika dam site

Scientific name	IUCN Status
Rotala robynsiana	CR
Xyris exigua	CR
Nymphoides tenuissima	EN
Rotala fontinalis	VU
Rotalasmithii	VU

4.2.4. Aquatic and Semi-Aquatic Fauna and Flora

A field manual of Zambian fishes and local key informant knowledge was used to identify the types of fish in the Kanyika stream. The types of fish reported[13] are presented in the table below. Some of these are only found in the waters during the rainy season and around dispersed pools during the dry season. Generally, there has been a reduction in the quantity of fish in water due to fishing and fluctuating water levels. The dam is planned to be restocked with some of these species during the operation phase.

Table 11 Names of fish species found in the Kanyika Dam

No.	*Scientific Name*

[13] COWI Report on Environmental & Social Remedial Measures, September 2018

1	*Pollymyrus castelnaui*
2	*Barbus lineomaculatus*
3	*Barbus barnardi*
4	*Barbus radiates Peters*
5	*Labeo altivelis Peters*
6	*Hydrocynus vittatus (abundant)*
7	*Clarias stappersii*
8	*Aethiomastacembelus frenatus*
9	*Pseudocrenilabrus philander*
10	*Serranochromis altus*
11	*Sargochromis mellandi*
12	*Tilapia rendalli*
13	*Oreochromis mortimeri*
14	*Tropheus moorii*
15	*Ctenopoma multispine*
16	*Microtenopoma intermedium*

With regard to the aquatic environment, IBAT lists two vulnerable cichlid species, *Oreochromis andersonii and Oreochromis macrochir,* which are both know from the Kafue drainage system. *Oreochromis mortimeri,* while not listed by IBAT is recorded by local communities (COWI, 2018) and is critically endangered. This is the case mainly due to the introduction of *O. niloticus,* which replaces it throughout its range, having been introduced by anglers and aquaculturalists. In addition, an endemic killifish, *Nothobranchius kafuensis,* is known from the seasonal and permanent streams of the area. The Biodiversity Assessment and BMP provide further guidance on the need for conservation of particular species.

Table 12 Red Data species (fish) recorded in IBAT within a 50km radius of the Kanyika dam site

Species (common name)	*Scientific name*	IUCN Status
Threespot tilapia	*Oreochromis andersonii*	VU
	Oreochromis macrochir	VU

4.2.5. Fishing Practices

The Kanyika reservoir has fish stocks, a source of food for the local community. The biodiversity assessment (see Annex J) has discussed the actual fish species present in the dam. Despite ongoing fishing activities by the community over the years, there are no accurate catch statistics available. The practice has been the catching of fish with mosquito nets in the willow ends of the dam. This practice has potential to cause a depletion of fish species. Fish usually breeds in willow waters and the use of a mosquito net implies catching all the fish in the willow ends - including the juveniles. This practice is not sustainable if the dam has to be utilized as source of fish for the local community.

4.2.6. Ecosystem Threats

Threats to the local aquatic resources include overfishing using mosquito nets and harvesting. Competition from introduced alien species is a significant threat to the natural fish populations, especially since *O. niloticus* is present in the catchment and is likely to impact negatively on all of the naturally occurring species. The dam poses an uncontrolled breeding environment for the *O. niloticus*.

The barrier created by the dam may impact on the upstream and downstream integrity of the river system, inhibiting the natural movement of species, restricting flows and causing negative changes in water quality and for the breeding of fish. The extensively farmed areas in the dam catchment, accompanied by the clearing of most of the natural forest

cover have the potential to enhance sediment loading into the dam and river. Details of the threats to the river system and the threatened aquatic fish species are discussed in the separate Biodiversity Assessment (Annex J).

4.3. Social Conditions

4.3.1. Social Conditions around the Dam

Kanyika Dam and its catchment are located in Kasempa District. Kasempa is serviced by a tarred road from Solwezi District. The tar road southwest from Solwezi reaches the junction at Mwelemu after about 28km, and proceeds in a more southerly direction towards Kasempa. After a further 85km, there is a road from Kalulushi, which joins the main road. 103km from Mwelemu, the Kabompo road heads west. At the 103km junction, the left turn is the road to Kasempa, which covers an additional distance of 43km. Total distance from Solwezi to Kasempa is 146km, while the distance from Lusaka to Solwezi is 586km.

Figure 15 Map showing route to Kasempa from Lusaka

The dam site is located about 12 km south of the Kasempa urban center along the Kasempa-Mumbwa road. It falls in the Kasempa constituency and is part of the Mutenda ward. The ward has a total population of 1,394 people (50.1% males and 49.9% females) with 851 households (COWI, 2018). The ward is one of the most highly populated wards in the constituency. The project area is in the Mufumbwe– Kasempa zone (3A), which is considered to be self-sufficient in food production. Although the area is populated by subsistence farmers engaged in agricultural activities, forest products like timber, honey and game are major sources of income. Horticultural activities are also major sources of income in the dry season. Cultivation of vegetables and at times field crops takes place along the banks of the streams, including Kanyika stream. Major crops grown include maize, sweet potatoes, groundnuts and various vegetables. Other sources of income include trading in agricultural products like field crops, vegetables and livestock, and forest products such as honey.

Mukinge mission is the main source of social services including a primary school, secondary school for girls and a nursing training school. In addition, the project area hosts an agricultural farm institute from where the farmers receive agricultural extension services.

Subsistence farmers make up most of the population. Only a few people are engaged in formal employment, mainly as teachers, agricultural or health workers and NGO staff. The administrative part of the district is characterized by commerce with small-scale and emergent farms in peri-urban areas. Cattle rearing is the most important economic activity, followed by crop production. Trust land and traditional land make up the two main forms of land tenure in the district. Most of the trust land is reserved forest area.

There are two schools that are close to the dam, Nkenyauna Secondary School (Day School) is located 2.5km north of the dam, and Kantenda Primary School lies south of the dam . The dam community access a health post close to the dam, which is called Kantenda Heath Post and is located next to Kantenda Primary School (and therefore about 2.5km south of the dam).

The former campsite location is a Kasempa Farmers Training Center, which is located about 1.5km north-east of the dam. There was one temporary movable/mobile office, which was placed near the borrow pit, north-east of the dam, but it has since been removed from site and vegetation regrew around the area. The only notable degradations are the borrow pit sites and the small access roads, which still remain unattended.

The access road to the dam about 600m west of the Kasempa – Mumbwa Road. While it is still usable, it may require some attention. The access to the other side of the dam from the downstream section will require an appropriate footbridge. During rainy season, the water runoff overtops the temporary bridge made out of logs, making access to the other side where the graveyard is located, impossible.

Figure 16 1st Picture showing footpath leading to temporary bridge and 2nd picture showing actual temporary bridge.

There is another pedestrian path, which is the principal crossing over the embankment. It may not be considered safe during the rainy season because it poses a slip and fall hazard to the community when accessing it during this period. The access route downstream (shown in the picture above) becomes the safest access point for the local community.

There is no water downstream except during the rainy season. However, the downstream environment where vegetable are grown seems to be a wetland as it contains water throughout the year. The local communities with vegetable gardens create channels where the “spring” water flows and they use buckets to water their gardens. In this respect, even when the dam does not spill water downstream, the community seems to have water from the wetlands for their subsistence farming.

Kanyika Dam is only 12km away from the Kasempa business center. There are also homesteads in about 1km radius from the dam where some boreholes have been sunk by World Vision. The local community accesses its drinking water from these boreholes and wells. The water from the wetland area downstream is solely used for irrigation of the vegetable fields. The washing and other domestic activities is done at people’s homes, which are 1km and more away from the dam.

The community uses pit latrines for sanitation. The previous contractor camped at the Kasempa Farmers Training Center, which still has some infrastructure to accommodate a new contractor. The Kasempa Farmers Training Center is equipped with a borehole already and has therefore easy access to portable water.

There are no waste dumps or pit latrines around the site. The community residing close to the dam (about 1km radius) buries and burns its waste at its respective households.

4.3.2. Administration of Water and Dam

A DMC is currently in place, consisting of 4 women and 6 men. However, the committee indicated that it requires further guidance and training in various issues. While the committee is active, it is still to finalize its constitution. Some unwritten regulations are already developed and implemented, and these rules concern fishing and vegetation conservation around the dam. The committee is not yet active in monitoring the site.

Strengthening and capacity building of the existing committee can ensure that communities can benefit fully from the irrigation water supply. Similarly, beneficiaries would benefit from increased training to improve their knowledge on irrigation agriculture and fishing.

4.3.3. Gender Equality, Gender-Based Violence and Sexual Exploitation and Abuse

In the Kanyika dam communities, respondents during the field visits claimed that women work as well. They are mostly engaged in cultivation and management of the farm produce. Men are mostly engaged in vegetable gardening and fishing.

Gender-Based Violence (GBV) and Sexual Exploitation & Abuse (SEA) exists among the dam communities, but it usually not reported, as reporting comes with significant social stigma. Generally, an estimate of 1 in 5 women in Zambia experience some form of sexual violence at some point in their lives.[14] In the Demographic and Health Survey of 2013-2014, 43% of women age 15-49 claimed to have experienced physical violence at least once since age 15; and 37% experienced physical violence within the 12 months prior to the survey. 47% of married women of the same age category report to have experienced physical, sexual and/ or emotional violence from their current or most recent husband or partner.[15] Alcohol and living in high-density areas have been identified as key issues contributing to higher rates of GBV.[16] Other factors contributing to GBV and SEA are sexual cleansing rituals, initiation ceremonies, women's economic dependence socialization of boys and girls, inadequate laws, lack of law enforcement, and intimate partner violence.[17] A baseline study conducted by Overseas Development Institute (ODI) in Zambia captured some key definitions of the types of GBV and SEA such as women being beaten (usually by their spouse), men engaging in forced sexual intercourse with young children, women being forced to have sex, mistreatment of children including through labor, forced early marriage, and women's rights being infringed.[18]

The same baseline mentioned as first address in GBV and SEA cases the Victim Support Unit in the Police service, although there seems to be doubt in their efficiency.[19] Key challenges for preventing and responding to GBV and SEA are that most cases go unreported, because survivors are reluctant to report them. On the supply side, infrastructure, shelters and transport, have critical gaps. In absence of shelters, the safety of survivors cannot be guaranteed. Prevention activities are still not sufficient to have a significant impact.

In April 2011, Zambia passed the Anti-Gender Based Violence Act no.1 of 2011. The Act offers a comprehensive framework for protection, the prosecution of perpetrators, and supports the means of survival for victims. It established

[14] Chidoori Rumbidzai Elisabeth, Putting Women First – Zambia's Anti Gender Based Violence Act from 2011, p. 1

[15] USAID, UNICEF, UNFPA, CDC, Zambia: Demographic and Health Survey 2013-2014, p. 273

[16] Z. Ngonga, Factors contributing to physical Gender Based Violence reported at Ndola Central Hospital, Ndola, Zambia: A case control study, In" Medical Journal of Zambia, Vol. 43.3., p. 145-151, 2016.

[17] ODI: Baseline Study, Stamping Out and Preventing Gender Based Violence (STOP GBV) in Zambia, March 2015, p. viii.

[18] Ditto, p. x

[19] Ditto

a fund to assist survivors; and it called for the establishment of shelters to support survivors, as well as it regulated monetary relief for them.

As a result of the Act, the Government has established 3 shelters across the country; a Police Victim Support Unit, as well as a series of one-stop centers across the country: At Mtendere and Chawama clinics in Lusaka; Buchi Clinic in Kitwe; Chipata Hospital; Mazabuka District Hospital; Livingstone District Hospital; Kabwe District Hospital; Ndola Central Hospital.

UNICEF, Young Women Christian Associates (YWCA) and World Vision have established further one-stop centers and drop-in centers. NGOs provide social services, counseling to victims (e.g. Lifeline Zambia, 24hrs toll free telephone counseling service).[20] Further services are provided by World Vision, Women and Law in Southern Africa, Zambia Center for Communication Programme. The Project 'STOP GBV Programme: GBV Survivor Services, Access to Justice ended some years ago. A UN Joint Programme on Gender Based Violence, 2012-2016 established an Anti-Gender Based Violence Task Forces in five provinces and at five district levels. It opened village-led one stop shops, trained GBV response groups at the village level, trained community-based care providers in psychosocial care, and established 60 community help desks in districts.

There is one center at the Kasempa Hospital though much communication and sensitization is needed. Additionally, there is need to have qualified personnel to handle GBV and SEA cases and provide psycho-social counseling and legal services. Information dissemination would be key in ensuring the vulnerable are protected.

In Kasempa, the Department for Community Development, with the support of World Bank funding under the Girls Education Women's Empowerment and Livelihood (GEWEL) project, provides education and awareness on the fear of discrimination or marriage failures to women. Asked about the line of reporting of GBV and SEA cases in the Kanyika Dam communities, respondents stated that survivors would first address the local clinic, then the Police Victim Support Unit, followed by the Government's Department for Community Development. Respondents further stated that more sensitization on this issue was required. Especially in view of public works project, respondents fear that contractors can lure little girls and married women, offering payment for their services.

4.3.4. Cultural Environment

Kasempa District has one constituency called Kasempa Constituency with 22 wards. There are three land tenures in the District: traditional, state and local authority. The traditional land is under two chiefdoms, Senior Chief Kasempa and Chief Ingwe. There are also 4 ex-Chiefs who are not officially recognized by the Government, but who are still respected by the communities and play a role in spearheading development in their areas.

The proposed sub-project area is predominantly traditional land, which is administered by The Royal Establishment under the leadership of His Royal Highness Chief Kasempa. Traditional village settlements dominate the proposed project area. Each village usually comprises of 10 housing units. Depending on the size, a few villages are then called sections and several sections form a ward. The proposed reservoir site, however, has very few settlements in the vicinity.

A third of Kasempa District land lies in the Kafue National Park and 2 Game Management Areas (GMA), namely: Kasonso-Busanga and Lunga-Luswishi. There are 4 lodges, namely, Lunga Lodge in Lunga – Busanga GMA; Mbizi Lodge in Lunga – Lusiwshi GMA; Leopard Lodge in Lunga – Luswishi GMA; and North Western Safari Lodge in Lunga – Luswishi GMA. Other tourist attractions in the district are: -

- the historical Kamusongolwa Hill near the Township.

[20] Chidoori Rumbidzai, 2011, p. 32

- the historical Shakutenuka slaughter chamber in the Township.
- the Shibalange Hill near Kelongwa
- the Lunga Cabins.

The majority of the district population are Kaonde language speakers. The Nsomo day is celebrated by the Kaonde people at Senior Chief Kasempa's Palace on 6th June every year. The Lwendela traditional ceremony is also celebrated in the district.

For the development of this ESMP, stakeholders were consulted, including the members of the Kanyika DMC, dam users and district stakeholders (Representatives from the Department of Social Welfare, Department of Arts and Culture, Department of Forestry, Department of Agriculture). Consultations were held in regards to the upstream and downstream activities around the dam.

Stakeholders claimed that the previous public works on the dam have not impacted the communities' cultural practices or heritage, and that there are further no significant or historical features in the area.

Stakeholders indicated that there is a graveyard located about 1.5km south west of the dam, commonly known as Kanyika Graveyard. The identified social impact is the access across the Kanyika stream downstream of the dam when heading to the graveyard. Previously when there was no dam and the stream was small, people could easily cross the stream to get to the graveyard. After the dam was built, access on the embankment was provided, except this was not safe during rainy season. One hazard identified when crossing the dam over the embankment is the slip and fall, which can result in death. Alternative access downstream of the dam has not been adequately attended to but does offer the best alternative.

In case chance finds occur during construction activities, chance find procedures are attached to this ESMP (Appendix B).

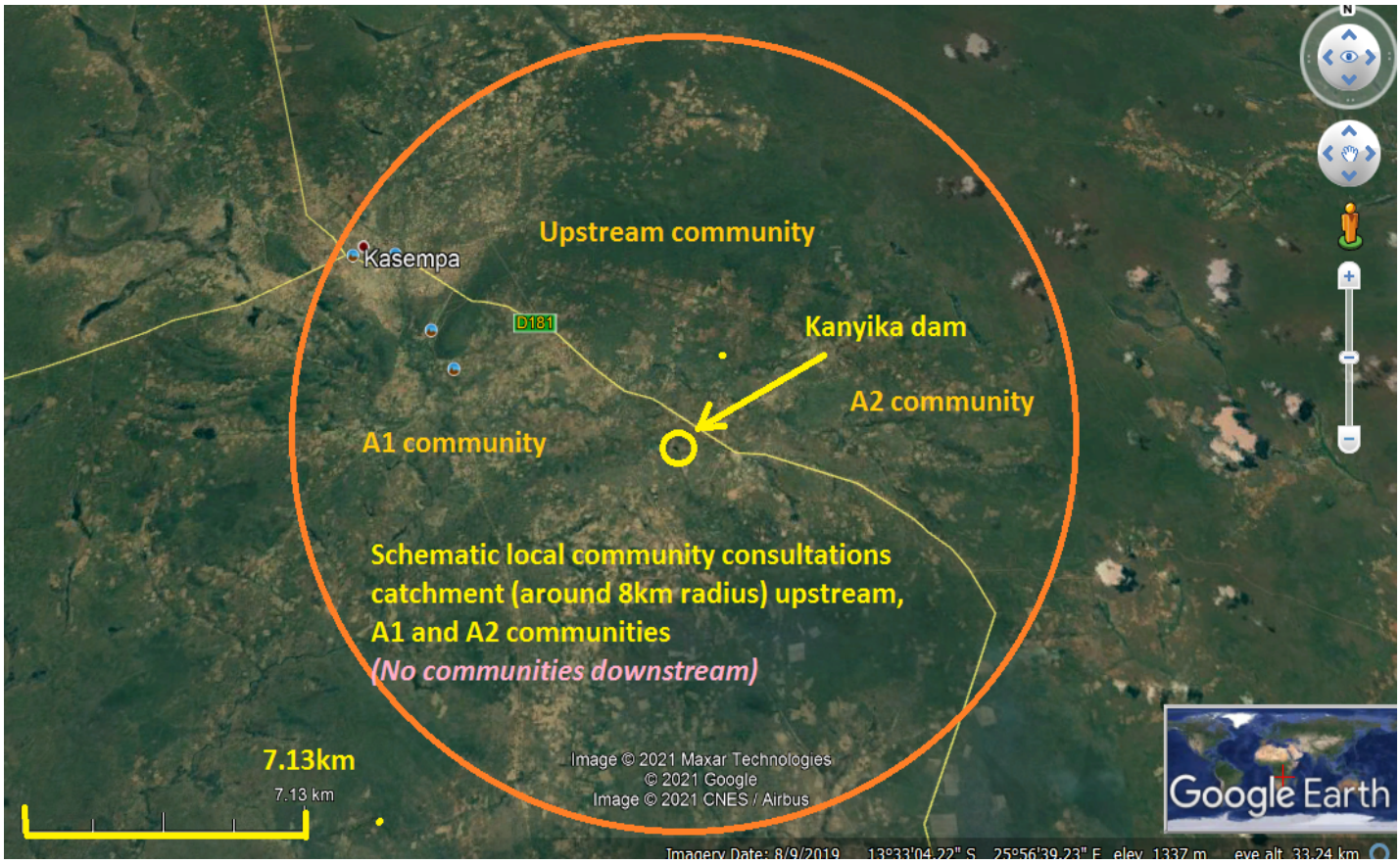


Figure 17 Schematic consultation coverage

5. Sub-Project Characteristics

5.1. Dam Characteristics

The dam is located approximately 12 km south east of Kasempa Central in the Kasempa District, North-Western Province. It is located on the Kanyika Stream, which drains to the Nkenyauna River. The Dam was first constructed in 2018 to provide water for irrigation and aquaculture. There have been no alterations undertaken at the dam, except for the control of water flows on the spillway and the stabilization of dam walls through the use of sand bags. The main dam characteristics are shown in Table 13.

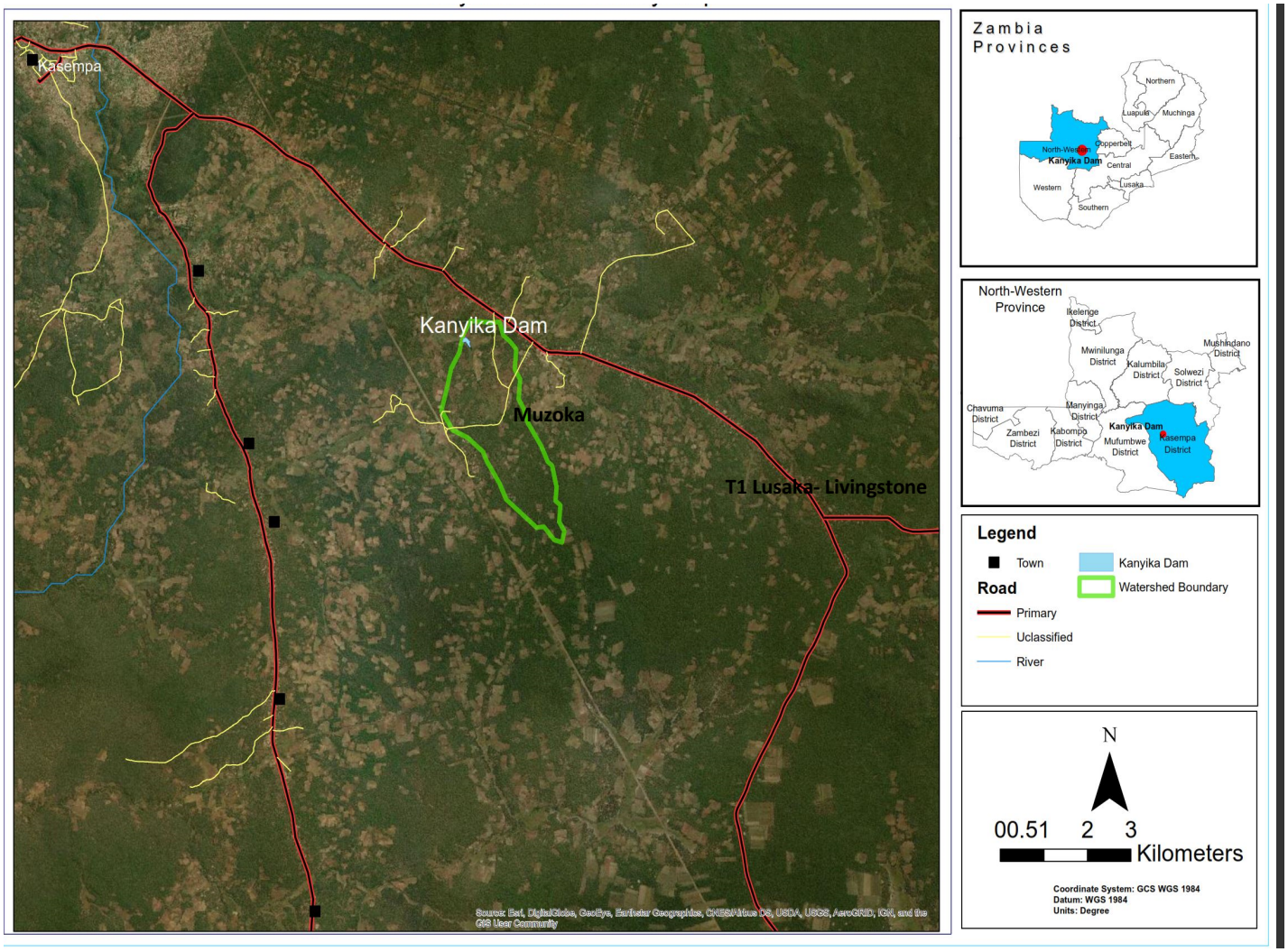


Figure 18 Google map showing location of Kanyika Dam, UNOPS 2020

Table 13 Main characteristics of Kanyika Dam

Dam Catchment Data

Catchment Area

Source Document	Year	km^2	Method of calculation
Ministry of Mines Energy & Water Development	2015	5.7	Unknown
COWI - Aurecon	2018	6.0	Survey works in 2018
COWI	2018	5.29	
Ministry of Agriculture	2020	5.29	Taken from COWI - Aurecon submission
UNOPS	2020	5.89	STRM 3D DEM (NASA) and ArcGIS

For calculation purposes for the remedial design works, the UNOPS 2020 value of **5.89 km^2** for the ***catchment area*** has been adopted.

MAP, MAR, Inflow

The Mean Annual Precipitation (MAP) for this area is 1000 mm.
The Mean Annual Runoff (MAR) for the area is 70 mm.
The MAR used is in accordance with the Zambia National Water Resources Master Plan.

Based on the above data, the average annual inflow at the dam site 5,890,000*0.070 = **412,300m^3.**

Dam Capacity

Source Document	Year	m^3	Method of calculation
Ministry of M E & WD	2013	271,000	Unknown
COWI - Aurecon	2018	270,000	Catchment Characteristics Document
COWI	2018	116,578	Full basin survey - topographic, UAV and bathymetric
Ministry of Agriculture	2020	271,000	Taken from COWI – Aurecom Submission

For calculations, the 2018 value of **412,300 m^3** has been adopted.

Assuming a 70mm MAR, the average annual inflow is	**412,300 m^3**
Current estimated capacity of the dam is	**116,678 m^3**

The site has been developed to only **28.30%** of its capacity. This is **3.53** times the current dam capacity.

Sedimentation

The catchment size is 5.89km^2 and assuming a sedimentation yield of 5000ppm (a poorly conserved catchment) with an assumed 100% trap efficiency of the dam, the dam will lose approximately 1167 m^3 capacity per year. This equates to 1% of its capacity lost on an annual basis.

Geotechnical Investigations: The SPT results indicate the compaction was variable, BH 4 was generally consistent in terms of bearing capacity; BH3 had a soft section at 3m - 4.5m; BH 2 was generally consistent and BH1 had a soft upper sector. These results indicate variable compaction within the embankment, with the BH3 sector having had minimal compactive effort applied.

Regarding the Atterberg Limits Result, all the materials sampled were CL i.e. sandy silts. As a rapid guide in assessing the suitability of soils for shoulder material reference is made to the Plasticity Product (PP). If the PP is above 600 it is considered suitable as a core material. Shoulder material is considered good between 400 and 200. Lower than 200 is either very coarse, but still usable depending on the grading. The results below indicate that these are predominantly silts, but they are acceptable as fill material.

Results of Geotechnical Material Sampled

Sample	Plasticity Index (PI)	% passing the 75 µ	Soil Classification	Plasticity Product (PP)
1	6.6/6.0	31.0%/37.0%	CL	205/222
2	8.7/ 6.9	34.3%/32.5%	CL	298/224
3	9.2/6.5	41.2%/36.4%	CL	379/236
4	6.5/7.2	36.6%/32.4%	CL	238/233

However, observations show that the embankment is clearly made up of material, which has variable compaction and had a tension crack on the downstream slope. There were areas of toe seepage and seepage from the outlet pipe

Crest tension crack

Embankment Crest and Slopes

The original design documents available for Kanyika Dam indicate that the upstream and downstream slopes were to be constructed as 3H:1V on the upstream and 2H:V1 on the downstream, with a crest width of 5m. Checks carried out during the recent dam inspection show that the embankment, while overall in a reasonable condition, has several problems, which will need attention in the remedial design.

In addition, survey work carried out both in 2018 by COWI and in 2020 by UNOPS reveals that there are variations in the as-built embankment from the as-designed.

Embankment Crest: The crest width of the embankment is variable along its length, but it is nowhere more than 4m, and generally between 3.5 and 3.8 m. The main crest surface itself appears to be in good condition and shows no signs of gullying or wash. There is no evidence of settlement either though there is much evidence of shoulder erosion with both upstream and downstream shoulders breaking away – in some places badly.

Breakup of downstream crest shoulder and narrowing of Ccest

Embankment Slopes: Sections taken from the recent survey indicate that the downstream slopes, while variable, are generally within the expected range and the upstream slopes are also variable but all slightly less than the design slope. They are still within acceptable limits – i.e., 2H:1V. The results of the geotechnical investigation will be used to carry out a series of slope stability analyses on the embankment to confirm the slopes are within an acceptable range.

Upstream slope condition – showing variable slopes

There is no grass cover along the upstream slope and a limited amount of rip rap placement at or just below the current level of the spillway channel, as the spill section. There was evidently no grass planted after construction works and the little grass that has grown since has been taken out during the repair works undertaken on the shoulders and gullies down the face from the rain wash and crest shoulder breakup. The face currently consists of loose material and is easily susceptible to further gullying and erosion in the coming rains.

This rip rap is inadequate for the wave action that has been experienced since the filling of the dam, and there is damage to the layer and the starts of “beaching” of the front face, where the rip rap has been washed away or broken up.

Breakup of rip rap and “Beaching” from wave action

The downstream embankment slope has a reasonable amount of grass cover except for the upper section towards the crest, which has been cleared of vegetation by the local remedial works that were carried out in an attempt to repair the breaking up shoulder and the gullying down the slope (see picture below).

Downstream slope condition

Internal filters: There appear to have been very limited internal filters and a small toe drain in the original design and it is not sure whether they were in fact implemented during construction - though there is a pile of rocks in the old riverbed.

Rocks in river section – evidence of rock toe

It is not clear whether they were placed during construction or washed in during the gullying close to the downstream toe by water running down from the end of the extremely limited spillway retaining wall that had been left unfinished. This has in effect created its own “toe drain” as it found its way back to the river.

Gully to incorporate in location of new toe drain

While there is evidence of seepage to varying degrees in places along or just downstream of the toe, particularly in the gully close to the right bank toe, much lush green vegetation growth can be observed on the left bank side of the embankment near the outlet pipe.

A substantial “boil” of water exiting from underground can also be observed near there. It is not confirmed if this is seepage passing beneath the embankment or from a leak in the outlet pipe. It is however running clear without any apparent sediment entrainment.

Extensive water “boil” exiting downstream near the outlet

The exact source of this extensive seepage will become more evident during the construction of the downstream toe drain and the rock toe and further, more extensive, remedial measures may be necessary to control this flow of water without prejudice to the safety of the embankment.

Service Spillway, Training Wall and Return Channel with Structures

The original design showed a 15m service spillway extending from the right-hand end of the embankment that has a masonry sill and abutments and is founded on a non-erodible bed of laterite rock.

There was to be an elevated pedestrian footbridge crossing directly above the spillway sill, from the end of the embankment to the right shoulder of the valley at the crest level of the embankment and supported by masonry pillars at 5m spacings. None of this was constructed and the current situation is an open channel – 12 m wide - with no sill section at all and no footbridge.

Location for service spillway and pedestrian bridge

There is no provision for any secondary or emergency spillway on this dam. There is an approach channel to the spillway some 40 m long with a training wall forming its left bank as can be seen in the picture above. For most of its length, its floor is close to the level of the current spillway sill section, but will need some work on it to suit the flow conditions required at the new spillway section.

This approach channel training wall links up with the main embankment at the position of the spillway sill (see picture below).

Approach channel training wall from embankment end

The spillway return channel has been cut to line and grade for its length down to the location of the last drop structure. The right bank of the channel is all in cut and the left bank should have a training wall constructed down its entire length. This has not happened and there is only a short section of the training wall extending for approximately 20 m (picture below).

Extent of spillway return channel training wall

There was evidence of erosion due to floods in the first rains resulting into the formation of gullies starting at the end of this wall and down near the right bank downstream toe of the embankment. Sand bags were laid and lined and stacked up along the left bank side of the spillway channel to act as a retaining wall.

From the end of this section of the earthen training wall there has since been a temporary wall made of sandbags down to the drop structure (at a distance of approximately 65 m) that has been constructed at the end of the channel. This has assisted in getting through the last rains without much damage to the channel or continuing to gully back to the river close to embankment toe (see picture below).

Sandbags forming left bank training wall

Sandbag training wall from drop structure

The original design was for four such structures to be constructed along the length of the channel. However, only the last structure was in fact constructed and no training wall or erosion protection works were implemented at the structure, so it sits exposed and relies on the sandbags to channel water through it.

Approach to drop Structure from return channel

Flood Design

A 1:100 year flood of 54 m^3/s was used in the original design. It is not known what method was used in obtaining this design flood in the initial design. No Safety Evaluation Flood (SEF) was given in the design report. The COWI Design Report from 2018 used a 1:100 year flood of 54.7 m^3/s with a Safety Evaluation Flood of 64.7 m^3/s.

The adopted Design Criteria for this sub-project is based on the Mitchell Formulae used extensively in Zimbabwe for the PMF estimation. The return periods have been checked in comparison with results obtained from the VKE and Pitman.

Based on the design criteria and current surveys the below is a summary of the spillway details:

Catchment Area.	6 km2
Max Probable Flood	159 m3/s
100 year Flood Estimate	72 m3/s
Fetch	0.54 km
Dry Freeboard	0.410 m
Service Spillway Width	12.50 m
Current Crest Level	1236.30 m
Spillway Level	1233.75 m
Current Freeboard	2.55 m
Coefficient of Discharge	1.8
Estimated Raising Required	0 m
Est. Free Board Required	2.55 m
Revised Crest Level	1236.30 m
River bed Level	1229.5 m
Maximum Embankment Height	7.80 m
Maximum Depth of Water	5.25 m

The design flood adopted requires no increase in the current freeboard of **2.55 m**

5.2. Overall Legacy Issues at the Dam

The legacy issues are illustrated below and mitigation measures are shown in Chapter 6.

5.2.1. Structural risks

Spillway risks:

- Spillway training walls not in good shape
- Drop structures need attention
- No emergency spillway is present
- Erosion at spillway due to floods resulting in the formation of gullies near the right bank of the embankment
- The spillway outfall after the drop structure not adequate
- The training wall runs for some short length and is not properly defined

Return channel drop structures and training wall risks:

- Erosion risks on the drop structures
- Gullying and erosion in the return channel

Embankment and slope stability risks:

- Erosion hazard and embankment stability
- Rip raps not in good shape in some sections of the embankment
- Crest narrowing as a result of erosion
- Shoulder erosion on the crests

Rock toe risks:

- No toe drain nor filters present for seepage control
- Water/seepage coming out of the ground near the outlet pipe chamber

The following pictures illustrate the above conditions:

Upstream slopes

upstream face of the dam

upstream slope and rip-rap

Eroded edges of the crest

eroded edges of the crest

Figure 19 Pictures showing status of upstream slopes

- Dam embankment has no slope protection in the form of grass or smaller planned vegetation.
- There are sections where the rip-rap appears to have been damaged and compromised performance.

Downstream slopes

Downstream face of the dam

Repair works on the downstream slope

Crest shoulders

Patchy grass and erosion towards the right bank of the embankment at toe area

Figure 20 Pictures showing status of downstream slopes

- The downstream slopes do not have adequate protection to counter soil erosion as evidenced by minor losses of materials in some sections
- Other visible signs of erosion were noticed on the downstream faces. Evidence of structural cracks were minimal apart from the sections with gravel and earth patches
- The downstream slope appears fairly uniform with evidence of repairs as some areas have been patched with gravel and ordinary earth with organic material properties especially near the shoulder to the crest.

Crest

Eroded Eeges of the crest

eroded edges of the crest

Edge of crest and upstream slope

Upstream slope and rip-rap

Figure 21 Pictures showing status of crest

- Evidence of shoulder erosion
- The crest width is narrowing as a result of soil erosion

Downstream toe

Outlet pipe

Patchy grass and erosion towards the right bank of the embankment at toe area

Patchy grassing on the downstream slope

Figure 22 Pictures showing status of downstream toe

- No toe drain or nor filters present for seepage control
- Water/seepage coming out of the ground near the outlet pipe chamber

Outlet pipe and seepage

greening due to seepage near the outlet pipe

greening areas due to seepage

Seepage

Figure 23 Pictures showing outlet pipe and seepage

Discharge structures

Spillway return

Spillway return

Non-erodable spillway bed

Drop structure near the spillway outfall

Drop structure at spillway outfall

Drop structure

	
Drop structure	Spillway return & sand-bags along the return
	
Drop structure	Drop structure

Figure 24 Pictures showing status of discharge structures

Emergency / auxiliary spillway

Drop structure & sand bags along the spillway return	Spillway return and drop structure at outfall
	
Spillway return	Spillway approach
	
Spillway channel	Spillway channel

Figure 25 Pictures showing status of spillway

- No emergency spillway is present at this dam
- Erosion at spillway due to floods resulting in the formation of gullies near the right bank of the embankment
- Sand bags were laid and lined and stacked up on the right side of the spillway channel to act as right spillway bank
- The spillway outfall after the drop structure not adequate
- There may be need to introducing a second drop structure downstream
- The existing low level pipe is in good working order from the preliminary investigations. However, no irrigation pipe/canal is connected
- The training wall runs for some short length and not properly defined

5.2.2. Environmental, Health and Safety Risks

Construction phase

Demobilization and Restoration Plan absence risks:

- Safety and health hazards for the community

Rehabilitation of disturbed works areas risks:

- Erosion and sedimentation

Rehabilitation of community roads risks:

- Loss of community access downstream
- Loss of biodiversity

Rehabilitation of borrow pits risks:

- Erosion and sedimentation
- Weed infestation
- Entrapment risk to wild animals
- Failure to rehabilitate causing increased malaria risks and increased risk of children drowning or injury

Community health and safety risks:

- Stagnant water ponds within the spillway bed can be likely vector breeding areas and may cause drowning risks as the spillway gets deeper and wider
- General serious or fatal incidents/drowning

Access across the river risks;

- Lack of a bridge/crossing with increased risk of community injury and drowning downstream during the rainy season.

Operation phase

Community health and safety risks:

- Injury or illness caused by lack of knowledge of dam risks
- Lack of capacity to respond effectively to emergencies related to the dam
- Lack of knowledge about actions to take in emergencies
- Serious or fatal incidents/drowning
- Increased prevalence of water borne diseases

Photos illustrating some of the conditions above:

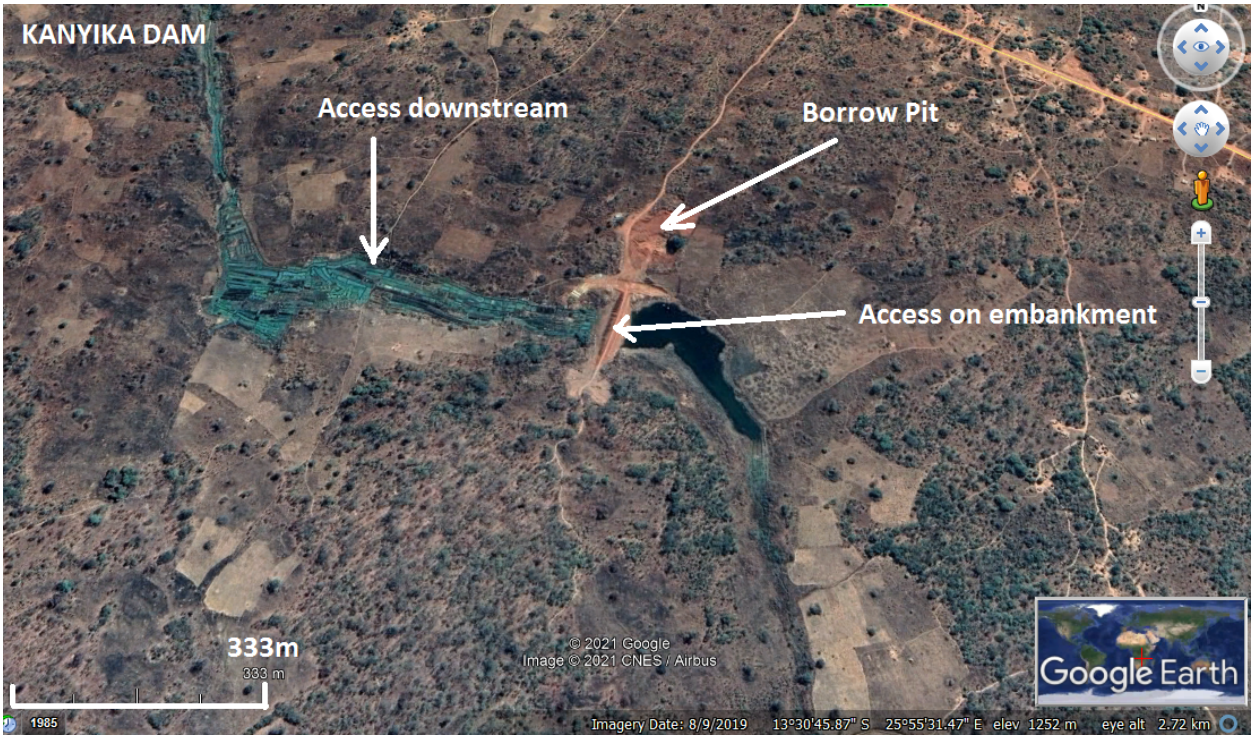
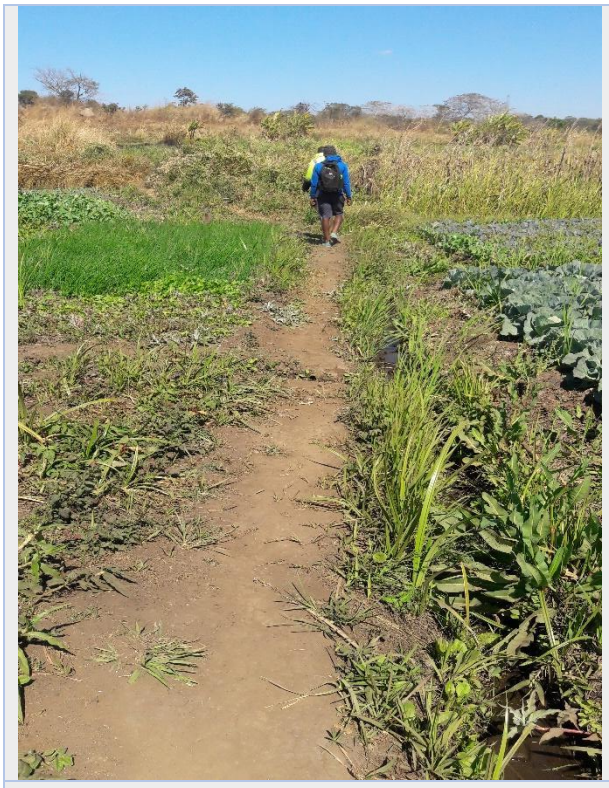


Figure 26 Google map showing sites of concern

Figure 27 First borrow pit getting eroded further.

Figure 28 2nd borrow site close to the dam

Figure 29 Crest requiring maintenance otherwise may not be safe



Foot path accessing the other side of the dam

Existing footbridge which overtops in rainy season

Figure 30 Existing footbridge a safety risk during rainy season

5.2.3. Social risks

Community development risks

- Food security – inadequate fish training for communities
- Erosion and sedimentation in the dam
- Lack of catchment management
- Unsafe access

5.3. Potential Communities Affected by Works

The rehabilitation of the dam will benefit at least 3 villages. The population of persons to benefit from the dam is estimated at around 40 households, around 25 households in the upstream end and northern end and 15 households downstream mostly in the northwestern and southeastern side of the dam. There could be more persons coming from Kalenda village to access the services of the dam. There are very few families with livestock in the area.

The communities engaged during consultations expressed their desire to engage in increased irrigation activities or livelihood improvements. As during dry season there is no flow from the dam to their gardens downstream, they irrigate their gardens using buckets. The area downstream of the dam is a wetland and therefore has natural groundwater, which can be accessed for irrigation. The dams still has fish stocks for the local communities.

Furthermore, the rehabilitation activities will create temporary local employment activities for the duration of the construction and will therefore benefit both, women and men. Contractors will be required to recruit local workers. The total workforce is not known yet but may be around 40 people. 15 out of this amount are likely to be externally recruited, including an engineer, a foreman, sitemen, a storekeeper, and those handling heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the Kanyika communities. Around 25 workers will be recruited from the Kanyika/Kasempa communities. Their tasks will comprise concrete works, work on the embankment, and any other manual tasks. Construction works will approximately take 6 months.

Since the sub-project activities are temporary in size and the amount of externally recruited workers will be small, there is no significant labor influx expected, including impacts on local resources and services. Similarly, risk of exacerbation of local existing conflicts is low. Also, the potential that a workforce meets local communities from different political or factional backgrounds is small.

For the 15 external workers, the contractor may require a site office, for meetings and for the storage of materials. However, out of the 15 people, only the foremen, site men and storekeepers, and those handling heavy machinery and equipment are likely to be at the site for the entire course of construction. Hence, 7-8 external workers may be at the site permanently. Workers will be transported to the construction site and likely remain there for the construction period. Staff, like the engineer, will visit the project site, but will not be there the entire time.

The contractor will have to build a campsite or rent nearby accommodation for the 12-15 workers, who are not transported to the site on a daily basis and who are not locally recruited, as well as for storage or materials; and will have to provide convenience facilities for the whole workforce. The community respondents and local authorities, during field visits, indicated that the previous contractor camped at the Farmers Training Center and only had a movable office (metal container) at the dam premises for convenience.

5.4. Dam Safety

The dam safety reports for Kanyika Dam include the Emergency Preparedness Plan (EPP) and the Operation and Maintenance document, which will be shared with stakeholders.

The primary goals of the EPP are as follows:

- To sensitize the surrounding communities for them to appreciate measures and actions to take in case of dam failure and for community members to understand their roles and responsibilities during an emergency.
- To ensure that arrangements are in place for an effective response at the scene and, as appropriate, at District, Provincial and National levels to a dam failure emergency;
- To ensure that, for reasonably foreseeable incidents, inundation consequences are minor;
- That potential emergency scenarios are identified and early detection measures are in place to identify the potential failure;
- To take practical measures that mitigate any consequences for human life, health, property, infrastructure and the environment.

It is incumbent on the dam owner to have an EPP in place and to ensure that the dam is safety evaluated, as prescribed, and that site monitoring and documentation are kept up to date by the operator. It is important that there is adequate training of the operator(s) to identify early signs of failure and the correct notification procedures. The emergency preparedness and responses should be established in advance. The plan should be regularly exercised, to make all parties aware of their roles and responsibilities as well as to identify possible flaws in the plans. A notification flowchart is essential for any EPP and the contacts in particular should be updated regularly.

Communication systems, which will include local languages must be robust and have back up alternatives - both in terms of contacts and systems. The notification flow chart has been developed in case of an emergency. The DMC and disaster management authorities have a key role in the plan. Training and sensitization of the parties involved will be undertaken prior and during construction works. The inundation maps, affected infrastructure in case of dam break, training plan, reviews and mitigation measures are included in the report. Documentation accompanying the flowcharts includes the following:

- Owners details
- DMC members
- Disaster management authorities chain
- Dam details and documentation
- Inundation mapping
- Preparedness
- Affected infrastructure

The operation and maintenance planning includes the following:

- Components of the infrastructure that require operation and maintenance, for example, replacement of dam components, flow monitoring, monitoring termite invasion, inspecting for leakage along the dam wall.
- A schedule and procedure for maintenance. These include tasks, such as inspections of the components, infrastructure and dam wall, identification of parts requiring replacement, and costing.
- Early warning systems for major maintenance.
- Other managerial, social, institutional and financial tasks such as setting user fees, collecting and accounting for the same.
- Required capacity building.

6. Proposed Remedial Works[21]

6.1. Embankment Remedial Design

6.1.1. Slope Stability

Slope stability analysis for the downstream embankment slope would require considerably more tests than are warranted for this size of dam.

Current Upstream slope approximately	1V:2.0H
Current Downstream slope approximately	1V:2.0H

On the basis of the shear box results, a stability analysis was undertaken. It indicated both, upstream and downstream failure conditions. Consequently, the dam embankment centreline will be offset to provide for a “notional” 1:2.5 slope on the upstream and a 1:2.5.

Slope stability analysis documentation and results will be included in the appendices at the end of the Design Report.

6.1.2. Rock Toe and Filters

The shifting of the centerline of the embankment will allow for the incorporation of an internal chimney drain and a rock toe blanket in the riverbed section. Finger drains off-takes at 20m will be installed for the remaining chimney drainage.

The rock toe will extend at least 1.5 m vertically up the embankment face from riverbed level and will incorporate a reverse filter on its upstream side to cater for any seepage passing through the embankment at this point.

In addition to controlling riverbed section seepages, the rock toe will provide additional stability weight against the embankment at its deepest section thereby increasing the overall stability. These are depicted in the figure below.

[21] Kanyika Dam Remedial Design, December 2020

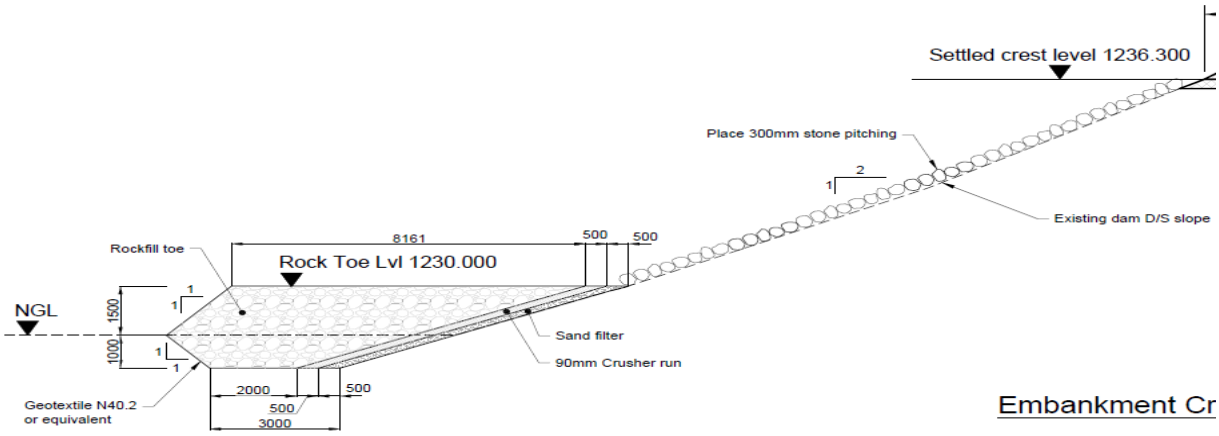


Figure 31 Typical section of rock toe and filter in the riverbed section

Concrete/stone pitched open toe drain: This will collect outflow from internal embankment filters - if any were constructed - and the runoff from the embankment slope.

This should be an open concrete- lined or stone-pitched drain that can be regularly cleaned out if necessary, as the open earth drains that are filled with stone invariably soon clog up with silt and become ineffective.

The upstream slope of the drain should match that of the downstream embankment slope - in this case 2:1 - and the downstream slope can be cut at 1:1 *(*see figure below).

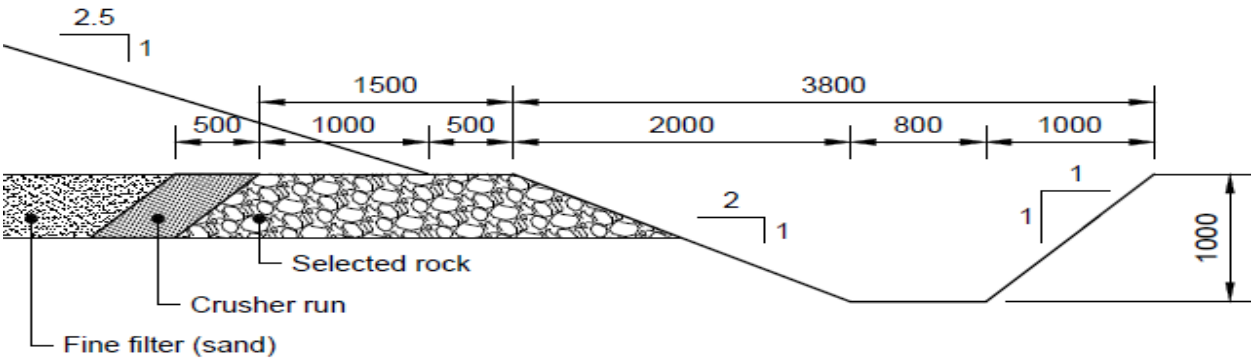


Figure 32 Typical section of toe drain at base of embankment

The surface toe drains on either side will end at the start of the rock toe and be diverted along the edges of the rock toe to discharge into the river bed. Both of these discharge drains will be fitted with fixed V notches to enable the measurement of the flow in the drains.

Slope Protection: To protect both, upstream and downstream slopes, from livestock damage it is proposed that stone pitching both faces will preserve the slopes more successfully than any fencing, as this is a communal area.

6.2. Service Spillway, Drop Structures and Training Wall

6.2.1. Service Spillway

The construction of the spillway as per the original design was never completed and the contractor moved off site before completing the spill section. To define the spillway, a 1m x 1m masonry levelling sill will be placed across the spillway channel in line with the embankment centerline with the spillway opening set at 12.5 m and the top of the sill at a level of 1233.75 – Full Supply Level. There will be a 2m wide by 0.3m deep set of gabion mattresses extending downstream from the sill (see figure below).

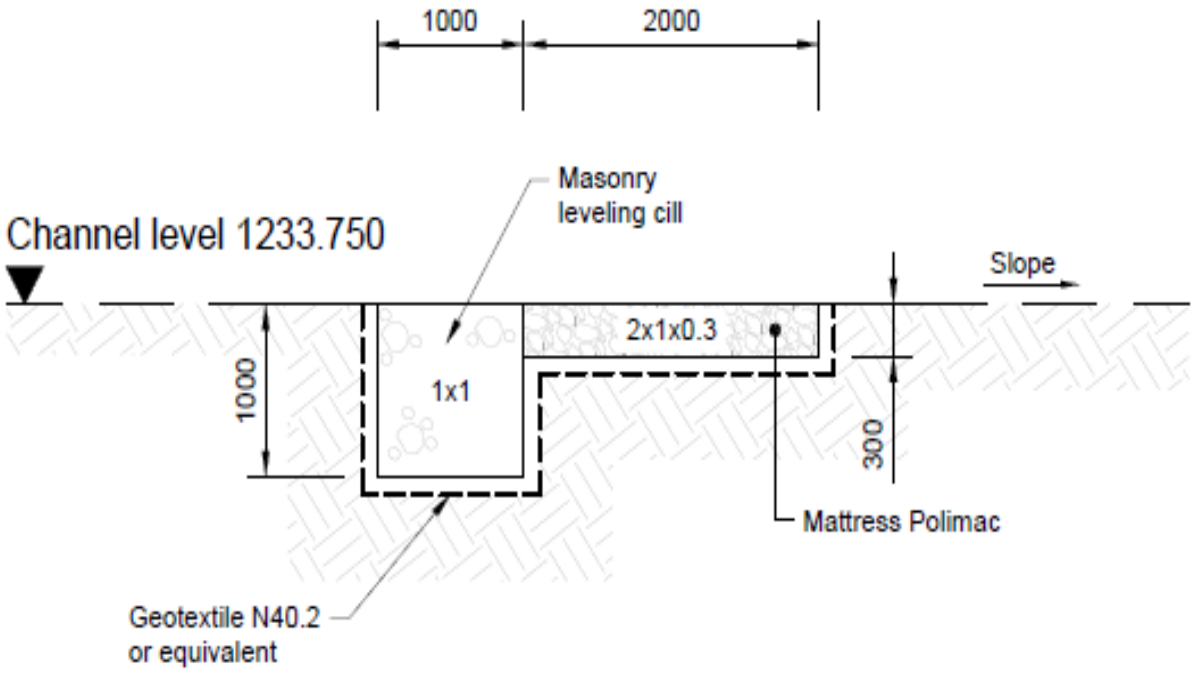


Figure 33 Section view of spillway levelling sill

6.2.2. Return Channel and Drop Structures

Similarly, the return channel floor – invert level and grade – as well as the concrete drop structures at the end of the channel were only partially completed. A temporary solution of a sandbag training wall to contain and train the water, was put in place for the 2019/2020 rains.

The originally proposed design included 4 drop structures constructed across the spillway return channel between the spillway sill and the existing drop structure at the end of the return channel. These are not considered as required given the catchment size and a time to concentration of less than an hour. The floods will be of short duration. Details of these construction arrangements are given in the drawings.

6.2.3. Return Channel Training Wall

The interim solution of sandbag training walls has survived the first rainy season and a full set of training walls will be constructed. The temporary left bank spillway return channel sandbag training wall will be replaced with 3.0m crested earthfill embankment with 1:2.0 slopes.

6.3. Outlets

The existing low-level outlet pipe is in working order from the preliminary investigations.

There is seepage along the pipe where it exits the embankment, but there is much seepage close to the outlet pipe valve chamber and it will need further investigation when the construction of the toe drain and rock to are taking place. However, the pipe will be incorporated into the chimney drain and have a dedicated reverse filter surround at the toe point of the embankment. Care must be taken not to damage this pipe during the excavations for the toe drain and rock toe (see figure below).

Figure 34 Outlet pipe and valve chamber with seepage point on left

6.4. Construction Materials and Amenities

Construction materials required for the remedial works as detailed above are as follows:

- Sand and stone for minor concrete works - 10km within the dam locality.
- Stone for gabion basket filling - 10km within the dam locality.
- Rock for riprap and downstream toe - 10km within the dam locality.
- Common fill for embankment raising and spillway training wall -10km within the dam locality.

- Wearing coarse gravel for roadway on crest - local ZNS gravel pits.

Preferred locations are within 12km of the dam. However, guidance on identification of sites will be as follows:

Sources of materials for construction will be identified by the contractor and approved by the engineer. Before finalizing the use of the site, it will be the responsibility of the contractor to engage the DMC and the local community with a view to get consent from the local leadership and avoid conflicts over land or other issues. Should the sources selected prove inadequate or unsuitable in any way, the contractor will be required to identify suitable alternative sources including additional borrow areas, and still execute the same channel of consultations to get clearance from the local leadership and the municipal council. The designation of certain areas as borrow areas does not imply that all the materials within that area are suitable for use in the dam embankment. The engineer's representative will indicate which materials from within the general borrow areas are to be used in the embankment and which are to be left unused.

Rockfill and Aggregate***:*** The rock requirements for the dam are concrete aggregate, placed rockfill for the embankment slope protection and the downstream toe, rock pitching of the downstream and upstream slopes, gabion baskets infill, coarse filter zones in the embankment, and rock for masonry and for backfill where specified or ordered. All suitable rock obtained from excavations for the dam and appurtenant works will be used in the structures, and every effort must be made to save as much rock as possible for this purpose.

Concrete aggregates will be obtained from the Zambia Environmental Management Agency (ZEMA) approved quarry sites or from an approved commercial supplier identified within Kasempa District or nearby, provided they are economical. In some cases the contractor will set up his own crushing and screening plant. However, the latter process may take longer to be approves by ZEMA, since this will require preparation of an Environmental Project Brief for the proposed activity at the proposed location. The contractor must arrange for petrographic testing and crushing value testing of the material he proposes to use, at his own cost, and must submit adequate proof that such material is not likely to lead to long-term deterioration of the concrete. The contractor must also ensure consistency in the quality, grading and properties of the material to be used as concrete aggregates. Further testing may be requested by the Engineer, in the event that the consistency is considered to be divergent from the original samples and will be to the cost of the contractor.

The rock sources for the dam have not been identified and will probably have to be obtained from the nearest commercial source or by commissioning local communities to collect suitable rock from suitable surrounding areas. In addition, the contractor should locate a suitable quarry site to open and possibly operate.

If the engineer considers that suitable rock from the required excavations, including overlying boulders, has been wasted by the contractor, he may order the contractor to make up such assessed losses with rock from any other source approved by the engineer's representative at the contractor's own expense.

Coarse filter material will be obtained either as a crusher-run product or by winning and screening, and if necessary washing, local deposits of gravely material.

Earthfill: Suitable material for use in the rolled earthfill of the dam has not been extensively located. No materials will be taken for any purpose from within 200 meters upstream or downstream of the dam

centerline, nor within 50 meters of the flood embankment, except for those materials won from necessary excavations as directed by the engineer's representative.

Sand: Sand will be required for the concrete and masonry and as filters in the earth fill embankments. It should be noted that it will be necessary to blend pit sand with river sand for use in concrete and for masonry mortar. The contractor is expected to have an understanding of suitable deposit sites prior to tendering.

Overhaul of Materials: There is no provision for the payment of overhaul of earthfill, gabion rock infill, rockfill or of concrete coarse aggregates and crushed filter material, and tenderers will include the full price of bringing these materials to the works from those areas designated for use in these documents, or from such other sources as may be selected by the contractor.

Transportation of raw materials: This activity will be well defined once the sources of raw materials are known. When transporting sand, quarry, gravel over a long distance and passing through a settlement of some community, the transporter will be required to cover the material with a tarpaulin and will use a defined route from the source to the construction site.

The social amenities required by the contractor include (see social conditions section of the ESMP):

Water supply: The contractor will provide temporary potable water storage facilities and connection to the existing local borehole that is within 1km downstream of the dam without compromising community access to the water. Water from this well should be tested and if safe for drinking can be used by the contractor and his/her staff.

Campsite: A campsite for 12-15 external workers- to be structurally constructed within the site off the access road which is the Kasempa – Mumbwa Road.

The contractor will provide the following at the campsite:

- Washing and sanitation facilities- incl. VIP latrines to be constructed within the site for ca. 40 workers (at least 2 latrines, 2m x 3m per toilet with opposite/alternate access and a privacy screen, one for men and one for women). Each toilet will have a hand wash basin.
- Cooking facility at the campsite- all the cooking activities will only be conducted at the designed facility. Waste management (non-hazardous waste)- collection from waste receptors within the site, and disposal at council designated site located Kasempa District as will be guided by the local authority.
- Waste management (hazardous waste)- collection within the site under stipulated conditions in the ESMP table. Remediate where necessary or dispose of as per regulations.
- Any hydrocarbon storage facility will require banded walls according to the stipulated ESMP table requirements. Any recyclers and re-users of waste must be licensed and monitored according to ZEMA guidelines.
- Temporary accommodation facilities for his staff. The temporary facility will be made up of local building materials or tents and with a minimum spacing requirement of 4.5sqm living space per staff, with adequate ventilation. Additionally, all workers at campsite will be consistent in following COVID -19 guidelines as provided for in the Management Plan, section 7.1.
- Office facility, a minimum space of 3m x 3m internal dimensions complete with air conditioning, an office table, at least 2 chairs, a common sink, internet, power connection with at least 1 dedicated

power point.
- Vehicle and machinery parking area.

Additionally, the contractor will ensure, to the extent possible, that the camps are constructed from materials that can easily be constructed and dismantled. Other than those listed above, supporting facilities such as drop-down toilets and generators set for energy production will be established. To ensure that the camps are kept small, the workers will be largely recruited from the local communities. The sites for campsites have not been identified. The contractor will make his own arrangements for a suitable site for his camp, after engaging the relevant local authorities. The contractor is expected to indicate where he intend to set up the site camps. The contractor will ensure that the identification and subsequent operation of the camp meets all requirements.

Access roads: Access to Kanyika Dam is by a 12 km Kasemba-Mumbwa road, as shown in the location map of this dam.

Labor force: The total workforce may be around 40 people. 15 are likely to be externally recruited, including an engineer, a foreman, sitemen, a storekeeper, and those handling heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the local communities. Approximately 25 workers will be recruited from the Kanyika/Kasempa communities.

6.5. Construction Programme

Considering the scope of works and the possible sources of materials as listed under item 9, materials, the rehabilitation works will be carried out within 6 months.

6.6. Drawings List Available to the Contractor

Table 14 Drawings List

No.	Description	Drawing No.
1.	Remedial Embankment Layout	ZM/DAMS/NA/C01
2.	Embankment Cross Sections	ZM/DAMS/NA/C02
3.	Embankment Sections	ZM/DAMS/NA/C03
4.	Spillway Layout	ZM/DAMS/NA/C04
5.	Spillway Details	ZM/DAMS/NA/C05

7. Risk and Impacts Mitigation Plan

This section provides the following: common construction works management plans, monitoring requirements and the rehabilitation management plan after the current proposed works. The contractor is expected to operationalize these plans with details of his/her method statement.

7.1. New Remedial Works General Construction Works Management Plan

Table 15 Remedial works management plan

Construction Phase Risk Mitigation Measures						
Aspect	**Risk/Impact**	**Mitigation measure** (prevent, reduce, mitigate, and compensate)	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Non Hazardous Waste Management						
Campsite **Construction activities**	Solid waste generation and releases into the environment Public health and safety hazards	• The contractor will screen the proposed campsite area and should prepare a waste management plan for the site preparation, construction, operation and decommissioning. This will be reviewed and approved by UNOPS. • The contractor will employ the waste management hierarchy in the management of waste at all the work site, including a) waste prevention, and b) waste reduction strategies, waste segregation with reuse and appropriate disposal methods. A record of waste generated and detailed waste transport method with disposal methods will be kept on site. The contractor is prohibited by law to burn or bury any type of waste. The waste handling procedures and PPE requirements will be detailed in the method statement/ plan.	Construction Phase Daily	• Properly designated waste collection and disposal points • Training/ sensitization records for 100 % of staff • Waste disposal records and logs • 100% cleaned up sit	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month
Hazardous Waste Management						

Construction activities **Vehicular operation** **Sanitary facilities**	Hazardous waste generation and releases into the environment such as hydrocarbons and sewer Public health and safety hazards	● The contractor will screen the proposed storage areas and prepare a plan for the site preparation, construction, operation and decommissioning, as part of a Site-Specific Hazardous Waste Management Plan. This will be reviewed and approved by UNOPS. ● The contractor will employ the waste management hierarchy in the management of waste at all the work sites, including a) waste prevention, and b) waste reduction strategies, waste segregation with reuse and appropriate disposal methods. A record of waste generated and disposal methods will be kept on site. The contractor is prohibited by law to burn or bury any type of waste. The contractor will produce site specific waste management plans and conduct regular waste segregation sensitization of workers. ● The contractor will dispose of hazardous materials at the Council/ ZEMA approved disposal sites. All bulk hydrocarbon storage tanks must be contained in a concrete bund that can accommodate 110% of the total volume of the product that is stored in the tank, with a concrete floor and no drain outlet. Any rainwater collecting in the bunded area that does not evaporate within a short time must be pumped into drums for disposal through concrete-line mechanical oil separators and the oil recovered and temporarily stored in a waste oil collection tank or sealed drums. The fuel dispensing pumps must also stand in a concreted area, with drains to an oil	Construction Phase Daily	● Properly designated waste storage, collection and disposal points ● Temporary storage areas for hazardous wastes concrete-lined and bunded ● Treated contaminated sites, 100 % ● Training/ sensitization records, 100% of workers ● Waste disposal records and logs available ● 100 % of sites are cleaned up ● 100% of sites specific waste management plans exist	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

		interceptor. ● The contractor will not wash vehicles in the sub-project area, to avoid contaminating the surface water with oil leakages from the vehicles.				
Soil Management						
Excavation activities during Proposed road rehabilitation, material sources extraction, rehabilitation works	Excavation resulting in release of dust, gas and particulate emissions Public nuisance and health and safety risks Soil destabilizatio n leading to erosion and land subsidence Road surface instabilities	● Following acquisition of relevant permits from local council and ZEMA, the contractor will prepare borrow pit method statements and management plans for each site to detail the operation of the site and compliance with the ESMP. ● The contractor will limit excavations and clearing to necessary worksites. ● The contractor will ensure that site installation, excavations and any other soil movement activity will not be done during the rainy season to avoid erosion of material and gully formation. ● The contractor will methodically conduct site assessments, selection, and operation of the sites as indicated below: A depth of utmost 2.5m will be excavated from borrow areas for safety reasons. The excavated slopes will be reduced to a stable slope, and indicated in the method statements. ● The contractor will create and maintain topsoil stockpiles. Topsoil depth ranges will be between 150 mm and 500 mm. The exact depth will be determined from the geotechnical site assessment. Topsoil will be stripped and stockpiled away from other materials. Topsoil will be only used for reclamation purposes when pit operation is complete.	Construction Phase Daily	● Minimized land and soil disturbances at the work sites ● Suppressed dust levels and soil movement / erosion ● All sites are soil stabilized sites ● Separate soil stockpiles to specification ● Drainage and run off control ● Site restoration, 90% for regeneration ● Site Method Statements and management plans prepared	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 3000/month

		• The contractor will incorporate drainage construction and runoff control at sites. Overburden soil will be used as a perimeter berm to direct drainage on the site or stockpiled separately from topsoil. • The contractor will rehabilitate and restore sites after works. This will include rehabilitating disturbed work areas and restoring as close as possible to original contours. Restore topsoil from stockpiles. Replant with native plant seed mixes, and combine with natural revegetation. Overburden soil can be used for landscaping.				
Land Use and Aesthetics Management						
Infrastructure rehabilitation works, Disturbance of sites, campsite construction	Changes in aesthetics, scenic view, visual character and land use	• The contractor will maintain consistency with existing land-use features and designs.	Construction Phase Monthly	• Minimized aesthetic impacts • Rehabilitated and restored sites, 100% • Blending land-use	Contractor Engineer and HSSE Officer UNOPS/IDSP	HSSE Officer Cost 2000/month
Surface and Groundwater Pollution Management						
Activities and Works around and on water bodies	Poor water quality Public health and safety risks	• The contractor will control siltation, minimize unchanneled runoff and soil erosion by constructing drainage channels. • The contractor will provide sanitary facilities in the form of 2 VIP toilets for the workers at the campsite (1 for females and 1 for males). These will be monitored and properly decommissioned by adding lime. • The contractor will inspect machinery and vehicles for spillages and leakages on a daily basis, before use.	Construction Phase Monthly Or as required in case of an emergency/ incident	• Refer to water quality results in the ESMP • Water quality results, monthly • The monitoring parameters will include biological, physical and chemical drinking water quality parameters. These will include parameters analyzed in this ESMP: pH,	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

		• The contractor will dispose of construction debris and any wooded debris in legally designated site at the council dumpsite. Disposal in the reservoir or water bodies will be prohibited. • The contractor will monitor water quality in the upstream basin and downstream by conducting initial water quality monitoring at commencement with monthly monitoring during construction.		conductivity (µg/cm), sulphates (mg/l), nitrates (as no3-n mg/l), total dissolved solids (mg/l), ammonia (as nh4-nmg/l), phosphates (mg/l), total suspended solids (mg/l), chemical oxygen demand (as mg o2/l, chlorides (mg/l), turbidity (ntu), hydrocarbons (mg/l) additionally with total and fecal coliform tests. If hydrocarbon contamination is suspected, the test will be included. The testing will be done at certified/ approved laboratories after proper sampling methods. ● Pollution control structures ● Training records, 100% of workers trained ● Inspections reports, weekly		
Air Quality and Noise Management						
Transportation, rehabilitation works at all	Biomass burning impacts, dust from the roads	● The contractor will use auxiliary sites close to the dam to minimize haul distances and avoid worksites close to	Construction Phase	● Complaints records ● Inspection sheets ● Receptor sites	Contractor Engineer and HSSE Officer	HSSE Officer Cost 2000/month

worksites, campsite activities	and sites, noise from equipment	sensitive receptors such as households, clinics, schools etc... ● Working hours to be limited to between 06:00 and 18:00. ● The community will be sensitized on working sites and routes. Equipment noises below acceptable limits. ● The contractor will continually water sites and limit soil movements during works by stone pitching sites or vegetation. However, care must be taken to ensure that water used for this activity does not deprive local communities or affect the dam water quantities	Daily	protection	UNOPS/ IDSP	
Construction materials (sand, stone, rock, gravel)						
Extraction and transportation activities	Land degradation, falls, waterborne diseases due to collecting water, health and safety injuries during mining, non ZEMA regulated activities, soil erosion, biodiversity loss, traffic accidents, noise and air quality, child labour from unregulated sources	● The contractor will source materials from reliable, regulated sources with ZEMA approved operations ● The contractor will refer to the relevant management plans in the table; traffic, labor, air, noise, water, , soil, land, health and safety. The contractor will also refer to the relevant management plans discussed in Appendix J.	Construction phase Daily	● Refer to the remedial design report ● Use of approved regulated miners ● Constant material supply ● Environmentally mitigated operations and keep a copy of their environmental assessment ● Refer to the relevant plans' performance indicators	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 3000/month

Campsite Management						
Construction, operation and decommissioning activities	Non-hazardous Waste management, Hazardous waste management, noise, wood fuel forest depletion, energy conservation, air pollution due to dust, water conservation, surface and ground water pollution, soil conservation, land pollution/ degradation, health and safety risks	• The contractor will refer to the relevant management plans in the table; air, noise, water, waste, biodiversity, soil, land, health and safety. • The Contractor will conserve resources – energy and water. He/she will collect and use what is required in a sustainable way. • The contractor will not use firewood/ forest for energy. • The contractor will not deprive the communities of their resources. • The contractor will not start wild fires or a fire in an undesignated area. Fire safety will be adhered to with extinguishers and assembly points on site.	Construction phase Daily	• Refer to the relevant plans' performance indicators • Limited vegetation clearance • Campsite operations inspection reports • Well kempt campsite • Decommissioned site after operations as indicated in the decommissioning plan	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 4000/month
Traffic Management						
Transportation of materials, vehicle and equipment movements, pedestrian movements	Poor road surfaces, conflict of use with the community, safety hazards	• Contractor will assess available access, rehabilitate if needed and provide appropriate signage where relevant to inform the local community. If any road infrastructure is closed due to the works, alternative routes must be assessed and constructed with minimal impacts on the community social and environment aspects. • Contractor will prepare the traffic management method statement which will be reviewed and approved by UNOPS in collaboration with IDSP. The method	Construction Phase Daily	• Safety inclusion • Existing community access infrastructure • Training records for communities and workers • Inspection reports • Complaints records • Traffic management plan in place	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 2000/month

		statement will firm procedures and include cost. The plan will include the need to cover the raw material with a tarpaulin to ensure there is no pollution caused. Additionally, once the source of raw materials is known, the contractor, working in consultation with the engineer and the local authority will define a route to use during the transportation of the raw material. ● Contractor will include hazard identification, risk assessment, safety measures such as signage, routes, parking areas, loading, unloading, reversing, crossings, sensitizations, fencing, competent drivers, working hours, operating low speed (about 10 to 20km/h). ● In summary the contractor traffic management plan will include: the desired flow of pedestrian and vehicle movements, the expected frequency of interaction of vehicles and pedestrians, illustrations of the layout of barriers, walkways, signs and general arrangements to warn and guide traffic around, past, or through a work site or temporary hazard, and how short term, mobile work and traffic situations will be managed. ● Responsibilities of people managing traffic in the workplace, responsibilities of people expected to interact with traffic in the workplace, and instructions or procedures for controlling traffic including in an emergency will also be included by the contractor.				

Biodiversity Management						

Aquatic biodiversity
 	
Works within habitats
	Biodiversity loss and ecological flow limitations	• The contractor will implement BMP (Annex J).
		• The contractor will minimize impacts on notable species and loss, fragmentation, alteration, disturbance and disruption of sensitive habitats, as guided in the BMP.
		• The contractor will avoid introduction of alien species that may affect other resident species in the waters.
		• The contractor and communities will avoid exploiting biological use of resources and invasive methods by following regulations and training.
		• The contractor will make reference to the BMP (Annex J) and prepare an aquatic biodiversity site/ habitat specific method statement for works, which the contractor will communicate to the workforce. This will include:
		  ○ Location of the specific works;
		  ○ Any details obtained in the pre-works services;
		  ○ Explicit details of mitigation measures which should be applied in the area;
		  ○ Details of any specific construction practices which should be applied in the area to protect biodiversity;
		  ○ Details of any timing restrictions which apply to works in the area;
		  ○ Restoration details for the habitats within the area where the method statement applies.
		• As guided in the BMP, the contractor is required to ensure that all employees
			Construction Phase
			
			Daily
				• Number and extent of undisturbed areas
				• Species register
				• Water quality results
				• Training registers and species protection regulations
					Contractor Engineer and HSSE Officer
					
					UNOPS/ IDSP/ Fisheries Forestry
						HSSE Officer Cost
						
						2000/month
						
						UNOPS ecologist consultant costs

		receive appropriate training in relation to biodiversity issues, so that the activities do not generate impacts on biodiversity. ● Making reference to the BMP (Appendix J), the contractor will maintain ecological services and ecologically rich areas, protect vulnerable and endangered species, and protect nests. ● The contractor will report all incidents to UNOPS and to authorities.				
Terrestrial Biodiversity Works within habitats	Biodiversity and habitat loss	● The contractor will adhere to the Mitigation measures as guided in the BMP (Annex J). ● As guided in the BMP, the contractor is required to ensure that all employees receive appropriate training in relation to biodiversity issues, so that the activities do not generate impacts on biodiversity. ● The contractor will take measures to avoid wildfires, and any use of firewood from the cutting of trees around the dam. The contractor must organize alternative energy sources. ● The contractor's works, rehabilitation of roads, operation of material sites and campsites should minimize on destruction of terrestrial biodiversity. ● Contractor to prepare an aquatic biodiversity site/ habitat specific method statement which will include: ○ Location of the specific works; ○ Any details obtained in the pre-works services; ○ Explicit details of mitigation measures which should be applied in the area; ○ Details of any specific	Construction Phase Daily	● Rehabilitation records and extents ● Extents and number of disturbed sites and species ● Maintain a fauna sighting and fatality register. Conduct regular monitoring of works to ensure compliance ● Training records and fauna register	Contractor Engineer and HSSE Officer UNOPS/IDSP/ Fisheries Forestry	HSSE Officer Cost 10000 UNOPS ecologist consultant costs

		construction practices which should be applied in the area to protect biodiversity; ○ Details of any timing restrictions which apply to works in the area; ○ Restoration details for the habitats within the area where the method statement applies. ● The contractor will report all incidents to authorities and UNOPS				
Community Health and Safety						
Lack of safety measures	Community health risks, which include accidents, injury and drowning in open sites such as a borrow pit.	● The contractor will install safety signage around the dam reservoir, embankment, crossings, material sources, roads, depressions, pits and other sensitive sites. ● The contractor will monitor traffic and road safety throughout the operations in order to maintain a safe working environment, including that workplaces, machinery, equipment and making sure processes under their control are safe and without risk to health. ● The contractor will sensitize communities on safety and response, including sensitize communities on vector and waterborne diseases prevention and management. ● The community living close to the dam and especially those living upstream of the dam will continuously be informed of the importance of avoiding open defecation. This practice can otherwise impact on the surface water quality and consequently may cause water borne diseases among the local community accessing this water. The contractor will prepare the site emergency preparedness	Construction Phase	● Adequacy of safety signage ● Training records ● Water quality free of coliforms and essentially within the WHO limits.	Contractor Engineer and HSSE Officer UNOPS/ IDSP Ministry of Health	HSSE Officer Cost 15000

		response plan which will be in a report and process flow format. This will include training, emergency personnel such as the DMC, contacts, emergency numbers, hazards identified (chemical, biological, physical or natural disasters), risk levels, evacuation and routes mapping, response-emergency reporting and evacuation procedures, critical operations.		● Refer to the technical safety reports		
Occupational Health and Safety						
Poor occupational health for the workers	Injury to workers and lost time	The contractor will implement all reasonable precautions to protect the health and safety of workers. To ensure effective management of the works in this respect, the contractor is expected to have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements. Preventive and protective measures should be introduced according to the following order of priority: ● Eliminating the hazard by removing the activity from the work process. Examples include using an alternative that is less harmful, etc…. ● Controlling the hazard at its source through use of engineering controls. Examples include machine guarding, acoustic insulating, etc… ● Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out,	Construction phase	● Training of workers, record in place ● All workers in appropriate PPE ● Good house keeping	Contractor Engineer and HSSE Officer	HSE Officer Costs

		workplace monitoring, limiting exposure or work duration, etc. .. ● Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE. ● The application of prevention and control measures to occupational hazards should be based on comprehensive EHS Guidelines.				
Gender Equality, GBV and SEA						
Gender Mainstreaming	Work force does not have gender parity	● The contractor will aim to recruit 50% women among their locally recruited workforce.	Construction Phase	● Contractor recruitment plan includes 50% women	Contractor UNOPS	
GBV/SEA	Sexual Abuse, Exploitation (SEA) and Harassment of work force vis-à-vis the local communities	● The IDSP and UNOPS will conduct stakeholder consultations held with a focus on GBV/SEA and child protection risk. ● The contractor will ensure that all workers understand and sign a Code of Conduct (CoC) that reference zero tolerance in regards to GBV/SEA/SH. This also includes consultants and suppliers. ● All CoCs will be disclosed through appropriate means (see SEP) – including in the local languages. ● The contractor will ensure community and stakeholder awareness on GBV/SEA and child protection response mechanisms. ● UNOPS to train senior GRM staff in GBV/SEA appropriate responses and referral mechanisms. Training of the GBV/SEA community focal point persons. ● The contractor will ensure that all sub-project-relevant cases are reported to UNOPS (establish agreements with relevant entities, distribute contacts for	Construction Phase	● Reports on results of stakeholder consultations ● Field monitoring missions are implemented at least once every month ● All CoCs have been disclosed through appropriate means ● Contractors has been provided with a standard CoC to use as a minimum ● 100% of all workers have been trained in the CoC and GBV/SEA risks and obligations ● Community awareness sessions have been implemented at least once ● 100% of senior GRM	Contractor UNOPS / IDSP	Gender Consultant UNOPS, 16.000/year

		reporting), if the survivor agrees, based on informed decision making. ● UNOPS will monitor developments in the sub-project areas and conduct continuous assessments to understand trends in GBV/SEA/SH and child protection related issues		staff has received training session on GBV/SEA responses and referral mechanisms ● Agreements have been reached with GBV service providers/ reporting entities		
GBV/SEA	Sexual Abuse, Exploitation and Harassment at the workplace	● The contractor will ensure the application of a system to prevent SEA in the company ● The contractor will ensure that all workers understand and sign CoCs, including consultants and suppliers. ● The contractor will ensure all CoC are disclosed through appropriate means and will also be conveyed in the local language, for easy comprehension. ● The contractor will ensure that all sub-project-relevant cases are reported to UNOPS (establish agreements with relevant entities, distribute contacts for reporting), if the survivor has agreed based on informed consent.	Construction Phase	● Field monitoring missions are implemented at least once every month ● All CoCs have been disclosed through appropriate means ● 100% of all workers have been trained in the CoC and GBV/SEA risks and obligations	Contractor/UNOPS	Gender Consultant UNOPS, 16.000/year
Labor and Working Conditions						
Labor and Working Conditions	General Risks and Impacts	● Contractors to recruit local workers where possible ● IDSP will establish and implement effective GRM (including address of GBV and SEA cases). ● Adequate Occupational Health and Safety requirements. This will be in compliance with the local Factories Act and OSHA Act. This includes complying with the safe working conditions and safe acts on site.	Construction Phase	● At least 60% of workforce at dam site is locally recruited ● Contracts contain labor influx provisions ● All workers have signed a Code of Conduct	Contractor UNOPS / IDSP	Included in GRM costs (not specific for labor influx UNOPS staff costs Contractor budget (awareness sessions in communities and

		• The contractor will incorporate strict COVID-19 prevention and management measures both at the campsites and worksites (See Appendix D and F)				for workers): 5.000 USD / 6 months
Labor Influx	Conflicts between local community members and workers based on cultural differences	• UNOPS/IDSP will conduct local community consultations during the sub-project design and implementation stage, as per SEP • The contractor will disseminate rigorous information dissemination about sub-project details and GRM, as per SEP (see below) • This will include awareness raising among local communities and workers • The contractor will provide information on CoC (in local languages) • Contractor to conducts cultural sensitization of workers	Construction Phase	• Monthly reports received on consultations and key issues identified • Information on CoC has been translated in local language • 100% of workers from outside have received training	Contractor UNOPS	UNOPS staff costs / travel budget of Safeguards staff 20.000 USD / year Contractor budget (costs for awareness sessions / training 5.000 USD / 6 months
Conflicts	Conflicts between workers, based on cultural or other differences Risks of disagreements between local workers and employers	• The contractor will design and implement a workers' GRM • The contractor will operate workers' GRM	Construction Phase	• Monthly reports on Workers' GRM received • Reports received on Workers' GRM	Contractor UNOPS	Contractor budget Staff costs and travel budget
Labor Influx	Increased risks of communicable disease, e.g. HIV/AIDS, STDs	• The contractor will implement awareness raising on HIV/AIDS and STD for the workforce	Construction Phase	• Every workers has received training	Contractor UNOPS	Contractors' budget (training costs, awareness raising in community costs, translation costs for COC)

						5.000 USD / 6 months
Occupational Health and Safety	Occupational Health and Safety Risks	• Occupational health and safety requirements will include hazard identification-elimination, substitution, controls, communicate risks, training, emergency preparedness and response, adequate and relevant personal protective equipment, incident investigations, monitoring • COVID-19 spread at the construction site to be mitigated through attached plan (see appendix D)	Construction Phase	• Emergency preparedness and response plan for occupational emergency situations • Report on COVID-19 mitigation plan implementation	Contractor UNOPS	HSSE Officer costs
Decommissioning and Rehabilitation Measures (Structured management to minimize environmental risk of dam construction impacts)						
Erected infrastructure **Demobilization of the contractor's services and equipment used in performing the work required under the contract**	Residue impacts Aesthetic impacts Safety hazards	• The contractor will review of the types of activities carried out on the site, including material extraction, machinery, buildings erected, waste handling and recovery operations. • The contractor will conduct identification of potential hazards, including an evaluation of the raw materials and waste products typically stored on-site, site hydrogeology, ecological effects, control measures for dam safety to prevent incidents, all items of plant and other materials, including buildings that may be decommissioned, rendered safe or removed from site for disposal or recovery in the event of demobilization and closure. • The detailed rehabilitation plan will be in the contractor's site method statement	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	HSSE Officer costs 40,000
Disturbed work areas, material sites and Borrow pits	Soil erosion, aesthetics, drainage, safety hazards	• The contractor will conduct detailed site inspections, define and map disturbed areas where rehabilitation/erosion control is required.	Construction Phase	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer	In rehabilitation cost

		● The contractor will develop costed method statements for each area, including problem statement, method of rehabilitation, resources needed and responsibilities. ● The contractor will rehabilitate areas disturbed during construction activities and during previous construction activities. Disturbed areas will be restored as close as reasonably possible to pre-construction state and the soils will be restored to a condition consistent with other resource uses. Disturbed areas, slopes will be replanted with native plant seed mixes suited to the area. Topsoil that has been stripped and stored as part of the construction activities is to be levelled out as part of stabilization and rehabilitation activities. Correctly preserved topsoil provides viable sources of seeds stock, biological life and nutrient conditions that lead to vegetation establishment in addition to native species that will be purchased for full rehabilitation use. For every tree removed three will be planted. The rehabilitation plan will be in the contractor's site method statement. ● Borrow pit rehabilitation – the contractor will partially fill borrow areas with acceptable material (approved by the supervisor's ESS staff) to form a safe landform and covered with topsoil. Drainage should be ensured to avoid accidents and public health risks. The areas of disturbance and steep slopes must be stabilized. The rehabilitation plan will be in the contractor method	After conclusion of works		UNOPS/ PIU	

		statement and borrow management plan. ● The contractor will implement rehabilitation and monitor effectiveness over three years.				
Access roads and paths used	Soil erosion, aesthetics, watershed restoration, safety hazards	● The contractor will conduct detailed site inspections, define and map disturbed areas where rehabilitation/erosion control is required. ● The contractor will develop method statements for each area, including problem statement, method of rehabilitation, resources needed and responsibilities. ● These roads accelerate erosion and contribute to siltation of the dam as well as water turbidity of the reservoir especially in the rainy season. The contractor will repair of any existing roads used in accessing the dam site for decommissioning activities. Some of the unnecessary paths around the dam should be closed by ripping and planting of vegetation. Restoration of any over ground access areas through replanting of native plant seed mixes suited to the area at three trees per one removed tree. Local/ native species are indicated in this ESMP. ● The contractor will create an ideal and safe crossing downstream of the dam. Crossing over the embarkment may not be safe for the community. ● Natural regeneration and adequate full area coverage assisted vegetation using native vegetation species will be implemented and monitored by the contractor.	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

		• The contractor will ensure that the rehabilitation plan will be in the contractor's site method statement and management plan • The contractor will implement rehabilitation and monitor effectiveness over three years.				
Campsite	Land use and aesthetics	• The contractor will remove all campsite facilities retaining those that need to be handed over to the community /DMC (if there will be any), for use. After accomplishing the dam construction works and before handing over, the campsite should be rehabilitated in an environmentally sound and acceptable manner to satisfy ZEMA regulations.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Contaminated materials and hazardous waste	Soil and water Pollution safety hazards	• The contractor will conduct detailed site inspections and prepare a snag list. Prepare snag list defining each area where remedial action is necessary, including location of waste oil drums and/or other hazardous chemicals, location of oil-contaminated soils and the required actions • The contractor will where possible return some materials to the suppliers, e.g. diesel and disinfectants for resale or reuse. The remaining materials be disposed of as waste, some of which may be deemed hazardous waste due to their composition e.g. oils. Such materials will be disposed of off-site in accordance with appropriate waste management regulatory requirements and facility waste management procedures. Soil contaminated with hydrocarbons will be excavated up to clean material beneath the base of the to the contamination	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer Supervisor/ PIU	In rehabilitation cost

		plume and bio-remediated in a land farm. Where the contamination plume is willow, in-situ bio-remediation will be conducted using nutrients and enzymes. Such sections will be mapped and backfilled with fresh soils. The rehabilitation plan will be in the contractor's site method statement.				
Pit Latrines	Pollution of groundwater and soil, safety hazards	● The contractor will decommission all VIP pit latrines that will be constructed by dismantling and the pits buried after applying lime. The rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Waste heaps and non hazardous waste	Landscape impacts, safety hazards	● The contractor will develop a snag list and conduct site inspections. ● The contractor will ensure that rubble including vehicle and machinery parts and derelict components are removed from the site and transported for disposal at a ZEMA/ local authority certified dump site. All the heaps of soil will be levelled and areas that were used as workstations will be re-vegetated. The rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Stock piling	Land use and aesthetics safety hazards	● The contractor will ensure that all heaps of overburden material should be used to back-fill the borrow pits and the sections properly levelled to suit the natural landscape. ● Stock-pilling/preservation of the felled trees - The recommended practice is that the contractor is required to stockpile all the felled trees. There will be no burning of burying any felled trees.	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Reservoir Water Quality	Ecological services and aesthetic impacts	• The contractor will set up a designated livestock area on the upstream that will be stone pitched for controlled livestock movement and watering to prevent soil movements. • The ground will be prepared and then pitching will be done before vegetation is planted.	Construction Phase	• Livestock watering area at the basin	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Embankment fencing **Embankment structural works**	Forest cover loss threats Embankment failure	• The contractor will install metallic poles in a liner fashion for the animal barricade at the ends of the embankment wall to replace the temporary log fencing. • The contractor will completely dig out ant habitants and their tunnels exposed and broken down then backfill and compact with suitable fill material	Construction Phase	• Permanent fencing to keep animals away from the embankment	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Covid 19 Pandemic	**Spread of Covid-19 pandemic among the workforce and the local community**	• The contractor will provide and implement relevant COVID-19 guidelines for all the workers to follow in the quest to avoid/prevent the spread of Covid-19 among the workforce and the local community. This will be consistent with the provisions in the WHO and Zambia's Public Health Regulations on COVID-19 management.	**Preparation and construction phases**	• Sensitization and actual provision of sanitizers and face masks.	**Contractor Engineer and HSSE Officer**	**Included in rehabilitation cost**

Table 16 Operation Phase Risk Mitigation Measures

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Non Hazardous Waste Management						

Construction and Operation activities	Waste releases from local communities Public health and safety hazards Potential waste types include domestic solid waste due to activities around the dam-plastics, containers, boxes, papers	• The DMC be trained on household waste management. There will be no disposal or storage of waste at the Kanyika dam site.	Operation Phase	• Properly designated waste collection and disposal points • Training/ sensitization records • Waste disposal records and logs • 100% of sites are cleaned up	DMC / Water User Committee Ministry of Agriculture DWRD	500/month
Hazardous Waste Management						
Operation activities- pest management, fertilizers	Hazardous waste generation and releases into the environment- Chemicals	• IDSP, Ministry of Agriculture, Department of fisheries will train the communities on operation activities that minimize pollution of water. These are outlined in the capacity and training program.	Operation Phase Monthly	• Non-polluting farming, animal watering and fishing methods (e.g. farmers not to push nitrate-based fertilizers into the surface water/dam) are applied • Training/ sensitization records, 100% • Water quality monitoring records	DMC/ Water User Committee Ministry of Agriculture DWRD IDSP	100/month
Surface and Groundwater Pollution Management						
Livestock watering and activities in the water	Siltation Poor water quality	• The IDSP will conduct and promote community farming methods that will not pollute the water- chemicals or runoff and soil erosion.	Operation Phase Quarterly	• Water quality results from the dam and main tributaries in the catchment	DMC Ministry of Agriculture	Once off- 20,000 700/month

		• The Department of Forestry, Community Development, Water Resources and IDSP will conduct catchment management sensitizations during community trainings to promote raw water quality in all catchment sources, review land use practices/ social needs, biodiversity conservation and minimize run off on a catchment scale. This will focus on creating a catchment management scheme. • Communities will continue sensitizing the farmers on catchment management practices, stock watering control and soil conservation.		• Pollution control structures • Training and sensitization records	Forestry IDSP	
Sanitation Management						
Community sanitation	Environmental pollution, public health risks	• The community will be trained in the impacts of open defecation.	Operation Phase	• Existing adequate sanitary facilities	DMC / Ministry of Health	500/month
	Breakout of water borne disease as a result of poor sanitation practices by communities living upstream of the dam	• Sensitization of the local community both those living upstream of the dam and those living around the dam, using a programme called Community Led Total Sanitation Programme (CLTS). This programme compels the members of the community to have at least one toilet per household. This in turn reduces and completely stops open defecation by the same community members.	Construction and Operation Phase	• Records of sensitization programme stating where sensitization took place, how many of these programmes, name and number of villages attended.	During Construction IDSP working with Ministry of Health During Operations Ministry of Agriculture working closely with Ministry of Health	**7000**
Pedestrian Infrastructure Management						

Maintenance of access infrastructure	Deterioration of access infrastructure, increased chronic sediment delivery, disturbed hill slope hydrology, and impacts to aquatic, riparian, and terrestrial ecosystems of roads crossings Safety hazards	• IDSP will sensitize the community on appropriate use of the infrastructure to avoid and minimize failure. It will carry out regular inspection and maintenance of the infrastructure, and maintain the infrastructure and safety measures. • IDSP will train dam committee on use, maintenance and monitoring requirements.	Operation Phase Quarterly	• Training records • Inspection records • Maintenance records	Dam committee IDSP	3000/year
Biodiversity Management and Flow Management						
Aquatic biodiversity Operational activities	Biodiversity loss and ecological flow limitations, population increases	• The BMP will be implemented accordingly to ensure appropriate measures are put in place for biodiversity conservation purposes where feasible. • Maintain ecological flows all year round and integrity of the ecological function. • UNOPS to increase basin water holding capacity by rehabilitating the structure in order to enable constant downstream flows and basin water levels. Otherwise the basin may run dry. This would also relocate the aquatic species from the dam. A system for equitable allocation of water is based on available supply. • Include gauge levels monitoring facilities. dam committee to strictly monitor inflows, retention water and outflows in order to have a balanced system.	Operation Phase	• Ecological flows monitor • Relevant quantity, quality and timing of water flows required to sustain ecosystems and the human livelihoods and well-being that depend on these ecosystems	Dam Committee Fisheries Forestry UNOPS IDSP	10000/year

		• UNOPS to include outlet infrastructure for downstream flows. • Dam committee to monitor the erosive capacity of the streams downstream for sediment barrier occurrence upstream. • Dam committee to monitor flow level changes downstream. Natural flows and dam controlled flows. • Communities to protect vulnerable and endangered species. • Avoid exploiting biological use of resources and invasive methods. • Secondary developments to take aquatic biodiversity into consideration.				
Terrestrial biodiversity, operational activities	Biodiversity and habitat loss	• The BMP will be implemented. • Active control of invasive and alien species after trainings by government departments. • The community will incorporate catchment management measures habitats around the dam. Avoid displacements and over exploitation of species.	Operation Phase	• Biodiversity conservation measures in place	Fisheries Forestry Ministry of Agriculture	1500/year
Loss of fish in the dam, which is of conservation concern	Food insecurity	• Ministry of Agriculture working with Department of Fisheries to train the community and DMC that benefit from the ecological value of the dam so they can learn sustainable fishing skills and preserve the fish juveniles in the willow waters	Operations Phase	• Training records showing number of persons trained and when	Ministry of Agriculture; Department of Fisheries	**6000**
Communication and Community Engagement						
Communication to Stakeholders	During operational phase, dam is not managed	• IDSP to train dam committee in E&S issues indicated in the UNOPS and contractor training plans.	Operations Phase	• Dam committee exists • Dam committee has been trained	IDSP local authorities	5.000

	well by local communities					
Dam Catchment Management						
Catchment management	Excessive rates of erosion and sedimentation	• The IDSP will ensure the DMC and the officers from Governmental departments, such as Water and Agriculture are appropriately oriented to appreciate the contents of the O&M Manual, use and benefits, for sustainable management of the dam catchment area.	Operation phase	• The following personnel trained in the implementation of the O&M; - Dam Committee, - Waters Affairs - Agriculture • Camp site officer	IDSP DWRD Dam committee	**Included in training costs above**
Community Health and Safety						
Lack of safety measures **Dam use Crossings**	Public health risks and diseases Drowning Injury Dam failure	• The communities will be trained by IDSP and government departments in maintenance of safety signage around the dam reservoir, embankment, crossings, material sources, roads. • The contractor safety signage plan, location and type will be presented for approval to the supervisors and PIU by the contractor. Safety areas will include undesignated or risky crossing points or activities around the dam, community warning prior to opening any valves, flooding, health, safety, planning, prevention and response, reporting faults and security measures at the dam.	Operation Phase	• Inspection reports • Training records • EPP revisions and reviews • Safety signage Plan and records • Refer to the technical safety reports	Dam Committee Ministry of Agriculture DWRD IDSP	2000/year
Gender Equality and GBV Action						
Gender Mainstreaming	Dam Committees do not have female members	• IDSP will define gender parity in constitution of the dam committee and include gender equality training in the training of dam committees.	Operation Phase	• Dam Committees have 50% female members	IDSO	Included in training costs above
Maintenance and Monitoring Management						

Dam maintenance	Structural deterioration Dam Management	• The IDSP will conduct further dam committee trainings on dam maintenance and dam safety. • The dam committee wil ensure incidents are reported to the resident IDSP staff and responded to. • UNOPS and IDSP will conduct Maintenance and Flow inspections trainings for communities and district officers. • IDSP will conduct periodical Dam safety assessments. • IDSP will employ record keeping for the Dam maintenance works done by the department and by the community.	Operation Phase Bi annual	• Dam committee Quarterly meetings and resolutions • Flow measurements and action plans • Training records • Dam maintenance records and monitoring records • Refer to technical safety reports	UNOPS IDSP DWRD Dam Committee	3000/ year
Monitoring measures	Lack of monitoring	• IDSP will conduct water quality measurements for parameters indicated in this ESMP. • IDSP will conduct and follow up on flow measurements. • The Ministry of Fisheries and Forestry will conduct biodiversity monitoring as guided in the BMP.	Monthly	• Refer to the biodiversity assessment • Monitoring records • Pictures • Training records • Flow measurements • Water quality results, monthly The monitoring parameters will include biological, physical and chemical drinking water quality parameters. These will include parameters analysed in this ESMP: pH, conductivity (µg/cm), sulphates (mg/l), nitrates (as no3-n mg/l), total dissolved solids (mg/l),	IDSP DWRD Dam Committee	4000/ year

				ammonia (as nh4-nmg/l), phosphates (mg/l), total suspended solids (mg/l), chemical oxygen demand (as mg o2/l, chlorides (mg/l), turbidity (ntu), hydrocarbons (mg/l) additionally with total and fecal coliform tests. If hydrocarbon contamination is suspected, the test will be included. The testing will be done at certified/ approved laboratories after proper sampling methods.		

7.2. Rehabilitation and Remediation Plan for the Previous Works' Sites

This plan is prepared in reference to the ESA Table 9-2 'Requirements for rehabilitation plan' which requires that rehabilitation specifications for embankments, borrow pits, access roads / tracks created during past construction/ and any areas of downstream erosion / embankment destabilization that has been caused by the previous construction works and the initial operation of the dam are prepared.

The main purpose of this plan is to:

- identify, rehabilitate and remediate the existing previous dam construction areas, which have environmental and safety issues;
- identify, rehabilitate and remediate existing incomplete dam construction works and sites to enable completion;
- outline the requirements to return previously disturbed sites to a state which is similar to the state prior to construction.

One limitation of this plan is that full restoration may not be possible, therefore rehabilitation and remediation with the aim to meet continuing or changing uses is foreseen. This rehabilitation is part of the main project construction works. Therefore implementation of this ESMP applies with an active dam committee role during and after construction for maintenance and monitoring.

The rehabilitation works are elaborated in the table below.

Table 17 Rehabilitation works management

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
Structural risks						
Spillway	Location: Images: Section 5 'Dam characteristics' Open unstable and/ or eroding slopes Risks: structure failure, soil loss	Refer to the dam design reports	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Rock quantities 100m^3 Equipment: Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator *Workmanship* Up to 5 machine operators and 10 laborers as per above and up to 4 months for the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	Trimmed, extended and stabilized slopes Gullying and erosion protection	In BoQ
Return channel drop structures and training wall risks	The structures have temporary sandbags to control erosion Risks: Gullies and erosion in the return channels	Refer to the dam design reports.	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earth works:	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated walls and adequate gabion presence	In BoQ

	Erosion risks on drop structures		Sand, quantities 105m^3 Rock, quantities 200m^3 Crusher runner from a commercial quarry , quantities 105m^3 Equipment: Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship* Up to 5 machine operators and 10 laborers as per above and up to 4 months for the equipment			
Embankment crest and slope stability risks	Temporary sandbags placed in risky areas to address erosion. Risks: Erosion hazard and embankment stability Embankment weakening.	Refer to the dam design reports.	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Sand, quantities 156m^3 Rock, quantities 300m^3 Crusher runner from a commercial quarry , quantities 156m^3 Equipment Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* Up to 6 machine operators and 10 laborers	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated walls and adequate gabion presence	In BoQ

			as per above and up to 4 months for the equipment			
Rock toe risks	No rock toe present for seepage control Risks: Weakening of side slope	Refer to the dam design reports.	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Rock, quantities 200m^3 Equipment backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* Up to 6 machine operators and 15 laborers as per above and up to 4 months for the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated walls and adequate gabion presence	In BoQ
Non-structural risks						
Waste and rubble snag list	Not present on site					
Hazardous waste snag list	Not present on site					
Borrow pits	Location: two existing borrow areas. Immediate upstream of the dam. with dimension about	Include earthworks, rehabilitation of the sites to promote drainage, aesthetic uniformity, and revegetation by seeding and natural succession vegetation, slopes and safety.	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction Contractor	Contractor liability period Site inspections Pictures Continuous maintenance during	Contouring Drainage Stabilized slopes Desired landform	In provisional sum Day works

	20mx20m) and another one further upstream almost in line with the first one, in the eastern direction. This one meanders a bit but approx. dimension would be 50mx30m). Coordinates: Immediate upstream of dam area - eastwards 13°30'45.84"S, 25°55'15.85"E; Further upstream of dam area - 13°30'44.71"S, 25°55'18.20"E Images: Section 4.1 Risks: community health and safety , biodiversity loss	Partially fill borrow areas with acceptable material to form a safe landform and covered with topsoil (there are some top soil vegetated heaps around the downstream borrow pit) or grading to a desired landform slope and drainage. Stock the existing vegetated sites' soils during borrow rehabilitation and place back when works are done. Plant native seeds in addition to the replacement of top soil to ensure coverage. Construct appropriate surface slopes with drainage channels to prevent water from collecting at the site. Final slopes within the site will be a maximum horizontal to vertical slope (H:V) of 3:1 or 33% grade. Ensure drainage to avoid accidents and public health risks. Stabilize areas of disturbance and steep slopes. Implement reinstatement by natural succession together with full cover assisted vegetation seeding interventions, which will require intense monitoring and maintenance within the 3 years maintenance period. This will include sub-base preparation, top-soiling, fertilizing and seeding for each area which requires rehabilitation.	Supervisor: UNOPS Remedial works will include earth ripping to enable regrowth of natural vegetation. Assisted vegetation (seeding and soil fertilization with watering) will be included on all sites to supplement possible natural vegetation. The unnecessary roads should be close by scarifying the roadway, ripping and recontouring. Re-establish natural drainage patterns on the closed roads. *Materials and equipment* Earthworks Spoil Soils for top soiling within the borrow area stockpiles Grass seeds- approved noncompetitive native species Watering equipment Fertilisers/ soil fertility promoters Equipment Backactor; tractor dumpers; and haul truck *Workmanship and timeline:* up to 6 machine operators and 5 local workers for less than 4 months.	the 3 year maintenance period		

Access routes	Location and Condition of the sites: 1 existing narrow gravel roads (about 2m wide) leading to the dam. This is about 600m. Also short distance access roads to the borrow pits) (Extents shown in google map under section 4.1). Risks: biodiversity loss	Rehabilitate and close the roads, which will not be used by the current contractor. Include earth ripping to enable possible regrowth of natural vegetation, even as assisted vegetation will be implemented on full coverage of the areas. Close unnecessary roads by scarifying the roadway, ripping and recontouring. Create an environment supporting over ground with natural regeneration to support the assisted vegetation. Assisted vegetation will included seeding, watering and maintenance of locally adapted vegetation. Re-establish natural drainage patterns on the closed roads.	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Limited gravel utilizing existing surface to form with a grader and tractor dumpers Grass seeds- approved noncompetitive local/ native species Watering equipment Fertilizers/ soil fertility promoters *Workmanship and timeline:* 4 Operators and 8 laborers as per above equipment 4 days per equipment	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Ripped roads for revegetation Revegetation	In provisional sum Day works
Eroded and disturbed areas	Open areas around the basin, material area slopes, specifically the upstream north eastern side of the dam. Risk: dam basin siltation, poor water quality contribution, limiting water use,	Implement reinstatement by natural succession with assisted vegetation seeding interventions, which will require intense monitoring and maintenance within the 3 years maintenance period. This will include sub-base preparation, top-soiling, fertilizing and seeding for each area which requires rehabilitation. Develop a costed method statement for disturbed sites. Designate livestock watering points and promote soil	*Timing:* day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Compacting, stone pitching material and native vegetation seeds for soil stabilization method Concrete trough, pump, tank	Contractor liability period Site inspections Pictures Continuous maintenance	Soil stabilization and livestock watering points	In provisional sum Day works

	soil movements and loosening	stabilization by stone pitching, compacting and/ or trough creation as an alternative watering mechanism to keep some animals from the dam basin. The last option is the more expensive one of the two.	Tractor dumpers; and haul truck for materials *Workmanship and timeline:* 10 laborers and 1 month use of the equipment			
Community health and Safety	Lack of safety signage around the dam Lack of safety and health sensitization over the dam Risk: accidents and waterborne diseases due to lack of knowledge and signage warning	Include a method statement for the design of signage and location mapping. This will be approved by the supervisor. Apply design-approved standard dam safety signage around the dam and contractor sites for construction and operational phases. Finalize and administer the community sensitizations and training planned in the ESMP. These include drinking water health, water borne diseases, avoidance of dangerous spillway crossings, swimming risks, emergency preparedness in floods or dam failure, EPP, safety signage, etc...	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Training plans Signage design and subcontractor Signage installation *Workmanship and timeline:* One trainer persons Signage installation 3 laborers	Contractor liability period Site inspections Pictures Continuous maintenance Dam committee regulation	Training records in all stipulated topics Existing correct signage Signage method statement	In provisional sum Day works
Flow gauges	Downstream flows	Flow monitoring	*Timing:* day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor, dam committee Supervisor: UNOPS *Workmanship and timeline:*	Contractor liability period Site inspections Pictures Continuous maintenance and biodiversity monitoring	Installed monitoring gauges Training records	In provisional sum Day works

			1 operator and 4 laborers Equipment: concrete mixer and poker vibrator equipment			

Implementation Role: contractor, dam committee
Supervisor: UNOPS

8. Capacity Building

Community / Stakeholder Health and Safety training plan

In compliance with the policy and legal framework, the environmental and social assessment recognized some training and knowledge gaps in relation to construction and operation phases of the Kanyika Dam. Capacity building will be the process used by which individuals and departments obtain, improve, and retain the skills, knowledge, tools, and other resources required for dam safety and environmental management at the dam. The training plan in Table 18 has been proposed for capacity building of district government staff, dam committee members and community members (upstream and those living on the north and south of the dam). The implementation and execution of the sub-project will include additional training of relevant staff and communities, stationed in the various sites, in environmental and social due diligence during construction and operation. UNOPS will supervise the training on behalf of IDSP. Identified trainers include: staff of local health centre, district department representatives, UNOPS E&S Team, UNOPS dam safety Team, IDSP and the contractor.

In addition, the contractor will include in their work plans and carry out training of workers on the required safeguards they are expected to implement as part of the daily activities. The training material will be derived from the ESMP and the sub-project's Technical Dam Safety documents, and other sources. This section does not cover the contractor's training requirements, which are detailed in Appendix H.

Training monitoring will be conducted by the IDSP and UNOPS by reviewing the training materials, filing training records and noting feedback and following up on recommendations/ action plan.

The training topics include:
For District Officers;

- Policy and legal framework
- Dam safety management
- Maintenance and ESMP requirements/ roles
- Monitoring measures and procedures
- Stakeholder Engagement Plan
- Dam operation and roles

For Communities;

- Policy and legal framework
- Dam safety management including Emergency Preparedness and Response
- Community health and safety, including drinking water and water borne diseases, avoidance of dangerous spillway crossings, emergency preparedness in floods or dam failure, swimming and drowning risks, first aid in the event of potential drowning, risks of crossing at the dam spillways, management of livestock around the dam, malaria prevention and management, bilharzia prevention and management, management of other water borne diseases, use of dam water for drinking and emergency preparedness interactions with wild animals
- Grievance Redress Mechanism (GRM) which includes GBV and SEA cases
- Maintenance and ESMP requirements/ mitigation measures and monitoring.
- Dam operation and environmental flow
- Catchment management
- Biodiversity management and monitoring

The proposed training plan is shown in Table 12[22]:

Table 18 Training plan

Training Content	Number of Days, Time, Frequency	Trainers / Supervision	Participants
Dam Safety-Emergency preparedness, and Community health and safety			
Emergency preparedness: Key Training Concepts: Hazards, floods and dam failure, roles and responsibilities, emergency preparedness, emergency response procedures and grievance redress mechanism *Community health and safety: Key Training Concepts: Pedestrian access infrastructure, Construction safety, Gender based violence, swimming risks, drowning risks, dam security, spillway crossing risks, management of livestock around the dam, use of dam water for drinking, wild animals, malaria prevention and management, bilharzia prevention and management, water borne diseases, dam maintenance and ESMP monitoring* *First aid: First aid basics and response*	5 after ESMP disclosure prior to construction works Repeated after 3 months and at completion	5 after ESMP disclosure prior to construction works Repeated after 3 months and at completion	100 community members 15 District DMMU members Dam committee

[22] UNOPS to have overview over planning and execution of training on behalf of the IDSP/P

Estimated Costs: 2,000 USD per session			
Grievance Redress Mechanism and ESMP monitoring requirements			
Key Training Concepts: Sharing of the Environmental and Social Management Plan (ESMP) by IDSP/ Contractor to the stakeholders	Key Training Concepts: Sharing of the Environmental and Social Management Plan (ESMP) by IDSP/ Contractor to the stakeholders	UNOPS: Environmental Specialist, Social Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental and Social Specialist	18 District Officers 2 officers from each of the following Departments: ● Town Council ● Ministry of Chiefs and Traditional Affaires ● DWRD ● Ministry of Health ● Forestry Department ● Ministry of Gender ● Community Development ● Ministry of Fisheries and Livestock ● Ministry of Agriculture
Estimated Costs: 1,500 USD			
Dam operation activities			
Key Training Concepts: Fishing regulations, species, fisheries conservation, catchment management, environmental protection, forestry regulations and biodiversity conservation measures, dam sustainability, nurseries, farming methods and dams, sustainable irrigation, pest management, water pollution, crop selection, soil conservation methods	3 at works commencement and repeated annually	UNOPS: Environmental Specialist Environmental health and safety Specialist Government: Agriculture Fisheries Forestry Community Development IDSP: Dam safety Specialist Environmental and Social Specialist	100 community members
Estimated costs: 1,000 USD per session			

9. Stakeholder Engagement

The Stakeholder Engagement Plan seeks to define a structured, purposeful and culturally appropriate approach to consultation and disclosure of information during the preparation of the ESMP and implementation stage. UNOPS and IDSP recognize the diverse and varied interests and expectations of stakeholders and seek to develop an approach for reaching each of the stakeholders in the different capacities at which they interface with the sub-project. The aim is to create an atmosphere of understanding that actively involves project-affected people (PAPs) and other stakeholders leading to improved decision making.

Overall, this Plan defines the stakeholder engagement requirements in regards to a) engagement prior to remedial works about the immediate dam safety concerns; b) engagement during (and related to remedial works dealing with construction impacts; and c) engagement in regards to the long term use of the reservoir, maintenance of infrastructure, ensuring vulnerable groups benefit from the sub-project, community health and safety, etc.

While COVID-19 restrictions are still in place, strategies will be employed to include smaller meetings, small FGDs to be conducted as appropriate taking full precautions on staff and community safety. Where meetings are not permitted, traditional channels of communications such as radios and public announcements will be implemented.

9.1. Grievance Redress Mechanism

Stakeholder engagement includes access to a Grievance Redress Mechanism (GRM) implemented by IDSP. The GRM is designed ensure that feedback can be received in relation to the remedial works for the Kanyika Dam. It is set up to respond to concerns and grievances of all community members and to receive feedback related to the environmental and social performance of all activities.

Stakeholder engagement forms a fundamental element to ensure that the GRM process and relevant contact details are well communicated to the respective communities in the dam areas, and that communities are consulted on the performance of the GRM to allow for potential adjustments where needed. This Stakeholder Engagement Plan lays out how the GRM protocols are disseminated to all stakeholders.

Dam committee members thereby play a key role in the GRM, as they receive grievances or feedback from community members in person; hold the keys to suggestion boxes and regularly empty them; assess and clarify grievances; provide feedback to community members; investigate grievances; provide appeals mechanisms for unsatisfied community members; document all grievances in a log/register; and report all grievances and their processes on a monthly basis to IDSP.

9.2. Stakeholder Participation

The preparation of the ESMP has relied significantly on local level stakeholder engagement in order to gain understanding of the needs of the dam communities, and potential risks and impacts as well as mitigation measures of the planned rehabilitation activities.

Stakeholder consultation was conducted through review of previous engagement notes from the WRDP reports, key informant interviews with government stakeholders, and focus group discussions and community consultations held during sub-project preparation. COVID-19 regulations were adhered to during engagement. The attendance sheets are shown in Appendix F.

It is important that affected communities and other stakeholders are given the opportunity to continually participate in the process during the remedial works. Therefore, consultations were held:

- To provide information about the previous and current sub-project and to get stakeholder information on key environmental and social baseline information at the sub-project site;
- To receive information on legacy site impacts of the previous project in relation to non-rehabilitated sites;
- To provide opportunities to stakeholders to discuss their opinions and concerns;
- To identify specific interests, roles and responsibilities of stakeholders and ensure their approval and participation in the development of the ESMP; and
- To inform the process of developing appropriate management measures as well as institutional arrangements for effective implementation of the ESMP.

A summary of the views and concerns raised during the consultations and field visits to the Kanyika dam communities are stated below:

Table 19 Stakeholder consultation concerns

Item No.	Department/Organization/Community member(s)	Concern/Input	Response provided
1.	District Commissioner	● The priority criteria must try to consider that Kanyika is in a climate change vulnerable area and is water stressed	● UNOPS design team has considered such parameters in the proposed remedial works
2	Social welfare	● Vulnerable persons must benefit from the infrastructure – female-headed households, chronically ill, child-headed households, aged and the disabled. Ensure it is usable by all persons e.g. access routes, irrigation and water use ● Men take part in most income generating activities including employment ● Women and the vulnerable benefit more than the men from the government's resource park through the department for gender equity	● The contractor and various local departments, such as agriculture and fisheries will train community members in the required skills to manage such ventures. Women will be represented in the whole programme including the vulnerable headed households ● The reason for the approach was to ensure the vulnerable homes are made better in terms of food security and

		● The sub-project should involve employment of both men and women ● The Zambia Police's Victim Support Unit VSU, Government Community Development and World Vision NGO deal in gender matters in the district. ● There have not been many local initiatives or programs due to lack of funding	other ventures ● The meeting participants were informed that the supervisors will ensure the contractor engages both male and female as this is the demand of the management plan and gender equality. ● It is anticipated that after training community members in various skills, specifically agriculture and fishing activities, there will be some form of empowerment.
	Arts and Culture	● Engage the locals during rehabilitation so that they adopt the ownership of the dam and they empower themselves. Use the local structures in all the programs	● The contractor has specific instructions to engage the local community throughout the preparation and construction period
	Forestry Department	● Afforestation and reforestation are vital for dam sustainability ● North Western Province and Kasempa, in particular, is facing challenges in preservation of trees in the areas that are outside the game management areas, due to charcoal burning. The environment around the project infrastructure is affected due to small scale farming activities upstream of the dam. The local community cuts down trees and clear any remaining vegetation to allow for small scale farming. ● The department has been advised to ensure the vegetation around the dam is preserved to control siltation.	● The community was strongly advised against cutting down trees as this will have an effect on the ecology of the environment round the dam. ● Same as above. And added that the community will be trained on best methods of farming which are not destructive to the local environment. ● UNOPS advised the department to also take part in sensitizing the community against destruction of the

			local ecology
	Agriculture Department	● The sites have sparse vegetation with significant disturbance to the natural ecosystem ● Cut off drains, silt traps and contour bands around the reservoir must be considered ● Kanyika Dam has siltation problems, mostly due to cultivations upstream and very close to the dam ● The local communities are already involved in small scale gardening downstream of the area. The dam committee should be encouraged to work with the local community in ensuring dam safety otherwise downstream activities may be impacted.	● This was observed and noted. Revegetation will be done by the contractor in the legacy sites ● The contractor will, during remedial works, work on arresting soil erosion and sedimentation. ● The community was advised not to cultivate upstream of the dam as this will have detrimental effects on the ecological benefits from the dam such as fish stocks in the dam. ● The emphasis was given for the need for the dam committee to take charge and ensure the dam infrastructure is protected.
	Community member(s)	● The Dam has been beneficial to most communities even distant and unanticipated ones ● Dam's structural structure problems have to be sorted out- Spillway capacity, drop structures integrity, erosion along drop structure surface, riprap and re-grassing, siltation in the basin and the seepage ● Access route downstream require rehabilitation ● Irrigation is needed as a livelihood source, canals should be properly constructed ● Dam safety is not in place. The	● This was noted. ● The community was informed that the contractor will soon be here to work on the structural and non structural non compliances observed at the dam. ● The management plan is framed in a way that rehabilitation works are mainstreamed in the contractor's scope of work. The rehabilitation requirements will be executed by the contractor. ● The scope that the contractor will execute includes working on the canals to revamp the original intent of the dam in the Kanyika community.

		access across the embarkment seems not safe during the rainy season ● Training is needed for the Dam Committee. ● ● Employment should involve the locals	● The remedial works include the aspects of making the dam safe for use by the public and the local community ● The Project scope includes the aspect of training the Dam Committee as well. ● The contractor is specifically advised to consider the locals especially for non-skilled labor requirements.

9.3. Stakeholder Communication Plan

Information disclosure will rely on the following key methods: community meetings in coordination with local authorities (headmen, dam committee, and district administration), community notice boards, phone communication (SMS), and radio broadcasts. At the national level information will be disclosed mainly by email and on the IDSP and UNOPS websites. Information will be disclosed in English, which is the official language of Zambia. Information will also be disclosed in the local language to ensure understanding of the critical issues. Local authorities, such as the District Administrator, local headmen, the Kanyika dam committee and the district disaster committee will be requested to inform communities in community meetings and through disclosure on social media where feasible.

Table 20 Stakeholder communication plan

Phase	Item to be disseminated	Actions	Responsibility	Registry Format
Information dissemination prior to remedial works about the immediate dam safety concerns	GRM	Community meetings with local headmen, dam committee, District Disaster Committee, community members – with social distancing Community notice boards Radio announcement / broadcast Email – national level stakeholders	IDSP Environmental and Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message
	ESMP	Community meetings with local headmen, dam committee, District Disaster Committee, community members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc… – with social distancing Community notice boards Radio announcement / broadcast Email / website – national level stakeholders	UNOPS Social Safeguards Specialist and IDSP Environmental and Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message, website
	Information on dam safety concerns	Community meetings with local headmen, dam committee, District Disaster Committee, community members – with social distancing Community notice boards	UNOPS Social and Environmental Safeguards Specialists; UNOPS Engineer	Minutes of meeting Messages produced for notice boards
	Information on construction	2 weeks before entrance of contractor – Meeting with local headmen, dam committee members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc. – with social distancing	UNOPS Social and Environmental Safeguards Specialists; UNOPS engineer; constructor	Minutes of meeting
Information Dissemination	ESMP	Community meetings with local headmen, dam committee, District Disaster Committee,	UNOPS Social Safeguards Specialist	Minutes of meeting

during remedial works		community members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc. – with social distancing Community notice boards Radio announcement / broadcast Email / website – national level stakeholders		Messages produced for notice boards Message sent to radio broadcaster Email message, website
	Any works-related information (on activities, details of construction activities, labor)	Community meetings with local headmen, dam committee, District Disaster Committee, community members, other relevant district authorities, e.g. fisheries, agriculture, social welfare etc. – with social distancing Community notice boards	UNOPS Social and Environmental Safeguards Specialists; UNOPS engineer; constructor	Minutes of meeting Messages produced for notice boards
	GRM	Community meetings with local headmen, dam committee, District Disaster Committee, community members – with social distancing Community notice boards Radio announcement / broadcast Email – national level stakeholders	IDSP Environmental and Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message
Information Dissemination in regards to the long term use	GRM	Community meetings – with social distancing Community notice boards	Dam Committee; District Disaster Response Team; local headmen	Minutes of meeting Messages produced for notice boards
	Information on dam safety concerns	Community meetings – with social distancing Community notice boards	Dam Committee; District Disaster Response Team; local headmen	Minutes of meeting Messages produced for notice boards

9.4. Stakeholder Consultation Plan

In addition to information dissemination, the sub-project will ensure consultations of the local community in view of all sub-project activities, including environmental and social aspects. Consultations will mainly take place through community meetings. The GRM will be another means of consultation, as complaints received will be filed, assessed and responded to (see separate document).

Table 21 Consultations during ESMP preparation

Project stage	Topic of consultation	Suggested Method, Time and Venue	Target stakeholders	Responsibilities
Consultations prior to remedial works about the immediate dam safety concerns	Overall sub-project activities / E&S mitigation measures	Community meetings – with social distancing	Community level stakeholders, including vulnerable groups	UNOPS
		Meetings with women's groups of other vulnerable groups – with social distancing	Vulnerable community members	UNOPS
		Consultation meetings with local headmen, dam committees and district authorities Venue: community meeting venue at the dam Time: June 2020 and April 2021	local headmen, dam committees and district authorities	UNOPS

Table 22 Consultations planned for the implementation stage

Project stage	Topic of consultation	Suggested Method	Target stakeholders	Responsibilities
Consultations during remedial works	Sub-project Activities / E&S Mitigation Measures ESMP Disclosure	Community meetings (all interested community members)	Community level stakeholders	UNOPS
		Suggestion box at district office, school, church	Community members, including vulnerable groups	IDSP Social Specialist
		Stakeholder meetings – with social distancing	Dam Committee and district level stakeholders	UNOPS
		email	National level stakeholders	UNOPS

	Venue: community meeting venue in the village or the school District council hall Time: to be agreed with the community and other stakeholders After document clearance and before construction works commence	Dam committee, local headmen, and District Disaster Committee to receive feedback in person	Community level stakeholders, including vulnerable groups	IDSP Social Specialist
		email	National level stakeholders	UNOPS

9.5. Proposed Strategy to incorporate the Views of Vulnerable Groups

UNOPS and IDSP will ensure that women, persons with disabilities, other members of vulnerable groups are participating effectively and meaningfully in consultative processes and that their voices are not ignored. This may require specific measures and assistance to afford opportunities for meetings with vulnerable groups in addition to general community consultations. For example, women may be more outspoken in women-only consultation meetings than in general community meetings. Similarly, separate meetings may be held with young people, persons with disabilities. Further, it is important to rely on other consultation methods as well, which do not require physical participation in meetings, such as social media, SMS, or radio broadcasting, to ensure that groups that cannot physically be present at meetings can participate.

In view of promoting gender equality, it is most important to engage women's groups on an ongoing basis throughout the lifetime of the sub-project. Women voicing their concerns and contributing in the decision-making process on issues such as community infrastructure should be encouraged, especially in various fora that predominantly consist of men.

GRMs are designed in such a way that all groups identified as vulnerable have access to the information and can submit their grievances and receive feedback as prescribed.

9.6. Reviews of Comments

IDSP will gather all comments and inputs originating from community meetings, suggestion boxes, GRM outcomes, and surveys. The information gathered will be submitted to the Social Specialist in the PIU, to ensure that the sub-project has general information on the perception of communities, and that it remains on target. It will be the responsibility of IDSP respectively to respond to comments and inputs, and to keep open a feedback line to the communities, as well as the local authorities. This SEP provides the overarching guidelines for the rolling out of stakeholder engagements.

10. ESMP Implementation Process

Step 1: Procurement and Bidding Process

Based on this ESMP and the designs for the Kanyika Dam works developed, UNOPS will prepare bidding documentation to procure a contractor to implement the project works at the Kanyika dam site. Specifications for environmental and social safeguards derived from the ESA and the ESMP will be included in the tender documents. Bidders receive key documentation outlining the requirements of the ESMP, as well as UNOPS Health & Safety requirements (see UNOPS Health & Safety Management Plan). The bidding documents will contain a general reference to the necessity to comply with this ESMP and will detail key tasks/mitigation measures/trainings, which the contractor will be obliged to undertake as part of his deliverables. These will include the required contractor's plans, COCs for workers, reference to workers' GRM the contractor will need to provide, compulsory workers and community trainings the contractor needs to implement. The bidding documents will contain requests for a detailed budget from the contractor for the implementation of all necessary actions to comply with this ESMP and specifically risk/impact mitigation measures laid out.

Step 2: Contractor Management

UNOPS will contract the contractor. The selected contractor will comply with all stipulations in this ESMP for the duration of the contract. These requirements equally apply to sub-contractors. It is the contractor's responsibility to ensure that subcontractors comply and demonstrate such compliance in submittals and during verification processes by UNOPS. The contractor will engage competent Health, Safety, Social and Environmental staff on site to carry out Environmental and Social mitigation measures set out in the ESMP. The Officer will be responsible for implementation and monitoring the contractor‘s compliance with the ESMP requirements and the environmental specifications.

The duties of the Officer will include but not be limited to the following: a) carry out health, safety, social and environmental site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to pollution control and adequacy of environmental mitigation measures implemented; b) monitor compliance with mitigation and protection measures, pollution prevention and control measures and contractual requirements; c) monitor the implementation of environmental mitigation measures; d) prepare monthly status reports for the site environmental conditions; e) advise the contractor on health, safety, social and environment improvement, awareness and proactive pollution prevention measures; d) recommend suitable mitigation measures to the contractor in the case of noncompliance; e) carry out additional monitoring of noncompliance instructed by the supervisor; f) inform the contractor and supervisor of environmental issues, submit contractor's plans to the supervisor and relevant authorities, if required; and g) keep detailed records of all site activities that may relate to health, safety, social and environment.

If pre-bid meetings, site visits and / or contract commencement meetings are carried out, the social & environmental and health & safety requirements and submittals should be discussed, both for day-to-day work and for social and environmentally critical stages or activities.

- E&S/GBV Codes of Conduct are required of contractors and subcontractors and their workers (equivalent to sample in Appendix C);
- Contractors provide details on contractor's oversight on environmental, social, health and safety performance;
- Contractor and sub-contractors to deploy a workers' grievance mechanism to handle the concerns

of their workers;

- Contractor will prepare and affirm all plans and method statements required in this ESMP prior to construction activities
  - Borrow pits and material sites
  - Contractor emergency response plan
  - Waste management
  - Campsite activities
  - Excavation works and stock piling
  - Sanitation and water management
  - Traffic management and access routes management
  - Biodiversity management
  - Signage design and plan
  - Training, engagement and sensitization

- Contractor will work within the requirements of legislative requirements and standards
- Contractor will carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor will carry out investigation and submit proposals on mitigation measures and implement remedial measures to reduce environmental impact.
- Non-compliance by the contractor may cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of UNOPS.

Step 3: Monitoring and Reporting Structures

UNOPS and IDSP will assign qualified and experienced environmental and social experts, as defined in the section on Institutional Arrangements. They will be responsible for routine supervising and monitoring all construction activities and for ensuring that contractor complies with the requirements of the contract.

- UNOPS will be responsible for and will oversee, supervise and monitor the works of the contractor, including the contractor's E&S performance.
- UNOPS will ensure regular supervision and monitoring of the implementation of all E&S mitigation measures laid out in this ESMP, as well as all trainings and other required activities.
- UNOPS will use the indicators all mitigation measures, as listed above in this ESMP, for its monitoring activities.
- A supervision and monitoring report will be prepared every month and shared with the PIU of ISDP and the World Bank. The contents of this report will include: progress of the civil works, implementation of the ESMP, confirmed the supervision of environmental and social specialist on site, photos records of works, camp areas, use of PPE, waste management, restoration efforts, grievances, accidents, communication, and training, among others.
- UNOPS will monitor and review all method statements prepared by the contractor to ensure that all areas that require remediation/ rehabilitation are covered and that the proposed methodologies are appropriate.
- UNOPS will take measures in the case of non-compliance. It will immediately liaise with the contractor, assess the risk level, significant and severe risks will cause for suspension of works until the non-compliance has been resolved to the satisfaction of UNOPS. Any significant loss of time caused by the contractor's non-compliance situations will be dealt with in accordance with the set procedures in the contract.

The contractor must report on all HSSE matters related to this ESMP to UNOPS on a monthly basis. UNOPS will administer the monthly reports from the contractor, and will prepare its own quarterly reports, based on its supervision and monitoring activities, as well as designated UNOPS activities in this ESMP to IDSP.

Quarterly progress reports will include the status of the implementation of risk mitigation measures, trainings, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local Dam Committee and local authorities. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP will be communicated to relevant ministries indicated.

IDSP will implement its own monitoring and supervision activities as they apply for all AF activities, including the remediation of Kanyika Dam. IDSP has the overall responsibility for monitoring and reporting, but is supported by UNOPS' monitoring and quality assurance activities. IDSP and UNOPS will jointly discuss any necessary amendments to activities, where necessary.

Step 4: Incident Reporting

The Contractor, UNOPS, and IDSP are required to report on any incidents related to the sub-project activities. The contractor will form the incident investigation team and will provide incident reporting on a monthly basis to UNOPS, and UNOPs will include summaries of incidents in its regular reporting to IDSP. Any incidents classified as 'severe' must be reported to the World Bank within 48 hours.

Incident reporting will follow the management and reporting process in Figure 32:

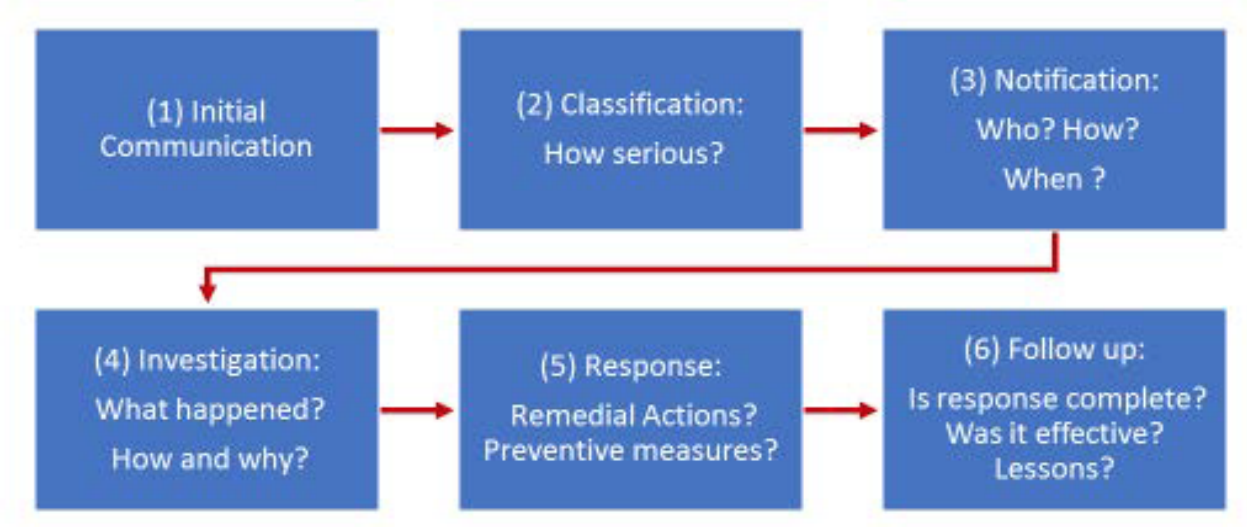


Figure 35 Incident reporting process

Incidents should be categorized into 'indicative', 'serious' and 'severe' (See Appendix G for World Bank classification of incidents).

- 'Indicative' incidents are minor, small or localized that negatively impact a small geographical area or a small number of people and do not result in irreparable harm to people or the environment.
- A 'significant' incident is one that causes significant harm to the environment, workers, communities, or natural resources and is complex or costly to reverse (see below for World Bank incident classification guide).
- A 'severe' incident causes great harm to individuals, or the environment, or presents significant reputational risks to the World Bank. Incident reports should use the format in Appendix G.

Severe incidents (an incident *that caused significant adverse effect on the environment, the affected communities, the public or workers*, e.g. fatality, GBV, forced or child labor) will be reported within 48 to UNOPS, IDSP and the World Bank.

Step 5: Handover for Operation

Once construction works and trainings are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Kanyika DMC who are part of the local community and local authorities.

Remedial actions that cannot be effectively carried out during construction must be carried out on completion of the works and before issuance of the acceptance of completion. UNOPS will be responsible for accepting the final works from the contractor and receiving approvals from IDSP. IDSP will manage the handover to the local entities and ensure that the dam communities have all capacities necessary to manage the dam. IDSP will be continually engaging with the communities and local authorities until the end of its lifespan.

References

Chidoori Rumbidzai Elisabeth, Putting Women First – Zambia's Anti Gender Based Violence Act from 2011, p. 1

Government of the Republic of Zambia, Irrigation Development Support Project, Environmental and Social Audit, April 2020

Ngonga, Z. Factors contributing to physical Gender Based Violence reported at Ndola Central Hospital, Ndola, Zambia: A case control study, In" Medical Journal of Zambia, Vol. 43.3., p. 145-151, 2016.

ODI: Baseline Study, Stamping Out and Preventing Gender Based Violence (STOP GBV) in Zambia, March 2015

Tosun, Hassan, Earthquakes and Dams, May 20th 2015, accessed at: https://www.intechopen.com/books/earthquake-engineering-from-engineering-seismology-to-optimal-seismic-design-of-engineering-structures/earthquakes-and-dams

USAID, UNICEF, UNFPA, CDC, Zambia: Demographic and Health Survey 2013-2014, p. 273

World Bank, Good Practice Note. Addressing Gender Based Violence in Investment Project Financing involving Major Civil Works, September 2018

World Bank, Managing the Risks of Adverse Impacts on Communities from Temporary Project Induced Labor Influx, OPCS and ESSAT, December 2016.

World Bank, Water Resources and Environment. Technical Note D1, Water Quality Assessment and Protection, 2003, p. 32, accessed at: http://documents1.worldbank.org/curated/en/514141468768597679/pdf/multi0page.pdf.

World Bank, General Environmental Guidelines, Pollution Prevention and Abatement Handbook, p. 438; accessed at: https://www.ifc.org/wps/wcm/connect/77a4c571-c743-48a8-9c6d-21d6ce77d017/genenv_PPAH.pdf?MOD=AJPERES&CVID=jqeDiLg.

Appendix A: Completed Checklist

IDENTIFICATION OF ENVIRONMENTAL AND SOCIAL RISKS RELATED TO THE REMEDIATION OF TEN - LEGACY DAM - IN ZAMBIA: Kanyika Dam

1-Date of the visit: 16th and 17th July 2020		
Name of the Environmental Specialist filling this checklist: Titus Chilongo		
Job Position: HSSE Analyst		
Have completed training in the Environmental and Social Safeguards of the World Bank: Yes / No…Yes		
Have read the Environmental and Social Audit report and the ISDS prepared for the Additional Financing of the project: Yes / No…a Yes		
Have you read the information available of this dam: Yes / No…Yes		
Note: if you marked No in any of these questions, you are not ready to fill this checklist. Please coordinate with the PIU team to provide you with these reports.		
2-Information about the Dam		
Name of the Dam: Kanyika Dam		
Location Kasempa	**Region** North Western Province	**District** Kasempa
Villages /communities	Kanyika	
Geographical location	**Coordinate South** S13°30'51.08''	**Coordinate East** E25°55'16.91''
3-Remediation works- please indicate the main proposed works that could cause environmental and social impacts		
Slope works	Material sourcing	Access routes
Outlets	Erosion/ soil loosening	
Infiltration	Site preparations/ clearing	
Other	Waste management	

4.MATERIALS NEEDED		
Does the project need aggregate or a new borrow pit	Yes	
Indicate potential sources to buy or extract the construction materials:	Within Kasempa	
Aggregates	Within Kasempa	
Sand/ clay	Within the Community	
Wood	Not Applicable	
Diesel for transportation	Kasempa Town	
Water source for the construction	Within the Community	
Water source for drinking for workers	Within the Community	

Contractors/builders		and Pemba Town
Estimated Number of workers to be hired for the construction works 15		**Who will pay in case of accidents or fatal accidents ……**The Contractor
Who will hire the workers	The Contractor	
Insurance provided to the workers	**Yes** ☐☐ No ☐☐Are contractors registered in Zambia in case compensations for accidents are needed	
		Contractors not yet engaged

5-General environmental conditions		
Is the dam is located within a protected area, KBA, or other sensitive location?	Yes ☐ **No** ☐☐	Name of the protected area:
What are the conditions of the forest or natural vegetation in the project site	Explain: Disturbed by various anthropogenic activities	

6-Evaluation of impacts and mitigation measures to be included in the ESMP (you can use additional paper)

Main environmental and social impacts: describe	Possible mitigation measures
Vegetation:	Re vegetation of open sites and around the Dam Minimized disturbance of forest cover
Will the construction works needs to cut trees	**Yes** X No o
If the project needs to cut trees – the project will need to plant 3 trees per 1 tree cut	Indicate local native species and fruit species that the contractor will need to plant Location Number of trees Access route and material sourcing areas- 3 trees per cut tree
Water:	Maintain water quality during works and minimize further siltation in the basin Construct VIP toilet and safely decommission
Roads:	Rehabilitate roads after works Promote community health and safety
Safety	Erect safety signage, sensitize the communities, minimize public health threats
Hazardous waste	Storage in concrete bund without an outlet to the environment. Collection of any spillages Approved disposal method.
Other:	

7-LEGACY ISSUES /REMEDIATION	
PLEASE INDICATE. Any of these legacy issues that are environmental legacies that need to be resolved by the project, costed and included in the contract of contractors. Recommend measures so the engineering team can include them in the remediation plans.	
Legacies	**Measures to be included in the ESMP**
o **Solid waste (Wood, plastic, etc)**	
o **Hazardous wastes (diesel containers, old machinery, batteries, paints, metals, contaminated waters or soil,**	
o **Borrow pits**	Decommissioning and rehabilitation of two borrow pits
o **Unsafe paths**	Rehabilitation of former contractor roads and road access to borrow pits

o **Unfinished crossing points for communities**	Crossing point over embankment is not safe as the crest gets narrower Crossing point downstream of the dam requires installation of new footbridge
o **Other: Environmental flows and outlets**	Inclusion of outlets, flow monitoring gauges
8- Ecological Flow. Have you to coordinate with the technical team the options to improve ecological flows below the dam Yes No (you need to coordinate) Yes	
What is the flow below the dam (m^3/s)	To be confirmed-
Are wetlands below the dam No	**Are critical species present in the wetland or rivers: Yes (indicate below species)** The initial assessment using IBAT indicates presence of species that may be endangered or may require special attention. The full biodiversity assessment was conducted and a BMP developed.
Are people using the water below the dam? What for?	Not all year round. Only in rain season when there are downstream flows
Based on these findings, please indicate if it is possible to install a structural solution to improve the ecological flow **No** **Explain:**	**Yes Explain:** Though inlet flows upstream are low in the dry months **Structural measures** Outlets, gauges, spillway rehab **Operational measures** Flow measurements, training
9) Biodiversity. It is expected that you performed survey to the area or collect data with experts on diversity of the area for each dam. Please indicate what groups have been investigated in the project area and preliminary observations.	
Plants	Mammals
Fish	Amphibians
Macroinvertebrates	Other groups
Please indicate issues of poaching, illegal trade, and other issues affecting the area	
Presence of sensitive species:	
Critically Endangered species:	**Endangered species:**

Vulnerable species	**Migratory species:**
Protected species in Zambia:	**Endemic/rare/globally important species:**
Based on the results of the field observation, data collected and the OP 4.04 definitions	This project has natural habitat YES / NO The project area has critical habitats YES /NO
Based on the project area and the risk and potential impacts, you have identified for biodiversity –	

1-Please indicate the recommend measures to protect these species and Prepare in a separate document a Biodiversity Management Plan (BMP) **2.In the area contains critical habitat and there is ecological flow needs please request to Prepare in a separate document as a Biodiversity and Ecological Management Plan (BMP)**	
10-Final recommendation	
Name: Titus Chilongo	**Date: 24 April 2021**
Signature: 	
Comments for the preparation of the ESMP and BAP incl. Ecological flow measures. Detailed environmental and social studies and inclusion of such matters in the designs. Further Ecological surveys	
Field visits registration	
Photo: Spillway drop structures – sandbags as "training wall"	Photo: One of the borrow pits (this one is close to the dam

Appendix B: Chance Find Procedures

This procedure was developed to protect and preserve both tangible and intangible cultural heritage records of Zambia. This procedure is included as a standard provision in the implementation of sub-project public works contracts to ensure the protection of cultural heritage (archaeological and historical sites). All contractors as well as sub-contractors and implementers will be required to observe this procedure as documented hereafter.

Excavation in sites of known archaeological interest will not be allowed under this sub-project. Where historical remains, antiquity or any other object of cultural or archaeological importance are unexpectedly discovered during construction in an area not previously known for its archaeological interest, the following procedures should be applied:

- Stop construction activities;
- Delineate the discovered site area;
- Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive remains, a full-time guard should be present until the responsible authority takes over;
- Notify the responsible foreman/archaeologist, who in turn should notify the responsible authorities (Ministry of Tourisms and Arts), the concerned governmental officers and local authorities (within less than 24 hours);
- Responsible authorities are in charge of protecting and preserving the site before deciding on the proper procedures to be carried out;
- An evaluation of the finding will be performed by the concerned officers from the Ministry of Tourism and Arts. The significance and importance of the findings will be assessed according to various criteria relevant to cultural heritage including aesthetic, historic, scientific or research, social and economic values;
- Decision on how to handle the finding will be reached based on the above assessment and could include changes in the sub-project layout (in case of finding an irrevocable remain of cultural or archaeological importance), conservation, preservation, restoration or salvage;
- Implementation of the authority decision concerning the management of the finding;
- Construction work can resume only when permission is given from the Ministry of Tourism and Arts after the decision concerning the safeguard of the heritage is fully executed;
- In case of delay incurred in direct relation to archaeological findings not stipulated in the contract (and affecting the overall schedule of works), the contractor may apply for an extension of time. However, the contractor will not be entitled for any kind of compensation or claim other than what is directly related to the execution of the archaeological findings works and protections.

Appendix C: Sample Code of Conduct for Workers

United Nations Charter: The values enshrined in the United Nations (UN) Charter, *respect for fundamental human rights, social justice and human dignity, and respect for the equal rights of men and women*, serve as overarching values to which suppliers of goods and services to the UN1 are expected to adhere.

Global Compact: The Global Compact is a voluntary international corporate citizenship network initiated to support the participation of both the private sector and other social actors to advance responsible corporate citizenship and universal social and environmental principles to meet the challenges of globalization. The UN strongly encourages all suppliers to actively participate in the Global Compact. And to that end, this Code of Conduct has been developed with recognition of the importance of the ten principles of the UN Global Compact and is viewed as an important means of integrating the Compact into the operations of the UN. The Code of Conduct addresses the issues included in the Compact in the areas of human rights, labor, environment and anti-corruption and interpretation of the Code should be undertaken in a manner consistent with the Global Compact. Suppliers interested in supporting the Global Compact and obtaining more information on the ten principles, can visit the Global Compact website at www.unglobalcompact.org.

International Labor Conventions and Recommendations: The International Labor Standards (i.e., Conventions and Recommendations) as established by the tripartite UN specialized agency, the International Labor Organization (ILO), have served as the foundation on which much of this Code of Conduct is based. It is the UN´s expectation that any supplier providing products or services to the UN will, in addition to the values of the UN Charter, adhere to the principles concerning International Labor Standards summarized below in paragraphs 4 – 9.2

1. Scope of Application:
The UN expects that these principles apply to suppliers and their employees, parent, subsidiary or affiliate entities and subcontractors. The UN expects suppliers to ensure that this Code of Conduct is communicated to their employees, parent, subsidiary and affiliated entities as well as any subcontractors, and that it is done in the local language and in a manner that is understood by all. In order for a supplier to be registered as a UN supplier or to do business with the UN, the supplier is required to read and acknowledge that this Code of Conduct provides the minimum standards expected of UN Suppliers. In addition, suppliers should note that certain provisions of this Code of Conduct will be binding on the supplier in the event the supplier is awarded a contract by the UN pursuant to the terms and conditions of any such contract. Failure to comply with certain provisions may also preclude suppliers from being eligible for a contract award, as reflected in the solicitation documents of one or more organizations in the UN. Prospective suppliers are invited to review the specific terms and conditions of contract and procurement policies of the organization(s) within the UN with which they would like to do business in order to ascertain their current and future eligibility.

2. Continuous Improvement:
The provisions as set forth in this Code of Conduct provide the minimum standards expected of suppliers to the UN. The UN expects suppliers to strive to exceed both international and industry best practices. The UN also expects that its suppliers encourage and work with their own suppliers and subcontractors to ensure that they also strive to meet the principles of this Code of Conduct. The UN recognizes that reaching some of the standards established in this Code of Conduct is a dynamic rather than static process

and encourages suppliers to continually improve their workplace conditions accordingly.

3.Management, Monitoring and Evaluation:
It is the expectation of the UN that its suppliers, at a minimum, have established clear goals toward meeting the standards set forth in this Code of Conduct. The UN expects that its suppliers will establish and maintain appropriate management systems related to the content of this Code of Conduct, and that they actively review, monitor and modify their management processes and business operations to ensure they align with the principles set forth in this Code of Conduct. Supplier participants in the Global Compact are strongly encouraged to operationalize its principles and to communicate their progress annually to stakeholders.
Labour:

4. Freedom of Association and Collective Bargaining: The UN expects its suppliers to recognize the freely-exercised right of workers, without distinction, to organize, further and defend their interests and to bargain collectively, as well as to protect those workers from any action or other form of discrimination related to the exercise of their right to organize, to carry out trade union activities and to bargain collectively.

5. Forced or Compulsory Labor: The UN expects its suppliers to prohibit forced or compulsory labor in all its forms.

6. Child Labor: The UN expects its suppliers not to employ: (a) children below 14 years of age or, if higher than that age, the minimum age of employment permitted by the law of the country or countries where the performance, in whole or in part, of a contract takes place, or the age of the end of compulsory schooling in that country or countries, whichever is higher; and (b) persons under the age of 18 for work that, by its nature or the circumstances in which it is carried out, is likely to harm the health, safety or morals of such persons.

7. Discrimination: The UN expects its suppliers to ensure equality of opportunity and treatment in respect to employment and occupation without discrimination on grounds of race, colour, sex, religion, political opinion, national extraction or social origin and such other ground as may be recognized under the national law of the country or countries where the performance, in whole or in part, of a contract takes place. The UN expects its suppliers to take all appropriate measures to ensure that neither themselves nor their parent, subsidiary, affiliate entities or their subcontractors are engaged in any gender-based or other discriminatory employment practices, including those relating to recruitment, promotion, training, remuneration and benefits.

8. Wages, Working Hours and Other Conditions of Work: The UN expects its suppliers to ensure the payment of wages in legal tender, at regular intervals no longer than one month, in full and directly to the workers concerned. Suppliers should keep an appropriate record of such payments. Deductions from wages are permitted only under conditions and to the extent prescribed by the applicable law, regulations or collective agreement and suppliers should inform the workers concerned of such deductions at the time of each payment. The wages, hours of work and other conditions of work provided by suppliers should be not less favorable than the best conditions prevailing locally (e.g. collective agreements covering a substantial proportion of employers and workers / arbitration awards / applicable laws or regulations) for work of the same character performed in the trade or industry concerned in the area where work is carried out.

9. Health and Safety: The UN expects its suppliers to ensure, so far as is reasonably practicable, that: (a) the workplaces, machinery, equipment and processes under their control are safe and without risk to health; (b) the chemical, physical and biological substances and agents under their control are without risk to health when the appropriate measures of protection are taken; and (c) where necessary, adequate protective clothing and protective equipment are provided to prevent, so far as is reasonably practicable, risk of accidents or of adverse effects to health.

Human Rights:

10. Human Rights: The UN expects its suppliers to support and respect the protection of internationally proclaimed human rights and to ensure that they are not complicit in human rights abuses.

11. Harassment, Harsh or Inhumane Treatment: The UN expects its suppliers to create and maintain an environment that treats all employees with dignity and respect. The UN further expects that its suppliers, as well as their parent, subsidiary and affiliated entities along with any subcontractors, will neither use or engage in, nor allow their employees or other persons engaged by them to use or engage in, any: threats of violence, verbal or psychological harassment or abuse, and/or sexual exploitation and abuse. Sexual exploitation and abuse violate universally recognized international legal norms and standards and have always been unacceptable behavior and prohibited conduct for the UN. Prior to entering into agreements with the UN, suppliers are informed of the standards of conduct with respect to the prohibition of sexual exploitation and abuse, expected by the UN. Such standards include, but are not limited to, the prohibition of: (i) engaging in any sexual activity with any person under the age of 18, regardless of any laws of majority or consent, (ii) exchanging any money, employment, goods, services, or other things of value, for sex, and/or (iii) engaging in any sexual activity that is exploitive or degrading to any person. The UN expects its suppliers to take all appropriate measures to prohibit their employees or other persons engaged by the suppliers, from engaging in sexual exploitation and abuse. The UN also expects its suppliers to create and maintain an environment that prevents sexual exploitation and abuse. United Nations contracts will contain provisions concerning a supplier´s obligation to take appropriate measures to prevent sexual exploitation and abuse. The failure by a supplier to take preventive measures against sexual exploitation or abuse, to investigate allegations thereof, or to take corrective action when sexual exploitation or abuse has occurred, constitute grounds for termination of any agreement with the United Nations. Moreover, no harsh or inhumane treatment coercion or corporal punishment of any kind is tolerated, nor is there to be the threat of any such treatment.

12. Mines: The UN expects its suppliers not to engage in the sale or manufacture of anti-personnel mines or components utilized in the manufacture of anti-personnel mines.

Environment:

13. Environmental: The UN expects its suppliers to have an effective environmental policy and to comply with existing legislation and regulations regarding the protection of the environment. Suppliers should wherever possible support a precautionary approach to environmental matters, undertake initiatives to promote greater environmental responsibility and encourage the diffusion of environmentally friendly technologies implementing sound life-cycle practices.

14. Chemical and Hazardous Materials: Chemical and other materials posing a hazard if released into the environment are to be identified and managed to ensure their safe handling, movement, storage, recycling or reuse and disposal.

15. Wastewater and Solid Waste: Wastewater and solid waste generated from operations, industrial processes and sanitation facilities are to be monitored, controlled and treated as required prior to

discharge or disposal**.**

16. Air Emissions: Air emissions of volatile organic chemicals, aerosols, corrosives, particulates, ozone depleting chemicals and combustion by-products generated from operations are to be characterized, monitored, controlled and treated as required prior to discharge or disposal.

17. Minimize Waste, Maximize Recycling: Waste of all types, including water and energy, are to be reduced or eliminated at the source or by practices such as modifying production, maintenance and facility processes, materials substitution, conservation, recycling and re-using materials.

Ethical conduct:

18. Corruption: The UN expects its suppliers to adhere to the highest standards of moral and ethical conduct, to respect local laws and not engage in any form of corrupt practices, including but not limited to extortion, fraud or bribery.

19. Conflict of Interest: UN suppliers are expected to disclose to the UN any situation that may appear as a conflict of interest, and disclose to the UN if any UN official or professional under contract with the UN may have an interest of any kind in the supplier's business or any kind of economic ties with the supplier.

20. Gifts and Hospitality: The UN will not accept any invitations to sporting or cultural events, offers of holidays or other recreational trips, transportation, or invitations to lunches or dinners. The UN expects its suppliers not to offer any benefit such as free goods or services, employment or sales opportunity to a UN staff member in order to facilitate the suppliers´ business with the UN.

21. Post-employment restrictions: Post-employment restrictions may apply to UN staff in service and former UN staff members who participated in the procurement process, if such persons had prior professional dealings with suppliers. UN suppliers are expected to refrain from offering employment to any such person for a period of one year following separation from service.

Appendix D: Managing COVID-19 Risks

UNOPS Guidelines for Construction Sites[23]

These requirements should be mandatory for UNOPS and all contractors, they should be issued in a formal, written instruction to the contractor using the template provided below.

Requirements: Construction sites should be treated like offices, with the following steps to be discussed with the Contractor and enforced by the UNOPS site supervisor.

General

1. Ensure that the people meeting the following criteria will not come to site:
    - any personnel showing symptoms of coughing, difficulty in breathing, fever, tiredness, aches and pains, nasal congestion, runny nose, sore throat or diarrhea, until a medical certificate is provided;
    - vulnerable persons (by virtue of their age, underlying health condition, clinical condition or are pregnant)
    - any person living with someone in self-isolation or a vulnerable person.
2. In the case that a worker is detected with COVID-19 the site will be closed and workers in contact with the individual will be required to self-isolate for 14 days until medical all-clear is granted.
3. Social distancing of at least 1 meter should be maintained at all times between personnel. Handshakes, hugs and other close contact interactions are therefore prohibited on site.
4. Hand washing station posted at the site entrance, with soap for all workers and people entering the site, and additional stations at locations in the site that make it possible for workers to frequently wash their hands. Hand sanitizers should be provided where hand washing facilities are unavailable to point.
5. A focal point to implement and monitor prevention measures should be designated.
6. No masks are needed on site for work unless hazardous materials are being used.
7. In case of any infringements, UNOPS will stop work of the contractor and delays that incur penalties will be the responsibility of the contractor.
8. UNOPS will refuse access to the site to any individuals seen breaking the hygiene protocols and may require the contractor to stop all works immediately.
9. UNOPS must cooperate with the Zambia country directives in response to the COVID-19 pandemic.
10. All cases should be reported to UNOPS as soon as detected, as well as to local health authorities.
11. These protocols are to be recorded as part of the HSSE requirements for the site.

Travel to sites

12. Wherever possible, workers should travel to site alone using their own transport.
13. Risk assessments should be used to determine the risks for local travel to sub-project sites and precautionary measures should be applied if these are deemed necessary.
14. Sites need to consider:
    - Parking arrangements for additional cars and bicycles

[23] This document was developed by field personnel and added to by construction personnel all over UNOPS. It should continue to be commented on by everyone, as we understand more about the virus and think of better ways to protect.

- Other means of transport to avoid public transport e.g. cycling
- How someone taken ill would get home.

Site Access Points

15. Focal point appointed by UNOPS or the contractor, with the site supervisor, will check the temperature and ensure hand washing prior to site entry of all personnel.
    - Focal point should have a thermometer to do so.
    - For larger sites, a nurse or medical staff may be provided, however, the goal is not to treat personnel who may have COVID-19, but identify any symptoms and ensure personnel are immediately removed from the site.
16. Focal point should ask the following questions to the staff:
    - Have you had a fever or other symptoms of the COVID-19 in the past 2 weeks?
    - Is there anyone in your household who has the symptoms or is ill with COVID-19?
    - Is there any person in your neighborhood or community who has been diagnosed with COVID-19?
    - Have you been abroad or in contact with travelers from different countries?
17. Ensure personnel wash or clean their hands before entering or leaving the site.
18. Stop all non-essential visitors.
19. Introduce staggered start and finish times to reduce congestion and contact at all time, if possible. Take into consideration appropriate timings for men and women, according to their other responsibilities. If there are fewer workers on sites ensure safety of female workers from sexual harassment (PSEA issues).
20. Monitor site access points to enable social distancing – site supervisor may need to change the number of access points, either increase to reduce congestion or decrease to enable monitoring.
21. Remove or disable entry systems that require skin contact e.g. fingerprint scanners
22. Reduce the number of people in attendance at site inductions and consider holding them outdoors wherever possible, also ensure 1 meter distance between participants during the inductions.
23. Drivers should remain in their vehicles if the load will allow it and must wash or sanitize their hands before unloading goods and materials.

Communication and awareness

24. Daily briefing on how to prevent exposure to COVID-19 and on the control measures in the site should be delivered.
25. Post posters about proper handwashing and respiratory hygiene at different sub-project sites (work fronts, temporary offices, and the sub-project operations campus)

Canteens and Eating Arrangements

26. Hand washing is enforced before mealtimes.
27. All personnel should be advised to observe safe distances during eating times.
28. All personnel should avoid sharing food and drinks with colleagues
29. The workforce should be asked to bring pre-prepared meals and refillable drinking bottles from home.
30. Site eating areas will be disinfected daily by the contractor.
31. All rubbish should be put straight in the bin and not left for someone else to clear up.
32. Where catering is provided on site, it should provide pre-prepared and wrapped food only. Where possible payment arrangements should be made such there will be no need to exchange money

e.g. contactless cards or pre-arranged monthly payments. Crockery, eating utensils, cups etc. should not be used.

Changing Facilities, Showers and Drying Rooms

33. Introduce staggered start and finish times to reduce congestion and contact at all times. Take into consideration appropriate timings for men and women, according to their other responsibilities.
34. Consider increasing the number or size of facilities available on site if possible.

Avoiding Close Working

There will be situations where it is not possible or safe for workers to distance themselves from each other by 1 meter. The following general principles should be applied:

35. Safety critical work should still be carried out with adequate personnel and under adequate levels of supervision to avoid incidents that may lead to loss of life.
36. Non-essential physical work that requires close contact between workers should not be carried out.
37. Work requiring skin to skin contact should not be carried out.
38. Plan all other work to minimize contact between workers.
39. Establish working groups to minimize the movement of people in the sub-project area to facilitate traceability and control, in case any possible contagion is identified.
40. Re-usable PPE should be thoroughly cleaned after use and not shared between workers. Ensure that female workers are given PPE purposefully designed for women.
41. Single use PPE should be disposed of so that it cannot be reused.
42. Stairs should be used in preference to lifts or hoists.
43. Increase ventilation in enclosed spaces.
44. Regularly clean the inside of vehicle cabs and between use by different operators.

Site Meetings

45. Only absolutely necessary meeting participants should attend.
46. Attendees should be 1 meter apart from each other.
47. Rooms should be well ventilated / windows opened to allow fresh air circulation.
48. Consider holding meetings in open areas where possible.

Cleaning

49. Enhanced cleaning procedures should be in place across the site, particularly in communal areas and at touch points including:
    - Taps and washing facilities
    - Toilet flush and seats
    - Door handles and push plates
    - Hand rails on staircases and corridors
    - Lift and hoist controls
    - Machinery and equipment controls
    - Food preparation and eating surfaces
    - Telephone equipment
    - Key boards, photocopiers and other office equipment
50. Rubbish collection and storage points should be increased and emptied regularly throughout and at the end of each day
51. Hired vehicle vendors should be informed to sanitize the interior of their vehicles daily. Drivers to be informed about the preventive measures as well.

52. Personnel using motorbikes should also sanitize the areas of the bike most touched.

Procedure in case of contagion

Any worker with symptoms of the COVID-19 should:

- Notify the supervisor that he/she is not fit to work
- Stay home for at least 14 days
- Maintain a minimum temperature control twice a day
- Report any person in his/her household of these symptoms and inform the supervisor
- Notify the doctor or health service if symptoms do not disappear or worsen.

Any personnel who is confirmed to be diagnosed with COVID-19 should report to the Health and Safety Advisor and the Manager on the site immediately. The reporting procedure should be in line with the EOI.CSG.2017.02 on Reporting and Management of Health & Safety and Social & Environmental incidents.

UNOPS Construction Site Supervision

Guidance: UNOPS personnel are expected to continue to work with contractors and other site personnel, unless there is a stop work order issued by the government. In the case that UNOPS personnel need to visit home in order to support family / relatives, this is understood and personnel may take leave. The sub-project will, if possible, seek additional UNOPS personnel to cover the gap in supervision, to ensure the quality of work continues to be maintained and that work site safety and COVID-19 procedures are followed.

Field Offices < 6 People and Field Monitoring

Requirements: In the general case that personnel are working and living in the same office, "work from home" is similar / same in terms of people as the office. In this case, personnel may continue to work in the office that they live in, however, "Reduced Contact Work" is advised. For field monitoring this involves:

- Ensure when visiting sub-project sites, physical distancing is maintained.
- Avoid consultations, meetings, gatherings which involve a large number of people, beyond the government advice, both for organizing and being a part of. For essential business requirements, limit the number of people (below 10) ensuring physical distance.
- Minimize travel which requires personnel traveling in a partner's vehicle or vice versa. Ensure adequate measures are taken.
- Any discussions with home owners or contractors are outdoors, at 1 meter distance.
- Offices maintain the same protocols with washing hands prior to entry.

In case travel restrictions involve being restricted from any movement at all, personnel will be encouraged to work from home.

Short monitoring/handover missions (for multiple sites)

- Create clusters of 10/15 sites to visit. Sites should be geographically close and visitable in a one (long) day mission.
- Prepare maps of those clusters of sites, including travel distances.
- Prepare mission timetables with detailed timing for each activity (visit of site A, movement, visit of site B, etc.).
- Ask the contractor to submit pictures and videos of sites ready for handover in a pre-handover evidence folder of the teamdrive shared with the contractor.
- Review submissions in detail and pre-clear the sites ready for handover.
- Coordinate with the client and make precise appointments for handover activities, update the mission timetable according to availability of client's representatives.

- Arrange cars for standalone trips of our Site Supervisors (cars should be provided with water tanks, soap, sanitizer, PPE, lunchboxes, etc.).
- Brief and debrief our Site Supervisors prior/after each handover mission.

For HSSE specific guidance and support, please see the following UNOPS intranet links, or write to hse@unops.org:
https://intra.unops.org/operations/oversight/risk-management/hsse
https://intra.unops.org/news/announcements/update-on-the-coronavirus-covid-19-outbreak
https://intra.unops.org/operations/oversight/risk-management/hsse/covid19-response-update

IRRIGATION DEVELOPMENT SUPPORT PROJECT (IDSP)

COVID-19 Response Planning and Monitoring

August 21, 2020

Table 23 COVID Monitoring Table

Project Name, P#, and contract #	Contract/ activity	Impact of Corona virus on operation	Action identified	Responsible for Action	Anticipated Impact Colour Coding levels of Risk: High = RED; Substantial = Orange; Moderate = Yellow and Low = Green Likelihood: Highly Likely=HL; Extremely likely=EL; Not likely=NL Timing: Short-term=ST; Mid-Term; Long-Term=LT			
					Description	Level (H, S, M, L)	Likelihood HL/ EL /NL	Timing (ST/ MT/LG)
IDSP								

Appendix E: Template for Conditions of Contract

DIRECTION TO IMPLEMENT HEALTH AND SAFETY MEASURES - COVID 19 EPIDEMIC

Dear Sir
[*insert name of contract*] ("Contract")
This is a Notice served under Sub-Clause xxx of the Contract.
Taking into account the circumstances arising out of the Covid-19 pandemic, the Employer's Representative, hereby, instructs you to implement the Health and Safety measures that are listed in appendix 1 of this notice.
These measures are deemed to be reasonable precautions to maintain the health and safety of the Contractor's Personnel and as such are not additional to your existing obligations under the Contract and will not be considered as a Variation.
The Employer's Representative also reminds the Contractor of its obligations under Sub-Clause 6.16 which states that:

> *In the event of any outbreak of illness of an epidemic nature, the Contractor will comply with and carry out such regulations, orders and requirements as may be made by the Authorities or local medical or sanitary authorities for the purpose of dealing with or overcoming the epidemic.*

The Contractor is required to submit evidence of its compliance with the above health and safety measures by [*insert date*].

Yours faithfully

……
[*Employer's Representative*]
for and on behalf of UNOPS

Appendix F: Attendance Sheets Stakeholder Consultations and Dam Committee List

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE: KANYIKA DAM DATE: 18/07/2020

S/N	NAME	GENDER	DESIGNATION	VILLAGE / ORGANISATION	CONTACT DETAILS	SIGNATURE
1	NGUNI EZEKIEL	M		THOMAS	0960 75733	Thomas
2	EVARISTO KANGWA	M		KANGWA	0960544586	
3	LEVY MULOTWA	M		THOMAS	0969432706	
4	ROBGES MANGOWANI	M		MANGOWANI	0953808923	
5	GOSPEL TIKI	M		[illegible]	0953465252	M THOMAS
6	MOFFAT NGUNI	M				
7	FAINWILL MUTANDA	M				
8	NGUNI SEPETILYA	M		THOMAS		NGUNI
9	EZEKIEL NGUNI THOMAS	M		NGUNI	0955453032	
10	THOMAS NGUNI	M		NGUNI	0956942349	
11	ROSA BWELUPE	F		BWELUPE		J. KAPEPA
12	TEDDY JACOB	M		MWELUMUKA		J. KABWITA
13	TEDDY KASUKA	M		KASUKA	0960757364	Teddy
14	TERAN MAKOLINO	M		MAKOLINO	0957572893	
15	BENARD MWELUMUKA	M		MWELUMUKA	0956080063	
16	TIKI GEORGE	M		TIKI	0962042332	
17	NICKSON NDALIFA	M		NDALIFA	0954481745	
18	KABARANGENGO MARTIN	M		KABARANGENGO	0955730416	M. Kabalangengo
19	KENNT MUKIMWA	M		MUKIMWA	0963992521	
20	WISDOM MULONGA	M		MULONGA	0969886398	W MULONGA
21	EDITH MULIMWA	F		MULIMWA	0760891263	

Figure 36 Attendance Sheet

Figure 37 Stakeholder Consultations

Appendix G - Kanyika DMC

Table 24 DMC

SN	NAME	POSITION	Sex	PHONE
1	Thomas Nguni	Chairman	Male	0956 942349
2	Gospel Giki	Vice chairman	Male	0966 551084 / 0956 247807
3	Ezekiel Nguni	Secretary	Male	0953 808923
4	Ronny Tolopa	Vice Secretary	Female	0762519307
5	Justiner Kabwebwe	Treasurer	Female	0972 958329
6	R Levy Mulofwa	Member	Male	0954 481300
7	Duran Kachambalele	Member	Male	0950 321541
8	Benard Mwelumuka	Member	Male	0955 080063
9	Esther Mulondoni	Member	Female	0969 533147
10	Getrude Mutanda	Member	Female	0956 756479

Appendix H: World Bank Incident Classification Guide and Incident Report Form

Table 25 WB Incident Classification Guide

Indicative
•Relatively minor and small-scale localized incident that negatively impacts a samll geographical areas or small number of people •Does not result in significant or irreparable harm •Failure to implement agreed E&S measures with limited immediate impacts
Serious
•An incident that caused or may potentially cause significant harm to the environment, workers, communities, or natural or cultural resources •Failure to implement E&S measures with significant impacts or repeated non-compliance with E&S policies incidents •Failure to remedy Indicative non-compliance that may potentially cause significant impacts •Is complex and/or costly to reverse •May result in some level of lasting damage or injury •Requires an urgent response •Could pose a significant reputational risk for the Bank.
Severe
•Any fatality •Incidents that caused or may cause great harm to to the environment, workers, communities, or natural or cultural resources •Failure to remedy serious non-compliance that may potentially cause significant impacts that cannot be reversed •Failure to remedy Serious non-compliance that may potentially cause severe impactsIs complex and/or costly to reverse •May result in high levels of lasting damage or injury •Requires an urgent and immediate response •Poses a significant reputational risk to the Bank.

An incident report should contain the following information:

Incident Report Form

Please report any incident within 24 hours to UNOPS:

Contractor	
Dam Site	
Report Date	
Reported By (Name and Title)	

i. Details of Incident

Incident Date	
Incident Time	
Incident Place	

ii. Identification of Type of Incident and Immediate Cause

1. Select the type of the incident from the list below. An incident can be classified at the same time as health&safety/environmental/social.

Type of Incident: (and incident can cover more than one type):

Type of Incident – Health & Safety		Type of Incident – Social	Type of Incident - Environmental
Moving Machinery/vehicles at project site	Dust, Fumes, Vapours that impact the population and/or environment	Misuse of Government property	Chemical/Oil Spill with impact on population and/or environment
Powered Hand tools	Noise	Damage to Cultural Heritage	Improper Disposal Waste
Hand Tools	Temperature or heat	Occurrence of infringement of labor rights	Disasters (Earthquake, Flood, etc)
Animals or insects	Overexertion	Occurrence of infringement of human rights	Water Pollution/ Sedimentation
Fire or Explosion at sub-project site	Structural Failure	Strike, demonstration	Damage to ecosystems (e.g. damage to flora/fauna)
Trips & smaller falls	Chemical/biological	Other (please specify)	Odor air Emissions
Drowning	Stress	GBV/SEA or Child Risks	Dust, Fumes, Vapors, Air pollution with impact on population and/or environment
Borrow-pit Management	Other (please specify)		Other (please specify)

2. For each type of incident, select the relevant descriptor(s) from the list. You can select up to 5 descriptors for each type of incident. If a descriptor is not listed below, please type in short descriptor in "Other". Add more rows as necessary.

Incident Type	Descriptor 1	Descriptor 2	Descriptor 3	Descriptor 4	Descriptor 5	Other
Health & Safety						
Social						
Environmental						

Provide a description of the immediate cause of the incident:

iii. Description of the Incident

Record all facts prior to and including the incident, if it was a planned activity, describe/list material, ecosystem and property damaged, etc:

iv. Root Cause Analysis

Select the root cause(s) of the incident from the list below. If 'Other', please specify:

Root Cause	Yes	No
Improper Planning		
Poor Maintenance		
Poor Supervision		
Poor Quality of Equipment		
No rules, standards, or procedures		
Lack of knowledge or skills		
Improper motivation or attitude		
Failure to comply with rules		
Other		

Additional Questions:
• Is the incident still ongoing or is it contained?
• Is loss of life or severe harm involved?
• What measures have been or are being implemented by the Implementer?

Appendix I: Summary of Construction Contractor Training Requirements

Training content	Number of days	Trainers/Supervision	Participants
Dam Safety-Emergency preparedness, and Community health and safety			

Emergency preparedness: Hazards, and dam failure, roles and responsibilities, emergency preparedness, emergency response procedures and grievance redress mechanism *Community health and safety: Safety talks, Pedestrian access infrastructure, Construction safety, Gender based violence, waste management, swimming risks, drowning risks, dam security, spillway crossing risks, management of livestock around the dam, use of dam water for drinking, malaria prevention and management, pollution prevention, bilharzia prevention and management and water borne diseases* *First aid: First aid basics and response*	Throughout	Contractor Supervision UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental Specialist	All staff Community members Contractor's first aiders
Grievance Redress Mechanism and ESMP requirements			
Sharing of the Environmental and Social Management Plan (ESMP) by Contractor to site accessing persons *Environmental management plans* *Grievance redress mechanism*	Throughout	Contractor Supervision UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental Specialist	All staff Community members

Appendix J: Biodiversity Assessment and Management Plan

EXECUTIVE SUMMARY

Kanyika Dam is an Earth fill dam located in Kasempa District of North-western Province. The dam's initial construction works were done in 2016. The IDSP has contracted UNOPS to prepare the environmental and social safeguards instruments for the remedial works on the dam. UNOPS has carried out a Biodiversity Assessment and prepared a Biodiversity Management Plan (BMP) for Kanyika Dam. The main objective of the Biodiversity Assessment and the BMP is to detect and mitigate any risks and negative impacts on the biodiversity within the sub-project area of influence of influence. The biodiversity assessment of the Kanyika dam sub-project area of influence of influence was conducted between 4th and 8th April, 2021 by a team of three (1 ecologist and 2 technicians). The aim was to determine flora and fauna impacts that may result from rehabilitation works on the dam and its operation. Based on the results of the assessment, management actions have been proposed that can help to protect and/or restore the biodiversity of the area. The study employed both quantitative and qualitative approaches in data collection and analysis. The quantitative approach involved collecting numerical characteristics of the terrestrial and aquatic biodiversity through established standard procedures as outlined in the methodology section of this report. The qualitative approach involved collecting non-quantitative characteristics of terrestrial and aquatic flora and fauna in the ecosystem of Kanyika sub-project area of influence of influence through observation and interviews involving community members and government officers connected to the project.

Biodiversity Assessment Results

For terrestrial flora, the results showed that 558 stems/ha of trees were enumerated with average Dbh of 10.43cm. Out of this total, 416 stems/ha were stems with Dbh ≥ 5cm while 141 stems/ha had Dbh < 5cm. The species diversity/richness was high in the project area of influence of influence with a total of 44 species enumerated and as supported by the calculated SI index of 3.27 from field data. The most dominant species were *Isoberlinia angolensis, Brachystegia boehmii, Anisophyllea boehmii, Ochna pulchra, Brachystegia spiciformis and Albizia adianthifolia* as indicated by the importance value indices (see tables 4.2). Analysis of stand level size distribution showed that the project area of influence of influence exhibited typical existence of a normal forest indicated by a reverse – j shaped graph obtained when Dbh size classes are plotted. Further analysis of stand level distribution for size classes of Dbh < 5cm showed a normal distribution which is indicative of massive regeneration potential, typical of miombo woodland.

For terrestrial fauna, the assessment revealed low diversity of animals in the sub-project area of influence of influence and this reduced presence of wildlife can be partly explained by the fact that the way of life for the community members in the area is the hunting of wildlife. There was one wildlife species found that is listed as endangered on the IUCN red list i.e. Martial eagle *(Polemaetus bellicosus)*. No plant species found is listed as endangered on the IUCN red list. The terrestrial habitat was found to be hill and dry miombo containing few big trees and a lot of juvenile trees in a very health condition. The habitat is characterised by a secondary forest with massive ability to regenerate despite anthropogenic disturbances. Furthermore, the health of the habitat was indicated by moderate crown cover (50%-75%) and good organic matter accumulation (50%-75%).

Assessment of the aquatic habitat showed slight modifications for the in-stream habitat while the riparian habitat is moderately modified. A total of 16 fish species inhabit the Kanyika Dam including the invasive Nile bream *Oreochromis niloticus* and the food chain is supported by a good diversity of primary producers (planktons). Species of conservation concern were not found in the project area of influence. Kanyika Dam is a small dam built on a non-perennial river. Ecological flows are therefore not continuous over the spillway.

Predicted Sub-project Impacts

The sub-project impacts on flora and fauna during the construction works for the remediation of the dam will be mainly due to clearing for access roads, worker's camp, parking and working areas for equipment. These and associated activities may result in the following potential impacts:

- Loss of indigenous vegetation on site;
- Loss of fauna habitats and consequently loss of fauna;
- Habitat fragmentation;
- Injury or mortality of fauna resulting from collision with vehicles, equipment on site; increased noise levels and hunting activities;
- Introduction of invasive species and pathogens as a result of movement of people and equipment into and out of the project site; and
- Possible loss of aquatic fauna and flora as a result of water contamination.

These impacts constitute relatively minor risks that can be managed by well-known and proven construction impact methodologies. Overall, the rehabilitation of un-remediated areas from the previous construction is expected to stabilize the environment around the dam wall and other areas of project disturbance, resulting in a reduction in erosion and sedimentation into the dam and the local drainage line. Provision is made for the management of these risks in the project ESMP and in this BMP.

Subject to the recommended mitigation, the continued operation of the dam is not expected to have material negative biodiversity impacts in the long term. Terrestrial and aquatic habitats in the area of influence of the dam have been significantly impacted over many years by anthropogenic activities. Most of the trees are in their juvenile stages indicating previous disturbance mainly from agriculture activities. The woodland habitat is a multi-storey. A shrubby layer of small trees of the same plant species found in the upper layers and grasses are present. Evidence of anthropogenic disturbances such as charcoal manufacturing, fuelwood collection, agriculture activities and fire occurrences are still prominent. However, the habitats seem very resilient to disturbances as plants easily regenerate when the pressure eases. This is unlikely to change because of the remedial works on the dam. All birds except for one (martial eagle (Polemaetus bellicose)) encountered and reported have an LC status on the IUCN red list (IUCN, 2021). Additionally, only one migratory bird species (Booted eagle (Hieraaetus pennatus)) was recorded for Kanyika dam area. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The dam does not pose a barrier effect to the fish population. The fish species listed on the IUCN Red List were not found during the study. The major threat to fish species, the Nile tilapia, introduced into the Kafue River system, appears to be present near the dam's impoundment. While the habitat integrity of the stream downstream of the dam is lower than the upstream reach, this does not appear to be related to habitat transformation caused by sediment settling in the dam and there is no significant increase in downstream erosion caused by the stream that could be

attributed to erosive waters. The main reason for poor habitat integrity downstream appears to be the practice of cultivation in the seasonally wet parts of the dambos and general habitat degradation in the surrounding areas due to bush clearing and overgrazing and not attributed to the presence of the dam's impoundment. Key management requirements are to continue efforts to improve catchment conditions to protect the water resource.

Proposed Mitigation Measures

Proposed mitigation measures are detailed in this BMP. For the construction phase, key measures are:

- Use of old site access roads, camp site, borrow pits and working areas to avoid clearing of new areas;
- All vegetation clearing activities will be subject to approval by the Project and Environmental Manager on site;
- Nonuse of indigenous timber/wood for construction works on site. Required timber or wood will be procured from licensed pine and/or eucalyptus dealers;
- Planting or seeding of alien or foreign flora species will not be allowed;
- Poaching (hunting) or killing of wildlife on site will not be permitted by the workers and will constitute breach of contract;
- Enforcement of speed limits;
- Protection of species of conservation concern and their habitats
- Vehicle and machinery operation will be restricted to daylight hours to avoid collisions with nocturnal and crepuscular fauna;
- No construction and related project activities will be permitted within dambos (dambos are willow wetlands found in southern, central and eastern Africa,) on site;
- Bush burning and or open fires in forested or vegetated areas will not be permitted;
- Training and capacity building: key employees and community members will be sensitized/trained in natural resources management, implementation of the BMP and their roles as well the importance of conservation;

For the operational phase, key measures are to provide training and support to the local communities to manage livelihood activities in the catchment, encouraging protection and sustainable use of the aquatic resource provided by the dam. These are to include:

- Sensitizing the local community to sustainable fishing methods and the importance of conserving aquatic resources;
- Training the dam committee to maintain the dam wall by removing woody vegetation, weeds, encouraging grass growth and controlling access by stock to minimise erosion paths;
- Supporting the local community to determine and implement sustainable farming practices in the dam catchment, by prohibiting cultivation in the riverine areas and around the perimeter of the dam, protecting and conserving threatened species, limiting habitat degradation due to clearing of woodlands and maintaining stocking ratios that do not result in significant overgrazing.

This support will initially be provided by the UNOPs project team and in the long term by the Ministry of Agriculture, Forestry and Fisheries and DMC.

Objectives of the BDA

Overall Objective

The overall objective of this BMP is to guide the remedial works on Kanyika Dam. The implementation of the BMP will mitigate imminent identified risks to the aquatic environment, terrestrial environment, and their associated livelihoods, and bring the dam's operational management into compliance with WB safeguards policies. Particular emphasis is put on the presence of sensitive habitats and species with a conservation status of concern (both flora and fauna).

Specific Objectives for Terrestrial Assessment

Specific Objectives of the Flora Assessment

i. To identify the botanical attributes of the sub-project site, including:
   - Compilation of species lists of all observed flora species;
   - Description of the extent and type of native species present;
   - Verification of the presence of threatened species or vegetation communities (per the IUCN Red List) ;

ii. To quantify the botanical attributes of the assessment site (if necessary), to:
   - Identify the species and size class found within the site, and determine the ecological/habitat significance of each; and
   - Map the locations of threatened flora species and indicate potential habitat for threatened species.

iii. To quantify the regeneration and invasive species status of the area.

Specific Objectives of the Fauna Assessment

i. To identify the fauna present in the area including:
   - Compilation of species lists of all observed fauna species;
   - Documentation of the presence of threatened species or animal communities (per the IUCN Red List);

ii. To quantify the faunal attributes of the assessment site (if necessary), to:
   - Determine species diversity within and around the sub-project site, and determine the ecological/habitat significance of each;
   - Map the locations of threatened animal species and indicate potential habitat for threatened species;
   - Identify existing and potential invasive species and cross breeding status at the sites.

Specific Objectives for Aquatic Assessment

- Collect, collate and compile comprehensive baseline information on the aquatic and riverine/riparian ecosystems;
- Determine the significance of aquatic ecological impacts caused by the dam, taking direct, indirect and cumulative impacts into consideration;
- Identify and describe the potential structural and non-structural measures to at least maintain or increase the ecological flow downstream of the dam;
- Develop a Biodiversity Management Plan for the affected dams under the project.

Institutional Arrangements for Biodiversity Management of the Sub-Project

The Kanyika Dam remedial works will be managed and implemented by the Ministry of Agriculture of Zambia. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the PIU will manage and implement the broader AF activities, it has contracted UNOPS to oversee and implement the remediation works of ten dams, including Kanyika Dam. The IDSP-PIU E&S Team is responsible for all E&S aspects of the project, which include biodiversity management. It will supervise and monitor all E&S aspects of all activities of the UNOPS Sub-PIU and UNOPS contractor at the Kanyika Dam.

The UNOPS Sub-PIU E&S Team is responsible for the implementation of the E&S mitigation measures laid out in this BMP. Where implementation is conducted by contractors, the UNOPS Sub-PIU E&S Team supervises and monitors all E&S related aspects of the contractor's works.

METHODOLOGY

Assessment Methodology

Spatial scale-procedures to determine project's area of influence

Terrestrial

This dam is considered as category B project, the direct area of influence for the terrestrial assessment is commensurate with other category B projects. The preliminary scoping also indicated that there was no need to have a larger direct area of influence. The area of influence was determined by the height of the dam. The dam height was used to find the throwback (0.5 km) of water from the dam embankment. Therefore, based on findings during the reconnaissance survey, the survey team established a radius of 500 meters surrounding the boundary of the water throwback area. ArcGIS software 10.4 was used to spatially design the area of influence to guide sampling for vegetation and fauna (see figure below).

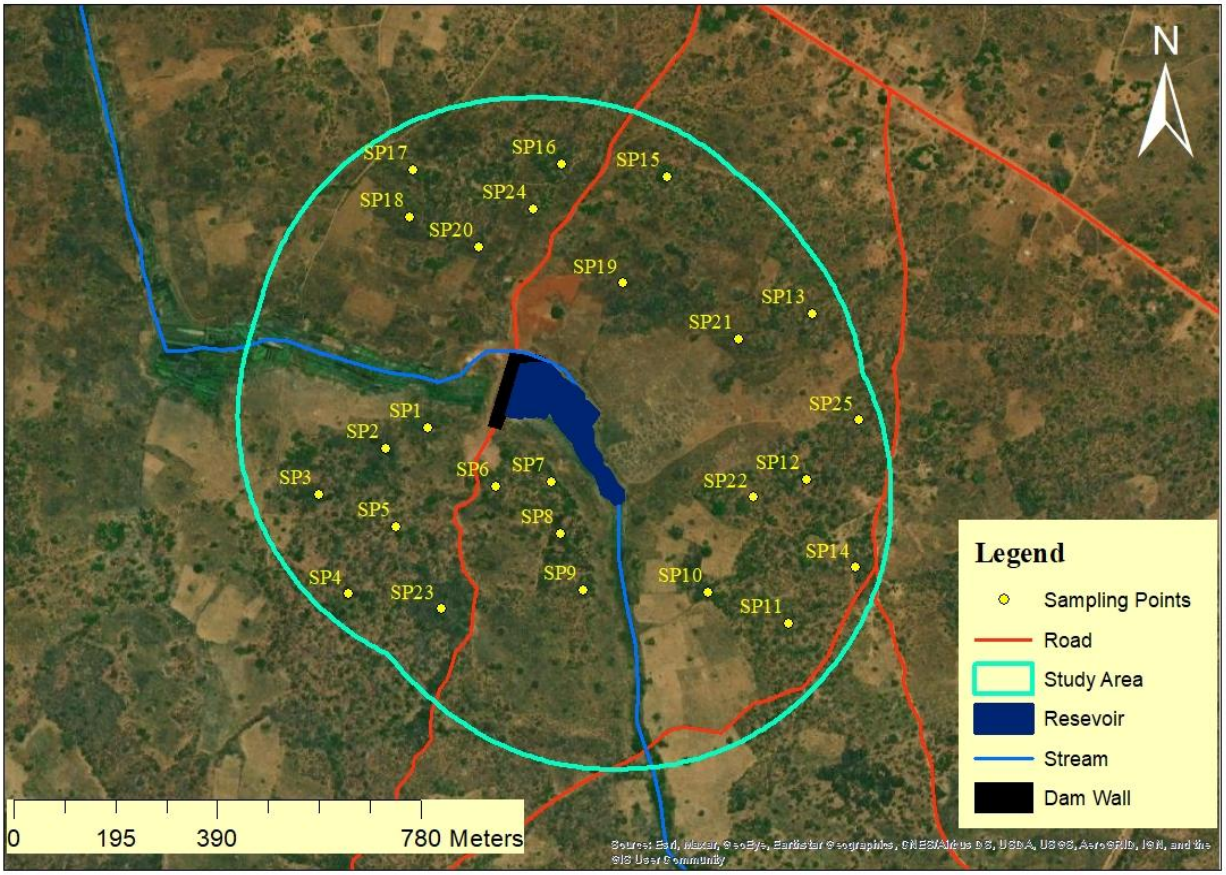


Figure 38 Project area of influence for the biodiversity assessment

Aquatic

This dam is considered as category B project, the direct area of influence for the terrestrial assessment is commensurate with other category B projects. The preliminary scoping also indicated that there was no need to have a larger direct area of influence. Similarly, for aquatic assessments the spatial scale was determined by the extent of the water in the reservoir and a 1 km stretch up and downstream. A 1 km

distance downstream was necessary to be able to assess the impact in an event that the dam wall failed. This stretch was also considered adequate to understand the downstream impact of the impoundment.

Value of ecological resources and vulnerability of receptors

For terrestrial resources, the valuation was based on the criteria given in the table below after (Latimer, 2009) while the valuation for aquatic and riparian ecosystems was based on the criteria developed by Kleynhans[24] (1996) tables 3-3 to 3-6. The IUCN Red list of endangered species was used to assess the vulnerability of receptors.

Criteria for vegetation integrity

Table 26 Criteria for vegetation integrity (Latimer, 2009)

Criteria for defining vegetation condition
High quality: Vegetation dominated by a diverse indigenous species, with defined structures (where appropriate), such as canopy layer, shrub layer, and ground cover, with little or few introduced species present.
Moderate quality: Vegetation dominated by a diversity of indigenous species, but is lacking some structures, such as canopy layer or ground cover.
Low quality: Vegetation dominated by introduced species, but supports low levels of indigenous species present, in the canopy, shrub layer or ground cover.

Table 27 Criteria for habitat integrity (Latimer, 2009)

Criteria for defining habitat quality
High quality: ● High degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. ● High species richness and diversity (i.e. represented by a large number of species from a range of flora and fauna groups). ● High contribution to a wildlife corridor, and/or connected to a larger area of high quality habitat. ● Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). ● Provides known, or likely habitat for one or more rare or threatened species listed under the IUCN.
Moderate quality: ● Moderate degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. ● Moderate species richness and diversity (i.e. represented by a large number of species from a range of fauna groups).

[24] Kleynhans developed his habitat integrity index by using it on riparian and in stream habitats. Kanyika reservoir is small-scale and the index was used mostly to evaluate the integrity of the riparian habitat and not the habitat of the reservoir per se

• Moderate levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Moderate contribution to a wildlife corridor, and/or connected to a larger area of high quality habitat. • Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • Unlikely to provide known, or likely habitat for one or more rare or threatened species listed under the IUCN.
Low quality: • Low degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component. • Low species richness and diversity (i.e. represented by a large number of species from a range of fauna groups). • Low levels of foraging and breeding activity, with the site used by native fauna for refuge and cover. • Unlikely to form part of a wildlife corridor, and/or connected to a larger area of high quality habitat. • Habitat that has experienced or is experiencing low levels of disturbance and/or threatening processes (i.e. weed invasion, introduced animals, soil erosion, salinity). • Unlikely to provide known, or likely habitat for one or more rare or threatened species listed under the IUCN.

Table 28 Criteria for aquatic habitat integrity (Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes, such as an increase in duration of low flow season, resulting in low availability of certain
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon et al., 1993). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993) is also included
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly, or alternatively indicated by human settlements, agricultural and industrial activities. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon et al., 1992).

Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.

Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon *et al*., 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.

Table 29 Descriptive classes for the assessment of modifications to habitat integrity (Kleynhans, 1996)

Impact Category	Description	Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

Table 30 Criteria and weights for the assessment of habitat integrity (Kleynhans, 1996)

In-stream Criteria	Weight	Riparian Zone Criteria	Weight
Flow modification	13	Exotic vegetation encroachment	12

Water quality	14	Exotic vegetation encroachment	12
Water abstraction	14	Inundation	11
Inundation	10	Water abstraction	13
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	7		
TOTAL	**100**	**TOTAL**	**100**

NB: Scores are then calculated based on ratings received from the assessment. The estimated impacts of the criteria are then summed and expressed as a percentage to arrive at a provisional habitat provisional habitat integrity assessment. The scores are then placed into the intermediate habitat integrity assessment categories (Kleynhans, 1996) as seen in Table 31.

Table 31 Intermediate habitat integrity assessment categories (Kleynhans, 1996)

Category	Description	Score
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 - 90
C	Moderately modified. A 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	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 - 39
F	Modifications have reached a critical level and the lotic 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

Evaluation of significance of impacts

Correct evaluation of impacts enables the accurate prescription of mitigatory measures. The following factors were considered in classifying each potential impact generated by the sub-project:

- **Frequency:** Occurrence of activity producing the impact, e.g. continuous, intermittent or a single event/less than once per year;

- **Likelihood:** Probability of impact occurrence (e.g., 100%, 50%, 0%);
- **Extent:** Spatial extent of the impact (e.g. within 2 km of site boundary, outside the sub-project site but within 20km, within 200km, within Zambia, outside Zambia;
- **Duration:** Extent in time of the impact. Short term impact (less than the life of the project), medium term impacts (equal to the lifetime of the sub-project) and long term impacts (greater than the lifetime of the sub-project);
- **Magnitude:** Impact magnitude defined in relation to the limit criterion specified by ZEMA or international standards where available;
- **Type of impact:** Positive or negative effect; direct or indirect action;
- **Potential significance:** A combination of all the factors described in the preceding bullet points is used to determine the type and significance of potential impact prior to mitigation. This is defined as low, medium or high.

Table 32 below presents the terminology used to describe and rank environmental and social impacts according to the categories defined above.

Table 32 Terminology used to describe environmental and social impacts

Category	Terminology	Definition
Scope of Impact[1]		
Frequency	Frequent Infrequent Rare	Uninterrupted or on a daily basis Once or more per day Less than once per day Single event/less than once per year
Likelihood	Certain Likely Unlikely No impact	Impact possibility estimated to be 100% Impact possibility estimated as between 50% and 99% Impact possibility estimated as < 50% Zero estimated possibility of impact
Extent	Local Provincial Regional National International	Within 2 km of the sub-project site Outside the sub-project site but <20 km away Outside the sub-project site but < 200 km away Within Zambia Outside Zambia
Duration	Short Medium Long	Less than the life of sub-project The life of project Greater than the life of sub-project
Magnitude[2]	Very low Low Medium High Very high	Defined in relation to the limit criterion where available, e.g.: ● Very low: Parameter < 10% limit criterion ● Low: Parameter 10 to <50% limit criterion ● Medium: Parameter 50 – 100% limit criterion ● High: Parameter 100 – 200% limit criterion ● Very High: Parameter > 200% limit criterion. Or, for qualitative assessments: ● Very low: No degradation/adverse alteration to resource/receptor ● Low: Minor degradation/adverse alteration to resource/receptor ● Medium: Moderate degradation/adverse alteration to resource/receptor.

		● High: Significant degradation/adverse alteration to resource/receptor. ● Very High: Permanent degradation/detrimental alteration to resource/receptor.
Type of Impact		
Effect	Positive Negative	Beneficial impact Adverse impact
Action	Direct Indirect	Impact caused solely by activities within scope of the sub-project. Impact which does not result directly from by activities within the scope of the sub-project, but which has a connection with the sub-project's presence.
Potential Significance		
Significance	Low Medium High	Any low magnitude impact, or medium magnitude impact that is unlikely to occur or is of short duration. Any medium magnitude impact that is certain or likely to occur and of medium or long duration. Also, any high magnitude impact that is unlikely to occur, of short duration, or local in extent. Any high magnitude impact that is certain or likely to occur, of medium or long duration, and regional in extent.
(1) (2)	All terms are characteristics of the impact(s). For example, duration refers to duration of impact, not the activity causing it. As indicated, the impact magnitude for some environmental aspects can be defined in relation to the limit criterion specified by ZEMA or international regulations, or best practices when national standards are not available. However, in the absence of definitive quantitative criteria, a qualitative assessment of the magnitude is used relating to the impact type.	

Approach to mitigation of impacts

The conservation objectives and actions in this BMP have been developed to ensure the systematic implementation of the mitigation hierarchy i.e. avoid, reduce (minimize) and remedy (restore) as shown in the figure below. This approach will allow for the careful management of risk and the best possible outcomes for the project and local communities, without compromising the health, function and integrity of the ecological system.

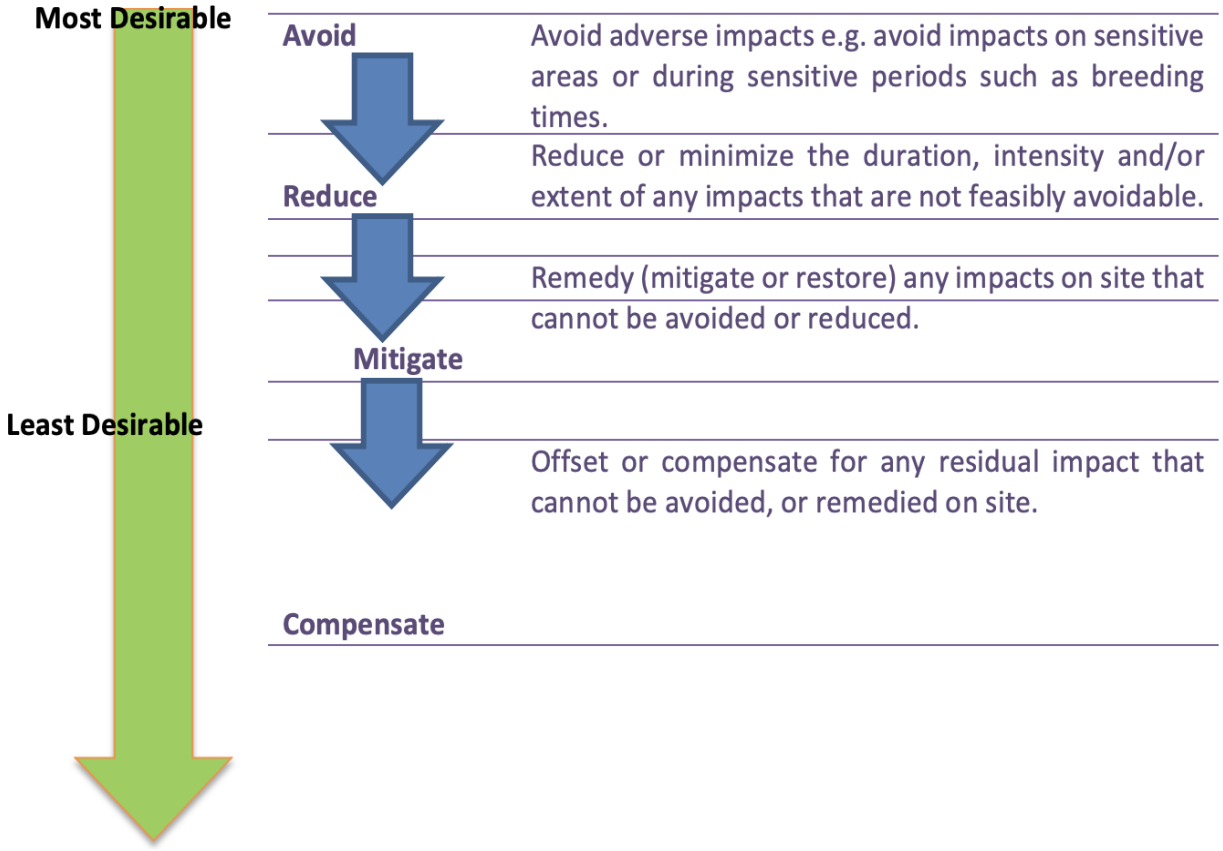


Figure 39 Approach to mitigation of impact

Data collection methods

Desk review

Prior to undertaking site surveys, a desk study was undertaken. This was aimed at helping to develop the study methodology and prepare the field work. The review was used to collect secondary data relevant for the terrestrial and aquatic ecological assessment.

Documents reviewed included but not limited to:

- Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia under the IDSP;
- Initial Environmental Project Brief for Kanyika Dam
- Various ecological studies including Zambia Environmental Management Agency Approved ESIAs and EPBs carried out in Southern Province with focus on those close to the sub-project site
- Satellite images of the sub-project site

The review also included internet research with the following websites being the main ones consulted:

- IUCN Red List;
- Birdlife Data Zone; and
- Ramsar Website

Completion of field surveys

Biodiversity Assessments were conducted by three professionals (one lead ecologist, and one aquatic assistance and one terrestrial assistant) over a period of 4 days from 5th April, 2021 to 8th April 2021.

Reconnaissance survey
The team conducted a reconnaissance survey of Kanyika Dam on 5th April, 2021 in the company of officers from various government departments. This was useful in obtaining an overview of the study site in terms of its land use and physical features e.g. soils, vegetation, topography etc.., which were then surveyed at a more detailed level. The reconnaissance survey also helped the assessment team to decide the area to be sampled and the sampling intensity.

Terrestrial ecosystems

- **Sampling design**

In order to generate data required for the assessment, a stratified simple random sampling method was employed. The sampling method was preferred in order to avoid sampling points falling on bare, or cropland. This method was suitable, because it had the advantage of spreading sample plots all over the areas of interest with no bias. Circular plots of size 0.13 ha were adopted. The sampling points (see figure 1 above) were randomly determined using data management tools in ArcGIS version 10.4 and coordinates recorded. The points were then located in the field using a GPS.

- **Sampling intensity**

Intensity of sampling is a ratio of the area sampled to the total area of study. The total area sampled was 3.25 ha while the sampling intensity used was 0.02 percent. The sampling intensity gave a total of 25 circular sample plots of 40 meters diameter. The sampling intensity was considered adequate due to the homogeneity of the area's vegetation cover as was discovered during the reconnaissance survey.

- **Floral survey**

The flora assessment was done by field walks guided by GPS used to track the sampling points earlier determined. For each sampling point, species identification was done based on expert knowledge and available field guides [Storrs, (1995); Smith & Allen, (2004); Phiri, (2005); and Fanshawe, (1971)]. Additionally, local community members were consulted, which provided important ethno-botanical information. For species that could not be identified, specimens and pictures were collected for cross referencing with different databases until the species were identified. To show or give a clear picture of the structure of the plant community in both qualitative and quantitative terms, flora attributes such as habitat, diameter at breast (Dbh), height, frequency, canopy cover, and litter cover were collected [Shukla and Chandel, (2000); Chidumayo, (1997) Table 3-8]. Floral data was collected from 24 x 400m^2 plots over a period of 4 days.

Figure 40 Field team collecting floral attributes

Table 33 Parameters measured from the main plot

Parameter	Comment
Plant species	Identified in the field by use of field guides (Storrs, 1995)
Tree diameter (DBH)	Taken at 1.3m for all trees with diameter >5cm
Tree Height	Total and bole height in m
Crown size	In m
Tree condition	Crooked, moribund, etc
Canopy condition	In %
Vegetation type	Open woodland, termitaria, riparian etc.

- **Faunal Survey**

Assessment of terrestrial fauna in the sub-project area of influence was done through a combination of methods. These included setting up traps for small mammals, observational walks within 500m radius around the dam and also discussions with local community members.

- **Setting up of Traps**

Camera traps and standard Sherman traps were set up around the dam area. These were meant to trap small mammals found around the dam. The traps were exposed for 24 hours at each site and checked every morning. All species encountered were recorded.

- **Observational walks and interviews with community members**

During walks, rocks, boulders and litter were turned over in search of terrestrial amphibians and reptiles. Community members who had lived in the area for 3 or more years qualified to be key informants as regards to the fauna of the area. Three persons were interviewed and the following questions guided the interviews: **(1)** what animals were once present in the area? **(2)** what animals are found in the area today? And **(3)** what in their opinion has caused the changes in animal population structures? For bird species, checklist of questions included: **(3)** What type of migratory birds you usually see in the area? **(4)** Do you notice any strange or extraordinary birds during certain seasons? **(5)** Do you know their names? and **(6)** When do they appear and leave each season? This is suitable for use where the subject of the assessment is not confined to one area or is rarely seen but known to occur in the area. Identification of species followed Carruthers (2017); Picker et al, (2004) including Sinclair and Ryan, (2003). The International Union for the Conservation of Nature (IUCN) Red list of threatened species was used to determine the status of the faunal species IUCN, (2021).

Aquatic Ecosystems

- **Sampling design**

The dam was stratified into four sampling points; downstream, at the dam wall, midpoint of the dam and upstream as shown in Figure 41.

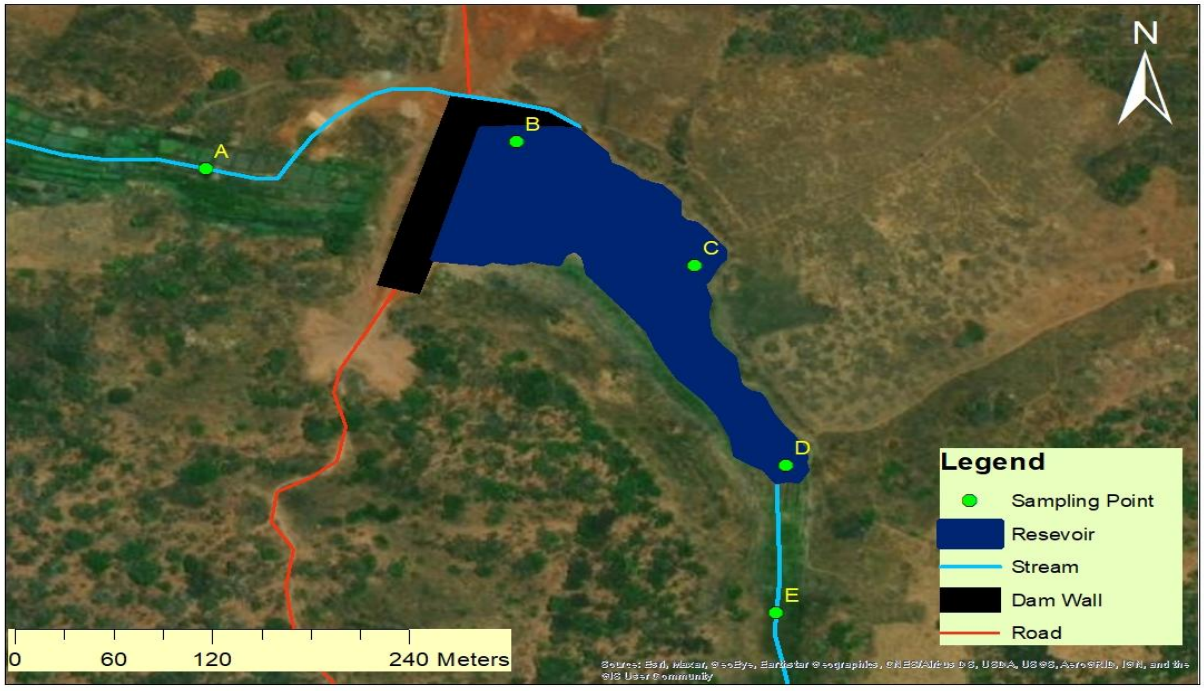


Figure 41 Sampling points for aquatic biota (field team, 2021)

The selection process of sampling areas relied on the length of the dam, and the 1 km distance downstream and upstream. Two sampling strategies were used; i) sampling from primary sampling units (PSUs) i.e. fishing points, ii) sampling from tertiary sampling units (TSUs) i.e. active fishers, downstream and upstream activities.

Table 34 The list of PSUs for the survey activity where data was collected

Sampling Point	PCU description	Coordinates
A	Down stream	25°55'9.759''E 13°30'50.272''S
B	Dam wall	25°55'15.848''E 13°30'49.589''S
C	Mid-point	25°55'19.39''E 13°30'52.602''S
D	Dam tail	25°55'21.192''E 13°30'57.449''S
E	Upstream	25°55'20.943''E 13°31'09.91''S

Dam wall Middle

Upstream Down stream

Figure 42 Aquatic sampling points for Kanyika Dam

- **Water Quality**

Water quality was measured using a calibrated multi-water parameter checker. In situ constituents considered in this study included temperature (ºC), pH, dissolved oxygen (mg/l) and transparency (m).

Figure 43 Some water quality testing tools used

- **Fish**

A variety of techniques were applied to sample fish species. The sampling methods depended on site characteristics and included cast netting, gill netting, angling and seine netting.

A quantitative and qualitative fish assessment was completed. Fish community structures and diversity were determined for each sampling site; this information was used to investigate basic community characteristics. The information and specific characteristics of dominant fish species, and the species occurring, allows for the analysis of the present ecological state of the aquatic ecosystem.

- **Plankton**

Water samples were collected in the field from sampling points using the plankton net, a total of two water samples were collected at each sampling point. The collected water samples were fixed with 10 % formalin. These water samples were then taken to the laboratory for plankton analysis. Using a microscope and field guide books Phytoplankton's and Zooplanktons were identified and recorded in the note book.

Figure 44 Field and lab equipment used for plankton analysis

- **Macroinvertebrates**

Macro-invertebrates were sampled with a kick net by holding the net frame firmly against the stream bottom and disturbing the substrate upstream (approximately a full arm's length) from the net with feet. The substrate was dug into deeply with the heel or toe to dislodge macro-invertebrates from the streambed. The dislodged plume of silt collected into a strategically located net in order to capture the dislodged invertebrates. The macro-invertebrates were then identified using a magnifying glass and identification keys by Simms and Blaylook (2002) and Walker (2011).

Data Analysis

Terrestrial

Data was analyzed using Microsoft Excel 2007 package. In each plot, the botanical name, diameter at breast height (Dbh, 1.37m) and stem height for tree species with Dbh < 5cm were collected as primary data. The collected information was used to determine: species list/diversity, ecological density, abundance, frequency, relative dominance, relative density, relative frequency, size class distribution for

trees, and relative importance value of every tree species**.** The Additionally, tables and graphs showing size class profiles were developed from diameter data collected in the study. Species richness refers to the total number of species recorded within the MLHPP study area. Also to have a clear understanding of species diversity, the Shannon Diversity Index (SI) and the Simpson Index (1-D) (Abiot and Gonfa, 2015) were used as stated in equation 1 and 2 respectively.

(1) $$\mathrm{SI} = -\sum PiLn(Pi)$$

(2) $$\text{Simpson Index (1 - D)} = \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

In the Shannon Diversity Index (SI), Pi is the number of individuals of species in a given plot divided by the total number of individuals in the plot, Ln is the natural logarithm, and is the sum of the calculations. The index incorporates the species richness and the proportion of each species in all sampled plots (evenness) (Cordell, 2005). Furthermore, production of maps and analysis of spatial attributes was done using ArcGIS software version 10.4.

Aquatic

For aquatic biodiversity Microsoft excel 2007 package was used to analyze fishing activity rates and fish species composition, diversity and abundance. All captured aquatic fauna and flora were checked against the IUCN red list of threatened species to ascertain their conservation status.

For water quality parameters, (ph, dissolved oxygen and water transparence) known reference values were used as benchmarks for which the project site's aquatic environment was assessed.

The habitat integrity analysis was based on a methodology by Kleynhans (1996).

RESULTS & DISCUSSION

Terrestrial Survey Results

Habitats

The main habitat found within the Kanyika dam area is a combination of hill and wet miombo woodland containing secondary forest. Most of the trees are in their juvenile stages indicating previous disturbance mainly from agriculture activities. The woodland habitat is a multi-storey formation with *Isoberlinia angolensis, Brachystegia spp, Anisophyllea boehmii,* forming the top storey while *Albizia spp, Strychnos spp and Phyllocosmus lemaireanus* dominated the mid storey. A shrubby layer of small trees of the same plant species found in the upper layers and grasses are present. Evidence of anthropogenic disturbances such as charcoal manufacturing, fuelwood collection, agriculture activities and fire occurrences are still prominent. However, the habitats seem very resilient to disturbances as plants easily regenerate when the pressure eases.

Table 35 Description of habitat and vegetation condition

Type of Habitat		Classification value (importance)	Reasons for classification
1.	Wet miombo Woodlands	Moderate	● Largely fragmented. ● Intact on one side of the dam due to presence of a graveyard in the vicinity. ● Natural vegetation cleared for agricultural purposes. ● High regenerative potential. ● Low presence of faunal species.
	Termitaria	High	● This habitat type was intact and well vegetated. *Markhamia obtusifolia* dominated this habitat with lots of holes in the mounds.
2.	Riparian	Low	● Riparian habitat is fragmented on the downstream by farming activities. ● Dam wall blocked water from flowing down stream. ● Many aquifers evident downstream of dam wall.
3.	Dambo	High	● Lots of grass species including *Cynodon* spp, *Phragmites* spp. Also lined with *Acacia* spp.

Flora

The study area has a high species diversity indicated by a total of 44 tree species enumerated during the survey (see tables 4.2) with an average Dbh of 10.43cm. There were 558.01 stems/ha of which 416 stems/ha had a Dbh ≥ 5cm while 141.35 stems/ha had Dbh < 5cm.

Isoberlinia angolensis is the most dominant species in the area indicated by an IVI of 32.4 followed by *Brachystegia boehmii* (table 4-2). The overall species diversity as measured by the Shannon Index (SI) (3.27765) was high (appendix 8.6).

Table 36 Species importance values and IUCN status

Botanical name	Relative frequency	Relative density	Relative dominance	Importance value	IUCN Status
Isoberlinia angolensis	84	13.2011	0.0722368	32.4245	LC
Brachystegia boehmii	72	11.1615	0.237777	27.7998	LC
Anisophyllea boehmii	72	2.49292	0.085151	24.8594	LC
Ochna pulchra	68	5.55241	0.3774004	24.6433	LC
Brachystegia spiciformis	60	4.64589	6.2733237	23.6397	LC
Albizia adianthifolia	64	5.04249	0.3316996	23.1247	LC
Strychnos spinosa	60	4.47592	0.0530719	21.5097	LC
Phyllocosmus lemaireanus	56	2.83286	0.0383445	19.6237	LC
Vitex doniana	56	1.69972	0.1115837	19.2704	LC
Pericopsis angolensis	48	6.57224	0.1564	18.2429	LC
Pterocarpus angolensis	52	1.52975	0.2686767	17.9328	LC
Erythrina abyssinica	48	3.00283	0.0874065	17.0301	LC
Strychnos cocculoides	44	2.60623	0.3014633	15.6359	LC
Albizia antunesiana	40	3.51275	5.0344626	16.1824	LC
Combretum zeyheri	40	1.69972	7.4393436	16.3797	LC
Syzygium guineense	36	2.54958	0.2415363	12.9304	LC
Brachystegia longifolia	36	1.47309	0.0622858	12.5118	LC
Combretum molle	28	1.64306	0.1533779	9.93215	LC
Marquesia macroura	24	1.07649	0.2491432	8.44188	LC
Uapaca kirkiana	24	0.90652	0.9139282	8.60681	LC
Dyplorhyncus condylocarpon	20	0.84986	0.4260497	7.09197	LC
Markhamia obtusifolia	20	0.56657	0.4260497	6.99754	LC
Bobgunia madagascariensis	20	0.3966	0.147422	6.84801	LC
Albizia amara	16	2.7762	0.0943501	6.29018	LC
Ficus sycomorus	16	1.07649	0.0622858	5.71292	LC
Albizia versicolor	16	0.28329	0.0445952	5.44263	LC
Acacia polyacantha	12	1.86969	0.3099548	4.72655	LC
Hymenocardia acida	12	1.35977	0.1194119	4.49306	LC

Piliostigma thonningii	12	1.13314	0.4260497	4.51973	LC
Terminalia sericea	12	0.96317	0.0943501	4.35251	LC
Uapaka sansibarica	12	0.56657	0.7484469	4.43834	LC
Sterculia quinqueloba	12	0.16997	0.3316996	4.16722	LC
Zanha africana	8	0.11331	0.0722368	2.72852	LC
Trema orientalis	8	2.15297	2.1602931	4.10442	LC
Terminalia stenostachya	8	1.1898	1.3267983	3.50553	LC
Steganotaenia araliacea	8	0.33994	12.961758	7.10057	LC
Brachystegia manga	8	1.13314	0.0722368	3.06846	LC
Mangifera indica	8	0.11331	0.3316996	2.815	LC
Phyllanthus muellerianus	4	2.54958	0.7135227	2.42103	LC
Pseudolachnostylis maprouneifolia	4	1.5864	0.1783807	1.92159	LC
Acacia sieberana	4	0.05666	0.2303469	1.429	LC
Erythrophleum africanum	4	0.7932	5.3071934	3.3668	LC
Monotes africanus	4	0.22663	0.0722368	1.43296	LC
Ficus wakefieldii	4	0.05666	5.3071934	3.12128	LC

The Dbh size class distribution both at stand level and species level shows vegetation structure in the study area. Distribution of tree diameters provides a means of understanding a forest composition and structure. Analysis of Dbh distribution Kanyika study site indicated a *reverse – J* distribution of tree diameters in which the number of trees declines rapidly with increasing size a characteristic typical of a normal forest (see Figure 45)

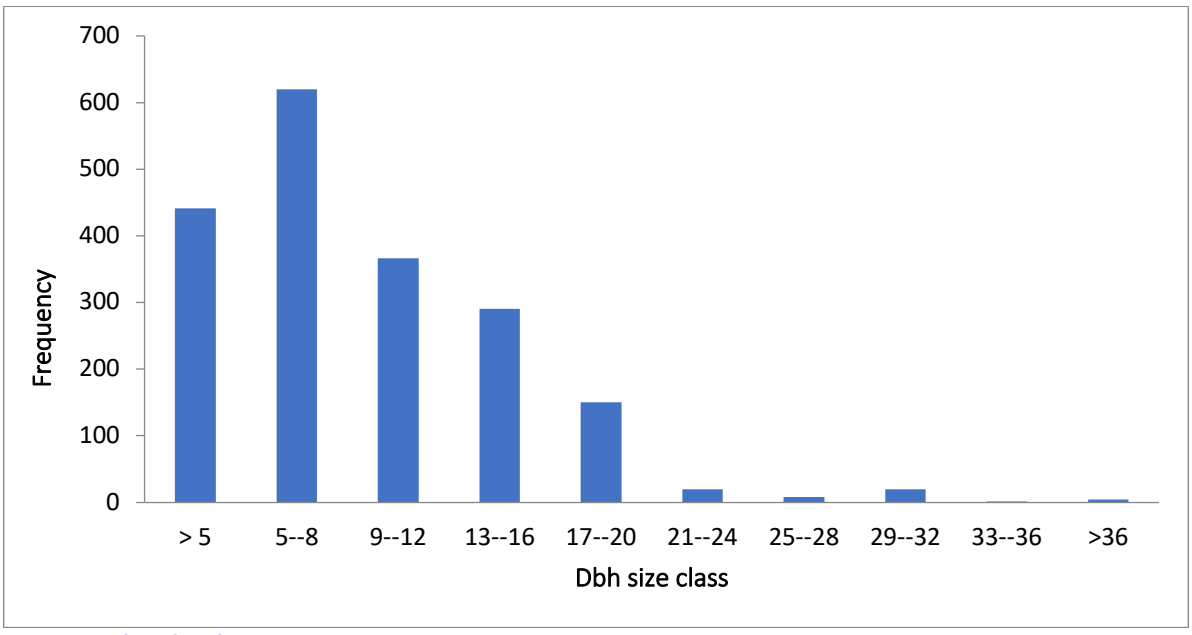


Figure 45 Size class distribution

Some parts of the area showed about 50 percent cover of shrubs as observed during the field visit (see figure 4.2). The shrubs were found growing in combination with tree regenerates especially in areas with recent human disturbances.

Figure 46 Shrubs growing in the area

The tree crown cover around the dam area is approximately 75 percent in some parts especially in the area close to the grave yard, while other areas exhibited crown cover below 50 percent. The areas with 75 percent crown cover had high density of small diameter but tall trees. The rapid growth in height is as a result of competition for light (figure 47).


Figure 47 Variation in crown cover between the area near grave site and the rest of the area

The sub-project area of influence has very good litter accumulation composed of deadwood and plant leaves etc... Litter accumulation of organic material and an intact litter layer are integral to a variety of

ecosystem functions, e.g. surface water storage, percolation and recharge, nutrient cycling, and support of certain plants and fungi (Collins et al. 2006). Furthermore, during field observations fungi (see figure 4.4) was captured (edible and non-edible mushrooms) species, which included; *Termitomyces* spp., *Russula* spp., *Luctarius* spp. and *Amanita* spp. This was also confirmed by community members who said that they always harvest mushrooms during the rainy season from the forested areas. The availability of a litter layer provides areas for primary production and decomposition necessary for maintaining functioning food chains. They nurture fungi essential to the growth of rooted plant organisms.

The abundance of organic debris and coarse litter on the substrate can significantly influence overall species diversity and food web structure. Fallen debris serves as cover for micro-invertebrates, amphibians, rodents, and even small birds.

Figure 48 Litter accumulation in the study area

A detailed analysis of soil cover, revealed that the sub-project area of influence contains good soil biological crust in most vegetated parts (see figure 4.5) despite being threatened by human agricultural activities. A mosaic of cyanobacteria, green algae, lichens, mosses, micro-fungi, and other bacteria form an important biological crust. This soil crust is important in the provision of soil stabilization, resistance to erosion, and enhanced soil water retention as this evidenced by amount of vegetation growing in the study area.

Figure 49 Green algae, ferns and lichens making up biological soil crust

Influencing the vegetation pattern around the settlements mainly are agriculture-related activities, which have impacted negatively on the forest composition and cover. Furthermore, uncontrolled fires around settlements have affected the flora regeneration potential for much of the area. The vegetation around the settlements was characterized by the remnant of miombo species.

Figure 50 Remnant vegetation and farming activities around communities

Fauna

The fauna listed in the tables 4.3, 4.4 and 4.5 represent information that was provided by key informants and through field observations by the survey team. The faunal richness was found to be low and this is attributed to the way of life of the local communities. Traditionally, the local communities are animal hunters, who depend largely on wild animals as a source of animal protein coupled with low faunal richness associated with miombo woodlands (Rodgers et al. 1996). Anthropogenic disturbances such as human settlement and agricultural activities have also contributed to low faunal abundance, particularly of large animals (especially the large mammals) which may have completely been depleted due to over hunting.

Table 37 Animals found and their IUCN status

Common name	Scientific Name	IUCN STATUS
Rat	*Rattus norvegicus*	LC
Giant mole rat	*Cryptomys mechowi*	LC
Hare	*Lepus victoriae*	LC
Tree squirrel	*Paraxerus cepapi*	LC
Slender mangoose	*Galerella sanguinea*	LC
Brown greater galago (Bush baby)	*Otolemur crassicaudatus*	LC
Sun squirrel	*Heliosciurus mutabilis*	LC
Cane rat	*Thryonomys gregorianus*	LC
Genet	*Bathyergus janetta*	LC
Wild cat	*Felis silvestris*	LC

Table 38 Common reptiles

Common name	Scientific name	IUCN status
Python	*Phyton sebae*	DD
Black mamba	*Dendroaspis polylepis*	LC
Rock lizard	*Agama atra*	LC
Sand lizard	*Pedioplanis lineoocellata*	LC
Spitting cobra	*Naja nigricollis*	LC
Puffadder	*Bitis arietans*	DD
Common lizard	*Agama agama*	LC

Table 39 Birds and their IUCN status

Common name	Scientific name	IUCN status
Tawny flaked prinia	*Prinia subflava***	LC
Crested francolin	*Dendroperdix sephaena***	LC
Broad tailed paradise whydah	*Vidua obtuse***	LC
Red eyed dove	*Streptopelia semitorquata***	LC
African mourning dove	*Streptopelia decipiens***	LC
Cape turtle (ring necked) dove	*Streptopelia capicola***	LC
African Jacana	*Actophilornis africanus***	LC
Meyers brown parrot	*Poicephalus meyeri***	LC
African green pigeon	*Treron calvus***	LC
Martial eagle	*Polemaetus bellicosus***	EN
Booted eagle	*Hieraaetus pennatus**	LC
African goshawk	*Accipiter tachiro***	LC
Helmeted guinea fowl	*Numinda meleagris***	LC
Wahlberg's eagle	*Hieraaetus wahlbergi***	LC

Key: * = Migratory; ** = Resident

Kanyika Dam and its surrounding areas are devoid of much fauna. Few mammals, reptiles and birds were seen and/or reported to exist in the area. Local community members interviewed attested to the fact that most fauna has been hunted down and only birds, butterflies, and grasshoppers are still plentiful in the area. All birds except for one (martial eagle *Polemaetus bellicose)* encountered and reported have an LC status on the IUCN red list (IUCN, 2021). Additionally, only one migratory bird species (Booted eagle *Hieraaetus pennatus*) was recorded for Kanyika dam area.\

Several colonies of red ants, black ants and grasshoppers (e.g. *Gymnobothrus lineaalba, Gymnobothrus temporalis, Acrida acuminate*), common house flies and assorted butterflies were observed in the sub-pproject site.

Figure 51 Black ants in the field

Aquatic Survey results

Results of the aquatic and riparian zone surveys for the Kanyika Dam are presented in this section. The data was collected through site inventories, which involved the direct measurement of some parameters on the site, reviews of relevant documents as well as interviews with relevant stakeholders in order to determine the anticipated sub-project impacts.

Habitats

The habitat for Kanyika Dam was found to be generally in a good state. The dam has a litoral zone, which is fairly vegetated with a limnet zone that offers refugia to the resident fish species. The well-lit literal zone acts as breeding and feeding ground for the fish. Using the habitat assessment index, the in-stream assessment shows that it is unmodified and the riparian zone has few modifications.

Table 40 The in-stream assessment for Kanyika dam

Instream	**Average score**	**Score**
Water abstraction	0	0
Flow modification	3	1.56
Bed modification	6	3.12
Channel modification	15	7.8
Water quality	5	2.8
Inundation	10	4
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total Instream	**80.7**	
Category	**B**	

Table 41 The riparian assessment for Kanyika Dam

Riparian Zone	**Average score**	**Score**
Indeginous vegetation removal	6	3.12
Exotic vegetation encroachment	0	0
Bank erosion	6	3.36
Channel modification	15	7.2
Water abstraction	0	0
Inundation	10	4.4
Flow modification	12	5.76
Water quality	5	2.6
Total Riparian	**73.6**	
Category	**CLASS C**	

The in-stream habitat of Kanyika Dam remains largely unaltered (class B) with limited modifications mainly with respect to channel modification and inundation. The riffle sections of the downstream have been turned into pools/ dambos thereby forming habitat for biodiversity of the stream during dry seasons.

Environmental Flows

The dam is located in the upper catchment were fish migrations may not be vital. With reference to the dam's hydrology given in the ESMP and design reports, small dams with a high MAR/Storage ratio allow for ecological flows, but if the streams are seasonal, the dams will spill during the runoff season. For environmental flows, where the storages are such that annual spills are limited; when the MAR / storage ratios are greater than approximately 1, then an environmental flow should be considered. Further to this, if environmental flows are required where the dam has small functioning outlet and pipes, it may mean that to change the outlets requires that the dam wall be breached down to an acceptable foundation i.e. riverbed and installed. Locating a non-compressible uniform foundation over an existing embankment will be an investigative challenge. Having high releases from the small dam will have very limited effect and further reduce its limited usage.This dam has spillway flows during run off season and has a working outlet (illustrated in Appendix 8.7- Hydrology and ecological flows). In addition, there are a number of natural water springs in the downstream area which further provide water and support biodiversity habitats.

Water quality

The results of four water quality parameters taken in-situ and those analyzed ex-situ are presented in Table 4.8. Laboratory results for pH are included in Table 4.8 in brackets. The ex-situ water quality results are also shown in Appendix 8.3.

Table 42 Water quality results

Reference values: Svobodova, Z and Machov, J. (1993). Water quality and fish health. FAO manual

#	Parameter	Sampling Point					
		WHO Ref. values	Borehole	A Downstream	B Midpoint	C Dam tail	D Upstream
1	pH	6.5-8.5	8.5 (6.66)	7.9 (5.94)	8.2 (6.20)	7.9	7.0 (6.20)
2	Dissolved Oxygen (mg/L)	5-7.5	8.1	5.8	8.9	7.9	6.5
3	Temperature (^oC)	25-30	29.8	26.6	29.3	25.8	27.9
4	Transparency (Secchi disc) (m)	0.25-0.6		0.46m	0.4m	0.45	0.43
5	Nitrates (as NO_3 –N mg/l)	10	<0.01	<0.01	<0.01		<0.01
6	Conductivity (µs/cm)	150-500	99	8	8		18
8	Total Suspended Solids (mg/l)		2.9	<1.0	<1.0		<1.0
	Phosphates (mg/l)	0.1	0.50	<0.01	0.20		0.20
	Chemical oxygen demand (as mg O_2/l)		3	2	2		2
	Alkalinity (as $CaCO_3$ mg/l)		50	10	12		20
	Total Dissolved Solids (mg/l)		49	4	4		9
	Ammonia (as NH_4-Nmg/l)	<0.06	<0.01	<0.01	<0.01		<0.01

A comparison of the monitoring values with reference values (Table 4-8), indicates the following:
The water quality parameters for Kanyika Dam fall within acceptable ranges for survival of aquatic biota. This means that the dam is suitable for cultivation of fish. The main purpose of Kanyika Dam is to provide irrigation water to small scale vegetable growers, the ex-situ pH results of dam water are not a hindrance to high crop yields. Vegetable crops grow well in pH range of 5.5 – 7. The pH for the dam water will notrender some plant nutrients toxic or unavailable for plant uptake. However, if the insitu results are the correct ones, then this hinders agriculture. pH will be further investigated in the site baseline quality analysis (refer to the BMP table).

Fish survey

A total of 16 species were recorded as occurring by the ecology assessment team; 11 of which were observed during sampling and the other 5 recorded from oral reports. Both reported and observed species are presented in the table 4.9 below and all are of least concern. Flows are experienced over the spillway during the runoff season.

Table 43 Fish species composition during the hot wet season

Common name	Scientific name	IUCN status	Migratory (Yes/No)
Red barb	*Barbus fasciolatus*	LC	No
Nile bream	*Oreochromis niloticus*	LC	No
Longbeard barb	*Barbus unitaeniatus*	LC	No
Straightfin barb	*Barbus Paludinosus*	LC	No
Stripped robber	*Brycinus lateralis*	LC	No
Redfin robber	*Brycinus imberi*	LC	No
African catfish	*Clarias gariepinus*	LC	Yes
African catfish	*Clarias theodorae*	LC	Yes
Africa catfish	*Clarias liocephalus*	LC	Yes
Redbreasted bream	*Coptodon rendalli*	LC	No
Dwarf bream	*Tilapia sparrmanii*	LC	No
Largemouth bream	*Serranochromis angusticeps*	LC	No
Purplemouth bream	*Serranochromis macrocephalus*	LC	No
Pink Happy	*Sargochromis giardi*	LC	No
Dwarf bream	*Pseudocrenilabrus philander*	LC	No

Figure 52 Types of fish caught in Kanyika Dam

Cichlids dominated the catch in Kanyika Dam. Of these *Pseudocrenilabrus philander* was the most abundant followed by *Coptodon rendalii* then *Sargochromis giardi* (Figure 4-9). The overall catch during the sampling was just from two points; near the dam wall and around the middle of the dam as indicated in table 44.

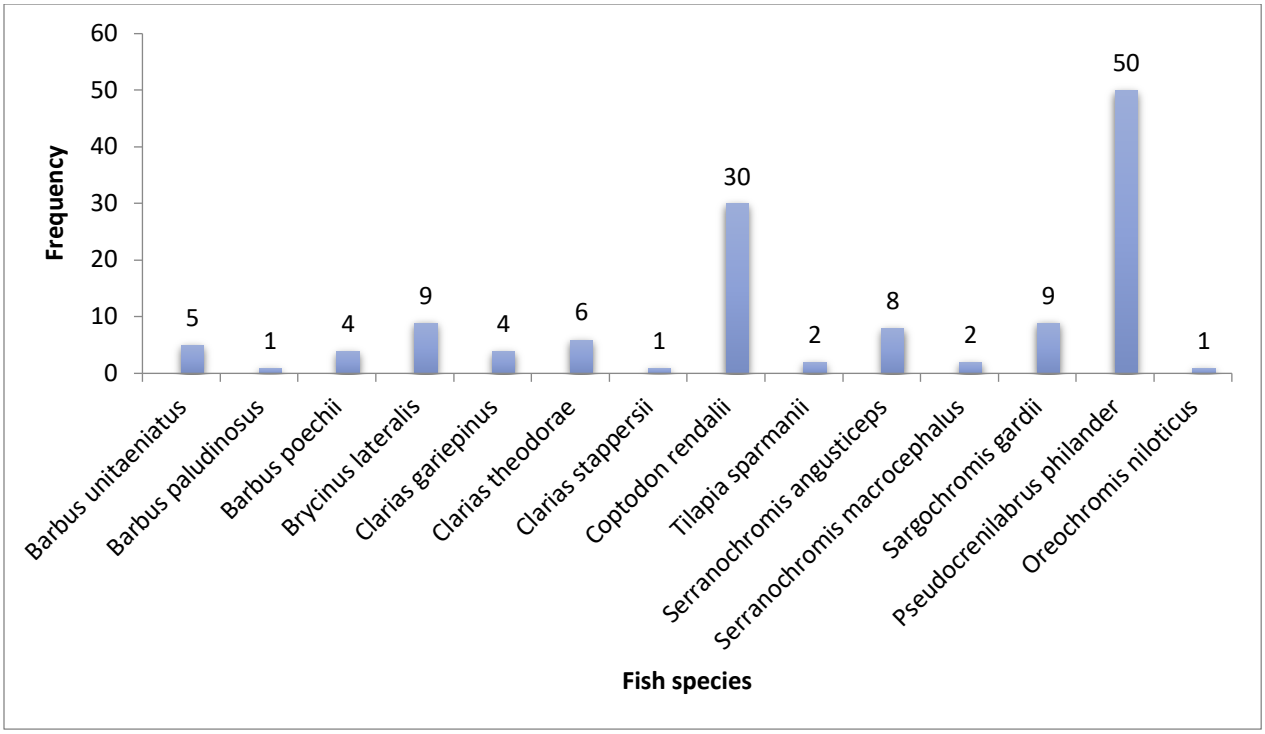


Figure 53 Fish abundance in Kanyika Dam

Table 44 Average total fish catch (kg) per sampling point

Description	Point A	Point B	Point C	Point D
Catch in KGs	0.0kg	0.17kgs	2.3kgs	**0.0kgs**

Cichlids are among the most popular for fish both for household level consumption and for the market. Their abundance in Kanyika can be attributed to failure by the locals to harvest them due to lack of appropriate fishing gear. This forces them to only fish in willow waters which are the nursery ground for the juveniles. The *O.niloticus* was found present, but the species of conservation concern were not present in the waters. This invasive species is common and was introduced in the Kafue River system were the dam falls. Interaction of the invasive species with the present species was not observed during the study.

The fishing activity rate (AR) (expressed either as a ratio or fraction between 0 and 1 or percentage) shows how often fishers go out fishing in a given period while fishing effort (FE) is the amount of fishing gear of a specific type used on the fishing grounds over a given unit of time. The AR and FE of Kanyika Dam is given in table 4.11.

Table 45 Fishing activity rate averages for the hot wet season

Description (AR/RE)	Point A	Point B	Point C	Point D	River Average
AR for Kanyika	0.1	0.3	0.0	0.0	0.1
No. of fishers	1	2	3	0	
Canoes	0	0	0	0	
Plank Boats	0	0	0	0	
Fiber Boat	0	0	0	0	
Dingi	0	0	0	0	
Aluminum	0	0	0	0	
Gillnets	6	6	6	6	
Baskets	0	0	0	0	
Seine Nets	1	1	1	1	
hooks	6	6	6	6	
No. of villages	1	1	1	1	

The activity rate for the community surrounding the Kanyika Dam is low. This shows that fishing in the dam is not a priority occupation for the communities. Several reasons can be attributed to this outcome. Firstly, it is important to note that alternative livelihoods have a direct bearing on the fishing activity rate of fishers within a given fishing area. Further, the rate at which fishers go out fishing varies according to seasonal changes. The survey team observed significant farming activities around the dam area, indicating that people were busy with their crop fields (the assessment was done during the main crop growing season). The local community at Kanyika did not seem to be traditionally a fishing community as several community members were seen traversing the area going to their vegetable gardens. Vegetable gardening is often an off season activity and this, according to information from the community is their alternative livelihood strategy.

Invertebrates, plankton and macrophytes

A number of macroinvertebrate species were observed (Table 4.12). These include bottom – dwelling animals such as crustaceans, worms and aquatic insects. Beetles, caddisflies, stoneflies, mayflies, hellgrammites, dragonflies, true flies, and some moths are among the groups of insects represented in stream. Macroinvertebrates are an important link in the food web between the producers (leaves, algae) and higher consumers such as fish. Planktons and macrophytes which are the primary producers in the Kanyika water system are presented in Table 46.

Table 46 List of macro-invertebrates

Common Name	Scientific name	Frequency

Whirligig beetle	Gyrinidae	various
Fry	Assorted	various
Crab spider	Thomisidae	2
Round worm	Nematoda	5
Fishing spider	Dolomedes	6
Freshwater slater	Asellus	6
Water strider	Gerridae	7
Crawling water beetle	Haliplidae	various

Table 47 Plankton and macrophytes for Kanyika Dam

PHYTOPLANKTON	ZOOPLANKTON	MACROPHYTE
Scientific name	**Scientific name**	**Common name**
Anabaena smithii	*Lepadella oblonga*	Duckweed
Closterium sp.	*Keratella valga*	Water lily
Euglena sp.	*Cydorus sphaericus*	lotus
Navicula sp.	*Diurella stylata*	Water hyacinth
Microcystis novacekii	*Asplanchna herricki*	
Semocephalus vetuloides	*Brachionus angularis*	
Pediastrum simplex	*Cyclops sp.*	
Staurastrum pseudosebaldi	*Copond sp.*	
Synedra	*Monostyla sp.*	
Micrasteris radiosa	*Simocephalus vetuloides*	
Distigma spp	*Brachionus angularis*	
Centritratus bruneus	*Trichocerca pusilla*	
Lepocindlis ovum	*Monostyla bulla*	
Cyclops spp	*Kerratella valga*	
Diaptom spp	*Makinoella tosaensis*	
Moina micrura	*Anabaena smithii*	
Brachious spp	*Sphaeroplea annulino*	
Colurella obtusa	*Ceridaphania cornuta*	
Ceriodaphnia cornuta	*Brachionus angularis*	
	Brachionus calyciflorus	

Evaluation of impacts

Using the criteria explained in subsection 3.1.3 of this report, the potential impacts that the proposed sub-project may have on the biodiversity in the area were evaluated and reported in Table 4-14. The unmitigated values are shown below. Impacts that involve species of conservation concern are higher due to the status of the species. It is anticipated that these and other impacts' levels of significance will be lower and managed once the proposed mitigation measures in the BMP are applied.

The project area of influence is modified with settlements, vegetation clearing and cultivation fields. It is not in a legally protected and internationally recognized area of biodiversity value**.** The Kanyika Dam might be classified as a critical habitat according to WB standards and the ESA[25] because it has a species of conservation concern (endangered species) and migratory species in the project area of influence that might be impacted[26] (refer to section 4.1 and 4.2). However, this is an existing dam and the short term sub-project aims to remediate the dam. It is a low to moderate critical habitat due to the modified habitat conditions and it is not located in a legally protected area, but, conservation measures should be in place to protect the species and their habitats. Therefore, the recommended biodiversity mitigation measures in the BMP table (section 5) and the ecological management and monitoring requirements suggested in section 5.3 and Appendix 8.6 significantly reduce the significance level of the identified impacts.

[25] ESA-ToRs for Biodiversity Team-'some dams have Critical Habitats as defined in the OP 4.04 and they do define actions to protect, restore or improve conditions to reduce impact on biodiversity

[26] ESA Table 3 and 9.3: (iii) dams resulting in moderate to high levels of risk where detailed field investigation shows presence of endangered species. Such sites may be those that potentially impact on endangered or critically endangered species.

Table 9-3: page 219 of the ESA-Preparation of a Biodiversity Action Plan (BAP) and ecological flow remediation actions

Table 48 Evaluation of impacts

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
1.0. TERRESTRIAL											
Site Preparation and Construction Phase											
Impacts on Terrestrial Biodiversity											
Flora clearing for site preparation and access roads	Loss of Indigenous flora species/reduction in population i.e. stocks per area Loss of the forest species	Paving way or creation of space for access roads, setting up of construction camp as well as excavation of laterite (borrow pits) for construction works will certainly demand for clearing of vegetation in certain locations of the site The contractor will avoid activities and vegetation clearing in the forests	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium
	Habitat fragmentation	Creation and/or rehabilitation of access roads, construction camp and setting up of working or operational areas will further fragment the already fragmented habitats on site	Rare	Likely	Local	Long	Medium	Negative	Indirect	Medium	Medium

	Loss of habitats and associated fauna	Vegetation clearing will result in loss of habitats for the fauna observed on site - birds, insects (invertebrates), mammals (mainly hares and mice) as while as reptiles (snakes and lizards) on site. Birds may also lose nesting trees. If not checked, this may consequently result in loss of fauna Loss impacts of the species of conservation concern, the martial eagle and migratory birds	Rare	Likely	Local	Short	Medium	Negative	Direct	High	High
Heightened noise levels	Disruption of fauna activities	Noise from heavy construction machinery (vehicles), increased number of people on site and general workings on site will likely unsettle or disturb the fauna. Sleeping schedules, feeding movements and resting time may be affected in this regard	Rare	Likely	Local	Short	Low	Negative	Direct	Low	Low
Vehicle-fauna collisions	Injury or mortality of fauna	Increased vehicular movement in the sub-project area of influence may potentially result in collisions with fauna on site that is not accustomed to this situation. In case of this occurrence, this can result in injury or mortality.	Rare	Unlikely	Local	Short	Low	Negative	Direct	Low	Low
Hunting and trading in wildlife	Reduced fauna population	If in-migration occurs as a result of project implementation it will likely increase demand for food including game meat. This may increase the risk of hunting wild game for meat. For the same reason, trading in wildlife may increase	Rare	Unlikely	Provincial	Short	Low	Negative	Indirect	Low	Low

Increased demand for medicinal use of flora and fauna as a result of In-migration	Increased exploitation of medicinal biodiversity in the sub-project area of influence	Because of the increased population resulting from in-migration, the demand for medicines from flora and fauna is also likely to increase. This is likely to be the case because of lack of hospitals and clinics in the sub-project area of influence.	Rare	Unlikely	Local	Short	Low	Negative	Indirect	Low	Low
Increased demand for firewood or wood based fuels	Debarking Cutting down of trees	Pressure on trees will increase with the increase in demand for firewood and wood based fuels which will be as a result of increased number of people in the area (in-migration)	Rare	Unlikely	Local	Short	Low	Negative	Indirect	Low	Low
Impacts on Terrestrial Habitats											
Destruction of existing habitats on site	Fragmentation and depletion of habitats	Project activities such as setting up of camp site, creation of access roads, creation of working area and claiming of laterite from borrow pits will contribute to the fragmentation and depletion of habitats on site.	Rare	Likely	Local	Medium	Low	Negative	Direct	Medium	Medium
	Reduced value or integrity of habitats	Mismanagement of sub-project activities can result in contamination of habitats. These activities include handling of hydrocarbons (fuel, oils and hydraulic fluids), industrial and domestic waste can also contribute to this impact. If not properly handled, hydrocarbons and different streams of waste can further reduce the value of habitats on site	Rare	Likely	Local	Medium	Medium	Negative	Direct/Indi	Medium	Medium

									r e c t		
	Introduction of Invasive species and pathogens	There is a possibility that Invasive plants and seeds may be accidentally or intentionally introduced into the sub-project area of influence by workers through clothing, vehicular movements, and as ornamental plants. In case of fauna, introduction may be mainly through pets.	R a r e	U n l i k e l y	L o c a l	M e d i u m	L o w	N e g a t i v e	I n d i r e c t	M e d i u m	L o w
Impacts on Biophysical Environment											
Increased risk of fire occurrences	Reduced habitats/ecosystems value and increased risk of injury or death of flora and fauna	The presence of humans on site carries with it the risk of bush/forest fires as a result of cooking, smoking, arson as well as accidents. The results fires can negatively affect both habitats and biodiversity species on site.	R a r e	l i k e l y	L o c a l	M e d i u m	M e d i u m	N e g a t i v e	I n d i r e c t	M e d i u m	M e d i u m
Air, Water and Soil pollution	Contamination of the biophysical environment	Biophysical environment contamination may arise from: ● Mismanagement of domestic and industrial waste on site; ● Spillages and leakages of chemicals on site such as fuels, oils and other liquid and solid based substances ● Exhaust emissions from machinery	R a r e	L i k e l y	L o c a l	S h o r t	L o w	N e g a t i v e	I n d i r e c t	M e d i u m	L o w

	Injury or mortality of fauna	• Dust generation from movement of machinery, excavations and related sub-project activities These activities can possibly reduce the value of the habitats as well as injure or even kill both flora and fauna species on site	Rare	Likely	Local	Long	Low	Negative	Indirect	Medium	Medium
Operations Phase											
Water Availability											
Water harvesting or storage in dam	Increased availability of water	Remedial works will increase the efficiency and capacity of the dam to hold water. This will make more water available for flora and fauna all year round. Stored water will also contribute to the charging of ground water system	Frequent	Certain	Local	Long	High	Positive	Direct	Medium	High
Dam Failure											
Risk of dam failure	Mortality or injury to flora and fauna	Dams always have an inherent risk of wall collapse. Even in the case of Kanyika dam, this may happen. In case of occurrence this may kill or injure flora and fauna downstream.	Rare	Unlikely	Regional	Long	High	Negative	Direct	High	High
2.0. Aquatic											

Site Preparation and Construction											
Compromised aquatic habitats for fauna and loss of breeding areas	Clearing vegetation Unprotected water bodies such as the dambos and springs	Creation of access roads, setting up of construction camp, clearing dam area of vegetation during rehabilitation, could contribute to an increase of siltation within aquatic habitats The project area of influence has dambos and springs. Activities around the sensitive water bodies can negatively impact their ecological functions	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium
Increase in water and noise pollution	Stresses flora, fauna and habitats	Some materials used during site preparation and construction could pollute the water in the dam During construction, there will be an assortment of machinery operating, and an increased number of people. Ultimately, this could increase noise levels (pollution) in the area. This could stress some lifeforms ●	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium
Increased fishing pressure	Reduced fish population	Project likely to increase number of people in the area. This could ultimately translate into increased demand for food items such as fish.	Rare	Unlikely	Provincial	Medium	Low	Negative	Indirect	Medium	Low
Increased demand for water	Compromised aquatic habitat	Construction is a task demanding water. Further, the construction workers will need water for personal use.	Rare	Unlike	local	Medium	Low	Negati	Indire	Medium	Low

				ly				ve	ct		
Hazardous waste contaminating habitats	Loss of flora and fauna, degraded habitats	Some by- products of construction work, could be hazardous. And if they are disposed in water, unintentionally or intentionally, they could degrade habitats, cause diseases and in some cases mortality to fauna and flora	Rare	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low
Operations Phase											
Increase in populations of flora and fauna	Populations of flora & fauna to increase, and habitats enhanced	When the dam is fixed, it will operate efficiently. The dam provides enough water all year round and an environment for species to thrive. The water body has more life forms than the springs or streams	Rare	Certain	Local	Medium	Medium	Positive	Direct	Medium	Medium
Habitat pressure caused by the dam	Over grazing, irrigation and fishing activities around the dam	When the dam is repaired, it will operate efficiently. This could trigger an increase in fishing, irrigation and livestock activities around the dam causing an increase in grazing pressure around the dam, irrigation area and fishing activities affecting vegetation, causing siltation which will affect the dam	Frequency	Certain	Local	Medium	Low	Negative	Direct	Low	Low

Maintained environmental flows downstream and protected dam habitats	The downstream flows will continue in relation to the design	The flows will be maintained as per the design and storage ratios. The habitats protection is part of the training programme for DMC. Once these are protected the biodiversity in the dam will be sustained. Species will be protected and will have conducive habitats to live in.	Rare	Certain	Regional	Long term	Medium	Positive	Direct	Medium	Medium
Decommissioning											
Increased ecological integrity	Increase in the life forms populations in the dam	The maintenance of the dam will ensure increased habitat integrity and populations of aquatic biodiversity	Frequent	Certain	Local	Medium	High	Positive	Direct	Medium	Medium
Settlements /Infrastructure downstream may be inundated and damaged	Loss of flora and fauna, infrastructure. And unfortunately, there could loss of human lives	Decommissioning could happen if there is a desire to reconstitute the environment. It involves well thought out plans to reinstate the initial river course by removing the weir.	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low
Increase in water pollution	Chemicals used for agriculture and loose soils from fields may run into the waters	Increased chemical pollution from agriculture practices which can lead to algae growth and eutrophication. Sedimentation due to soil erosion resulting from farmlands and agriculture land tilling methods around the dam, upstream and downstream	Frequent	Likely	Local	Medium	Medium	Negative	Indirect	Medium	Medium

Impacts Summary

Terrestrial Biodiversity Environment

Negative Impacts during rehabilitation works include:

- Vegetation clearing for site preparations
- Loss of fauna due to vegetation clearing and activities on the site
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens
- Loss of species of conservation concern

Positive Impacts during operation and maintenance include:

- Increased water availability for fauna growth

Negative Impacts during operation and maintenance include:

- Vegetation clearing due to anthropogenic activities
- Loss of fauna due to vegetation clearing
- Possible deterioration of water quality downstream due to biocides that may be used during irrigation agriculture
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens
- Loss of species of conservation concern

Aquatic Biodiversity Environment

Positive Impacts during rehabilitation works include:

- Increased ecological integrity leading to increase in the life forms populations in the dam

Negative Impacts during rehabilitation works

- Compromised aquatic habitats and breeding areas for fauna through vegetation clearing
- Pollution of water which stresses flora, fauna and habitats
- Increased demand for water compromising aquatic habitat
- Loss of species of conservation concern

Positive impacts during operation and maintenance include:

- Increase in populations of flora and fauna when habitat integrity is enhanced
- Maintained environmental flows in relation to the river hydrology

Negative impacts during operation and maintenance include:

- Compromised aquatic habitats for fauna due to overgrazing and increased vegetation clearing
- Possible deterioration of water quality downstream, upstream and in the dam due to biocides that may be used for agriculture and soil erosion due to farming methods
- In case of maintenance failure and dam failure, downstream habitats may be inundated and damaged with loss of flora and fauna.

- Loss of species of conservation concern

Concluding Impact Statement

Kanyika Dam provides a permanent water body in the project area of influence. The dam is located on the seasonal Kanyika Stream. The Kanyika Stream is part of the larger Kafue fishery as it is a tributary of the Nkenyauna River. Nkenyauna River is a tributary of the Lufupa River, which flows into the Lunga River and finally into the Kafue River. There are also some natural water springs around the area.

Subject to the recommended mitigation, the continued operation of the dam is not expected to have material negative biodiversity impacts in the long term. Terrestrial and aquatic habitats in the area of influence of the dam have been significantly impacted over many years by anthropogenic activities. Most of the trees are in their juvenile stages indicating previous disturbance mainly from agriculture activities. The woodland habitat is a multi-storey. A shrubby layer of small trees of the same plant species found in the upper layers and grasses are present. Evidence of anthropogenic disturbances such as charcoal manufacturing, fuelwood collection, agriculture activities and fire occurrences are still prominent. However, the habitats seem very resilient to disturbances as plants easily regenerate when the pressure eases. This is unlikely to change because of the remedial works on the dam. All birds except for one (martial eagle (*Polemaetus bellicose*)) encountered and reported have an LC status on the IUCN red list (IUCN, 2021). This is an endangered species, which can create a critical habitat for the dam. Additionally, only one migratory bird species (Booted eagle (*Hieraaetus pennatus*)) was recorded for Kanyika dam area. However, this is an existing dam in a modified habitat and the project entails short term remedial works with mitigation measures. The old sites will be prioritised as contractor sites to avoid habitat disturbances. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The dam does not pose a barrier effect to the fish population. The fish species listed on the IUCN Red List were not found during the study. The major threat to fish species, the Nile tilapia, introduced into the Kafue River system, appears to be present near the dam's impoundment. While the habitat integrity of the stream downstream of the dam is lower than the upstream reach, this does not appear to be related to habitat transformation caused by sediment settling in the dam and there is no significant increase in downstream erosion caused by the stream that could be attributed to erosive waters. The main reason for poor habitat integrity downstream appears to be the practice of cultivation in the seasonally wet parts of the dambos and general habitat degradation in the surrounding areas due to bush clearing and overgrazing and not attributed to the presence of the dam's impoundment.

Since the dam was first only 3-4 years ago it is still unlikely that the remedial works may encourage additional cultivation through increased irrigation activities and will not change the current patterns of stock use or fishing that have existed since construction. Key management requirements are to continue efforts to improve catchment conditions, particularly around the perimeter of the dam, by discouraging cultivation in the riverine areas. This will be the responsibility of the nominated dam committee, with assistance and support from the Ministry of Agriculture, Forestry and Fisheries and DMC. Irrigation farming methods that protect the land and water resources will taught to the DMC and farmers. Together with control of overfishing, better catchment management will assist in stabilizing the available aquatic resource for sustainable use by local communities. Species of conservation concern should be protected during construction and post construction, and the relevant government departments must be involved according to the national and international biodiversity standards, agreements and regulations. Mitigation strategy for construction and operation phase includes the following: to remove or reduce

adverse impacts on natural habitats/ species or their functions, keeping such impacts within socially defined limits of acceptable environmental change; restricted conversion or modification by using old sites and limiting site clearing or aquatic invasive works; reintroduction of species; mitigation measures to minimize the ecological damage; and post development restoration works; restoration of degraded and legacy habitats.

BIODIVERSITY MANAGEMENT PLAN (BMP)

In an Effort to enhance the management of biodiversity in the project area of influence, a site-specific Biodiversity Management Plan (BMP) has been developed in this section and Appendix 8.6 –Habitat management and includes Ecological management and monitoring for the identified endangered species. The BMP is based on the ecological assessment detailed in the preceding sections of this report. The ecological assessment identified the ecosystems (habitats) as well as the flora and fauna present in the project area of influence. It also gives information on the extent of potential impacts anticipated. Information gathered in the ecological assessment was used for the preparation of this BMP

Objectives

The objectives of this BMP are to provide a structure to manage impacts according to the mitigation hierarchy, provide a road map for the implementers of the mitigation measures and track performance over time.

Scope

The BMP's focus is to manage the potential impacts outlined in above and implements mitigation measures for those impacts.

Table 49 Biodiversity Management Plan

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
SITE PREPARATION AND CONSTRUCTION PHASE						
TERRESTRIAL						
Indigenous Flora						
1.1.1	Increase in flora clearing activities for site preparation and access roads	To avoid and where not feasible minimize the loss of indigenous vegetation	The contractor will ensure that vegetation clearing is subject to approval by the Project management team or Manager on site to avoid unnecessary flora loss. Riverine buffer zone will not be disturbed (Appendix 8.6- dam and dambo management). Flora management will be included in the sites' method statements (refer to ESMP).	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			The contractor will use old site access roads as they are still open. Only in instances where existing access roads need widening will the necessary clearing be done. This measure will ensure avoidance of unnecessary vegetation clearing. Roads will not be close to riparian buffer zones/ water bodies (Appendix 8.6- dam and dambo management).	Mobilization	End of construction works	Contractor Supervision- UNOPS
			Whenever possible e.g. at camp sites, the contractor will ensure that trees will be cut at knee height to promote coppicing at the end of the sub-project	Mobilization	End of construction works	Contractor Supervision- UNOPS
		Avoid use of indigenous wood/timber	The contractor will not use indigenous timber/wood for construction and related works on site as this will not be allowed. When timber is required, it will be procured from licensed pine and/or eucalyptus dealers	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS

			The contractor will sensitize and discourage its employees from using Charcoal and firewood on site. Instead alternatives such as gas stoves will be promoted	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
1.1.2	Habitat loss by the introduction of Invasive flora species	Avoid and/or prevent the introduction of invasive species	The contractor will not allow the planting or seeding of alien or foreign flora species on site. To this effect, all employees on site will be sensitized.	Beginning of construction works	Project closure	Supervision- UNOPS
			The contractor will implement an alien invasive species prevention protocol to prevent the introduction and transfer of invasive plant species. This will include the avoidance of affected areas by staff and vehicles where possible and wash down procedures for Project vehicles that are suspected to have been in areas infested with invasive species.	Beginning of construction works	Project closure	Contractor and UNOPS Supervision- UNOPS
			The contractor will ensure that only non-invasive local plant species are used for revegetation efforts under the project	Beginning of construction works	Project closure	Contractor Supervision- UNOPS
Fauna						
1.1.3	Injury and/or loss of fauna	To preserve fauna in and around the project site	The contractor will not allow or permit hunting or killing of any wildlife on site. Hunting will constitute a serious breach of contract and will be reported to relevant authorities. Fauna management will be included in the sites' method statements (refer to ESMP). The martial eagle will be protected by the contractor and any siting of this will be reported in the defined reports. Its habitat will be undisturbed and reported to the Engineer before any works if encountered.	Beginning of construction works	Project Closure	Contractor, ZAWA, Traditional Authorities and DMC Supervision - UNOPS

			The contractor will avoid clearing/cutting down of trees in riparian habitats and on the edges of wetlands for any purpose. This is because trees in the riparian habitats are mainly used for nesting by indigenous birds.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will ensure that active bird nests are not damaged during site preparation and construction activities. As far as possible tree and scrub clearance will not be undertaken during the breeding season (March to August inclusive). Should clearance during this time be necessary a preclearance nesting bird check of the vegetation to be cleared will be undertaken by the Biodiversity Specialists and a decision on whether to move the nest or defer the clearance will be made by the Biodiversity Specialists.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.4	Injury or mortality of fauna due to accidents	Avoid collisions of vehicles with fauna on site	The contractor will ● Provide driver awareness and training; ● Enforce speed limits; ● Restrict vehicle and machinery operation to daylight hours to avoid collisions with nocturnal and crepuscular fauna ● Report any collision, document species affected and area of occurrence for record keeping and development of better abatement strategies.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.5	Disturbance or disruption of fauna due to construction works	To avoid disturbance of nocturnal fauna on site	The contractor will restrict construction and related works to day time (6AM – 6PM). Night working and the use of excessive artificial lighting will not be permitted to avoid adverse impacts on	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

			nocturnal and crepuscular fauna observed on site. Strong lightning sources may also disturb migration or night movement of certain species.			
			When there is need to use lighting at night, the contractor will ensure that Non-UV sources of lighting are utilized so as not to attract the nocturnal insects and thus other fauna that feed on them. This will help to avoid the risk of predation competition and high mortality of insects.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
		To avoid disturbance of fauna on site during day time	To reduce noise on site, the contractor will: Service all equipment and vehicles in line with manufacturers specifications; Not allow idling of vehicles on site and unnecessary honking; Sensitize employees on the need to minimize noise on site	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.6	Introduction of invasive fauna species into the project area of influence	To avoid the introduction alien fauna species	The contractor will: ● Develop Project staff conduct guidelines that would include the interdiction of transporting live or dead animals, plants or seeds in Project related vehicles; ● Inspect company vehicles for illegal fauna and flora products before access to site is granted; ● Provide Project staff with a hygiene and vaccination campaign; ● Train staff to recognize key invasive species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
Habitats						

1.1.7	Increased destruction of existing habitats on site Loss and disturbance of species of conservation concern	Avoid further fragmentation of habitats	The contractor will not create new access roads on site. Instead old ones will be rehabilitated for continued use Habitats were the specifies of conservation status frequent will be left undisturbed	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
		To maintain the natural extent of the springs in sub-project	The contractor will not carry out any construction and related sub-project activities within springs and the forests.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will set the construction camp site at least 100m from the nearest spring and the riverine. It is strongly recommended that the old camp site areas	Beginning of construction works	Project Closure	UNOPS and DMC
			The DMC and UNOPS will ensure that there are no agricultural activities within identified water bodies, forests and along the riverine	Project mobilization	On-going	Traditional Authority and DMC
1.1.8	Loss of integrity of the terrestrial habitats	To preserve the integrity of the vegetation on site	The contractor will carry out construction works such as cement mixing in already disturbed areas. Preferably those areas utilized during the initial construction works should be used whenever possible	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
			To minimise risk of pollution, the contractor will: Store all hydrocarbons including fuels, used oils, new and used oil filters and grease in designated places fitted with spillage protection mechanisms such as bunding and impermeable flooring Train employees handling these materials in material handling and spill prevention	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS

1.1.9	Increased fire outbreaks	To avoid outbreaks of bush or forest fires	UNOPS and the contractor will not allow bush burning and or open fires in forested, riparian buffer zone or vegetated areas. Employees will be sensitised to this effect.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
			The contractor will sensitise employees on the dangers of forest fires to both humans and the ecosystem and how to avoid them.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
AQUATIC (SITE PREPARATION AND CONSTRUCTION PHASE)						
1.2.1	Increase in vegetation clearing	To ensure that clearing of vegetation is avoided at all costs or alternatively, done at a minimal level to maintain its integrity.	The contractor will avoid unnecessary clearing of vegetation. Where this is not feasible, the contractor should ensure that clearing of vegetation is kept at a very minimal scale.	Beginning of construction works	End of construction works.	Contractor Supervision - UNOPS
1.2.2	Increase in pollution and siltation of water	To ensure that pollution, soil loosening and siltation is controlled To protect the springs and dambos	The contractor will carefully handle materials that have a potential to cause pollution. Work sites will control soil erosion and prevent soil loosening activities. Solid waste will be disposed of in a matter prescribed by ZEMA and the local town council. The contractor will protect the springs and the dambos. Activities are to be avoided around these site. The contractor will maintain buffer zones (Appendix 8.6- dam/ dambo management).	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS

1.2.3	Increased fishing pressure that could lead to a reduction in fish population	To avoid depletion of fish population on account of heightened fishing pressure	The DMC collaborating with other stakeholders (Department of Fisheries, Ministry of Livestock and fisheries, Traditional authorities, fishers) will issue fishing passes to fishers on rotational basis. This should be informed by research as regards the standing biomass of fish at any particular time. Further, fishers should be encouraged to harvest fish by way of employing passive gears such as hooks and lines, and gillnets. Gillnets of mesh size less than 63 mm should not be allowed to avoid capturing immature fish.	Project mobilization	On -going	● DMC ● Traditional leaders ● Fishers ● Department Of Fisheries ● Ministry of Livestock and Fisheries ● Supervision UNOPS
1.2.4	Pollution of soils and water by hazardous waste products	To ensure that these are handled and disposed of in a manner that does not cause harm to habitat and its constituents	The contractor will adhere to best practices recommended by ZEMA when handling such materials. The waste will be kept in bunded facilities. The final handlers will be licensed waste management handler. Hydrocarbons will not be allowed in water. Any spill will be handled using spill kits and isolation methods. These will be disposed of in a matter prescribed by ZEMA. The contractor will maintain water quality monitoring including establishing baseline water quality. This will include the pH investigations which were inconclusive during the study (section 4.2.2).	Project mobilization	End of construction works	Contractor Supervision - UNOPS
1.2.5	Increased demand for water	To ensure prudent usage of water throughout construction phase and thereafter	The contractor will ensure that construction water does not compromise aquatic biodiversity requirements and environment.	Project mobilization	On-going	● Contractor ● Supervision UNOPS ● DMC ● Traditional leaders

						Department of Water resources development
1.2.6	Increased demand for water could compromise aquatic habitats	To ensure prudent usage of water throughout site preparation, construction phase and thereafter	Water is such a critical commodity. Thus, the contractor and other stakeholders (traditional leaders, DMC, Departmental of Water resources development) will ensure prudent usage of this resource. Suffice to mention that the sub-project area of influence is prone to droughts.	Project Mobilization	On-going	● Contractor ● Supervision UNOPS ● DMC ● Traditional leaders ● Department of Water resources development
OPERATIONS PHASE						
TERRESTRIAL						
Flora						
2.1.1	Increase in vegetation restoration	To promote catchment management (Appendix 8.6)	Dam Management Committee and IDSP will initiate the revegetation exercise to restore flora in cleared areas on the peripheral of the dam within 500m. Exposed areas will be tilled to a depth of 20cm and top soiled were possible. The area will be seeded with indigenous trees and grass species. This will be done between November and February during the rainy season (Appendix 8.6- dam and dambo management) The Ministry of Agriculture, Forestry and Fisheries will implement catchment management with DMC and traditional leaders for upstream protection and dam conservation needs. Catchment management is detailed in Appendix 8.6.	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS Forestry, WARMA, Agriculture, Fisheries etc.
Fauna						

2.1.2	Increase in conservation/management of fauna on site	To conserve/manage fauna within the dam's area of influence	Dam Management Committee in collaboration of the Local authorities will continue implementing fauna management actions during the operation phase of the dam. These measures will include: Prohibition of hunting Prohibition of tree cutting within the vicinity of the dam Prohibition of agricultural activities within springs and sensitive habitats within the sub-project area of influence Continued sensitization on the benefits of flora and fauna conservation	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS
Invasive Species						
2.1.3	Increase in invasive fauna and flora species management	To Prevent colonization of project area of influence by invasive species	UNOPS and forestry will train the DMC and selected local community members on the implementation of invasive species management Communities will not introduce invasive species. Any spotted invasive species will be controlled by the DMC from the start.	Project Operation Phase	Completion of training	UNOPS DMC
Demobilization						
2.1.4	Increase in site disturbances and aesthetics effects	To leave the site in the initial or better state relative to the baseline	At the end of construction works, the contractor will remove all equipment and structures from construction camp site; turn over the soil on site to a depth of 20cm; Re-slope to mimic the natural terrain; and Re-vegetate with indigenous flora species	End of construction works	Demobilization	Contractor Supervision - UNOPS

			At the end of remedial construction works, the contractor will rehabilitate all borrow pits on site as described under section 2.1.3 of this BMP	End of construction works	Demobilization	Contractor Supervision - UNOPS
AQUATIC (OPERATIONS PHASE)						
2.2.1	Increase in populations of flora, fauna; when habitat integrity is enhanced	Providing a conducive habitat for aquatic biodiversity	The Contractor will rehabilitate the dam which is a habitat for aquatic biodiversity and will protect habitats during works. DMC will be trained in proper sustainable fishing methods and dam protection. Protection of the springs by the DMC and community by using allowed fishing methods and protecting their integrity.	End of construction works	Demobilization	DMC IDSP
2.2.2	Maintained environmental flows	To enable and promote ecological flows of the dam and protection of springs	The UNOPS design will ensure ecological flows over the spillway according to the dam's storage ratio and the stream's non perennial flow regime. The IDSP and UNOPS will train the DMC on flow monitoring and its importance. The DMC and IDSP will monitor flows. DMC will ensure protection and maintenance of. The springs and dam will be protected by conserving the features, avoiding gardens around them and siltation, using proper fishing methods, preventing invasive species, and prevention of soil erosion. Protecting these habitats will ensure continuous protection of life forms and their flow during runoff seasons	End of construction works	Demobilization	DMC IDSP

2.2.3	Increased habitat pressure caused by the dam leading to over grazing, increase in irrigation area, and fishing activities close to the dam	To reduce pressure on the area around the dam	DMC to ensure vegetation is maintained around the dam and animal feeding is away from the dam. Catchment management training programmes included in the training plan. The DMC will not allow grazing close to the dam and vegetation will be maintained. Preventing cattle and human activity to intervene in riparian/wetland areas would be important to avoid further degradation (Appendix 8.6- Dam and dambo management).	End of construction works	Demobilization	DMC Traditional leaders Forestry Fisheries IDSP
2.2.4	Pollution and sedimentation of water which stresses flora, fauna and habitats	To minimise contamination of water and loss of biodiversity	The DMC will take part in catchment management and protection of buffer zones (Appendix 8.6) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC will allocate specific livestock watering points that have some erosion control vegetation and rock features to minimise soil loosening.	End of construction works	Demobilization	DMC Traditional leaders IDSP Forestry
2.2.5	Potential growth of algae in the dam due to irrigation (use of chemicals) and from livestock droppings	To ensure preservation of the environment and quality of water upstream, in the dam and downstream during agriculture and irrigation activities	The IDSP/ Ministry of Agriculture will ensure that the local community are trained the best way to practice crop and animal agriculture to ensure preservation of the environment and quality of water	During project rehabilitation period	Operation phase	Ministry of Agriculture/IDSP
2.2.6	Pollution and sedimentation of water which stresses flora, fauna and habitats	To minimise contamination of water and loss of biodiversity	The DMC will take part in catchment management and protection of buffer zones (Appendix 8.6) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC	End of construction works	Demobilization	DMC Traditional leaders IDSP Forestry

			will allocate specific livestock watering points that have some erosion control vegetation and rock features to minimize soil loosening.			
2.2.7	Overexploitation of fish resources which reduce fish population	To ensure that fish resources are sustainably utilized	The DMC and other key stakeholders (Min. of Fisheries, traditional leaders,) should exert some form of control with respect to who can fish, where, when and how. The dam should not be open access with respect to fishing. The DMC and traditional leaders, Min. of Fisheries and Livestock, will ensure that awareness and education executed as regards sustainable harvesting of fish DMC and fisheries will ensure controlled catching and breeding season breaks will be enforced. Fishing methods will be regulated by DMC with sustainable methods to prevent catching and destruction of eggs, invertebrates, plankton, and small fishes. Biodiversity will be protected by sedimentation control and pollution prevention by the communities; and catchment management. The DMC and Fisheries will not introduce invasive species in the water	End of construction works	On-going	DMC Ministry of fisheries & Livestock Traditional leaders
2.2.8	Increased education and awareness on threatened species	To create awareness and educate the communities concerning the	The DMC collaborating with the Dam Management Committee and traditional leaders, Min. of Fisheries and Livestock, to ensure that awareness and education	Project mobilization	On-going	Supervision DMC Ministry of Agriculture Ministry of Fisheries and Livestock

	Capacity building- Increased knowledge and ability among locals	threatened species to ensure sustainability	executed as regards sustainable harvesting of fish. Further, the DMC working hand in hand with Traditional leaders, Ministry of Fisheries and Livestock, UNOPS to train locals, employees on matters such as dam management, biodiversity conservation and implementation of the BMP.			Traditional leaders
2.2.9	Increase in invasive fish species	O.niloticus is present and might be promoted	The DMC and fisheries Department will not introduce further invasive species in the waters. Introduction of any other species vulnerable to the invasive species such as O.niloticus will require further assessments and control. Fisheries will train and sensitize the DMC on invasive species.	Operation		DMC Fisheries Traditional leadership
2.2.10	Increased irrigation farming upstream close to the riparian zone Increase in irrigation activities downstream	To ensure that the integrity of the riparian zone upstream and downstream is sustained to forestall siltation of the aquatic habitats To reduce siltation	The DMC collaborating with Min. of Agriculture, Traditional leaders, Min. of Fisheries and Livestock, will ensure that no one is farming along the riverine. Those with farming plots along the same, have to be relocated/ provided with alternative pieces of land away from the riverine. Where they can continue farming.	Construction and operation phases	On-going	DMC Ministry of Agriculture Ministry of Fisheries and Livestock Traditional leaders
2.2.11	Increase in populations of flora, fauna; & habitat integrity enhanced	To ensure that flora, fauna and habitat are well secured	The DMC working in collaboration with other stakeholders (Ministry of Fisheries and Livestock, Ministry of Agriculture, traditional authorities, will formulate management plan to secure these resources. The plan should be reviewed time and again in tandem with changing dynamics on the ground	Project mobilization	On-going	DMC Ministry of fisheries and Livestock Ministry of agriculture Traditional authorities

2.2.12	Increased infrastructure failure and sedimentation due to lack of maintenance activities In case of maintenance failure and dam failure, settlements/infra structure downstream may be inundated and damaged with loss of flora and fauna. And unfortunately, there could loss of human lives	To ensure that sedimentation is controlled To ensure dam functionality To promote maintenance activities post rehabilitation works	The contractor will execute designed works with expected skill supervised by UNOPS. Afterwards, there should be regular monitoring of the dam's integrity by key stakeholders to forestall decommissioning. There will be adherence to the operations and maintenance manual by the relevant stakeholders as indicated in the manual. The stakeholders (DMC, Ministry of fisheries and Livestock, Ministry of Agriculture, Water resources development, Ministry of water, sanitation and environmental protection, Traditional leaders) should collectively invest efforts to ensure that the dam wall and other accompanying structures are always in a good condition. They will also implement catchment management activities over a period of time (Appendix 8.6).	Project mobilization	On-going	DMC Ministry of Agriculture Ministry of Fisheries and Livestock Traditional leaders Water resources development department

* = Non-wood forest products.

Follow-up and Monitoring

The monitoring plan for the Project was developed to ensure the proper implementation and effectiveness of mitigation measures. Parameters or indicators to be monitored have been developed by adhering to the SMART nomenclature (scientific, measurable, accountable, reliable, and time-bound).

The aims or purposes of this monitoring plan are to: observe the deviation from the baseline conditions of the observed biodiversity and environmental factors and assess the effectiveness of the impact mitigation/management interventions put in place; and prevent the occurrence of serious negative project impacts on the biodiversity and environment by facilitating timely corrective actions on project aspects and management interventions not yielding the intended results.

Table 50 Biodiversity Monitoring Plan

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
1.0 Terrestrial						
Construction Phase						
1	Loss of vegetation cover.	To avoid where possible or limit loss of vegetation as much as is possible.	The contractor will use already cleared areas where possible. Where there is need to clear, clear boundary or working area will be defines and fenced off as the only defined area where vegetation clearing will take place.	During remedial works	● Contractor	Vegetation maintained in the present condition except for defined areas as demanded by project works/accessories.
			The contractor in consultation with FD personnel will ensure trees are cut in such a way as to promote coppicing.	During remedial works	● Contractor working with Forestry Department	Trees cut at knee height.
2	Loss of habitat Loss of species of conservation concern	To ensure availability of diverse habitats for various forms of insects and animals.	The contractor will conduct a re-forestation program in areas that will lose vegetation cover inevitably during the rehabilitation works and also in areas that do not have much vegetation cover due to initial construction works. Make sure the specific location of habitats for these species are protected and marked	At completion of remedial works.	● Contractor ● Forestry Department ● Dam management committee	Degraded sites artificially aided to regenerate by onset of rain following completion of works.
3	Soil degradation	To restore soil organic matter and soil micro-organisms lost due to trampling and compaction by equipment and machinery during remedial measures.	The contractor will restock affected areas with miombo vegetation to allow for re-colonization of the associated biodiversity.	At completion of remedial works.	● Contractor ● Forestry Department ● Dam management committee.	Affected areas restocked with miombo vegetation.

4.	Loss of soil properties needed to support terrestrial	To avoid polluting the soil with spent oil (oil from the engine) and/or fuel.	The contractor will ensure that the equipment and machinery used is in good working conditions. No fuel and oil leakages. Vehicles and other equipment should be parked and stored in designated places when not in use.	During remedial works	● Contractor ● UNOPS	Affected sites restored by use of oil adsorbents, with report indicating how much was used.
5.	Rehabilitation of legacy and current sites	To ensure that all impacted sites are brought back to their near original state.	The contractor will rehabilitate all impacted sites or opened up areas by providing for regeneration of vegetation in the affected areas	At the end of remedial works	● Contractor ● UNOPS	Re-vegetation / Tree planting done.
6.	Training / Capacity building	To ensure compliance to various environmental parameters and knowledge of dam operations and maintenance	UNOPS will develop a dam operation manual and selected relevant sections to capacity build in the DMC. The contractor with stakeholders will provide trainings to the DMC and community. Guided by the supervising engineer, selected topics will be covered to sensitize the local community	At the end of remedial works and before commissioning of the dam	● UNOPS working with Ministry of Agriculture and local council	No. of trainings/sensitization meetings held
Operation phase						
1.	Loss of ecosystem services provisioning	To restore the inherent ability of the miombo woodlands to provide ecosystem services such as NWFP*, ethnobotanic value etc.	The DMC and Forestry with the catchment management Committee will conduct reforestation of the impacted areas. They will: ● Promote biological diversity conservation programmes that have positive impacts on the natural ecosystems. These include bee keeping, and conservation agriculture. Additionally, promotion of NWFP (such as caterpillar, mushrooms,	During and after rehabilitation works. Monthly visits in the initial stages then quarterly after the reforested areas establish and when community structures become fully functional.	● DMC ● Local traditional leadership ● Ministry of Agriculture ● Forestry ● Catchment committee	Reforestation of cleared areas done at the onset of the rain season following completion of rehabilitation works. Fliers for community sensitization produced not more than 3 months after completion of works.

			wild fruits etc.) through provision of ready market opportunities. This can encourage and motivate local communities to focus more on activities that are friendly to the natural ecosystem. ● Conduct community awareness programmes on various issues dealing with biological diversity and ecosystem management and conservation. ● Implement community based natural resource management ● Catchment management (Appendix 8.6) DMC will control and monitor any invasive weed infestation			One community sensitization meeting report per quarter.
2.	Loss of flora in the stream catchment areas has the potential to degenerate water resources	To ensure continued availability of water for animal watering and vegetable gardening.	The DMC and Forestry will protect the Nkakula stream catchment area through proper management of the forest ecosystem around the area (No cutting of trees).	During and after completion of rehabilitation works.	● Contractor ● Forestry Department committee. ● Local traditional leadership. ● Dam committee	Catchment area protection sensitization programme.
	Loss of species of conservation concern (flora and fauna)[27]	To determine the species types, numbers, variations in quantities To protect habitats and enhance conservation	Species of conservation concern will be recorded and monitored by the DMC. Any deaths or injuries will be on record. Wildlife and Forestry department will be involved in training, sensitizations	After completion of rehabilitation works. Annually 3-5 years	● DMC ● Local traditional leadership ● Ministry of Agriculture ● Forestry	Reporting on species of conservation concern and their habitats Photos etc. Habitat changes

[27] Refer to Appendix 8.6 (c)- Ecological monitoring and evaluation for operation phase monitoring for these species

		To promote skills and knowledge of species of conservation concern To understand the uses of the resources To determine threats on the species	and monitoring. The habitats will be mapped and protected Avoid disturbing or clearing species of conservation concern The DMC will work with the relevant stakeholders to protect habitats Avoid activities in critical and sensitive habitats Protect the breeding grounds Introduce additional numbers of the same species		● Wildlife ● Catchment committee	Numbers and types of species Uses of the resources Training records Incident reports No. Of threats
2.0 Aquatic						
Construction phase						
1.	Loss of feeding and breeding grounds	Loss of feeding and breeding grounds	The contractor will maintain any feeding and breeding grounds for aquatic life during works.	During rehabilitation works.	● Contractor ● UNOPS ● DMC ● Fisheries	Protected breeding grounds
2.	Loss of natural springs and dambos	Loss of habitats	The DMC and contractor will avoid activities around these sites	During rehabilitation works	● Contractor ● UNOPS ● DMC	Protected natural water sites
3.	Soil erosion from disturbed areas causing siltation in the reservoir and parts of upstream and downstream	To arrest soil erosion from taking place which smother sediments that provide food nutrients for aquatic species.	Ensure the disturbed areas are revegetated to arrest occurrence of soil erosion	During rehabilitation works	● Contractor	No sites in the surrounding environment are opened up to soil erosion.
4.	Increased fish abundance in the dam due to favorable	To ensure sustenance and improved fish stock abundance in the dam.	The DMC and fisheries will regulate fishing activities to protect the stock from overfishing.	After rehabilitations works	● Fisheries department ● DMC	Dam management by-laws drafted by completion of

	breeding and feeding grounds				● Local traditional leadership	rehabilitation works
5.	Increased impacts on the species of conservation concern	To avoid any mortalities of these species	The contractor will conduct robust visual observations before undertaking any works The DMC and fisheries will implement a monitoring survey of this species post-construction.	During and after rehabilitation works	● Contractor ● Fisheries department ● DMC	No mortalities recorded for every 6 monthly reporting period
Operation phase						
1.	Increased feeding and breeding grounds for fish once the dams are restocked with fish	To main the feeding and breeding grounds for fish and ensure sustenance of fish production.	DMC and Fisheries will protect the breeding grounds for fish by ensuring no fishing activities take place in willow waters. DMC and Fisheries will protect fish species by monitoring the quantities and using safe fishing methods DMC will monitor and control invasive weeds	During and after rehabilitation works.	● Department of Fisheries ● Local Traditional Leadership ● DMC	Dam management by-laws drafted by completion of rehabilitation works.
2.	Bed modification: Low deposition of silt	To maintain reduced siltation in the dam so as to maintain diverse habitats.	DMC will maintain riparian vegetation around the dam by prohibiting cutting and farming close to the dam. DMC, Forestry and Fisheries and other stakeholders will conduct catchment management (Appendix 8)	During and after rehabilitation works.	● Forestry Department ● Fisheries Department ● Local Traditional Leadership ● DMC	Dam management by-laws drafted by completion of rehabilitation works.
3.	Increase in solid waste disposal in the reservoir compromising water quality and thus affecting aquatic species due to	To keep the dam free from solid waste disposal to ensure good water quality. No debris to obstruct sunlight for photosynthetic processes guaranteeing	DMC will protect the dam from solid waste disposal by completely arresting indiscriminate disposal of waste.	During and after rehabilitation works.	● DMC ● Local traditional leadership	Reports from dam committees to the District Management Committee on solid waste disposal submitted every month.

	decomposition of organic matter, depleting oxygen in the reservoir	oxygen generation in the water column for aquatic species				Management of generated solid waste in the community close to the dam in place.

* = Non-wood forest products.

Evaluation of monitoring

The evaluation of the monitoring programme will be on-going and as follows:

- Daily: General monitoring updates, reporting of incidents impacting biodiversity and emergency response;
- Monthly: Compilation of monitoring progress report, environmental training delivered, details on any major incidents/events, general progress of the monitoring program; and
- Quarterly: Summary report on quarterly biodiversity monitoring programs, review quarterly performance and apply adaptive management if required.

Implementation of the BMP

Step 1: Roles and responsibilities of different stakeholders for BMP implementation

Table 51 Roles and Responsibilities of relevant stakeholders in in BMP implementation

Name of Authority/ Entity	Key Role and Responsibility
IDSP/ Ministry of Agriculture	IDSP under the Ministry of Agriculture (MoA) bears the overall responsibility of ensuring that the implementation of the project in its planning, rehabilitation, operational and demobilization phases follows the environmental safeguards prescribed in the BMP. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the PIU of the IDSP will manage and implement the broader additional financing activities, it has contracted UNOPS to oversee and implement the remediation works of the remedial dams, including Kanyika Dam. The IDSP-PIU E&S Team is responsible for all E&S aspects of the IDSP. It will supervise and monitor all E&S aspects of all activities of the UNOPS Sub-PIU and UNOPS contractor at the Kanyika dam. The IDSP-PIU will retain the primary responsibility for ensuring that environmental and social commitments for the Kanyika Dam are met throughout the sub-project lifespan vis-à-vis the World Bank. ● The IDSP-PIU will establish a schedule of supervision and monitoring for the BMP of the Kanyika Dam. ● The IDSP will have an environmental specialist who will oversee the UNOPS staff with regards to the BMP tasks. At least one additional MoA field staff member with HSSE responsibilities will be located at Kanyika dam for continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP. ● The safeguards supervision includes the operationalization of the dam, during which period the IDSP personnel will be working with the respective local authorities, dam committee and local communities, in preparation for smooth handover when IDSP ceases to exist as a project. ● The PIU will implement capacity building and training of local stakeholders to ensure their informed cooperation in E&S matters during the remedial works and during the operational phase of the dam as well as advising the dam committee. ● IDSP will implement its own monitoring and supervision activities as they apply for all activities, including the remediation of Kanyika Dam. IDSP has the overall responsibility for monitoring and reporting, but is supported by UNOPS' monitoring and quality assurance

	activities. IDSP and UNOPS will jointly discuss any necessary amendments to activities, where necessary.
UNOPS/ Supervising Engineer	The IDSP-PIU has contracted UNOPS to implement the remediation sub-project of Kanyika Dam under the AF, including the day-to-day environmental and social management and implementation of the measures described in this BMP. UNOPS has been tasked with the design of the remedial works and the preparation of this BMP. UNOPS will further be responsible for the preparation of the tender document and supervision of the contractor for the remedial construction works including the implementation of safeguards mitigation measures. Specifications for safeguards derived from the BMP will be included in the tender documents. Bidders receive key documentation outlining the requirements of the ESMP, as well as BMP. The bidding documents will contain a general reference to the necessity to comply with this BMP and will detail key tasks/mitigation measures/trainings, which the contractor will be obliged to undertake as part of his deliverables. Supervision will involve the management of the contractor and liaison with and reporting to the IDSP-PIU throughout the contract period. The UNOPS Sub-PIU E&S Team is responsible for the implementation of the BMP mitigation measures laid out in this BMP. Where implementation is conducted by contractors, the UNOPS Sub-PIU E&S Team supervises and monitors all E&S related aspects of the contractor's works. The environmental specialist, social specialist and ecological specialist will be involved in the environmental and social management of Kanyika Dam. In addition, the team will supervise and monitor the implementation of the BMP mitigation measures by the contractor. The team will establish a regular supervision and monitoring schedule, including site visits, and will prepare and submit quarterly environmental and social monitoring reports to the IDSP-PIU. UNOPS will be responsible for and will oversee, supervise and monitor the works of the contractor, including the contractor's E&S performance. ● UNOPS will ensure regular supervision and monitoring of the implementation of all mitigation measures laid out in this BMP, as well as all trainings and other required activities. ● UNOPS will use the indicators all mitigation measures, as listed above in this BMP, for its monitoring activities. ● A supervision and monitoring report will be prepared every month and shared with the PIU of ISDP and the World Bank. The contents of this report will include: progress of the civil works, implementation of the BMP, confirmed the supervision of the safeguards specialist on site, photos, records of works, restoration efforts, terrestrial and aquatic environments management, grievances, accidents, communication, and training, among others. ● UNOPS will monitor and review all method statements prepared by the contractor to ensure that all areas that require remediation/ rehabilitation are covered and that the proposed methodologies are appropriate. ● UNOPS will take measures in the case of non-compliance. It will immediately liaise with the contractor, assess the risk level, significant and severe risks will cause for suspension of works until the non-compliance has been resolved to the satisfaction of UNOPS. Any significant loss of time caused by the contractor's non compliance situations will be dealt with in accordance with the set procedures in the contract.

ZEMA	To undertake enforcement, compliance, review and monitoring of environmental assessment management plans. Visit, inspect and monitor the site or specific activities at any particular time
Government ministries and other stakeholders- Pemba district	The duty of the local authorities in the project area of influence with regards to the BMP is to coordinate with the project and stakeholders (s) on BMP commitments pertaining to site assessments, habitat management, fishing methods, re-vegetation, capacity building and training, inspections and participating in the project public outreach. The stakeholders have operation responsibilities for habitat management. The IDSP will inform the relevant offices for catchment management. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP will be communicated to relevant ministries indicated.
Contractor	UNOPS will contract the contractor after preparation of bidding documents. The selected contractor will comply with all stipulations in this ESMP for the duration of the contract. These requirements equally apply to sub-contractors. It is the contractor's responsibility to ensure that subcontractors comply and demonstrate such compliance in submittals and during verification processes by UNOPS. The contractor will engage competent full time Health, Safety, Social and Environmental staff on site to carry out Environmental and Social mitigation measures set out in the ESMP/ BMP. The Officer will be responsible for implementation and monitoring the contractor's compliance with the BMP requirements and the environmental specifications. The duties of the Officer will include but not be limited to the following: a) carry out environmental including biodiversity site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to adequacy of environmental mitigation measures implemented; b) monitor compliance with mitigation and protection measures, prevention and control measures and contractual requirements; c) monitor the implementation of environmental mitigation measures; d) prepare monthly status reports for the site environmental conditions; e) advise the contractor on environment improvement, awareness and proactive pollution prevention measures; d) recommend suitable mitigation measures to the contractor in the case of noncompliance; e) carry out additional monitoring of noncompliance instructed by the supervisor; f) inform the contractor and supervisor of environmental issues, submit contractor's plans to the supervisor and relevant authorities, if required; and g) keep detailed records of all site activities that may relate to biodiversity. If pre-bid meetings, site visits and / or contract commencement meetings are carried out, the biodiversity requirements and submittals should be discussed, both for day-to-day work and for environmentally critical stages or activities. ● Contractors provide details on contractor's oversight on safeguards performance; ● Contractor and sub-contractors to deploy a workers' grievance mechanism to handle the concerns of their workers; ● Contractor will prepare and affirm all plans and method statements required in this BMP and ESMP that affect biodiversity and habitats prior to construction activities ● Borrow pits and material sites ● Contractor emergency response plan ● Waste management ● Campsite activities ● Excavation works and stock piling

	● Sanitation and water management ● Traffic management and access routes management ● Biodiversity management ● Training, engagement and sensitization ● Contractor will work within the requirements of legislative requirements and standards ● Contractor will carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor will carry out investigation and submit proposals on mitigation measures and implement remedial measures to reduce environmental impact. ● Non-compliance by the contractor may cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of UNOPS. The contractor must report on all HSSE matters related to this BMP to UNOPS on a monthly basis. UNOPS will administer the monthly reports from the contractor, and will prepare its own quarterly reports, based on its supervision and monitoring activities, as well as designated UNOPS activities in this BMP to IDSP. Quarterly progress reports will include the status of the implementation of risk mitigation measures, trainings, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local Dam Committee and local authorities.
Local community and Dam Committee	As owners of the dams, the dam community will be encouraged to be active partners during the construction. It will be regularly consulted on a variety of issues. It will further be asked to report any misconduct by the contractor or contractor's personnel to the IDSP-PIU, through the Grievance Redress Mechanism (GRM), which has been designed for the AF activities. Community members will be appointed by the dam committee to verify that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the Stakeholder Engagement Plan (SEP) in the ESMP, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the biodiversity mitigation measures undertaken. The dam is operated by a DMC, which consists of community members. The Kanyika dam committee is active, consisting of three women and seven men (Refer to the ESMP). Due to the complexity of managing dams, the management structure is widened to include public agencies such as agriculture, water resources, fisheries and forestry departments as advisors and trainers. The committee has been involved during planning, construction and operation phases. The level of involvement in the maintenance and management will depend on the type of technology, the range of maintenance activities and capacity building offered to the committee. Therefore, UNOPS and IDSP have and will further inform communities of their expected obligations and contributions during consultations and training. Upon completion of the remedial works, there will be a hand-over of the management, operation and maintenance of the dam to the Kanyika dam committee. In order to successfully operate the dam, and limit impacts on people and environment, the dam committee members require further capacity building and training. Training will include issues such as dam safety management/ structural deterioration; habitat management; dam usage and best practice,

	biodiversity protection, erosion control and conservation (see training plan is included in the ESMP). Quarterly reports will also be made available to the local Dam Committee and local authorities. MoA has representatives at the dam who will periodically report to IDSP.

Step 2: Incident Reporting

The Contractor, UNOPS, and IDSP are required to report on any environmental and biodiversity incidents related to the sub-project activities. The contractor will form the incident investigation team and will provide incident reporting on a monthly basis to UNOPS, and UNOPs will include summaries of incidents in its regular reporting to IDSP. Any incidents classified as 'severe' must be reported to the World Bank within 48 hours.

Incident reporting will follow the management and reporting process below:

1) Initial communication
2) Classification: how serious?
3) Notification: Who? How: When?
4) Investigation: What happened? How and Why?
5) Response: Remedial actions?; Preventive actions?
6) Follow up: Is response Complete? Was it effective? Lessons?

Incidents should be categorized into 'indicative', 'serious' and 'severe' (Refer to World Bank classification of incidents in the ESMP). 'Indicative' incidents are minor, small or localized that negatively impact a small geographical area or a small number of people and do not result in irreparable harm to people or the environment. A 'significant' incident is one that causes significant harm to the environment, workers, communities, or natural resources and is complex or costly to reverse (see below for World Bank incident classification guide). A 'severe' incident causes great harm to individuals, or the environment, or presents significant reputational risks to the World Bank. Incident reports should use the format in the ESMP.

Step 3: Handover for Operation

Once construction works and trainings are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Kanyika dam committee who are part of the local community and local authorities. IDSP will be continually engaging with the communities and local authorities until the end of its lifespan.

CONCLUSION

The biodiversity ecological assessment was conducted in compliance with local and international guidelines in determining the baseline ecological conditions in the sub-project area of influence. The mitigation measures for the reconstruction/rehabilitation sub-project impacts on the terrestrial and aquatic ecosystems (flora and fauna) have been devised as following the criteria in Chapter 3.1.4 of this report.

Based on the outlined effects in Chapter 4.2, ecological findings, sub-project site suitability analysis, close interaction with community members and government officials, the team established the following:

1. There was no proper feasibility study undertaken for the construction of Kanyika Dam. This resulted in constructing a dam without having to look at the possible environmental costs that may come up with such an undertaking. This action has caused serious negative implications on the terrestrial ecosystem of the sub-project area of influence.
2. Dam construction was not demand driven with respect to local community needs. As such, communities never fully developed a sense of responsibility and care towards the dam's maintenance and its resources.
3. Due to initially poor site location design, the dam was constructed very near to the source of the stream (within 5km) putting the sustainability of the stream flow at risk because of possible increase in destruction of water recharge zone resulting from expected increase in agricultural activities to be triggered by dam construction.
4. The dam has already disturbed terrestrial and aquatic ecosystem of the area. Therefore, reconstructing/rehabilitating it will only amplify the impacts unless mitigation measures are implemented.

The BMP was built up in the optics of pursuing reconstruction/rehabilitation works of the dam and its subsequent operation and mitigation measures were elaborated.

REFERENCES

1. African wildlife Foundation (2021): African Wild dog. (https://www.awf.org/wildlife-conservation/african-wild-dog).
2. Amon, G., 1992: Clearing of deep – rooted perennial vegetation has altered freshwater
3. Amy Blaylock, 2002: Aquatic Macroinvertebrate identification key
4. Camporeale, C., and Ridolfi, L., 2006, Riparian vegetation distribution induced by river flow variability: A stochastic approach, Water Resour. Res., 42, W10415.
5. Carruthers, V. (ed) (2017): Wildlife of Southern Africa: A field guide to anilas and plants of the region. Struik Nature, South Africa.
6. Department of Environment and Heritage Protection. 2017. *Guide to determining terrestrial habitat quality: A toolkit for assessing land-based offsets under the Queensland Environmental Offsets Policy Version 1.2.* State of Queensland
7. Department Water Resources Development, 2016. Environmental project brief (epb)/Environmental & social management plan (esmp). The construction of Nabowa dam (Chief Mwene Mutondo, Kaoma district), Lusaka, Zambia.
8. Desanker, P. V., Frost, P. G. H., Justice, C. O. and Scholes, R. J. (eds). 1997. *The Miombo Network: Framework for a Terrestrial Transect Study of Land-Use and Land-Cover in the Miombo Ecosystems of Central Africa*. IGBP Report 41 Stockholm, 109pp.
9. Eyre, T.J., Kelly, A.L, Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. 2015. *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual*. Version 2.2. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.
10. Fanshawe, D. B. 1971. The vegetation of Zambia. Government Printer, Lusaka.
11. FAO, *State of the World's Forests 2007*, Food and Agriculture Organization of the United Nations, Rome, Italy, 2007.
12. FAO, "Global forest resources assessment: options and recommendation for a global remote sensing survey of forests," *Forest Resources Assessment Programme Working Paper* 141, Food and Agriculture Organization of the United Nations, Rome, Italy, 2007.
13. Kleynhans, C.J., 1996 A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. Journal of Aquatic Ecosystem Health 5: 41–54
14. Kolding. J, Musando. B and Songore. N., 2004. *Inshore fisheries and fish population changes in Lake Kariba*
15. Latimer, W., (2009) Assessment of Biodiversity at the Local Scale for Environmental Impact Assessment and Land-use Planning, Planning Practice & Research, 24:3, 389-408,
16. Ministry of Agriculture, 2020. Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia Additional Financing Irrigation Support Development Project (P102459 & AF-P172140), Lusaka, Zambia.
17. IUCN (2021). IUCN Red List of Threatened Species. Version 2021.2. <www.iucnredlist.org>. Downloaded on 30 April, 2021.
18. Muma A.K, (2000). In: Starkey P and Simalenga T (eds), 2000. Animal power for weed control. A resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. ISBN 92-9081-136-6.
19. Norman, J.M., Campbell, G.S., 2000. Canopy structure. In: Pearcy R.W., Ehleringer J.R., Mooney H.A., Rundel P.W. (eds) Plant Physiological Ecology. Springer, Dordrecht. https://doi.org/10.1007/978-94-010-9013-1_14.

20. Phiri, P.S.M. 2005. *A checklist of Zambian vascular plants*. Southern African Botanical Diversity Network Report No. 32. SABONET, Pretoria.
21. Skeleton. P., 2006. Field Guide to Fish species of Southern Africa.
22. Storrs A.E.G. 1995. *Know your trees; Some of the common trees found in Zambia*. Regional Soil Conservation Unit.
23. Syampungani, S. (2008). *Vegetation change analysis and ecological recovery of the Copperbelt miombo woodland of Zambia*. PHD Thesis, Stellenbosch University.
24. Utsungi, K. and Malingaliwa, K., 2002. *Field Guide to Zambia Fishes*, *Plankton and Aquaculture*.

Appendix 8.1:Terrestrial data collection forms

Tree data collection sheet						
Altitude:.....	**Plot No:.....**	**Date:.....**	**Quadrant No:...**	**Plot size**		
Centre of plot (GPS reading)		**Vegetation type.....**				
N.....						
E.....						
Recorder:.....						
Species (Tree ≥5cm)	**Height (m)**	**DBH (cm)**	**Crown size**		**Notes**	
			width	**Length**		

Regeneration Plot Data collection sheet

Regeneration data collection sheet				
Altitude:.....	**Plot No:.....**	**Date:.....**	**Quadrant No:...**	**Plot size**
Centre of plot (GPS reading)		**Vegetation type.....**		
N..... **E.....**				
Recorder:.....				
Species	**Count**	**Notes**		

Fauna data collection sheet

1. Mammals			
Species	**No. seen**	**Signs- write details**	**Other faunal species**

2. Birds			
Species	**No. seen**	**Signs- write details**	
			Amphibians
			Invertebrates
Notes:			

Appendix 8.2: Aquatic Data collection Forms

SAMPLING FORM 1

FISH SPECIES

A. Length-Weight Data

To be completed at every sampling point **Sampling Day:…….**

Coordinates:…… Date:……/……/…….

Sample ID	Name of Species	Number	Length (mm)	Weight (g)	Gear
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					
17.					
18.					
19.					
20.					
21.					

22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

Sampling Form 2
WATER QUALITY

B. Physicochemical Parameters

Sampling Point …… Sampling Day:……
Coordinates:…….. Date:……/……/…….

SAMPLING POINT	DO (mg/L)	Temp (C^0)	pH	Cond mS/m	Sech. reading	TDS
downstream						
Upstream						
Mid of the dam						
At the weir						

Sampling Form 2

C. Aquatic plants

Sampling point …… Sampling day:……
Coordinates:…….. Date:……/……/…….

S/#	Species	Monocots	Dicots
Emergent			
Submerged			
Free floating			

D. Macroinvertebrates survey

Order	**Sub/Family**	**English name**	**Comments**
Odonata	Libellulidae	Dragonflies	
	Aeshnidae	Dragonflies	
Diptera	Tabanidae	Horseflies	
	Culicidae	Mosquitoe	
	Chironomidae	Midges	
Coleoptera	Gyrinidae	Whirligig beetles	
Hemiptera	Corixidae	Water boatmen	
	Gerridae	Pondskaters/water striders	
Ephemeroptera	Baetidae	Mayflies	
Crustacea	Potamonautidae	Crabs	
Gustropoda	Thiaridae	Snails	
Any other species			

Formulae used in calculating trees species quantitative attributes
Important Values Indices (IVI) shows the dominance of a species in relation to other species in a stand or community (Curtis & Mcintosh, 1959). The IVI was obtained by the below formula
Importance value Indices (IVI) = $\frac{RF + RD + RBA}{3}$

Where:

- RF = Relative Frequency;

Relative frequency = $\frac{\text{Number of plots in which species is present} * 100}{}$

Total number of plots recorded

- RD = Relative Density; and

Relative density = Number of stems recorded for species * 100
Number of stems recorded for all species

- RBA = Relative Basal Area

Relative basal area = Basal area of a species in a community * 100
Total basal area of all species in the community

Appendix 8.3 Water Quality Results

SCHOOL OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
ENVIRONMENTAL ENGINEERING LABORATORY

P.O Box 32379, Lusaka

PHYSICAL/CHEMICAL EXAMINATION OF WATER

Attn : UNOPS
Lusaka
Sampled by : Client
Report date : 18.05.2021

Laboratory Results

Sample ID	Kanyika Borehole	Kanyika Upstream	Kanyika Middle	Kanyika Downstream
Sampling date	**12.04.2021**	**12.04.2021**	**12.04.2021**	**12.04.2021**
Parameter				
pH	6.66	6.20	6.20	5.94
Conductivity (µs/cm)	99	18	8	8
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3 –N mg/l)	<0.01	<0.01	<0.01	<0.01
Alkalinity (as $CaCO_3$ mg/l)	50	20	12	10
Total Dissolved Solids (mg/l)	49	9	4	4
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01
Phosphates (mg/l)	0.50	0.20	0.20	<0.01
Total Suspended Solids (mg/l)	2.9	<1.0	<1.0	<1.0
Chemical oxygen demand (as mg O_2/l)	3	2	2	2
Chlorides (mg/l)	6.0	<1.0	<1.0	3.0
Turbidity (NTU)				
Hydrocarbons (mg/l)	<0.005	<0.005	<0.005	<0.005

Tests carried out in conformity with " Standard Methods for the Examination of water and Wastewater APHA, 1998".

Appendix 8.4 Botanical Results

Botanical name	No. of Plots Species Occurred	Frequency (n)	Density	Basal area	RF	RD	R.Dom	Imp. Value	IUCN Status
Isoberlinia angolensis	21	233	0.132011331	38.4895	84	13.201133	0.0722368	97.273369	LC
Brachystegia boehmii	18	197	0.111614731	126.6933	72	11.161473	0.2377770 1	83.399250 1	LC
Anisophyllea boehmii	18	44	0.024929178	45.37048	72	2.492917 8	0.0851509 7	74.578068 8	LC
Ochna puchra	17	98	0.055524079	201.088	68	5.552407 9	0.3774004 2	73.929808 3	LC
Brachystegia spiciformis	15	82	0.046458924	3342.577	60	4.645892 4	6.2733237	70.919216	LC
Albizia adianthifolia	16	89	0.050424929	176.7375	64	5.042492 9	0.3316995 9	69.374192 5	LC
Strychnos spinosa	15	79	0.044759207	28.278	60	4.475920 7	0.0530719 3	64.528992 6	LC
Phyllocosmus Lemaireanus	14	50	0.028328612	20.43086	56	2.832861 2	0.0383444 7	58.871205 7	LC
Vitex doniana	14	30	0.016997167	59.4545	56	1.699716 7	0.1115837 4	57.811300 5	LC
Pericopsis angolensis	12	116	0.06572238	83.3337	48	6.572238	0.1564000 4	54.728638	LC
Pterocarpus angolensis	13	27	0.01529745	143.1574	52	1.529745	0.2686766 6	53.798421 7	LC
Erythrina abyssinica	12	53	0.030028329	46.5723	48	3.002832 9	0.0874065 3	51.090239 4	LC
Strychnos cocculoides	11	46	0.026062323	160.6269	44	2.606232 3	0.3014633 3	46.907695 6	LC

Albizia antunesiana	10	62	0.035127479	2682.483	40	3.5127479	5.0344626	48.5472105	LC
Combretum zeyheri	10	30	0.016997167	3963.861	40	1.6997167	7.4393435 6	49.1390603	LC
Syzigium guineense	9	45	0.025495751	128.6963	36	2.5495751	0.2415362 7	38.7911113	LC
Brachystegia longifolia	9	26	0.014730878	33.18738	36	1.4730878	0.0622858 1	37.5353736	LC
Combretum molle	7	29	0.016430595	81.72342	28	1.6430595	0.1533778 9	29.796437 4	LC
Maquesia macroura	6	19	0.010764873	132.7495	24	1.0764873	0.2491432 4	25.325630 5	LC
Uapaca kirkiana	6	16	0.009065156	486.9629	24	0.9065156	0.9139281 8	25.820443 8	LC
Diplorhynchus condylocarpon	5	15	0.008498584	227.0095	20	0.8498584	0.4260496 9	21.275908	LC
Markhamia obtusifolia	5	10	0.005665722	227.0095	20	0.5665722	0.4260496 9	20.992621 9	LC
Bobgunia madagascariensis	5	7	0.003966006	78.55	20	0.3966006	0.1474220 4	20.544022 6	LC
Albizia amara	4	49	0.02776204	50.272	16	2.776204	0.0943501	18.870554 1	LC
Ficus sycomorus	4	19	0.010764873	33.18738	16	1.0764873	0.0622858 1	17.138773 1	LC
Albizia versicolor	4	5	0.002832861	23.76138	16	0.2832861	0.0445951 7	16.327881 3	LC
Acacia polyacantha	3	33	0.018696884	165.1514	12	1.8696884	0.3099548 3	14.179643 2	LC
Hymenocardia acida	3	24	0.013597734	63.6255	12	1.3597734	0.1194118 5	13.479185 2	LC

Piliostigma thonningi	3	20	0.011331445	227.0095	12	1.1331445	0.4260496	13.559194	LC
Terminalia sericea	3	17	0.009631728	50.272	12	0.9631728	0.0943501	13.057522	LC
Uapaca sansibarica	3	10	0.005665722	398.7905	12	0.5665722	0.7484469	13.315019	LC
Sterculia quinqueloba	3	3	0.001699717	176.7375	12	0.1699717	0.3316995	12.501671	LC
Zanha africana	2	2	0.001133144	38.4895	8	0.1133144	0.0722368	8.1855512	LC
Trema orientalis	2	38	0.021529745	1151.056	8	2.1529745	2.1602930	12.313267	LC
Terminalia stenostachya	2	21	0.011898017	706.95	8	1.1898017	1.3267983	10.5166	LC
Steganotaenia araliacea	2	6	0.003399433	6906.336	8	0.3399433	12.961758	21.301701	LC
Brachystegia manga	2	20	0.011331445	38.4895	8	1.1331445	0.0722368	9.2053812	LC
Mangifera indica	2	2	0.001133144	176.7375	8	0.1133144	0.3316995	8.4450140	LC
Phyllanthus muellerianus	1	45	0.025495751	380.182	4	2.5495751	0.7135226	7.2630977	LC
Pseudolachnostylis maprouneifolia	1	28	0.015864023	95.0455	4	1.5864023	0.1783806	5.7647829	LC
Acacia sieberana	1	1	0.000566572	122.7344	4	0.0566572	0.2303469	4.2870041	LC
Erythrophleum africanum	1	14	0.007932011	2827.8	4	0.7932011	5.3071933	10.100394	LC
Monotes africanus	1	4	0.002266289	38.4895	4	0.2266289	0.0722368	4.2988656	LC

Ficus wakefieldii	1	1	0.000566572	2827.8	4	0.056657 2	5.3071933 7	9.3638505 9	LC
		1765		29013.96					

Appendix 8.5: Species diversity by Shannon and Simpson index

Botanical name	Freq (n)	pi	pi^2	ln (pi)	pi ln(pi)
Acacia sieberana	1	0.00057	3.21E-07	-7.476	-0.0042
Acacia polyacantha	33	0.0187	0.00035	-3.979	-0.0744
Albizia adianthifolia	89	0.05042	0.002543	-2.987	-0.1506
Albizia amara	49	0.02776	0.000771	-3.584	-0.0995
Albizia antunesiana	62	0.03513	0.001234	-3.349	-0.1176
Albizia versicolor	5	0.00283	8.03E-06	-5.867	-0.0166
Anisophyllea boehmii	44	0.02493	0.000621	-3.692	-0.092
Bobgunia madagascariensis	7	0.00397	1.57E-05	-5.53	-0.0219
Brachystegia boehmii	197	0.11161	0.012458	-2.193	-0.2447
Brachystegia longifolia	26	0.01473	0.000217	-4.218	-0.0621
Brachystegia manga	20	0.01133	0.000128	-4.48	-0.0508
Brachystegia spiciformis	82	0.04646	0.002158	-3.069	-0.1426
Combretum molle	29	0.01643	0.00027	-4.109	-0.0675
Combretum zeyheri	30	0.017	0.000289	-4.074	-0.0693
Diplorhynchus condylocarpon	15	0.0085	7.22E-05	-4.767	-0.0405
Erythrina abyssinica	53	0.03003	0.000902	-3.506	-0.1053
Erythrophleum africanum	14	0.00793	6.29E-05	-4.837	-0.0384
Ficus sycomorus	19	0.01076	0.000116	-4.531	-0.0488
Ficus wakefieldii	1	0.00057	3.21E-07	-7.476	-0.0042
Hymenocardia acida	24	0.0136	0.000185	-4.298	-0.0584
Isoberlinia angolensis	233	0.13201	0.017427	-2.025	-0.2673
Mangifera indica	2	0.00113	1.28E-06	-6.783	-0.0077
Marquesia macroura	19	0.01076	0.000116	-4.531	-0.0488
Markhamia obtusifolia	10	0.00567	3.21E-05	-5.173	-0.0293
Monotes africanus	4	0.00227	5.14E-06	-6.09	-0.0138
Ochna pulchra	98	0.05552	0.003083	-2.891	-0.1605
Pericopsis angolensis	116	0.06572	0.004319	-2.722	-0.1789
Phyllanthus muellerianus	45	0.0255	0.00065	-3.67	-0.0936
Phyllocosmus Lemaireanus	50	0.02833	0.000803	-3.564	-0.101
Piliostigma thonningi	20	0.01133	0.000128	-4.48	-0.0508
Pseudolachnostylis maprouneifolia	28	0.01586	0.000252	-4.144	-0.0657
Pterocarpus angolensis	27	0.0153	0.000234	-4.18	-0.0639
Steganotaenia araliacea	6	0.0034	1.16E-05	-5.684	-0.0193
Sterculia quinqueloba	3	0.0017	2.89E-06	-6.377	-0.0108
Strychnos cocculoides	46	0.02606	0.000679	-3.647	-0.0951

Strychnos spinosa	79	0.04476	0.002003	-3.106	-0.139
Syzygium guineense	45	0.0255	0.00065	-3.669	-0.0936
Terminalia sericea	17	0.00963	9.28E-05	-4.643	-0.0447
Terminalia stenostachya	21	0.0119	0.000142	-4.431	-0.0527
Trema orientalis	38	0.02153	0.000464	-3.838	-0.0826
Uapaca kirkiana	16	0.00907	8.22E-05	-4.703	-0.0426
Uapaca sansibarica	10	0.00567	3.21E-05	-5.173	-0.0293
Vitex doniana	30	0.017	0.000289	-4.075	-0.0693
Zanha africana	2	0.00113	1.28E-06	-6.783	-0.0077
				s	44
				N	1765
				Sum (pi ln pi)	-3.27765
				sum (pi2)	0.053901
				Shannon index	3.27765
				Simpson index	18.55261

Appendix 8.6: Habitat Management

Catchment Management and Dam Management Guidelines

a) General Integrated Catchment Management Guidelines

A Catchment means a geographical area which naturally drains into a water resource and from which the water resource receives surface or ground flow that originates from rainfall[28]. During the ESMP and BMP assessments for the rehabilitation sub-project, concerns were expressed about the management of the upper catchment of the River, which should be handled by stakeholders in the operation phase for sustainability even though the area seems to not be modified. The study has shown that the habitats seem very resilient to disturbances as plants easily regenerate when the pressure eases. However, there may be threats of future modification if the catchment is not protected and managed.

These concerns related mainly to existing land use practices which may result in erosion and siltation problems including water quality problems for the dam. The present land-use practices at the Kanyika Dam sub catchment may be unsustainable due to issues related to crop farming close to the water bodies, livestock grazing, livestock watering practices, tree cutting, fuel wood collection and fires. These result in high sediment loads and nutrient enrichment of the water bodies, particularly after rainfall events, thus impacting on the water quality with the potential to undermine the long-term storage capacity of the Dam and rivers which will affect the biodiversity habitats.

To address these, and other threats in the catchment, the Water Resources Management Authorities (WARMA) provides for catchment management and local government offices and DMC have to put in place catchment management to examine land-use practices within the dam catchment, to identify key areas to be targeted to move towards more sustainable management of the catchment, and to develop a plan that serves these ends while also identifying how local communities can benefit through the proposed activities. A draft plan that can be used by the stakeholders is presented below:

1) Policy and regulatory framework with the relevant institutions
    - Forest Act No. 4 of 2015
    - Fisheries Act of 2011
    - Water Resources Management Act (WARMA) No 21 of 2011 and Department of Water Resources Development DWRD- Reference for catchment management provisions
    - Zambia Wildlife Act of 2015
    - Water Act, 1964
    - Lands Act of 1964
    - Agriculture Lands Act No 57 of 1960; and
    - WASH legislation

According to WARMA, The Water Resources Management Act of 2011 provides for a decentralized management system in line with the principles of Integrated Water Resources Management (IWRM) that manages water resources at catchment and sub-catchment levels and promotes local participation

[28] WARMA Act

through formation of Water User Associations (WUAs)/ DMAs. Functions of catchments and sub-catchments (enshrined in Part III section 18 & 20 of WRM Act No 21 of 2011):

- Coordinating, supervising, monitoring and evaluating Water Resources Management activities in the water catchments
- Disseminating Water Resources Management information, regulations and standards to the public
- Collecting, monitoring and analyzing hydrological and hydrogeological data for WARMA decision making
- Developing water allocation plans and making recommendations on water allocations for the issue of permits
- Contributing to the development of catchment management plans, sub catchment plans for water allocation decisions and other water use plans
- Promoting participatory water harvesting and water conservation initiatives

2) The vision for the integrated catchment management plan for the Kanyika Dam catchment can be derived from the key issues raised in the consultation process, which is to ensure sustainable land use practices to protect the water resources of the catchment while enhancing biodiversity, dam uses and the livelihoods of the communities in the catchment.

3) Underlying this vision, are the following aims of the plan, derived from the studies and the consultation processes:
   - To provide for the establishment of a Catchment Council/ Catchment Management Committee, which will coordinate and oversee the preparation and implementation of the plan
   - To provide a snapshot of the current status of the catchment
   - To ensure ongoing engagement with stakeholders on the priorities and implementation of the plan
   - To ensure the reduction of soil erosion and sedimentation in the catchment and to protect the water quality of the dam
   - To support the improvement of livelihoods of the communities in the catchment
   - To address other key biodiversity related issues in the catchment, as will be identified.

4) Principles that drive conceptualization and implementation of the plan.
   - Participatory management
   - Using labor intensive/ involving approaches
   - Using local resources
   - Empowering local communities, particularly women and youth
   - Sustainability

5) Catchment-wide projects will be proposed to protect the dam, or may already be in place or planned for implementation. These can include:
   - Communication and awareness
   - The establishment and functioning of the Council
   - Formulation and training of the DMC and users association
   - Community capacity building and training;
   - Provision of sanitation facilities
   - A sustainable livelihoods programme
   - A sediment management programme

- A reservoir/ dam management plan
- A dam sediment study
- The establishment of new monitoring points and revision of monitoring frequency
- Implementation of water quality monitoring variables
- Accreditation of a water laboratory
- Zoning plan for use of upper catchment
- Mapping of key wetlands
- Development of policy on management of invasive plants
- Creation of indigenous plants nursery
- Energy sources assessments
- Provision of off-channel livestock watering points
- Zoning of buffer zone around dam
- Dam and Dambo Management

6) Time lines:

It will take time and years for the activities identified in the plan to change the current land-use practices across the catchment, but there will be a good foundation of community understanding of the issues on which to build, and there are already good practices in the catchment which can be built on, developed further, and disseminated more widely.

7) Funding:

For catchment management to be sustainable in the long-term, sustainable funding beyond what is currently available through the dam rehabilitation sub-project is required to continuously support the catchment management activities. These include the sustainable funding for the functioning of the committee, which will require relatively small amounts, and funding for the implementation of catchment management activities, which will require larger amounts. Total estimated costs will be established by the stakeholders council for instance for the first 5 years then per annum costs. There are three potential sources of funding for implementation: donor funding, funding from government budgets, and funding through introducing a system of Payment for Environmental Services (PES)/ User fees (WARMA Act). These require significant discussion and engagement between the community, policy makers, stakeholders and government representatives.

b) Dam/ River Management

This section provides guidance on retaining, maintaining and where necessary re-establishing vegetated riparian buffers around the sensitive water resources (River and dam) managed, and work sites (campsite, slopes, borrow areas etc.) as pointed out by the area of influence and in the BMP management plan Section 5. The following riparian zone management procedures will be implemented:

- Vegetation retention of existing undisturbed local provenance native plants should be standard practiced by the contractor and locals
- Restoration of native vegetated sites and buffers which have been degraded or removed, re-vegetation of slopes, should (where practical be restored) with native vegetation equivalent in type, form, density, and diversity to that occupying the adjacent area or more as approved by the engineer. Planted buffers should consist of a mix of native trees, shrubs and groundcover using natural and assisted vegetation as indicated in the ESMP.

- These buffers and revegetated sites should be sustainable, with the least practical need for human intervention. Management activities may periodically be necessary to remove invasive species, for hazard reduction to prevent wild-fires and ensure community safety.
- Riparian vegetation provides a natural boundary. Buffers should be measured outward from any recognized damp land vegetation fringing the water resource or where the margins of missing riparian vegetation are uncertain, and the rain season banks of the water body.
- Buffer composition should comprise under-storey vegetation (grasses), over-storey (tall shrubs, trees) and carbon-rich tree parts on the ground matching the density and diversity of undisturbed local native vegetation.
- Natural springs will be protected and activities will be away from such water points
- Wildfires control measures must be in place to protect riparian buffer zones.
- Unpaved roads pose a risk to waterbodies due to stormwater causing surface erosion and associated water channeling which increases the rate of contaminated water movement. These must not be close to the dam or rivers. There will be a buffer between the busy roads and the water bodies.
- Maintaining some grass at the water inlets to beneficial for sediment and contaminant filtration purposes.
- Contamination prevention is important with land use activities set up and operated to have minimal impact on buffers and associated water resources. Precautionary strategies to protect buffers from harm, erosion may include:

a. restricting land disturbance activities to the low rainfall seasons;
b. managing stock numbers, feeding, watering and location to lower risks areas;
c. isolating potentially harmful materials from water;
d. immediate and effective waste spill clean-up;
e. use of structural stormwater retention/ drainage systems/ slopes;
f. implementation and sensitization of environmental management plans; and
g. training of staff, locals and contractor in good operational practice.

c) **Ecological Management and Monitoring**

The following management and monitoring guidelines are based on World Bank operational policies for critical habitats/ identified threatened species of conservation concern:

i. Management Guidelines:

Critical Habitats

Critical habitat is defined as areas with high importance for biodiversity, including:

(a) Sites that may include areas with known high suitability for bio-diversity conservation; and sites that are critical for rare, vulnerable, migratory, or endangered species. Habitat important to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or under national law

Kanyika dam may qualify important biodiversity conservation area because of having species of conservation concern as listed in the IUCN Red list. However, it is in a modified habitat, and it is not in a legally protected site.

In such areas, the following management measures will apply to conserve the species:

OP4.04 Appendix A Issue	Management measures to be taken
Alternative sites	IDSP with UNOPS will ensure that no other viable alternatives within the region exist for development of the project in habitats of lesser biodiversity value- *the project is already*

	existing and involves remediation for the safety of the dam and also aims to close off safeguards risks. Old existing sites are proposed for the current works to minimise and avoid disturbing new sites.
Legal compliance and approvals	IDSP with UNOPS will ensure that prerequisite approvals are obtained for work on the site- *the site is not in a legally protected area but it will be ensured that the contractor works with Forestry, Wildlife and Fisheries departments (BMP table)*
Increase in impacts magnitude on species/ habitats	IDSP with UNOPS will ensure that impacts will not lead to increasing adverse impacts on those biodiversity values for which the critical habitat was designated and that mitigation measures are in place to minimise and avoid impacts on the species of conservation concern. Any residual adverse impacts on biodiversity will be adequately mitigated- *Mitigation strategy is proposed in the BMP table. These include:* ● *to remove or reduce adverse impacts on natural habitats or their functions, keeping such impacts within socially defined limits of acceptable environmental change.* ● *restricted conversion or modification by using old sites and limiting site clearing or aquatic invasive works;* ● *reintroduction of species;* ● *mitigation measures to minimize the ecological damage* ● *post development restoration works; restoration of degraded and legacy habitats;*
Benefits for critical habitat of concern	The IDSP with UNOPS have proposed rehabilitation of sites both legacy and proposed sites to promote habitat integrity which may in turn benefit the species of conservation concern. *The project will not convert or degrade any critical habitat, either on-site, in adjacent or downstream areas and will not involve significant conversion or degradation of critical habitats*
Reduction in the population of any Critically Endangered, Endangered, or range-restricted Vulnerable species	Mitigation strategy includes measures to avoid loss of populations. The IDSP will ensure the following: (a) the project will not convert or degrade any critical habitat, either on-site, in adjacent or downstream areas- *the dam is existing and no further significant clearing is expected or invasive water works, but species of concern might be encountered and must be protected and conserved by the contractor and the community* (b) The project will not involve significant conversion or degradation of critical habitats, including forest areas- *as above* (c) A robust and appropriately designed, long-term biodiversity monitoring and evaluation program aimed at assessing the status of critical habitat is integrated into the management program- *shown below under monitoring section 5.3 and below*

ii. Monitoring and Evaluation Measures:

A BMP necessitates the creation of systems and structures for the sub-project planning, implementation, monitoring and evaluation. This involves knowledge on the aspects, impacts, framework, indicators, process analysis and documentation. Contractor and operation monitoring measures are set out in the section 5.3 of this BMP. According the OP 4.04, such measures should always include provision for monitoring and evaluation to provide feedback on conservation outcomes and to provide guidance for developing or refining appropriate corrective actions.

A robust and appropriately designed, long-term operation phase biodiversity monitoring and evaluation program aimed at assessing the status of critical habitat and species is important for sites that have

species of conservation concern. Long term monitoring requires funding and is therefore beyond the present project's budget similar to catchment management above.

Long-term operation phase monitoring will follow up on the current BMP findings and management recommendations. The objectives include; measuring changes in the quantity and quality of the species, variability and ecological interactions. It will look at clear measures for conservation and protection of the species. Various field methods can be used including the ones used for this BMP study. The monitoring system will be continuously revised and improved. The following are some of the questions the operation phase monitoring and evaluation programme will answer in the long run:

- Are the species of conservation concerns habitats being degraded?
- Are the populations of the species of conservation concern declining?
- What are the threats to the biodiversity?
- What is the local biodiversity knowledge of these species?
- Who are end users of the natural resources?
- How do communities use the natural resources?
- How have the management interventions worked?
- feedback on conservation outcomes and
- guidance for developing or refining appropriate corrective actions

Operational phase monitoring roles are proposed below using existing local structures. The IDSP will communicate with these actors and set up a monitoring programme. Once in place, the monitoring programme should involve a variety of relevant stakeholders that can ideally form a Biodiversity monitoring committee for the monitoring programme. However, these participants need to be skilled in data collection methodologies and knowledgeable of the project. A capacity building exercise might be necessary for operation phase monitoring. The following actors who have biodiversity mandates are shown in the monitoring table in section 5.3-operation phase and their roles and responsibilities for implementation are detailed here. The IDSP will have to communicate with these actors and set up a monitoring programme.

a) Community-the traditional leaders and DMC

- The community will need to understand the value of the species of conservation concern. This can be done by annual training and sensitization programs with incentives.
- The community should have a register of such species and location of their habitats.
- The DMC should have regulations relating to protection of such species as guided by the district stakeholders below.
- Incidents involving these habitats and species will be reported to the relevant stakeholders and records will be kept by the DMC
- The DMC will assist the stakeholders in carrying out conservation measures
- Control of settlement patterns and cultivation land allocations. These should not be in or disturb sensitive habitats and species.
- They will assist with flow monitoring after training by IDSP

b) Parks and wildlife

The department is involved in wildlife conservation, designation of protected areas, management and control of hunting, including enforcement of international biodiversity agreements.

- They will set objectives for the monitoring and evaluation program

- They will annually train and sensitize the community in conservation and good fishing practices that will protect aquatic fauna
- They will sensitize the community on emergency reporting, invasive species and species of conservation concern
- They will review the DMC's regulations and offer sector guidance
- They will conduct annual site inspections and monitoring reporting submitting to the district and IDSP
- They will conduct detailed biodiversity assessments and reporting every 3-5 years for the project area of influence

c) Forestry

The department establishes, controls the utilization and management of forests. It provides for the establishment and management of national and local forests, conservation and protection of forests and trees and licensing and sale of forest products.

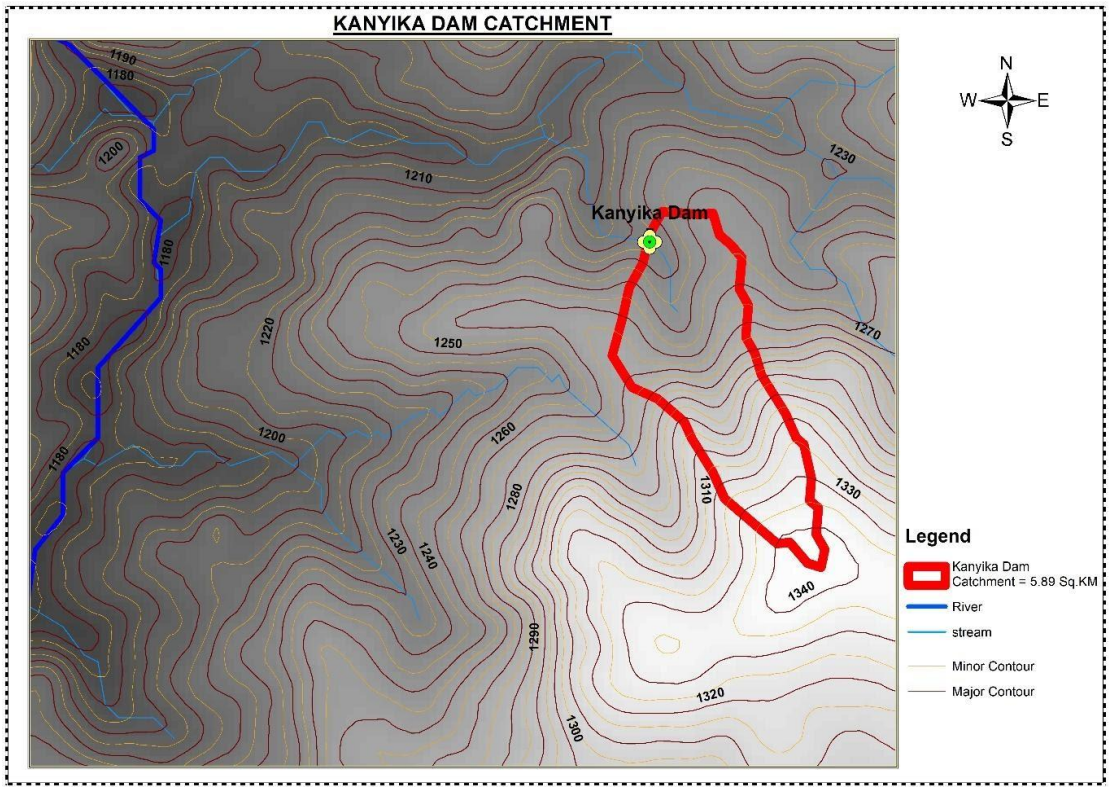
- The department has on-going monitoring program for protected species and offer permits, including enforcement of international biodiversity agreements. Protected species monitoring can feed into this programme.
- They will set objectives for the monitoring and evaluation program
- They will annually train and sensitize the community in forest uses/ benefits, conservation practices that will protect flora and habitats
- They will sensitize the community on emergency reporting, invasive species and species of conservation concern
- They will review the DMC's regulations and offer sector guidance
- They will conduct annual site inspections and monitoring reporting submitting to the district and IDSP
- They will conduct detailed biodiversity assessments and reporting every 3-5 years for the project area of influence

d) Agriculture

- They will set objectives for the monitoring and evaluation program
- They will annually train and sensitize the community in conservation and proper agriculture practices that will protect habitats and species
- They will sensitize the community on invasive species and species of conservation concern
- They will review the DMC's regulations and offer sector guidance
- They will conduct annual site inspections and monitoring reporting submitting to the district and IDSP
- They will conduct flow monitoring
- They will take part in conducting detailed biodiversity assessments and reporting every 3-5 years for the project area of influence

Appendix 8.7: Hydrology and Ecological flows

A plan view of the Kanyika Dam catchment



Dry spillway channel, June 2020

Upstream