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 Katembula Dam

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Prepared by UNOPS for the Government of the Republic of Zambia

Names of Authors

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

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AF	Additional Financing
AR	Activity Rate
BDA	Biodiversity Assessment
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

MAR	mean annual runoff
MWDSEP	Ministry of Water Development Sanitation and Environmental Protection
NWFP	Non-wood Forest Products
msl	mean sea level
NGO	Non-governmental Organization
ODI	Overseas Development Institute
OP	Operational Policy
OPCS	Operational Policy and Country Services
PAD	Project Appraisal Document
PAP	Project Affected Person
PDO	Project Development Objective
PGA	Peak Ground Acceleration
PSU	Primary Sampling Unit
PIU	Project Implementing 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
Sp	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

Katembula Dam is located in Lufwanyama District of the Copperbelt 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 under the Water Resources Development Project (WDRP) and brought near completion in 2018. Its purpose was to supply water to some areas of Lufwanyama District. This new district has no reliable source of water supply. The dam was also build to provide water for livestock, aquaculture, irrigation developments and most importantly serve source of water supply to the Lufwanyama Township. No works have been executed to improve or complete the dam since 2018.

The WDRP 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 WRDP, including Katembula 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) and Biodiversity Management Plan (BMP), on behalf of the Government of the Republic of Zambia. Following a biodiversity assessment, a BMP was prepared as a separate report and has been annexed to this ESM. The objectives of this ESMP read together with the BMP 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 Katembula Dam include:

a) Crest tension cracks probably due to settlement of the embankment fill, caused by sponging and seepage along the toe of the dam;
b) Piping of water down the side of the emergency spillway as settlement shears vertically down the side, causing erosion;
c) The tight turn of the channel below the emergency spillway into the main river channel, which is likely to result in channel erosion on the bend.

The key non-structural legacy of the dam include:

d) Rehabilitation of the borrow pit site;
e) Restoration of access routes to the borrow pit and site office;
f) Demolition of the structure used as a site office.

UNOPS is in the process of completing a detailed design for the remedial works on Katembula Dam. The works may change the nature and scope of the existing dam operation activities, if it is decided that the emergency spillway is included in the remedial works. The works will be implemented in two ways: construction and demobilization activities and the existing sites' remediation activities.

Institutional Arrangements: The sub-project works on Katembula 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 Additional Financing (AF) activities, it has contracted UNOPS to oversee and implement the remediation works on ten dams, including the Katembula Dam. UNOPS will procure and oversee a contractor for the remedial works on the dam.

The dam community is expected to own this sub-project and report any grievance or misconduct by the contractor or its personnel to the IDSP-PIU through the Project 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 Katembula dam management committee (DMC). In order to successfully operate the dam, and limit its negative impacts on people and environment, the DMC members 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; BMP; community health and safety; gender equality and Gender Based Violence (GBV); labor and working conditions; decommissioning and rehabilitation measures; and maintenance and monitoring.

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

Social concerns include the failure to stock the dam with fish posing risks of food insecurity; and a lack of capacity / training for community members to benefit fully from irrigation water supply. In regards to the latter, people of Katembula require robust sensitization to encourage them to conduct agricultural activities.

The ESMP further includes a capacity building and training plan that lays out necessary training for DMC members, community members, and other stakeholders in relation to the construction and operation phase of the planned works at Katembula 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 necessary information regarding the works; and to allow for the consultation of stakeholders on dam-related environmental and social issues.

1. Introduction

Katembula Dam is located in Lufwanyama District, in the Copperbelt Province of Zambia. The dam is located approximately 105 kilometres by road, southwest of Kitwe, Zambia's second-largest city (by population). The town is traversed by a number of rivers. One of these is the Lufwanyama River, on which the Katembula Dam has been constructed. It flows from north to south, about 70 kilometres (43 miles) west of Kitwe and enters the Kafue River. Lufwanyama sits at an average elevation of 1,224 meters above sea level.

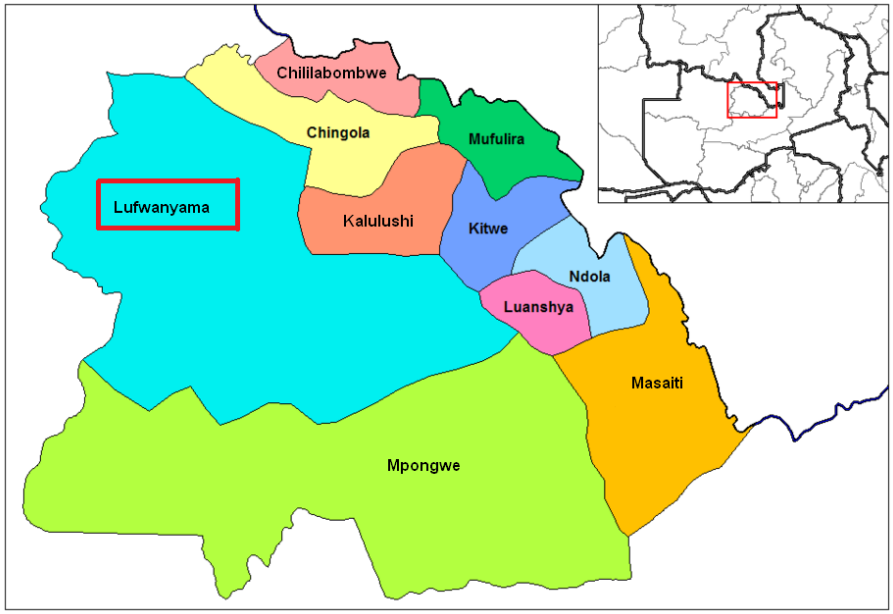


Figure 1: Map of the Copperbelt Province showing location of Lufwanyama District

Katembula Dam is one of ten dams that have been selected for remedial works under the World Bank funded IDSP. The current structural integrity of Katembula Dam has been heavily compromised with observed legacy issues, and therefore has become a threat to the safety of the local community. UNOPS has been tasked to prepare this Environmental and Social Management Plan (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 desk reviews, interviewed and consulted key sub-project stakeholders, and gathered field data at the dam site. Initial field screening visits by the team revealed the need for an in-depth biodiversity assessment of the dam site. The biodiversity assessment was undertaken, the data analyzed and a BMP developed as a separate report, which was annexed to this ESMP

Dam rehabilitation works will commence after the approval and disclosure of this ESMP. The ESMP will be communicated to the stakeholders prior to the works. Dam rehabilitation works are anticipated to take 6 months.

1.1 Project Background and Description

Katembula Dam is a zoned earthfill dam, which was constructed to a gross storage capacity of 2,030,000 m^3 with a maximum wall height of 10.4 m. The dam is fairly new, and construction only neared completion in March 2018. Construction was undertaken under the World Bank-funded WDRP. The proposed remedial works will be undertaken under the World Bank-funded IDSP.

The Water Resources Development Project (WRDP)
The WRDP became effective in 2013 and was closed in 2018. The Project Development Objective (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 support to the design, rehabilitation and construction of 100 small dams. Of these, only 12 dam sites were procured for construction or rehabilitation. Two of the twelves dams had issues with the foundation conditions and therefore were dropped from the list. The 10 dams remaining include Katembula Dam.

***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 provisions 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 Katembula 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 issue, 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 Irrigation 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 realise its original intent (which was to the benefit 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) preparing an ESMP and Biodiversity 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 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 Katembula Dam and the 9 other dams will be implemented under activity 2.

Phase 2 of the 2019 agreement and activity 2 of the AF provides remedial activities to reduce the risks/impacts related to construction and operation of the Katembula Dam and provide support through training and capacity building, which is required to safely operate the dam 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 Katembula 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 DMC comprising of member of the beneficiary communities;
e) Implementation of the Environmental and Social Management Plan (ESMP), including remediation of environmental legacy areas such as borrow pits and spoil 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 Katembula 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 Katembula dam community, local government authorities, representatives of the GRZ, and members of the World Bank and IDSP teams. Field visits were conducted to the Katembula 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 Operational Policies (OPs). Reference is made to the initially prepared and approved EPBs (WRDP 2017), the Remedial ESMP for 8 dams (COWI 2018), the Environmental and Social Audit (ESA) (IDSP 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.

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 Plan 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, matrix and checklist methods of 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	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.	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 the dam's safety and integrity are likely to have environmental impacts. Provisions for mitigation measures for identified sub-project impacts are put 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 mainstreamed in this ESMP to ensure the contractor's compliance with the regulations during the rehabilitation of the dam.
Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997	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		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.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	the Council has issued a decision letter.		
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 BMP, which details 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, once trained in the same. 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 Fisheries Department will be involved to educate the community activity. UNOPS, on behalf of the GRZ, has included actions to ensure species are protected with the involvement of the relevant Fisheries Department in the District.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
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 for the administration of lands and deeds registration and land surveys and mapping.	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.
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, on behalf of the GRZ, will 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	The Act establishes the Agricultural Land Board and	UNOPS to ensure enforcement during	The sub-project construction work and dam operation activities may be carried out on agricultural lands and thus

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
13 of 1994 (Cap. 187)	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.	preparation and construction phase Monitoring: Ministry of Agriculture	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, 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 UNOPS, on behalf of the GRZ, will comply with the requirements of this regulation, if protection of wildlife is required. The ESMP determines appropriate action to ensure preservation of national parks and protected areas, wildlife, and protected and endangered species by including ecologists on the team. The biodiversity assessment was conducted and a BMP prepared, annexed to this ESMP
Forestry Resources Management			

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
The Forest Act No. 4 of 2015	Control, manage, conserve and administer national and local forests; Participation of local communities, traditional institutions, and NGOs; conservation and sustainable use of forests and trees.	UNOPS IDSP Monitoring: Zambia Forestry Commission (yet to be established) / currently by the Department of Forestry	The project area is close to a forest reserve, protection of the reserve will be provided with guidance of the Department of Forestry. In situations where forest resources are affected by the project, approvals and permits from Forestry Department will be obtained prior to disturbing the forest. Permits and approvals are the responsibility of the contractor.
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, on behalf of the GRZ, will 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	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 being compliant by providing safe working sites.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	dependants of workers who die as a result of such accidents or diseases.		
Community Health and Safety			
The Public Health Act of 1995	Prevention and suppression of diseases and regulation of all matters connected with public 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.	Contractor, UNOPS Monitoring: Ministry of Health	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. UNOPS, on behalf of the GRZ, will 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	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.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	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		
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 Ministry of Community Development and Social services	Worker influx bears risks of GBV cases. UNOPS and its contractors will comply with all the regulations under this Act. Sensitisation, reporting and referral pathways will be put in place.
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	Construction and operational activities will	UNOPS to ensure enforcement during	COVID-19 prevention and management measures are included in this ESMP.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Disease (COVID-19) Statutory Instruments *	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.	preparation and construction phase	

- 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 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 triggered policies and actions to be followed by the IDSP AF/UNOPS and the constructor. The ESA indicated 6 triggered policies for the project, but the Katembula Dam sub-project has not triggered the OP 4.12 **(**Involuntary Resettlement), because there is no anticipated resettlement for the sub-project; 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 Water Ways). The reason is that the Katembula Dam was created by blocking the Katembula Stream which is a tributary of the Lunga River and subsequently part of the Kafue river system. The Kafue River is not internationally shared with another country but is a tributary to the Zambezi River, many kilometers away. The pollution or contamination that may be introduced in the Katembula Stream will not reach Zambezi River due to the distance between the Katembula Stream and the Zambezi River.

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 Katembula 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 Katembula 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.

[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.

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 populations on both aquatic and terrestrial ecosystems were identified in the ESA as an area of weakness in the previous safeguard instruments. Cumulative changes brought about by the dam may negatively affect the downstream aquatic and wetland environment. A comprehensive biodiversity assessment was concluded and a management plan is annexed to this ESMP. 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. Katembula Dam was constructed on a perennial stream and therefore has continuous flow downstream. This ESMP provides 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). In addition, UNOPS Ecological Experts conducted a biodiversity assessment and developed a BMP, which is annexed to this ESMP, to promote conservation of flora and fauna during and after the remedial works.
OP 4.06	Forests	This policy is triggered because potentially during future operation of the dam and expansion of the agricultural areas, tree loss and impacts on riparian forest could occur. In future, the Ministry of Agriculture will have to obtain relevant permits for expansion of agricultural activities around the dam, whenever need arises during the operational stage. Increasing populations supported by the irrigation schemes will create additional pressure on surrounding habitats, which may be important in the cases where the dam is in habitats with little transformation. A BMP has been prepared. The document discusses baseline investigations of terrestrial habitats, flora and fauna for purposes of ensuring the potential biodiversity impacts are taken care of during the remedial works. Other parameters discussed in the BMP include the environmental restoration and the subsequent monitoring plans based on the results of the field assessments.

OP 4.37	Safety of the dam	This policy is triggered because of the identified legacy structural non-compliances which compromise on the integrity of the Katembula Dam. 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 safe**.**

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

The Katembula 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 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 Katembula Dam. The IDSP-PIU Environmental & 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 Katembula 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.

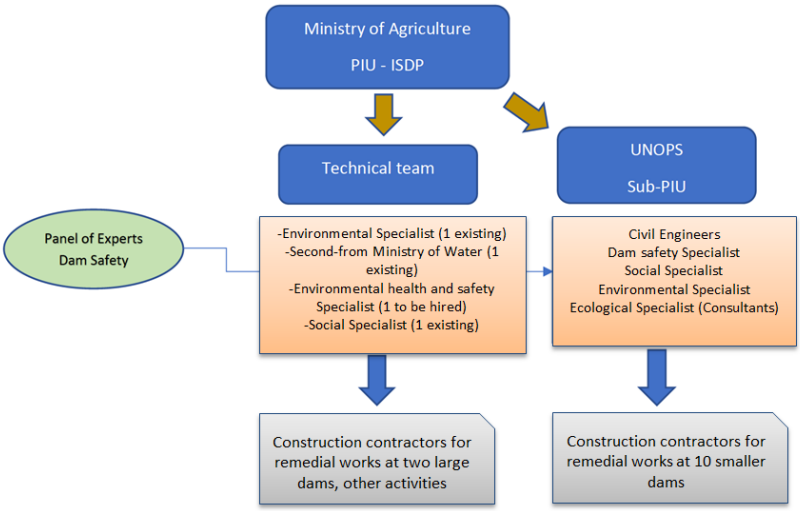


Figure 2: Institutional arrangement for sub-project implementation

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 therefore 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 of ensuring that environmental and social commitments for Katembula 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 Katembula 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 Ministry of Agriculture (MoA) field staff member working with the environmental health and safety specialist should take up the responsibilities of ensuring 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 Katembula 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, DMC and local communities, in preparation for a 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.

3.2 United Nations Office for Project Services (UNOPS)

The IDSP-PIU has contracted UNOPS to implement the remediation sub-project of Katembula 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 and 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 Katembula dam site.

The environmental specialist, the social specialist and the ecologist will be involved in the environmental and social management of Katembula 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 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 this ESMP, and will brief the Katembula 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, GBV, 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 the owner of the dam, the dam community will be encouraged to be an active partner during the construction and operational period. The committee will be regularly consulted on a variety of issues (see stakeholder engagement section) and will be encouraged to report any grievance or misconduct by the contractor or contractor personnel to the IDSP-PIU through the 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 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 communities are consulted throughout the construction and operational phases.

The dam is operated by a DMC, which consists of community members living in the vicinity of the dam. Currently the committee is semi-active, and consists of 4 women and 6 men, as shown in Appendix G. The Katembula DMC is a 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 widened 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 will continue to inform communities of their expected obligations and contributions during consultations and training.

The DMC has not commenced the dam monitoring activities. The committee is yet to set rules, through a constitution, which will be communicated to the users. Some aspects to be covered include fauna and flora conservation rules in the Katembula dam environment.

During the remedial works, the DMCwill be trained to manage the dam during the lifespan of its operation stage. Once the remedial works are completed, the contractor will hand-over the dam to the DMC who will ensure sustained maintenance of the dam during the operation period. Capacity building of the DMC members become very important for them to effectively manage to maintain the dam and its environment. It is planned that their training must include dam safety management/structural deterioration; gender equality; health and safety aspects, erosion control and conservation.

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

4.Environment and Socio-economic Baseline Conditions

4.1 Physical Conditions

4.1.1 Geology

Regional Geological Information

The Copperbelt regional geology has been assessed by F. Mendelsohn (1961) and V.D. Fleischer in 1976. The Chantete Mine Site belongs to the Copperbelt Province of Zambia. The geology of the Copperbelt area consists of a belt which extends for approximately 500km in an arc from the border of Zambia and the southern end of the Democratic Republic of Congo (DRC) and extends into Zambia and Angola in the western direction. The belt gives a metallogenic geological formation of about 80km in width. The geology is mainly made up of the early to middle Precambrian Basement Complex overlain by the late Precambrian Katanga Super group[3].

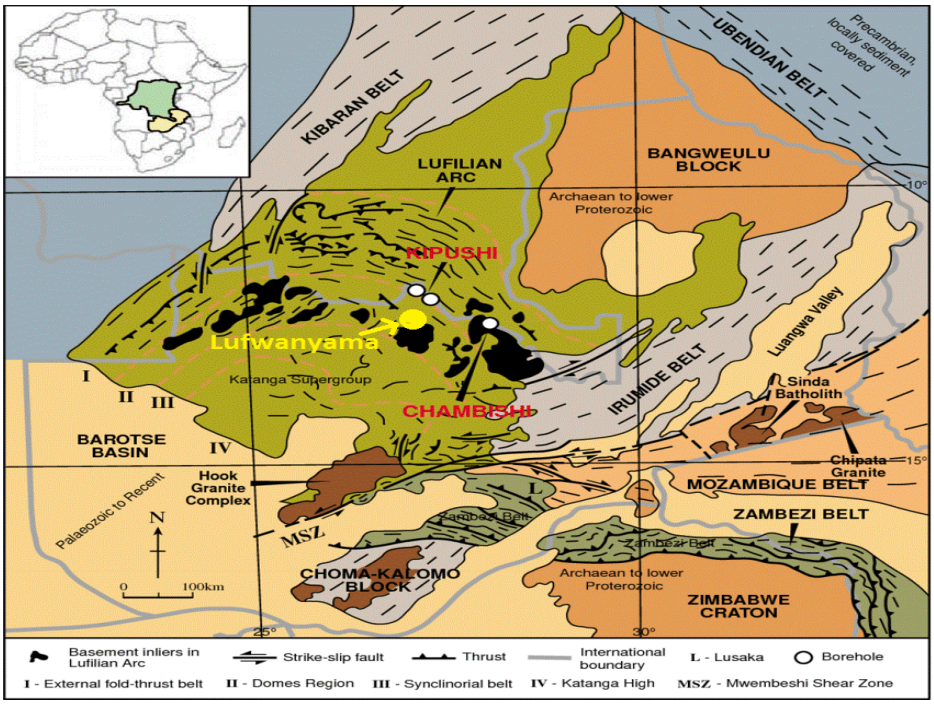


Figure 3: Map showing the geology of Lufwanyama District

[3] F. Mendelsohn (1961) and V.D. Fleischer 1976

Lufwanyama is rich in emeralds, copper and timber. However, the district has enormous unexploited natural resources and requires investment in all sectors of the economy to combat poverty. Situated in the Copperbelt Province, Lufwanyama is among the least developed districts in the country despite being endowed with the best emeralds in the world and copper deposits. Copper mineralization occurs in gently northward-dipping dolomites and dolomitic limestones underlying a sequence of phyllites and cacarenites.

The mineral-rich district has the lowest population on the Copperbelt, currently at 78,503 as recorded in the 2010 census[4].

4.1.2 Topography

The study area is generally hilly and gently undulating with some low lying areas. The topography of Lufwanyama District is characterized by a series of mountains and valleys oriented in the north to south direction.

Around the dam and in the areas close to the dam, the general topography ranges from 1208m to 1228m above the sea level. The highest point of the district are the western areas, which measure around 1266m above sea level. The south western area of the district drops to around 1200 and 1980m, which is the direction of the overflow from the dam to join the Luswishi River.

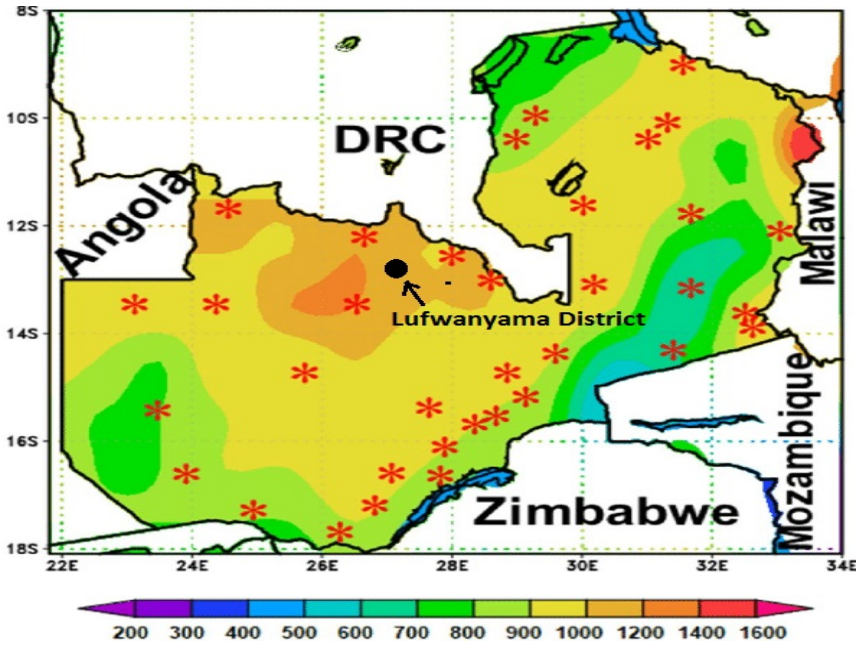


Figure 4: Map showing topography of the project area

[4] http://www.daily-mail.co.zm/lufwanyama-district-agrarian-mineral-timber-rich-land/

4.1.3 Groundwater

Basic infrastructure in Lufwanyama District is scarce and public services are only being developed. Most of the people in the area use private boreholes, shallow wells and the various rivers and streams as water source. Sanitation is limited to pit latrines (both protected and unprotected) causing a clear risk of contamination of groundwater sources.

The Katembula Dam is one potential source of water for the Lufwanyama District. The plan is to extract water from the dam, treat it and supply it to the offices and some houses that are able to afford to pay for water in order to sustain treatment process.

4.1.4 Surface Hydrology

The dam is located along the Katembula Stream, which flows into Lufwanyama River, which flows into Luswishi River. The Luswishi River flows into Chipupushi River, which then sends its water into the Kafue River. The local community activities along the Lufwanyama River and the resulting impacts on quality and ecology of the river system do not extend to the transboundary impacts of the surface water bodies, as these are very far from Lufwanyama District.

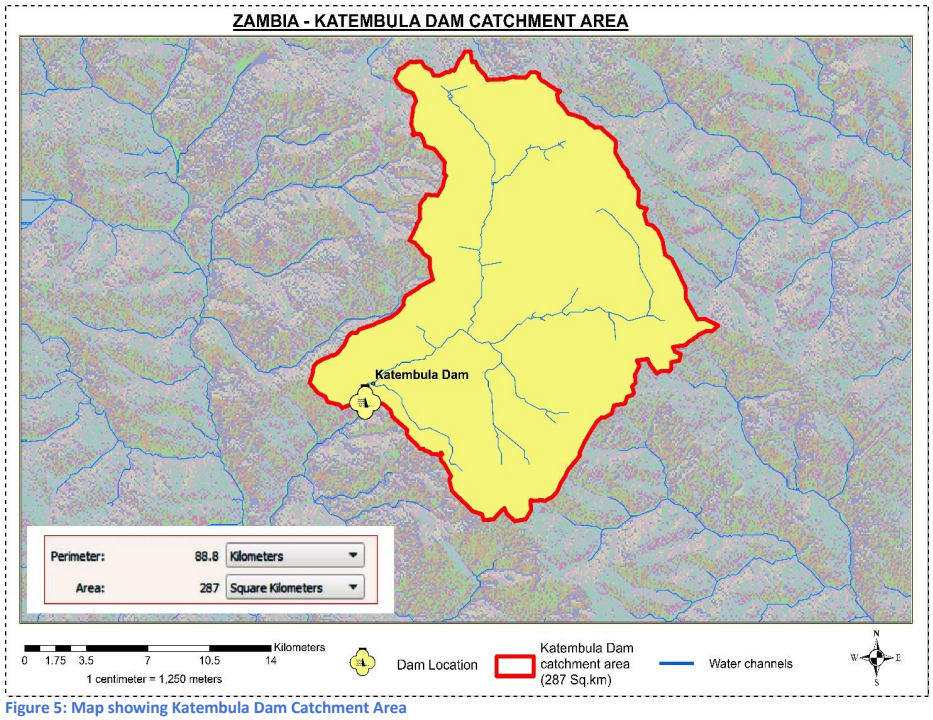


Figure 5: Map showing Katembula Dam Catchment Area

The projections on the extent of the flood on the Katembula Dam and downstream are shown in the figure below.

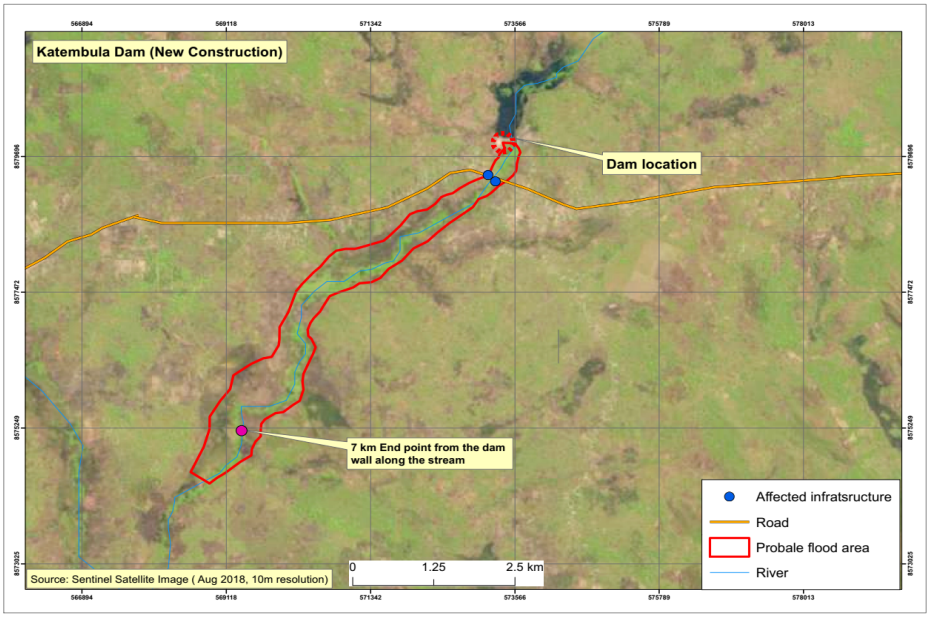


Figure 6: Katembula Dam Flood Map

4.1.5 Surface Water Quality

Settlements generally consist of extended families, some close to the Katembula River while some are far away from the river. The sub-project area communities have settled mainly along the M18, which is a tar road. Gravel roads provide access from the M18 to both sides of the dam wall, and a single small road extends up the west side of the dam to communities at the upper end of the FSL. Those away from the river draw water from their wells. In most cases unprotected water from these wells is used for domestic purposes. Communities close to the river do access water from the river for domestic purposes. However, thee some members of the same community - living near the Katembula River - have dug shallow wells along the banks of the river. These draw water from shallow wells for their domestic purposes. The only set back with that is that these wells dry up during dry season.

The dispersed nucleated settlements are mostly on the western end of the dam with a clearance of about 50m. There are few settlements on the eastern side of the dam, but those are with a clearance of about 100m from the dam. Otherwise, a number of settlements are located away from the dam. There are a few boreholes in operation by the local community, for their domestic use. The dam may not suffer from siltation aspects, because it has well vegetated surroundings except for the areas where the borrow pits are located.

Plate 1: Katembula Dam - Spillway channel in the east

Plate 2: Picture showing no settlements near the dam

The dam site on the Katembula River was selected as the best option for a new dam for the newly established Lufwanyama urban centre that has no reliable water supply. The dam has been built to serve this requirement, as well as water for livestock, aquaculture and eventually irrigation development and the dam has been built to serve the township. Upstream of the Katembula River are very few subsistence farmers who can be educated on how best to conduct their farming in order not to cause siltation and avoid contaminating the surface water body through nitrates and phosphates (through reckless application of fertilizers in their fields). Otherwise, the water quality is generally good for use as proposed by the local administration.

To confirm quality of water accessed by the local community in the sub-project area, water samples were collected about 50m from the footbridge on the upstream end of the dam, within the reservoir (see Plate 5), and analyzed at the University of Zambia.

Plate 3: Picture showing water in the reservoir and the sampling point

Table 3 shows the results of the water quality sample taken at Katembula Dam in June 2020, compared with other dams under this project. The test results indicate that the relevant parameters are all within the statutory limits for WHO drinking water parameters.

Additionally, water analysis results obtained in 2016 also show that the water quality in the Katembula reservoir is good enough for domestic chores.

Table 3: Water analytical results for Katembula 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	Nachibunga 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 Lab Manager /Co-ordinator

Table 4: Katembula Dam - Water Analysis Results obtained in June 2020

Element	Katembula Dam	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard[56]
pH	6.82	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	194	1500	
Sulphates (mg/l)	1.70	250	
Nitrates (as NO_3-N mg/l)	< 0.01	500	
Total Dissolved Solids (mg/l)	97	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	7.00	-	250
Chlorides (mg/l)	8.00	250	
Turbidity (NTU)	1.59	5	
Hydrocarbons (mg/l)	< 0.005	-	10

Source: Extracted from Table 3 above

As discussed earlier, the water quality was found to be acceptable for use as drinking water. All the parameters critical for monitoring purposes were within the WHO Guideline limits for drinking water. The phosphates and sulphates levels were also within the statutory requirement, indicating that there is little activitiy around the dam that may contaminate the dam to levels of non-compliance. It is therefore a genuine call to have the Katembula Dam utilized as a source of water supply to the Lufwanyama District.

Additionally, the 2016 water analysis results also show the same trend in terms of levels of compliance. All parameters were within the statutory limit, confirming the suitability of the water body for use as source of water supply to the residents of Lufwanyama District.

The 2016 water quality results at Katembula Dam are presented in the table below.

Table 5: Water Quality Data Sampled and Analysed 29/03/2016

Parameter	Unit	Value	WHO Guidelines maximum permissible levels for drinking water
Conductivity	µS/cm	124	1500
Eh		-45	
DO	mg/l	7.04	5
pH	-log[H^{+}]	7.8	6.5 – 8.5
TDS	mg/l	62	1000
TSS	mg/l	164	-
Turbidity	NTU	<1	5
Chloride	mg/L	80	250
SO_4	mg/L	<0.1	250

[5] 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.
[6] 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.

4.1.6 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.

An important input parameter for the engineering design of a dam is the Peak Ground Acceleration (PGA - a measure of earthquake acceleration on the bedrock outcrops). PGA is used to assess the seismic hazard of an area (in terms of probabilistic approach) and is expressed in ***g*** (the acceleration due to earth's gravity) as either a decimal or percentage; in m/s2 (1*g*=9.81 m/s2) or in **Gal**, where 1Gal is equal to 0.01m/s² (1*g*=981Gal).

According to Global Seismic Hazard Assessment Program (GSHA), conducted between 1992 and 1999, the mean PGA value for most parts of Zambia lies between 0.4 – 0.8g with a 10% excess probability in 50 years, corresponding to a return period of 475 years.

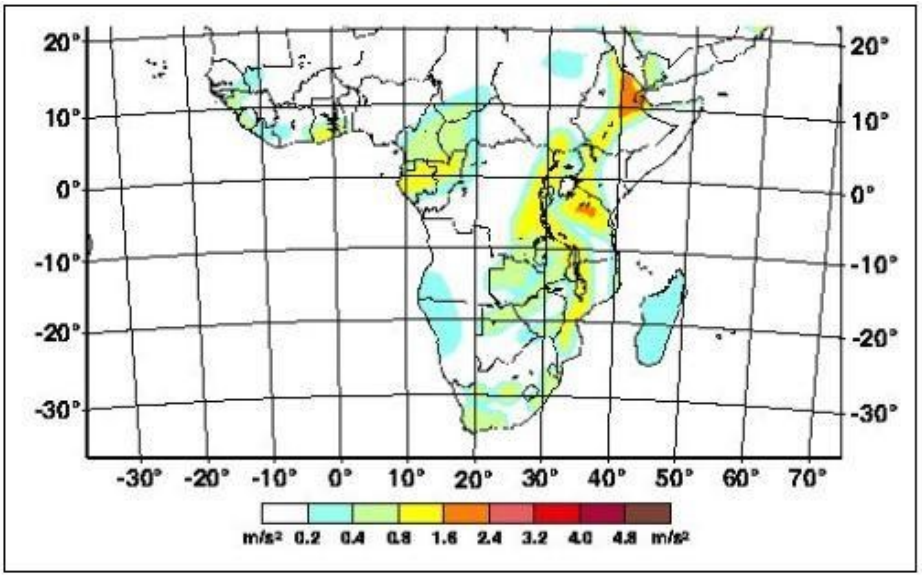


Figure 7: Distribution of mean PGA values for East and South Africa according to (GSHAP*)*

The result of this study was a hazard map, which places northern parts of Zambia in a relatively low zone that exhibits mean PGA values between 0.5 – 0.9g, similar to those of GSHAP. Though the risk may not be high, it may be recommended that seismic hazard be given due consideration in the design of structures such as dams in Lufwanyama District, for safety reasons. The study particularly recommends that all lifeline and critical installations and infrastructure, such as hospitals, bridges, dams and electrical power plants should be designed and built to withstand significant levels of seismic action.

There has been some earthquakes and tremors on the Copperbelt where Lufwanyama District is located. The Copperbelt region in Zambia has been a subject of seismic activity, which is induced by concentrated mining activities. In this respect, Lufwanyama may not be considered an environment free of seismic activities. Hence the call to have dam construction, rehabilitation and/or remediation factor in seismic hazard to ensure sustainability of the dam. Correct material is available to achieve a good result that takes care of seismic hazards, because geotechnical investigations show that there is no evidence of material that is unsuitable (Convergence Zone (ITCZ)).

Lufwanyama District has average annual temperatures ranging from 6^0C to 15^0C in June and 27^0C to 32^0C in December.

Rainfall Pattern: The annual rainfall compressible, collapsible, dispersive or can liquify on the dam embankment.

4.1.7 Climate and Climate

4.1.7.1 Climate

The regional climate has distinct dry, cool (May to September) and wet, warm (October to April) seasons. The district experiences a relatively moderate subtropical type of climate, which is determined by the humid Congo Air Mass and the Inter-Tropical average is about 1,232 mm whereas the relative humidity average is about 65%. The most reliable meteorological stations situated close to the site are Simon Mwansa Kapwepwe International Airport Ndola Meteorological Station and Kafironda Meteorological Station, which is located approximately 60km south east. The site itself has no meteorological station. Therefore, the closest meteorological station was used for the sub-project area.

Rainfall: Mean annual rainfall at Simon Mwansa International Airport (SMIA) is 1247 millimeters (mm) and occurs predominantly between November and March. The 30-year maximum 24-hour rainfall event was calculated to be 126mm and the 100-year 24 hour rainfall event was 149 mm.

Temperature: Temperatures vary from a minimum of 7.5°C (average minimum cold season temperature) to a maximum of 31°C (average maximum hot season temperature). The altitude of the Copperbelt (1250m - 1400m) moderates the climate so that extremely hot temperatures are rare.

Humidity: Average monthly relative humidity for the weather station in Ndola, over the 30-year period (1980-2010), indicates that monthly relative humidity varies from 78% in the wet months (December to March) to 39% in September. This is a range of 39%. In the cool dry season (May to September) the average monthly humidity drops from 56% (May) to 39% (September). Average monthly relative humidity during the warm, wet season stays relatively stable at 78%.

4.1.7.2 Climate Change

According to the World Bank[7], 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. The adverse impact of climate change has been

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

on food and water security, water quality, energy and the sustainable livelihoods of rural communities. Coupled with poverty, this also limits economic development.

Zambia is divided into three agro-ecological zones with rainfall as the dominant distinguishing climatic factor (Figure 8). Zone I lies in the western and southern part of the country and accounts for about 15% of the land area. It receives less than 800mm of rain annually. It used to be considered the bread basket of the nation, but for the last 20 years it has been experiencing low, unpredictable and poorly distributed rainfall. The observed meteorological data suggests that it is currently the driest zone, very prone to drought and has limited potential for crop production. Zone II covers the central part of the country, extending from the east through to the west. It is the most populous zone with over 4 million inhabitants and has the highest agricultural potential. The soils here are relatively fertile. It receives about 800–1000mm of rainfall annually, which is evenly distributed throughout the crop growing season. Zone III, where Lufwanyama District is located, spans the northern part of the country and has a population of over 3.5 million. It receives over 1000mm of rainfall annually. The high rainfall in this region has resulted in the soils becoming leached. It is suitable for late maturing varieties of crop[8].

Agriculture in Lufwanyama depends on rainfall to a very large extent. Since the 1990s, crop production in the country in general has faced negative impacts of extreme climate events, which are believed to be manifestations of long-term climate change. Zambia has experienced some of its worst droughts and floods in the last two decades[9].

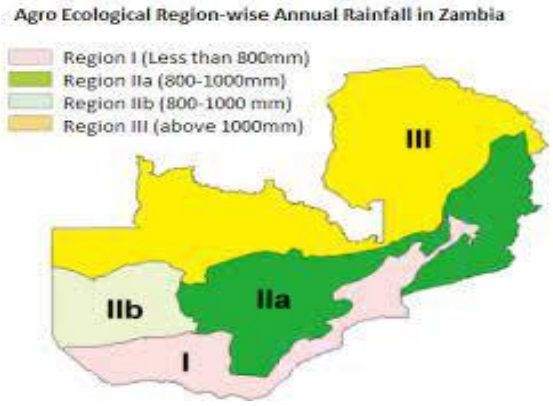


Figure 8: Ecological Zones in Zambia

The Katembula 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 pattern exceeding 1000mm, which implies the area can make suitable 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 advantage with the Katembula dam environment is that it has not yet been encroached by subsistence farming. The communities in North-Western Province

[8] An empirical economic assessment of impacts of climate change on agriculture in Zambia, World Bank, 2007
[9] Ditto

depend mostly on goats and growing of farm produce, such as maize cabbage and other types of crops at small scale.

Climate projections for Zambia[10] 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:

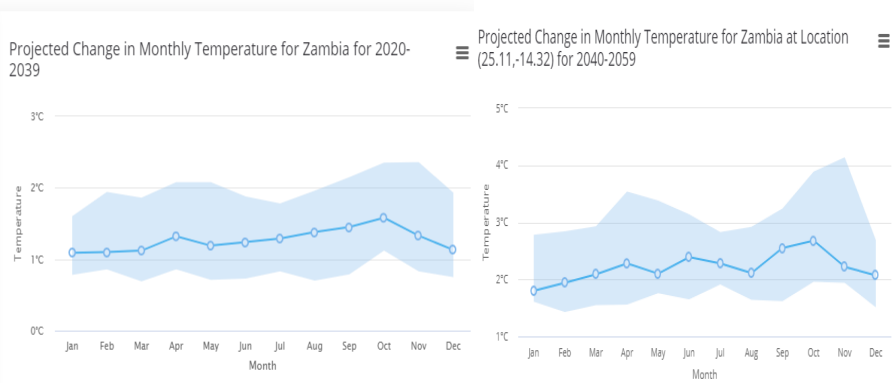
Temperature

- 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 significant, 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.



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

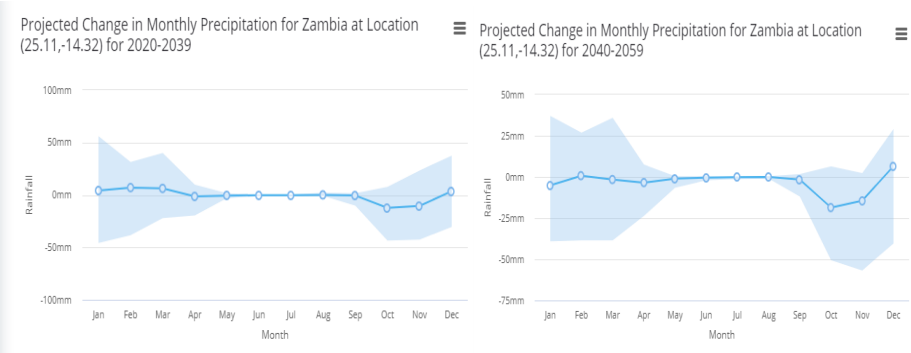


Figure 9: Projected changes in monthly temperatures for Zambia 2020-2059

4.1.8 Land Use and Soil Type

Existing soild form on geologically old parent material, such as the basement complex geology of Lufwanyama District with the associated humid tropical climate and naturally occurring rainforest vegetation.

Most of the people in Lufwanyama survive on farming, as the area is blessed with fertile soil. Maize is the most widely grown crop followed by sorghum and millet. Small-scale farmers currently are able to supply maize to the Food Reserve Agency (FRA). Lufwanyama also produces a lot of vegetables and carrots, which are mainly sold at Kitwe at Chisokone market. The district is also known for being a major supplier of sweet potatoes to Kitwe, Kalulushi and Ndola.

Other than growing crops in designated areas away from the dam, the local community rears domestic animals, such as chickens, sheep, goats and cattle. On the western side of the sub-project areas are some fields, which do not have any impact on the quality of water as they are located in the lower elevations compared to where the dam is located. Cultivated crops include maize, millet and groundnuts. Most of the local farmers grow them in an inter-cropping system to save time, land and labor.

4.2 Biological Conditions

4.2.1 Flora

Much of Lufwanyama area is covered by Miombo woodlands. The Miombo woodland cover is widespread in the Zambezian region. It ranges from Angola to Tanzania and accounts for close to 80% of the woodland cover in Zambia. This woodland type is dominated mainly by the tree species *Brachystegia, Isoberlinia* and *Julbernadia.* This habitat is common for agricultural cultivation especially for grain crops, such as maize.

Vegetation in the sub-project area is described as Miombo woodlands even though the area itself has been heavily disturbed by human activities, to the extent that trees have been depleted in the area. In the areas around the sub-project area, regenerated vegetation formis some thick, three-storeyed forest with some evergreen canopy, comprising either *Parinari ssp.* predominantly miombo and *Jubernardia, Isoberslinia* and *Brachystegia* species. Common hard wood tree species include: *Pterocarpus angolensis, Guibourtia coleosperma, Faurea intermedia, F. saligna, Afzelia quanzensis* (Pod Mahogany), *Swartzia madagascariensis, Burkea africana, and Pericopsis angolensis*.

Plate 4: Vegetation type around Katembula dam area

The Katembula riverine vegetation is characterized by common plants: growing palms like *Phoenix reclinata*, and *Raphia farinifera*, ferns such as Royal fern (*Osmunda regalis*), Bog scaly lady fern (*Thelypteris confluence*), and various types of grasses, though not completely covered due to anthropogenic activities. The immediate sub-project area riverine trees include *Syzygium cordatum, Syzygium guineense ssp afromontanum, S. owariense, Gardenia imperialis, Rothmmania whitfieldii* and *Swatrzia madagascariensis.*

Plate 5: Vegetation in the riparian regions

4.2.2 Habitats

The distribution of vegetation around Katembula Dam can be divided into three zones:

Part 1- Upstream of the dam basin: There was no cultivation observed in the immediate sections of this area. However, there are practices of subsistence farming in the upper or upstream sections of the dam, almost 1km away from the dam reservoir. The habitat in the sections taken up for subsistence farming is already disturbed due to clearing of land for the small scale farming activities. The local community will need to be sensitized through Ministry of Agriculture not to contaminate the Katembula River with fertilizer runoffs, otherwise this may affect quality of water in the dam and finally affect source of water for the entire Lufwanyama District and those living in the downstream sections of the dam.

Part 2 – In the dam basin area: The area is completely depleted of vegetation, as the habitat functions change from terrestrial to aquatic species in the reservoir. Overall, habitat integrity in the dam has regenerated over time to form part of the aquatic ecosystem.

Part 3 – Downstream of the dam basin: The area is depleted of trees and covered with scanty vegetation. This is the area that may be covered by the irrigation canal once completed. Presently there are no gardens or small scale farming in the region. There are however small sections of peasant farming downstream of the Katembula dam.

In summary, the northeastern as well as the southwestern fringes of the dam; and the lower part of transect, have abundant grass with some reasonably rich regeneration of trees. It has undergone minimal human influence (only about 10%). There are no signs of agriculture activities there. The locals only cut a few trees for construction of grain storage bins. However, the western fringe of the Katembula Dam has undergone a lot of human influence due to crop production activities. There is no gazetted forest or protected areas near Katembula Dam.

The distribution of vegetation cover is as shown in the google map below.

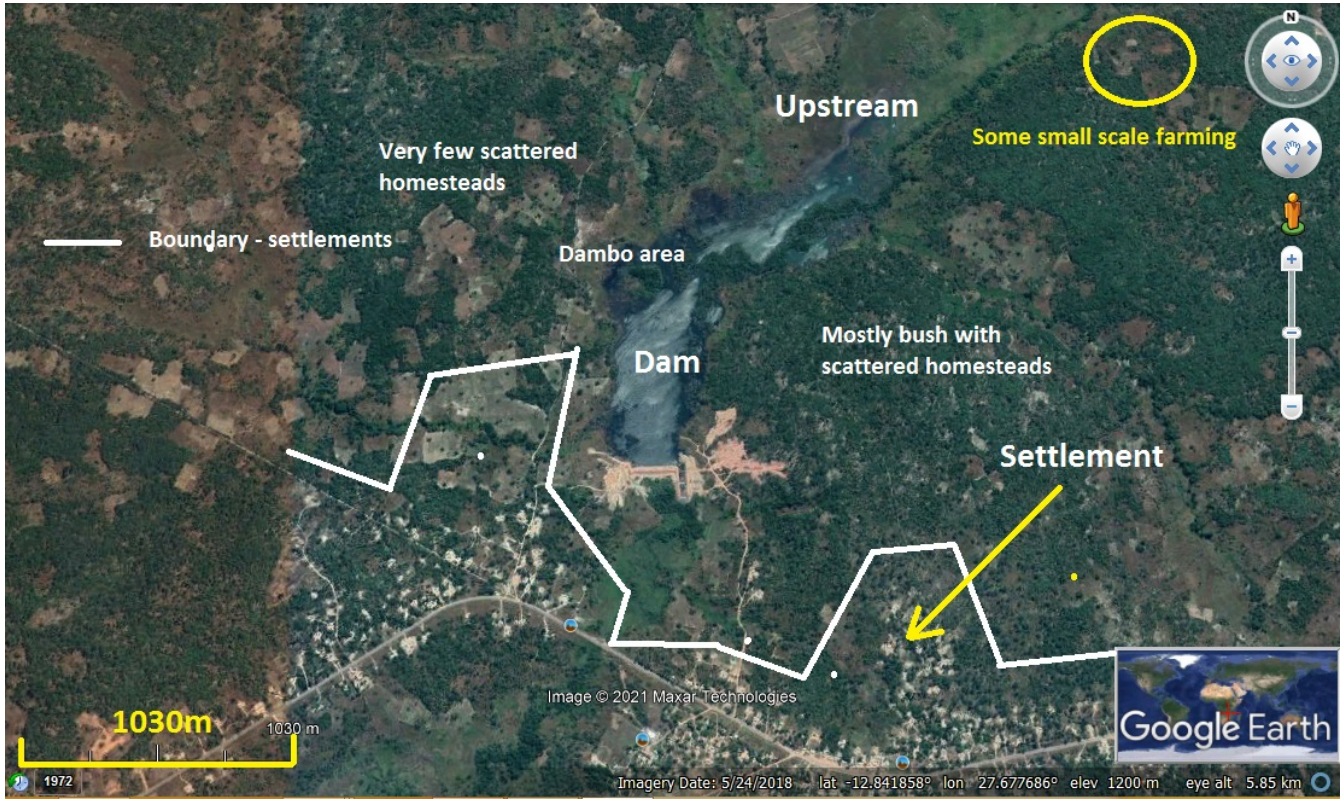


Figure 10: Google map showing vegetation cover around Katembula dam

4.2.4 Fauna

The Katembula dam sub-project area and most of Lufwanyama District have been ecologically disturbed over the years because the area is heavily inhabited by humans. There used to be animals of many kinds, such as elephants, impalas, lions etc.. over 70 years back, but some of these animals especially the impalas were depleted though hunting, while the rest were localized in the game parks, such as the West Lunga and the Kafue Game Parks. The sub-project area therefore is devoid of any special or protected animal species in the area, except for common ones like rodents and maybe a bit of monkeys in certain places.

Reptiles that could be found in the area include; Crocodile (*Crocodilus niloticus*), Water monitor (*Varanus niloticus niloticus*), Snakes such as Spitting Cobra (*Naja nigricollis*), Puff adder, Black mamba (*Dendroaspis polylepis*), Python, green tree snake. Others are common lizards, Chameleon (*Chamaeleo dilepis dilepis*), Blue headed lizards (*Agama Atricollis*). Marsh terrapin tortoise (*Pelomedusa subrufa*) and bell's hinged tortoise (*Kinixys belliana spekii*) are also common.

Assessments of the fauna in the sub-project area, including aquatic species, were conducted and a BMP developed, which is annexed to this document.

i) Fish species

Fish Species in Katembula Stream. The table below shows the fish that are found in the Katembula Stream at present. The Misenga fish is a local delicacy and mostly caught by women using big baskets.

Table 6: Table showing the type of fish species found in the Katembula River

	Local name	Scientific name	Period of year when abundant
1	Imisenga	*Barbus spp*	March to April
2	Imita	*Clarias spp*	Beginning of Rain season
3	Ching'ong'o	*Synodontis spp*	November to December
4	Umuntotongwa (Eel fish)	*Aethiomastacembelus frenatus*	December
5	Amalemba/Mintesa	*Marcusenius spp*	April
6	Inkomo	*Ctenopoma Multispine Peters*	November
7	Insonga meno	*Hepsesetus odoe*	October
8	Yellow Machine	*Seranochromis altus Winemiller*	September to October
9	Pale (big breams)	*Sargochromis mortimeri*	September to October

Source: KI; community consultative meeting

(COWI 2018 Report)

ii) **Bird species**

The bird species found in the project are listed in the table below

Table 7: Bird species in the Sub-Project Area

No.	Common Name	Scientific Name
1	Greater Honeyguide	*Indicator indicator*
2	African Grey Hornbill	*Tockus nasutus*
3	Woodland Kingfisher	*Halcyon senegalensis*
4	Red-colored Widowbird	*Euplectes ardens*
5	Square-tailed Drongo	*Dicrurus ludwigii*
6	Brown Falcon	*Falco berigora*
7	Red-necked Francolin	*Francolinuus afer*
8	Thick-billed Green Pegeon	*Treron curvirostra*
9	Great Egret	*Egretta alba*
10	Racket-tailed Roller	*Coracias spatulatus*
11	Marabou Stock	*Leptoptilos crumeniferus*
12	Turtle Dove	*Streptopelia turtur*
13	Golden-tailed Woodpecker	*Campethera abingoni*
14	African Pied Wagtail	*Motacilla aguimp*
15	Spur-winged Goose	*Plectropterus gambensis*
16	Bronze Sunbird	*Nectarinia kilimensis*
17	White-naked Raven	*Corvus albicollis*
18	African Reed Warbler	*Acrocephalus baeticatus*
19	Common Snipe	*Gallinago gallinago*
20	African Marsh Harrier	*Circus raniforus*
21	Rose-ringed Parakeet	*Psittacula krameri*
22	Barn Swallow	*Hirundo rustica*
23	Black Shouldered Night Jar	*Caprimulgus nigriscapularis*
24	Dark Chanting Go-Hawk	*Melierax etabates*
25	Crested Guineafowl	*Guttera pucherani*
26	Senegal Coucal	*Centropus senegalensis*
27	Crowned Plover	*Vanellus coronatus*
28	Laughing Dove	*Streptopelia senegalensis*
29	Owl-Grass Owl	*Tyto capensis*
30	Bateleur eagle	*Terathopius ecaudatus*
31	Black-eyed Bulbul	*Pycnonotus barbatus*
32	Wax bill	*Serinus striolatus*

Source: KI; community consultative meeting

(COWI 2018 Report)

iii) Snakes and Reptiles in the Project Area

Table 8: Snakes and Reptiles in the Sub-Project Area

No	Common name	Scientific name
1.	African Rock Python	*Python sebae*
3.	Southern Tree Agama	*Acanthocerus atricollis*
4.	Twig or Vine Snake	*Thelotornis capensis capensis*
5.	Boomslang	*Dispholidus typus*
6.	Common African Chameleon	*Chamaeleon chamaeleon*
7.	Monitor lizard	*Varanus exanthematicus*
8.	African Puff-adder	*Bitis arietans arietans*
9.	Black–necked Spitting Cobra	*Naja nigricollis nigricincta*
10.	Black-mouthed Mamba	*Dendroaspis polylepis*

Source: KI; community consultative meeting

(COWI Report, 2018)

iv) Mammals found in the Project Area

Like in many rural parts of Zambia where a lot of people are settled, most of the animals have been wiped out due to poaching and also some have run away in fear of human beings. There are mostly small animal species in the area with lots of barrowing rodents, the *Rodentia rodentia* type.

Table 9: Mammals in the Project Area

No	Common name	Scientific name
1	Vervet Monkey	*Cercopithecus aethiops*
2.	Bush Pig	*Potamochoerus porcus*
3.	Tree Squirrel	*Paraxerus cepapi*
4.	Water Mongoose	*Atilax paludinosus*
5.	Common duiker	*Sylvicapra grimmia*
6.	Scrub hare	*Lepus saxatilis*
7.	Greater Cane Rat	*Thryonomys swinderianus*
8.	Bushbuck	*Tragelaphus scriptus*
9	Black Rat	*Rattus rattus*
10	Bush Squirrel	*Xerus inauris*

Source: KI; community consultative meeting

(COWI, 2018)

v) Insect Species in the Sub-Project Area

Table 10: Table showing list of insect species in the Sub-Project Area

No.	Common name	Scientific name	Order/Family
1	Honey bee	*Apis mellifera*	*Hymenoptera*
2	Termite	*Microtermes goliath*	*Isoptera*
3	Ants	*Dorylus helveolus*	*Formicidae*
4	Red ants	*Solenopsis spp.*	*Formicidae*
5	Butterfly		*Papilionacea*
6	Moths		*Papilionacea*
7	Wasp	*Belonogastar junceus*	*Vespidae*
8	Beetle		*Coleoptera*
9	Dung beetle	*Helicopris spp*	*Scarabaeidea*
11	Cicada	*Cicadetta spp.*	*Cicadidea*
12	Mosquito	*Anopheles spp.*	*Culicidae*
13	House fly	*Musca domestica*	*Diptera*
14	Honey bee	*Apis mellifera*	*Hymenoptera*
15	Termite	*Microtermes goliath*	*Isoptera*
16	Stink bugs		*Hemiptera*
17	Grass hoppers		*Orthoptera*
18	Dragonfly and Damselflies		*Odonata*
19	Giant cricket	*Brachytrypas membraneus*	*Orthoptera*
20	Cicada	*Cicadetta spp.*	*Cicadidea*

Source: COWI Report, 2018

Among the animal species recorded by COWI (2018) from community consultations, the Southern African python (*Python sebae*) is the only Red Data species, listed as 'Vulnerable' in the latest International Union for Conservation of Nature (IUCN) Red Data classification.

Use of the Integrated Biodiversity Assessment Tool (IBAT)[5] as an adjunct to screening level assessment shows 26 potentially occurring Red Data species - 5 mammal, 14 bird, 2 fish and 5 plant species - within a 50 km radius of the dam site. Most of these are likely to have been recorded in the protected areas, which are all Forest Reserves (FRs). Twenty-one FRs occur within the 50 km buffer, with the largest being the Lamba Headwaters FR, the Kafue Headwaters FR, the Kisangwa, Lushishi, and No. 39 and 44 FRs, having a combined and more or less contiguous area of around 5,000 km^2. The boundary of the Lamba Headwaters FR is within 2 km of the dam. Most of the FRs in this area have been severely encroached in the past decade, located only 40-50 km south and west of Chingola and Kitwe, which are major towns.

Five endemic fish are known from drainage system (pers. comm. W Aken, March, 2020) as well as the two vulnerable Red Data cichlid species, recorded by IBAT. Both of the cichlids are threatened by *O. niloticus,* which has been introduced into Zambian river systems by anglers and aquaculturalists[11].

Table 11: Red Data Species recorded within a 50km radius of the Katembula dam site

Species (common name)	Scientific name	IUCN Red Data Status
Mammals		
Black rhinoceros	*Diceros bicornis*	CR
African wild dog	*Lycaon pictus*	EN
White-bellied pangolin	*Phataginus tricuspis*	EN
Hippopotamus	*Hippopotamus amphibius*	VU
Leopard	*Panthera pardus*	VU
Birds		
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 idae*	EN
Grey crowned crane	*Balearica regulorum*	EN
Egyptian vulture	*Neophron percnopterus*	EN
Lappet-faced vulture	*Torgos tracheliotos*	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

[11] World Bank Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia, April 2020, Page 33-47

Species (common name)	Scientific name	IUCN Red Data Status
Fish		
Threespot tilapia	*Oreochromis andersonii*	VU
	Oreochromis macrochir	VU
Plants		
	Rotala robynsiana	CR
	Xyris exigua	CR
	Nymphoides tenuissima	EN
	Rotala fontinalis	VU
	Rotala smithii	VU

Source: World Bank E&S Audit Report, 2020

4.2.5 Ecosystem Threats

As indicated before, there is no gazetted forest or protected area near Katembula Dam. However, the habitat environment around the dam is reasonably rich, except for the western section, which has been disturbed by human activities. The community will have to be continually sensitized in order to protect the environment around the dam especially that the sole purpose of this dam is to supply water to the Lufwanyama District.

The biodiversity assessment conducted contains relevant steps to conserve the ecosystem. Following the biodiversity assessment of the area, the BMP was developed. Details on the threats to the river system and any possible threats to the fish species and other aquatic parameters are discussed in the BMP annexed to this document.

4.3 Socio-economic Conditions

4.3.1 Location and demography of Mwinilunga District

Situated in the Copperbelt Province, Lufwanyama is among the least developed districts in the country despite being endowed with high quality emeralds and copper deposits. The mineral-rich district has the lowest population in the Copperbelt, the 2010 census recorded 78,503 as recorded. Lufwanyama is located in an area of 9,849 square kilometers and has a population density of 8.0 persons per square kilometer. The district has six chiefdoms and shares its boundary with Kitwe, Kalulushi, Mpongwe, Masaiti, Luanshya, Chingola, Kasempa and Solwezi.

The Katembula Dam is located roughly 63 km west of Kitwe. It is located on the perennial Katembula Stream, which is a tributary of the Lufwanyama River, which in turn flows into the Kafue River. The co-ordinates are -12.844504° S, 27.676823° E. Katembula Dam is located in Kansoka Ward. The sub-project area is also in Chieftainess Shimukunami's area, inhabited by Lamba speakers.

Kasonka Ward has an estimated population of 6,360, consisting of 48 per cent women and 52 per cent men, with 1,267 households. Settlements generally consist of extended families. The sub- area communities have settled mainly along the M18, which is a tar road. Gravel roads provide access from the M18 to both sides of the dam wall, and a single small road extends up the west side of the dam to communities at the upper end of the FSL.

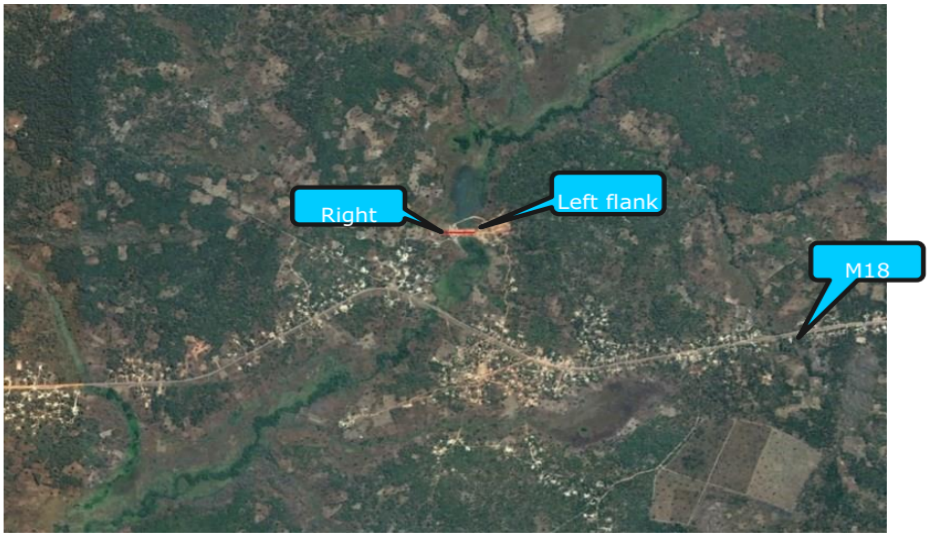


Figure 11: Location of Katembula Dam
Source: COWI Report, 2018

The main villages in the area are Manda, Kanchigwe, Songo, Manjimela, Chaisa, Pungwa, Lundwe, Kambinji, Vambi, Chipimpi, Chifulo, Kangaye, Thomashi, Chishima, and Kaputula. Traditional leaders in Lufwanyama include Chief Nkana, Chief Lumpuma, Chief Mukutuma, Chieftainess Shimukunami, Chief Fungulwe and Chief Shibuchinga[12].

4.3.2 Sources of Livelihood

Most of the people in Lufwanyama live on farming produce as the area is blessed with fertile soil. Maize is the most widely grown crop followed by sorghum and millet. Lufwanyama also produces a lot of vegetables including carrots, which are sold at Kitwe's Chisokone market. The district is also known as a major supplier of sweet potatoes to Kitwe, Kalulushi and Ndola.

Mining is another main activity in Lufwanyama, next to timber production and farming. Kagem Emerald Mine is the world's single largest producer of emeralds. It is housed in Lufwanyama and it covers an area of about 41 square kilometres. The mine accounts for about 20 per cent of global emerald production. Gemfields acquired the Kagem Mine in November 2007 and owns 75 per cent shares, while the Zambian government holds 25 percent shares in the mine. The other companies operating in Lufwanyama include Chibuluma Mine,

[12] Ditto, pag 23

Fivewood International, Kishi Mine, Grizzly Mining and Miku Mining. Currently, there are about 400 people with mining licences, but they do not have mining equipment for both open and underground operations.

4.3.3 Social and Livelihood Conditions Around The Dam

Only few community members live in the close vicinity of Katembula Dam, they are mainly on the western side of the dam. Their small scale farming activities are conducted close to their homesteads, but away from the dam, there is a buffer of about 100m composed of overgrown grass and shrubs. Agricultural activities in the proposed sub-project area are small scale farming, which includes rearing of domestic animals, such as chickens, sheep, goats and cattle. Cultivated crops in the sub-project area include cassava, maize, millet, sorghum, beans, sweet potatoes, and groundnuts and most of them are grown in an inter cropping system to save time, land and labor.

The settlements are therefore concentrated mostly on the south-western side of the dam and along the M18 road in the south-eastern direction of the dam. Both settlements are not more than 500m away from the dam (see figure 12). There is a settlement, though, at the northern end of the dam (upstream), which is located at least 1.5km away. This is the community that will need to be sensitized to ensure they manage fertilizer use in their field properly to avoid runoffs from these field from contaminating the Katembula River (upstream section).

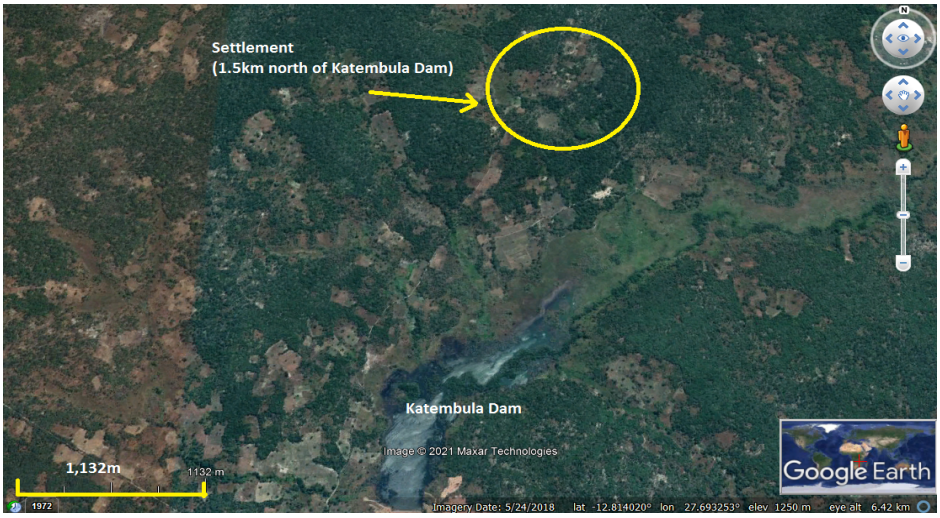


Figure 12: Google map showing some settlement, north of the dam

The dam is actually located at a sub-centre, which is serviced by various social services. These include the Katembula Primary, Katembula and Lufwanyama Secondary schools, Katembula Rural Health Centre and the Lufwanyama District Hospital, located in the Lufwanyama urban centre, less than 1km from the dam. Most infrastructure is located not less than 500m from the dam, in the south-western direction (figure 13).

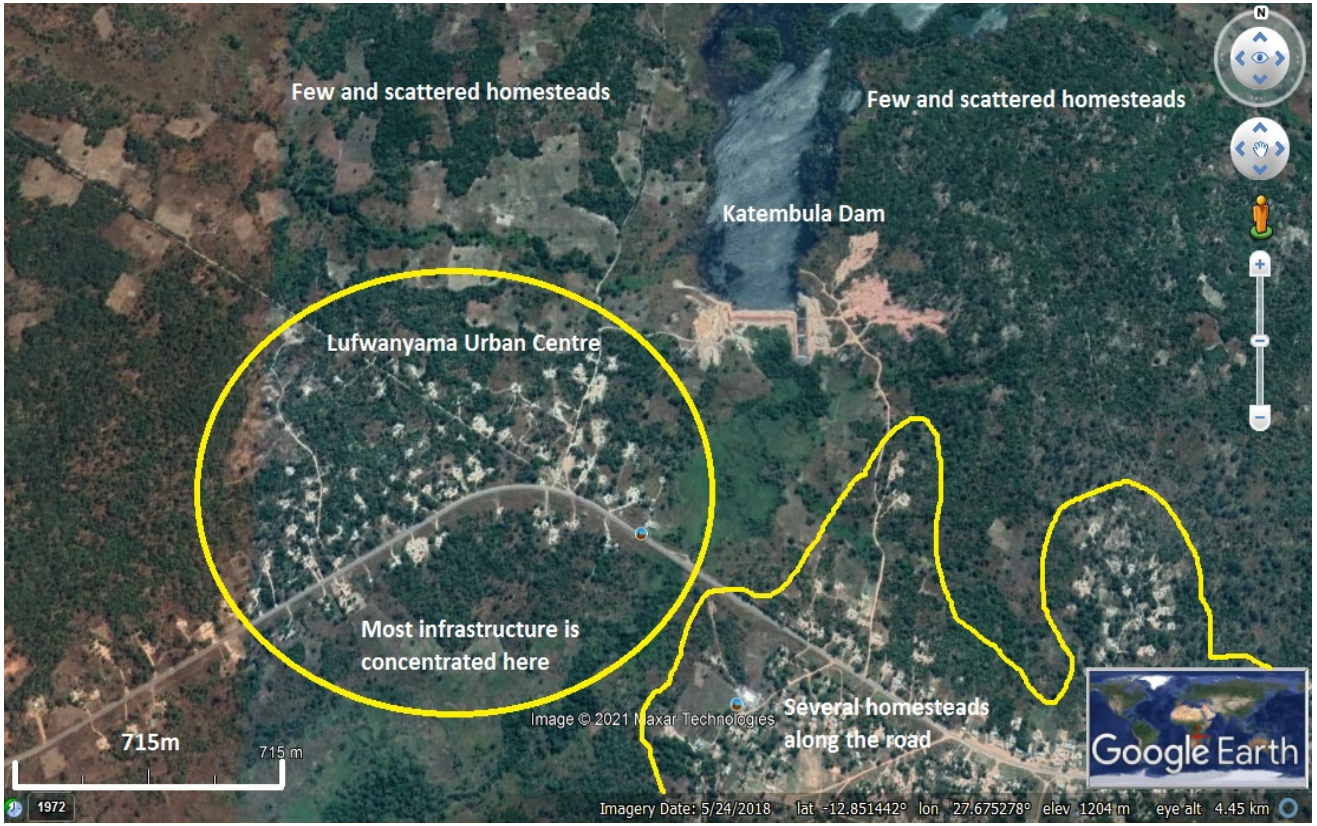


Figure 13: Google map showing Katembula Dam and the surrounding environment.

The google map below shows the location of some of the main institutions in Lufwanyama District south-west of the dam: Lufwanyama District Hospital and the Lufwanyama District Council.

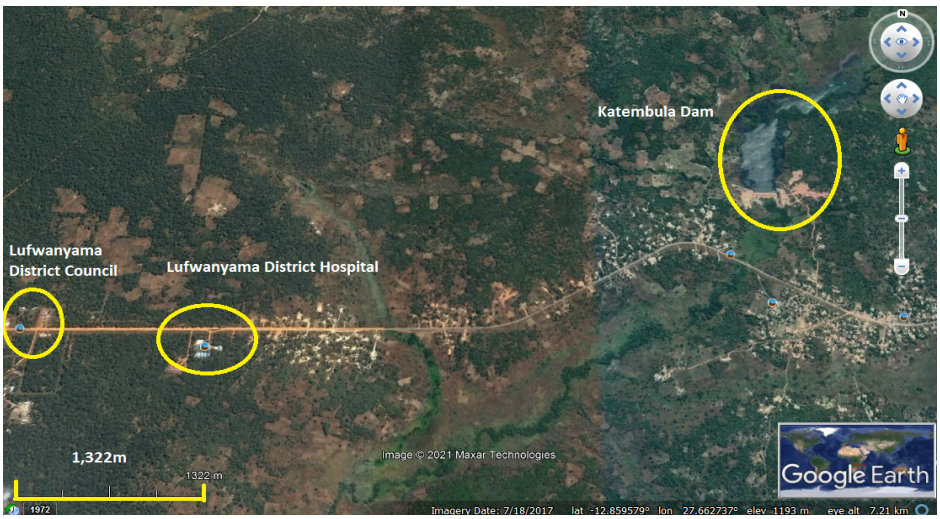


Figure 14: Google map showing Lufwanyama District Hospital in relation to location of the dam

The previous contractor had a site office block less than 50m away from the spillway channel, east of the project site. The entire workforce had rented apartments within the local community along the M18 road, but close to the Project Area. Water was accessed from one of the boreholes in the local community. The community along the road (M18) and the few homesteads south-west of the dam do not have flushable toilets, but latrines. The site officers accessed the latrines from the nearby areas when in need.

Figure 15: Google map showing the location of the site office and borrow areas

The access road off the main road (M18) that used to be accessed by the former contractor is in bad shape and may not be used unless the new contractor works on it. The current access is now passed the previous turn, at the curve of M18 road. This access leads to the dam as well (figure 16).

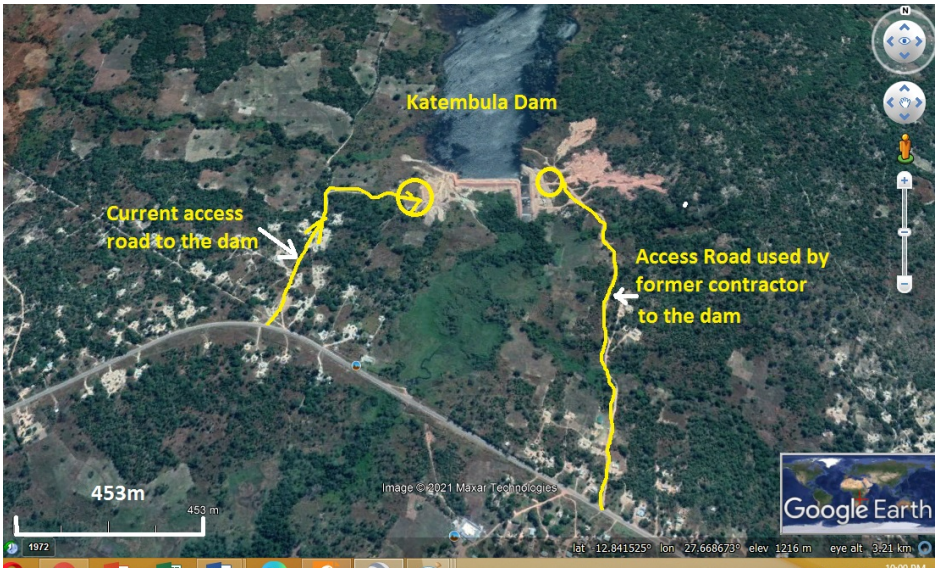


Figure 16: Google map showing the two access points from M18

4.3.4 Fishing

Currently, the fishermen from the local community fish in the dam and sell the fish to the local community and to some M18 road users. As previously discussed, the dam site on the Katembula Stream was selected as the best option for a new dam for the newly established Lufwanyama urban centre that has no reliable water supply. The dam has therefore been built to serve this requirement, as well as to provide water for livestock, aquaculture and eventually irrigation development. During the consultative process, the community requested that the dam be stocked with fish once rehabilitated.

4.3.6 Administration of Water and Dam

Katembula Dam has a DMC in place, though it is not active as yet. The committee consists of 10 members, 4 women and 6 men. The committee is yet to receive training on various topics and to develop a constitution to guide its management of the dam.

Strengthening and capacity building of the existing committee will ensure that communities benefit fully from the dam, because they will be able to appropriately maintain the facility for years to come.

4.3.7 Gender Equality and Gender-Based Violence and Sexual Exploitation and Abuse

Women at Katembula are involved mostly in small scale cultivation of vegetable and tomatoes for sale, while some of their husband were engaged in cultivation of maize (subsistence farming) and others work fishermen. There are a few men and women that work as house maids and garden boys in the High Cost area.

According to respondents, and common with many other sites, Gender-Based Violence (GBV) exists among the dam communities, but it is 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.[13] 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.[14] Alcohol and living in high-density areas have been identified as key issues contributing to higher rates of GBV.[15] Other factors contributing to GBV 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.[16] A baseline study conducted by Overseas Development Institute (ODI) in Zambia captured some key definitions of the types of GBV, 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.[17]

The same baseline mentioned as first address in GBV cases the Victim Support Unit in the Police service, although there seems to be doubt in their efficiency.[18] Key challenges for preventing and responding to GBV 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 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, 24 hrs toll free telephone counseling service).[19] 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.

[13] Chidoori Rumbidzai Elisabeth, Putting Women First – Zambia's Anti Gender Based Violence Act from 2011, p. 1
[14] USAID, UNICEF, UNFPA, CDC, Zambia: Demographic and Health Survey 2013-2014, p. 273
[15] 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.
[16] ODI: Baseline Study, Stamping Out and Preventing Gender Based Violence (STOP GBV) in Zambia, March 2015, p. viii.
[17] Ditto, p. x
[18] Ditto.
[19] Chidoori Rumbidzai, 2011, p. 32

Zambia Alliance for Women's mission is to empower women to take charge of their lives through promotion of Gender Equity and Equality, Environmental Sustainability and Social Justice so that the right to a healthy life is enjoyed by the present and future generation. ZAW has its presence in Lufwanyama District to educate the women and the under privileged for their right to a healthy life.

The Katembula dam communities indicated that they report cases of GBV to the Police Victim Support Unit and wait for police intervention, after the victim has been attended to at a clinic. In some cases community members also report GBV cases to the Community Development Unit of the local government for counseling or other services. Some community members indicated that those affected by domestic violence cases fear to report their husbands due to a fear of losing their marriage. Additionally, the husbands fear to become a laughing stoke in the community.

4.3.8 Cultural Environment

Traditional leaders in Lufwanyama include Chief Nkana, Chief Lumpuma, Chief Mukutuma, Chieftainess Shimukunami, Chief Fungulwe and Chief Shibuchinga.

The area is predominantly inhabited by Lima and Lamba speakers. Traditional ceremonies include the annual Chibalankala and Chitentamo and Nsengela for the Lamba people, which are administered by Chiefainess Shimukunami.

Land tenure in the dam basin area is generally traditional, administered by Chieftainess Shimukunami. As discussed earlier, traditional village settlements are not far from the dam. Each village comprises of ca. 10 housing units. Depending on the size, a few villages are called sections, and several sections form a ward. The reservoir site, however, has very few settlements in its direct vicinity.

For the development of this ESMP, stakeholders were consulted, including the Katembula dam users and district stakeholders (District Commissioner, representatives from Department for Social Welfare, Department for Arts and Culture, Department of Forestry, Department of Agriculture). Consultations were held covering the upstream and downstream communities (650 households) 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. In case chance finds occur during construction activities, chance find procedures are attached to this ESMP.

Stakeholders indicated that graveyards are located far off from the dam and therefore do not anticipate any impacts on their movements to the graveyard once works start. No potential cultural environment and cultural heritage impacts are expected.

Below is the stakeholder population consulted in Lufwanyama District.

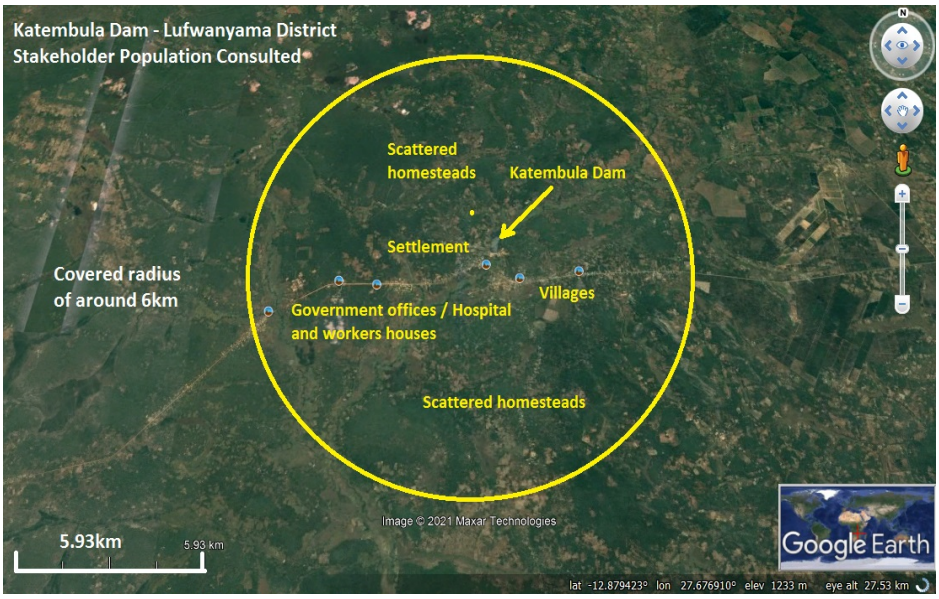


Figure 17: Schematic consultation coverage

5.0 Sub-Project Characteristics

5.1 Dam Characteristics

Katembula Dam is a zoned earthfill dam located approximately 9160 km west of Ndola about 7 km before Lufwanyama Municipal Council along Kalulushi Kasempa road (M18) of Zambia. The planned gross storage capacity is 2,030,000 m^3 with a maximum wall height of 10.4 m. The dam is fairly new with construction having neared completion as of March 2018. The dam is located on the perennial Katembula River (Location reference: S12.844504°, E27.676823°), which is tributary of the Lufwanyama River and which in turn flows into the Kafue River.

The dam is filled by means of runoff from a catchment of 5.36km^2. The main purpose of the dam is to provide water for irrigation, aquaculture, livestock and most importantly as source of water supply for the Lufwanyama District. Below is a google map showing the location of the dam, with the roads clearly marked.

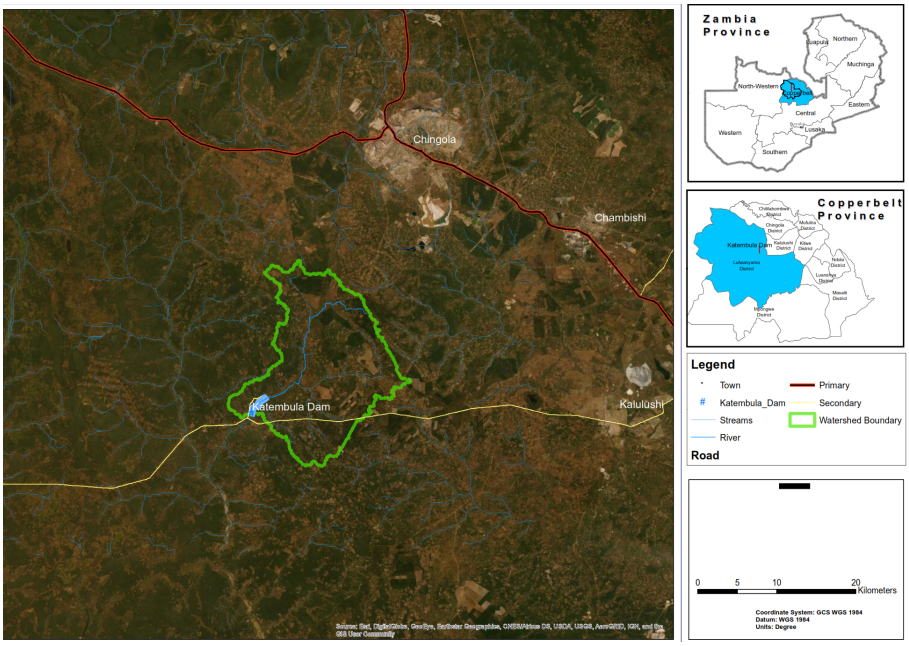


Figure 18: Google map showing location of Katembula Dam, UNOPS 2021

5.1.1 Dam Catchment Data

Table 12: Katembula Dam Catchment Data

Source Document	Year	km^2	Method of calculation
Ministry of Agriculture	2013	-286.33	Not known
COWI	2018	265	Adopted Ministry figures
UNOPS	2020	283	STRM 3D DEM (NASA) and ArcGIS

MAP, MAR and Inflow Data:

- The Mean Annual Precipitation - MAP - for this area is **1000 mm.** This is a reasonably high rainfall area.
- The Mean Annual Runoff - MAR - for the area is 17,178,000m^3.
- The MAR used is in accordance with the Zambia National Water Resources Master Plan.

Catchment yield at the site of the dam is 283,000,000*0.006 = 16,980,000

5.1.2 Dam Capacity

Table 13: Katembula Dam Capacity

Source Document	Year	m^3	Method of calculation
Ministry of M E WD	2014	*2,029,724*	Desktop study
COWI - Aurecon	2018	*2,030,000*	Full basin survey – topographic, UAV and bathymetric

Assuming a 70mm MAR the average annual inflow	**16,980,000**
Current estimated capacity of the dam	**2,030,000 m^3**

The site has been developed to only 11.96 % of its capacity. MAR. It must be noted however, that these figure are simply estimations assuming for the 70mm MAR and the average annual inflow.

5.1.3 Sedimentation

With the catchment size of 4,81 km^2 and assuming a sedimentation yield of 5000ppm (a poorly conserved catchment) with an assumed 100% trap efficiency of the dam, the capacity loss per year is yet to be determined by the engineers.

Geotechnical Investigations:
Geotechnical surveys and investigations were conducted to obtain information on the current geotechnical Dam conditions, and on the materials required for the rehabilitation of the Dam. The survey is comprised of:
a) Geotechnical investigation for the Dam.

b) Dam construction material investigation.

The objectives of geotechnical surveys were:

a) To obtain data on Dam integrity.
b) To obtain information for weak foundation countermeasure planning.
c) To obtain latest information/data on possible borrow pits and quarries as well as physical properties of the materials.

The results of the geotechnical investigations will be presented as soon as the current design works are completed.

5.2 Current Embankment and Spillway Status

5.2.1 Embankments and Crest Slope

The original design documents available for Katembula indicate that the upstream and downstream slopes were given as 3:1 on the upstream and 2.5:1 on the downstream, with a crest width of 4m. Checks carried out from the recent dam inspection show that the embankment is in fair condition due to the following:

- The embankments upstream and downstream of the dam have some slope protection with present of wild vegetation in small patches though in some area sections are left out and exposed (see photo attachment below).

Plate 6: Condition of embankment crest

- In sections where there is rip-rap, it appeared to be sufficient at the time of inspection, but there is need for grass /vegetation protection on the upstream slopes of the dam.

- Visual inspections of the upstream showed no signs of maintenance repair works. The upstream slope is regular and well defined and fit-for-purpose

Plate 7: Downstream slope with march areas

The downstream slopes also appears to be in fair condition though an appearance of marsh arears indicates an occurrence of seepage.

Plate 8: Presence of a soft toe on the right bank flank of the embarkment

Plate 9: A green marsh area

This is a green marsh area on the right at the toe level where seepage was observed at the right bank (a portion in front of downstream face and the emergency spillway. Additionally, the following were observed;

- A presence of gullies noticed on the downstream slopes showed signs of remedial works through filling with natural earth (most likely after a heavy down-pour of rain).

- Minor Erosion of the Crest and the rip-rap on the upstream slope and crest. The rip-rap is functional and adequate. The crest is regularly horizontal.

5.2.2 Internal Filters & External Drains

It was noted that a French toe drain existed but there's need to verify its location and functionality.

The outlet pipes appear to be in good working condition in respect to their design and capacity function, but it would be important to ascertain the extent of the rusting of the pipes. Further the pipes are too small for maintenance cleaning and desilting.

Plate 10: Rusty outlet pipes

There are no irrigation lines connected to this point.

5.2.3 Spillway, Training Wall and Return Channel with Structures

The main (service) spillway is in good working condition with 3 drop structures along the discharge channel. Huge boulders lined along the discharge channel will have to be to be broken down and removed from the channel as they are reducing the capacity of the spillway.

Plate 11: Incomplete emergency spillway

The size of the boulders entails controlled-chemical blasting of the boulders to normalize the capacity of the spillway channel; caution must be exercised in the application of chemical degradation of rocks to avoid pollution of the water otherwise other means of breaking the rocks without destabilizing the dam wall will have to be employed. The use of explosives is not recommended as this has potential to destabilize the structural integrity of the dam wall and the spillway structures.

The emergency spillway is incomplete. These works were not finished to completion in the previous project implementation phase. It is recommended to complete the earthworks for the emergency spillway as this is important to safely carry the design flood for the dam as per original design.

Plate 12: Incomplete emergency spillway (2nd picture)

Signs of soil erosion and seepage were observed around the abutments of all the 3 drop structures especially on the right side of the spillway channel. It is hereby recommended that gabion baskets be introduced and installed in steps or alternatively protection works for the embankment sides be introduced in the form of grouted stone pitching.

Plate 13: Erosion on the third side of the 3rd drop structure

Plate 14: Erosion near the left side of the 1st abutment structure

The downstream banks along the training wall have been being eroded as seen on areas where sandbags have been placed.

Plate 15: Erosion on the abutment of the 2nd drop structure

The erosion in the picture above is also on the training wall. Sandbags were installed as temporal measure to arrest the situation from deteriorating further.

Training wall earth works appear inadequately compacted and also the side supports seemed to have given-in leading to differential cracks/settlement as observed along the embankment. It is also recommended that in-situ compaction tests be carried to ensure adherence to standards and specifications as these works are on-going.

Plate 16: Differential settlement along the training wall.

Plate 17: Crack along the training wall near the right abutment of the 3rd drop structure

5.3 Overall Legacy Issues at the Dam

The legacy issues are illustrated below and mitigation measures are discussed in chapter 6.

5.3.1 Structural Risks

Embankment and slope stability risks:

- Overtopping risks with current crest level
- Erosion hazard and embankment stability
- Rip rap in bad shape
- Shoulder erosion on the crests

Spillway risks

- Erosion on the 1st, 2nd and 3rd abutments of the drop structure along spillway channel
- Erosion on outfall
- No emergency spillway is present

Rock toe risks:

- Seepage at toe level area (introducing a rock toe (Which is highly recommended) should be done to control seepage/phreatic line)

Removal of Boulders in the Service Spillway Channel

- A number of “huge” boulders along the service spillway, from the spillway approach channel all the way to the 3rd drop structure. These are reducing the capacity of the spillway channel

Training wall

- Remediation works required by cut and fill and reconstruction of the earthworks.
- The compaction did not seem competent

1. Upstream Slope

Minor Erosion of the crest and the rip-rap on the upstream slope. The rip rap was sufficient at the time of the inspection. The functionality of the rip rap is adequate but more grass and vegetation protection is required especially on the upstream slopes of the dam. The presence of indigenous wild grass and other vegetation forms was observed in small in-effective patches with sections left out and exposed

The upstream slope is regular and well defined and fit-for-purpose. No repair works in the form of maintenance or rehabilitation were observed on this section of the dam.

2. **Downstream Slope**

The downstream face of the dam wall has grass protection and small vegetation. It also has marsh areas where seepage is likely occurring. The indigenous grass and vegetation is sufficient for erosion protection on the downstream slope. The downstream slope is well defined and regular. A few gullies noticed on the downstream slopes showed signs of remedial works through filling with natural earth (most likely after a heavy down-pour of rain).
At the time of the inspection, no visible seepage was observed on the downstream surface.

3. **Crest**

Minor erosion of the crest and the rip-rap on the upstream slope and crest. The rip-rap is functional and adequate. The crest is regularly horizontal.

4. Downstream toe	
	
The soft toe was noticed at the right bank flank of the embankment	The area (on right) at the toe level where seepage was observed. The area is dump with green marsh. Seepage was observed in the area at the right bank (a portion in front of downstream face and the emergency spillway). It is recommended to introduce filters and rock toe/toe drain to control the seepage.

Plate 18: Upstream, Downstream toe and Crest pictures

5.3.2 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 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

Environmental flow releases risks:

- Inability to monitor and assess downstream ecological effects of dam operation

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 unrest. Engaging the community will be critical

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
- Disturbance / destruction of flora around the project area

The google map below shows the existing borrow pit sites that have not been rehabilitated.

Figure 19: Google map showing position of borrow pit sites at Katembula Dam

The borrow pits location coordinates are as follows;

Borrow Pit 1:	-12.842691°;	27.679512°
Borrow Pit 2:	-12.843900°;	27.679832°
Borrow Pit 3	-12.844422°;	27.681040°

Plate 19: One typical borrow area requiring restoration

Plate 20: Access road from borrow pit to project area eroding

Plate 21: One of the access route to the dam from the main M18 (east of the dam)road needing attention

Plate 22: Spillway site showing erosion of the training walls

5.4 Potential Communities Affected by Works

The rehabilitation of the dam will benefit a population at least 5,000 households living within the Lufwanyama urban area, as the main purpose of the dam will be the source of raw water which the water utility company will abstract, have it treated and supply to the community in the Lufwanyama urban area at a fee. Other benefits will include fishing from the dam, access to water for livestock and for irrigation purposes. Within a radius of 1km, there are no inhabitants north, north-west and north east of the dam. There are, however, inhabitants about 500m south east of the dam but the population is concentrated along the M18 road. There are a few homesteads close to the dam, about 100 to 400m west of the dam, and the number of households does not exceed 10. Further west and south-west of the dam is where about 70% of the Lufwanyama population live. Most people in the sub-project area are peasant farmers, growing maize, sorghum, etc…, while others in the vicinity are fishermen. The unfortunate part is that fish is almost depleted in the dam due to poor methods of fishing.

Community members consulted indicated that the promise given to them to restock the dam with fish must be honored. But there will be need to educate this community on the best methods of fishing to avoid depletion of fish. For those farming upstream, there will be need to educate them on how to apply fertilizers to avoid downstream contamination of water. The position of the dam currently does not affect any local member of the community. The works to be conducted, which are remedial and rehabilitation works, may affect those living not more than 400m south-west. There are also those that live along the M18 road, along the gravel access road to about 400m before the dam, who may be affected due to noise and dust from trucks that will be carrying necessary materials for rehabilitation works.

Currently the Katembula Dam is a source of fish in Lufwanyama though it could be used more. The dam is also used once in a while to draw water for irrigation at a small scale. Once completed, the dam will have significant socio-economic benefits, especially if it serves as a source of water supply to Lufwanyama residents

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 will be approximately 60 people. 15 of them will likely be externally recruited, including an engineer, a foreman, site men, 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 45 workers will be recruited from the Katembula communities as first priority before extending to villages far off from the dam. 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, the risk of GBV/SEA cases and local level conflicts over sub-project modalities is anticipated to be low. The 15 external workers will likely rent a house or two in the Lufwanyama urban center since this is only less than 2km from the dam. The project area may have a site office which the contractor will commit to demolish after completion of the remedial and rehabilitation works. There may be no need for a workers campsite).

In the case where the contractor desires to access more land than allocated for his work, the Contractor will have to engage the local traditional leadership for a piece of land and the Contractor will ensure there is a paper signed off for the agreement.

The previous contractor had a site office which was only 40m away. The rest of the workers were local workers coming from their own homes in the throughout the construction period.

5.4 Dam Safety

The dam safety reports for Katembula 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:

- 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 must be robust and have back up alternatives - both in terms of contacts and systems. Use of appropriate local languages will be ensured for ease of understanding by local community members. 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

6.1 Design Floods

The adopted Design Criteria for this sub-project will be based on the Mitchell Formulae used extensively in Zimbabwe for the PMF estimation. The return periods will be checked in comparison with results obtained from the VKE and Pitman. The figures have not been determined yet, as the design considerations are still underway. Therefore, a Safety Evaluation Flood has not been determined yet and so are other parameters such as the Maximum Probable Flood rate, the 100 year flood estimates, etc…

6.1.1 Summary table based on surveys

Based on the design criteria and current surveys, some data that is available is as presented below, as spillway details. Those not yet known will remain blank until such a time when the document can be updated.

Catchment Area.	283 km2
Max Probable Flood	___ m3/s
100 year Flood Estimate	___ m3/s
Fetch	___ km
Dry Freeboard	___ m
Service Spillway Width	30.000 m
Current Crest Level	1196.49m
Spillway Level	1192.5 m
Coefficient of Discharge	____
Current Freeboard	2.94 m
Estimated Raising Required	**2.41 m**
Est. Freeboard Required	___ m
Revised Crest Level	___ m
Riverbed Level	___
Height of Dam	**10.4m / max ____m depth of water**

The design flood adopted requires a decrease in the current freeboard of **2.41m**

The design flood adopted dictates a raising of the current minimum crest level by a minimum of 1.8m to provide a total freeboard of 2.11m. The raising of the embankment by 1.8m will be exclusive of a 1km gravel wearing course.

6.2 Embankment Remedial Design

The designs have been done but undergoing review. The option considered is to construct an emergency spillway on the western side of the dam.

6.4 Service Spillway, Drop Structures and Training Wall

The designs have been prepared, but undergoing review. Details will be provided as soon as the data is made available.

6.5 Outlets

Awaiting official data on the new designs, if there will be, on outlets.

6.6 Construction Materials

Construction materials that will be required for the remedial works at Katembula Dam, will not be far from the following, once it is decided on the remedials and rehabilitation works to be conducted.

- Sand and stone for minor concrete works
- Stone for gabion basket filling
- Rock for rip rap and downstream toe
- Common fill for embankment raising and spillway training wall
- Wearing coarse gravel for roadway on crest - local ZNS gravel pits.

The actual material sites to note and records of the distances from the dam will be determined by the engineer once the materials required are confirmed and once it is determined that good quality material can be obtained locally.

Possible and suitable sources of rockfill, aggregates, earthfill and sand will be identified by the contractor and approved by the engineer. Before finalizing on the use of the site, it will be the responsibility of the contractor to engage the Dam Management Committee (DMC) and the local community in order to get consent from the local leadership on the use of the site as source of raw materials and avoid land and other conflicts. Should the sources selected for construction materials prove inadequate or unsuitable in any way, the contractor will be required to identify suitable alternative sources including additional borrow areas, and will be expected to go through the same channel of communication with the local persons/authority and consultations with the local community before use of the identified source.. 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. Payment for winning and use of materials from any new sources will be at rates to be negotiated on the basis of existing tendered rates. It will be the contractor's responsibility to ensure that only suitable materials are taken from the approved sources.

Rockfill and Aggregate: The rock requirements for the dam has been 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. This will be confirmed by the engineer.

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 it is economical. In some cases, the contractor will set up their own crushing and screening plant. However, the latter process may take longer to be approved by ZEMA, since this will require preparation of an Environmental Project Brief for the proposed activity at the proposed location. 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, as specified in the contract documents, 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. Limited test pits will be proposed and detailed information will be indicated in the Materials Report.

No materials will be taken for any purpose from within two hundred meters upstream or downstream of the dam centerline, nor within fifty 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 will be responsible for locating suitable deposits prior to tendering thereof for approval by the engineer's representative.

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 for 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 defined once the sources of raw materials are known. When transporting sand, quarry and gravel over a long distance and passing through a settlement, 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 within the Chieftainess Shimukunami's village, without compromising community access to the water. Water from this borehole will be tested and if safe for drinking can be used by the contractor and its staff.

The contractor will provide the following at the campsite:

- Washing and sanitation facilities- incl. mobile toilets or VIP latrines to be present on site, since most workers will be coming from nearby local community. The site office must be equipped with the necessary sanitation facilities. VIP latrines if they have to be constructed will be 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.
- Waste management (non-hazardous waste)- collection from waste receptors within the site, and disposal at council designated site located in Lufwanyama 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.
- If temporary accommodation facilities for the staff will have to be built, the facility will be made up of local building materials or tents and with a minimum spacing requirement of 4.5sqm living space per staff.
- Site 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 shall ensure to the extent possible that the camps are made from materials that can easily be constructed and dismantled. Other than those listed above, supporting facilities such as drop down toilets, generator set for energy production will be established. To ensure that the camps are kept small, the employees will be obtained from the local people who will be coming from their own homes. The sites for campsites have not been identified. The Contractor will make his own arrangements for a suitable site for his camp, after thorough engagements with the relevant persons within the local community. Once concluded with the local community and its leadership as well as the local authority, the Contractor is expected to provide a full report to the engineer, informing him of where they will finally set up their site camp(s). It will be the Contractor's responsibility to ensure the identification and subsequent operation of the camps meet the local and international environmental and social safeguards.
Access roads: Access to Katembula Dam is by a small gravel road, not more than 3km from the main M18 road, as shown in the location map of this dam.

Labor force: The total workforce may be around 50 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 35 workers will be recruited from the Lufwanyama communities.

6.7 Construction Programme

To be updated once the designs are officially launched.

7. Risk and Impacts Mitigation Plan

This section provides the following.

- common construction works management plans,
- monitoring requirements
- aspects requiring rehabilitation, and
- rehabilitation management plan for non-structural items.

The contractor is expected to operationalize these plans with details of respective method statement for proposed measures to comply with the safeguards requirements.

7.1 New Remedial Works General Construction 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**	Hazardous waste generation and releases into the environment	• 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	Construction Phase Daily	• Properly designated waste storage, collection and disposal points • Temporary storage	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

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**
Sanitary facilities	such as hydrocarbons and sewer Public health and safety hazards	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 sensitisation 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		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		

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**
		sealed drums. The fuel dispensing pumps must also stand in a concreted area, with drains to an oil 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 dam rehabilitation, material sources extraction, rehabilitation works	Excavation resulting in release of dust, gas and particulate emissions Public nuisance and health and safety risks Soil destabilization 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 are not done during the rainy season to avoid erosion of material and gully formation. • A depth of utmost 2.5m will be excavated from new borrow areas for safety reasons. The excavated slopes will be reduced to a stable slope and indicated in the method statements. • For a new borrow site area, which is approved by the Engineer, the contractor will seek approval for use of the site as source of construction material. The	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 • Revegetation plan in place in collaboration with local forest officer.	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 3000/month

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**
		caution here is that obtaining a permit may take not less than 2 months and hence the need to identify already existing sites and develop plan for managing the site. • 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 used only for reclamation purposes when pit operation is complete. • 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 remedial works. This will include rehabilitating disturbed work areas and restoring as close as possible to original contours. Restore topsoil from stockpiles. Overburden soil can be used for landscaping. For revegetation, the contractor will collaborate with the local forest office on the type of plants to plant in open areas.				

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**
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	• Minimised 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, minimise 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. • The contractor will dispose of construction debris and any wooded debris in legally designated site at the council dumpsite. Disposal in the	Construction Phase Monthly Or as required in case of an emergency/ incident	• Water quality results, monthly The monitoring parameters will include mostly physical and chemical drinking water quality parameters. Biological not included due to various limitations on the sampling protocols. These will be as follows; pH, conductivity (µg/cm), sulphates (mg/l), nitrates (as No3-n mg/l), total dissolved	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

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**
		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.		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) and hydrocarbons (mg/l). 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 worksites, campsite activities	Biomass burning impacts, dust from the roads and sites, noise from equipment	• The contractor will use auxiliary sites close to the dam to minimise haul distances and avoid worksites close to sensitive receptors such as households, clinics, schools etc. • Working hours to be limited to between 06:00 and 18:00. • The community will be sensitised on	Construction Phase Daily	• Complaints records • Inspection sheets • Receptor sites protection	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

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**
		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				
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	• 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, labour, air, noise, water, biodiversity, soil, land, health and safety. The contractor is also expected without fail to make reference to the BMP 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

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**
	unregulated sources					
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						

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**
Transportation of materials, vehicle and equipment movements, pedestrian movements	Poor road surfaces, conflict of use with the community, safety hazards	• The 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 statement will firm procedures and include cost. The management plan will cover parameters such as covering the transported raw materials with tarpaulin and avoid pollution of the environment or disturbance to the local community. Additionally, once source of material is known, the contractor working in consultation with the engineer and the local authority will define a route to use throughout the construction period. • Contractor will include hazard identification, risk assessment, safety measures such as signage, routes, parking areas, loading, unloading, reversing, crossings, sensitisations, fencing,	Construction Phase Daily	• Safety inclusion • Existing community access infrastructure • Training records for communities and workers • Inspection reports • Complaints records • Site-Specific Traffic Management Plan in place	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 2000/month

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**
		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 and Flow Management						
Aquatic biodiversity **Works within habitats**	Biodiversity loss and ecological flow limitations	• The contractor will ensure the requirements pertaining to environmental flows as discussed in the BMP, annexed to this ESMP, are implemented during the construction period. Consistent with the content in the BMP, the contractor will ensure the communities is sensitized/trained and will avoid	Construction Phase Daily	• Number and extent of undisturbed areas • Species register • Flow measurement inclusion • Water quality results • Training registers and species protection	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Fisheries Forestry	HSSE Officer Cost 2000/month UNOPS ecologist consultant costs

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**

		exploitation of biological resources.
		• Contractor will review the contents of the BMP regularly update its workforce and the local community on the BMP requirements. Specific method statement for works 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 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 receive appropriate training in relation to biodiversity issues, so that the activities do not generate impacts on biodiversity.
		• Making reference to the BMP annexed, the contractor will maintain ecological services and ecologically rich areas, protect vulnerable and endangered
				regulations		

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**
		species, and protect nests. • The contractor will ensure protection of flows and reservoir water levels during rehabilitation works, allow for movement of aquatic species and sediments from the upstream to the downstream and avoid and minimise pollution of waters and quality degradation, minimising soil movements and sedimentation. This measure will be monitored through flow measurements and downstream water analysis on a quarterly basis • The contractor will report all incidents to UNOPS and to authorities.				
Terrestrial Biodiversity **Works within habitats**	Biodiversity and habitat loss	• The contractor will ensure they implement the proposed measures as guided in the BMP annexed to this document The contractor is required to ensure that all employees receive appropriate training in relation to the content of the BMP. The contractor will avoid clearing unnecessary areas for works and disturbances to the habitat and ecology. Wherever possible the felling of significant/mature trees will be avoided and connectivity between areas of forest habitats will be maintained. • In the event that trees are cut to provide access to some infrastructure at the dam	Construction Phase Daily	• Rehabilitation records and extents • Extents and number of disturbed sites and species • Training records and fauna register	Contractor Engineer and HSSE Officer UNOPS/IDSP/ Fisheries Forestry	HSSE Officer Cost 10000 UNOPS ecologist consultant costs

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**
		or when setting up a campsite, the contractor will record the number of trees cut for purposes of making a replacement at at the right time, in consultation with the Department of Forestry. • Consistent with the directive in the BMP, the contractor will take measures to avoid wildfires, and any use of firewood from the cutting of trees around the dam. The contractor must organise alternative energy sources. • The contractor's works, rehabilitation of roads, operation of material sites and campsites should minimise on destruction of terrestrial biodiversity. • Contractor will prepare site specific measures to enhance conservation of biodiversity site/ habitat sites. The specific method statement which will include: o Location of the specific works; o Any details obtained in the pre-works services; o Explicit details of mitigation measures which should be applied in the area; o Details of any specific construction practices which should be applied in the area to protect biodiversity; o Details of any timing restrictions		• Vegetation cleared only in worksites Number of trees cut and their details recorded for replacement (biomass equivalent) at rehabilitation phase		

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**
		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, injuries and drowning in open sites such as borrow pits.	• 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 sensitise communities on safety and response, including sensitise communities on vector and waterborne diseases prevention and management. • The contractor will decommission stagnant water points, provide good quality drinking water, and practice hazardous waste management to promote health. • Contractor will prepare the site emergency preparedness response plan	Construction Phase	• Adequacy of safety signage • Training records	Contractor Engineer and HSSE Officer UNOPS/ IDSP Ministry of Health	HSSE Officer Cost 15000

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**
		which will be in a report and process flow format. This will include training, emergency personnel/ 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.				
	Contamination of water in the reservoir as a result of poor farming practises and open defaecation upstream	• The community living close to the dam, including those upstream shall be sensitised on the importance of having own latrine and avoid open defecation.		• Water quality free of coliforms. All parameters within the WHO limits	Ministry of Health & Ministry of Agriculture	
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	Construction phase		Contractor Engineer and HSSE Officer	HSE Officer Costs

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**
		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, 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 job General EHS Guidelines. • Ensure availability of emergency preparedness and response tools, • Ensure COVID-19 spread at the construction site to be mitigated through		● Training of workers, record in place ● All workers in rightful PPE and practice good house keeping ● Emergency Preparedness and Response Plan in place ● Report on COVID-19		

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**
		attached plan (see appendix D).		mitigation plan implementation		
Gender Equality and GBV						
Gender Mainstreaming	Work force does not have gender parity	• The contractor will 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	Contractor UNOPS / IDSP	Gender Consultant UNOPS, 16.000/year

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**
		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		• 100% of senior GRM 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 CoCs 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
Labour and Working Conditions						

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**
Labour 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 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. • The contractor will incorporate strict COVID-19 prevention and management measures (See Appendix D and F) .	Construction Phase	• At least 60% of workforce at dam site is locally recruited • Contracts contain labour 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 for workers): 5.000 USD / 6 months
Labour 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	• The contractor will design and implement a workers' GRM.	Construction Phase	• Monthly reports on Workers' GRM received	Contractor UNOPS	Contractor budget Staff costs and travel budget

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**
	on cultural or other differences Risks of disagreements between local workers and employers	• The contractor will operate workers' GRM.		• Reports received on Workers' GRM		
Labour 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
		•		•		
Decommissioning and Rehabilitation Measures (Structured management to minimise environmental risk of dam construction impacts)						
Erected infrastructure **Demobilization of the contractor's services and equipment used in performing the**	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	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	HSSE Officer costs 40,000

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**
work required under the contract		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 demobilisation and closure. • The detailed rehabilitation plan will be in the contractor's site method statement.				
Disturbed work areas 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. • 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	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

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**
		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 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	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

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**
		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 ensure safe crossing of the local community in the lower section of the dam (north western area), the point which gets submerged in rainy season, crossing over to the other side of the dam (from south western to north eastern side and vice versa). • Natural regeneration and adequate full area coverage assisted vegetation using native vegetation species will be implemented and monitored by the Contractor.				

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**
		• 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	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer Supervisor/ PIU	In rehabilitation cost

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**
		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 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	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

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**
		areas that were used as workstations will be re-vegetated. The rehabilitation plan will be in the contractor's site method statement.				
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

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**
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 sanitiers and face masks.	Contractor Engineer and HSSE Officer	**In**cluded in **rehabilitation cost**
Environmental Flow	Ecological flows	• The contractor will install the user friendly durable flow gauge for regular flow measurements (water levels and water release) to record downstream flow impacts • Ensuring reasonable flows downstream to meet ecosystem needs, during construction works • UNOPS will conduct training for the DMC on flow reading and management. • A rock toe will be incorporated into the design of the downstream embankment drainage. A suitably sized rock toe should be considered to be incorporated into the remedial design. This should have a double filter layer along its intersection with the current downstream face at the toe to allow for safe drainage.	Construction Phase	• Training and flow monitoring	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

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 will be trained on household waste management. There will be no disposal or storage of waste at the Katembula 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, fertilisers	Hazardous waste generation and releases into the environment- Chemicals	• IDSP, Ministry of Agriculture, Department of fisheries will train the communities on operation activities that minimise 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%	DMC/ Water User Committee Ministry of Agriculture DWRD IDSP	100/month

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**
				• Water quality monitoring records		
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. • The Department of Forestry, Community Development, Water Resources and IDSP will conduct catchment management sensitisations during community trainings to promote raw water quality in all catchment sources, review land use practices/ social needs, biodiversity conservation and minimise 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.	Operation Phase Quarterly	• Water quality results from the dam and main tributaries in the catchment • Pollution control structures • Training and sensitisation records	DMC Ministry of Agriculture Forestry IDSP	Once off- 20,000 700/month
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

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**
	Breakout of water borne disease as a result of poor sanitation practices by communities living upstream of the dam	• Sensitization of the local communities, 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 a 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 sensitise the community on appropriate use of the infrastructure to avoid and minimise failure. It will carry out regular inspection and maintenance of the infrastructure, and maintain the infrastructure and safety measures. • IDSP will train DMC on use, maintenance and monitoring requirements.	Operation Phase Quarterly	• Training records • Inspection records • Maintenance records	DMC IDSP	3000/year

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**
Biodiversity Management and Flow Management						
Aquatic biodiversity; Constructio and 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 to the extent possible • • Ensure maintenance of 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. DMC to strictly monitor inflows, retention water and outflows in order to have a balanced system. • UNOPS to include outlet infrastructure for downstream flows. • DMC to monitor the erosive capacity of the streams downstream for sediment barrier occurrence upstream. • DMC to monitor flow level changes downstream. Natural flows and dam controlled flows. • Communities to protect vulnerable and	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	DMC Fisheries Forestry UNOPS IDSP	10000/year

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**
		endangered species. • Avoid exploiting biological use of resources and invasive methods. • Secondary developments to take aquatic biodiversity into consideration.				
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 shallow waters.	Operations Phase	• Training records showing number of persons trained and when	Ministry of Agriculture; Department of Fisheries	**6000**
Terrestrial biodiversity, operational activities	Biodiversity and habitat loss	• Ensure protection of available terrestrial species in the project area to the extent possible, guided by the BDMP. • 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
Communication and Community Engagement						
Communication to Stakeholders	During operational phase, dam is not managed well by local communities	• IDSP to train DMC in E&S issues indicated in the UNOPS and contractor training plans.	Operations Phase	• DMC exists • DMC has been trained	IDSP local authorities	5.000

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**
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. • Budget allowing, the borrow pit sites can have protection fencing to deter children from slipping in.	Operation Phase	• Inspection reports • Training records • EPP revisions and reviews • Safety signage Plan and records	DMC Ministry of Agriculture DWRD IDSP	2000/year
Dam Catchment Management						
Catchment management	Excessive rates of erosion and sedimentation	• The IDSP will ensure the DMC and the officers from Government 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; - DMC - Waters Affairs - Agriculture - Camp site officer	IDSP DWRD DMC	Included in training costs above
Gender Equality and GBV Action						

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**
Gender Mainstreaming	DMC do not have female members	• UNOPS will define gender parity in constitution of the DMC and include gender equality training in the training of DMC.	Operation Phase	• DMC have 50% female members	IDSP	Included in training costs above
Maintenance and Monitoring Management						
Dam maintenance	Structural deterioration Dam Management	• IDSP will conduct further DMC trainings on dam maintenance and dam safety. • The DMC will ensure incidents are reported to the resident IDSP staff and are worked on. • 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	• DMC quarterly meetings and resolutions • Flow measurements and action plans • Training records • Dam maintenance records and monitoring records	UNOPS IDSP DWRD DMC	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 indicated in the BAP.	Monthly	• 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	UNOPS IDSP DWRD DMC	4000/ year

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**
				include parameters analysed in this ESMP: pH, 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) tests If hydrocarbon contamination is suspected, the test will be included. The testing will be done at certified/ approved laboratories after proper sampling methods		
Waterborne diseases and Fishing practices	Poor community health and extinction of fish species	• Government to provide deliberate programmes aimed to educate the communities affected, with the best practice in regards to ensuring there are no pads around their community and also to	Monthly	• Number of engagement programmes held on the topic	Ministry of Health and Ministry of fisheries	USD 10,000

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**
		ensure good fishing practises are well inculcated in their minds.				

7.2 Rehabilitation Plan

This section discusses aspects requiring rehabilitation before the contractor demobilizes from the project area. The remediation plan is to a large extent covered in the actual remedial design works, and hence the discussion in this section is limited to aspects which are non-structural. This Rehabilitation Plan is prepared in reference to the ESA Table 9-2 'Requirements for rehabilitation plan', which provides guidance for 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.

The main purpose of this plan is to identify and rehabilitate the existing aspects previously disturbed by dam construction works, which have caused environmental and safety issues. It is prepared with the objective to further outline requirements to ideally return previously disturbed sites to a state which is similar to its pristine condition. However, rehabilitation to pristine conditions may not be fully possible given that in most cases residue impacts remain at worksites. Therefore, rehabilitation with the aim to meet continuing or changing uses is foreseen. Rehabilitation will be part of the main project construction works and therefore will be costed and included in the BoQ.

The table below identifies aspects requiring rehabilitation by the contractor to ensure compliance with environmental safeguards which include demobilization of the contractor and the restoration of the Katembula dam site.

In addition to the aspects identified specifically for rehabilitation by the contractor, effective monitoring tools are discussed below:

a) ***Environmental flow releases***
   There is need to designate a flow gauge reader to record flow results, to ensure continued monitoring and management of downstream ecological impacts.

b) ***Performance monitoring***
   There is need to undertake performance and impact monitoring of dam operations as a basis for adaptive management and to inform methods and tactics to manage long term impacts.

c) ***Downstream ecological flow***
   There is need to install gauge plates to measure water levels and water releases for purposes of developing data necessary for evaluation of downstream flow impacts.

d) ***Flooding of springs***
   During the remedial works, the IDSP, UNOPS and the contractor, should investigate the risk of flooding the springs when the dam embankment/spillway is heightened. This will inform various departments to prepare against loss of functionality and perennial water supply into the dam.

Table 14: Table showing non-structural aspects requiring rehabilitation at Katembula Dam

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
Structural risks						
Spillway	Location: Images: Section 5 'Dam characteristics' Unstable drop structures Risks: structure failure, and collapse of the footbridge	Yet to be proposed	*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* _____ Equipment: Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator *Workmanship* Up to ___ machine operators and ___ laborers as per above and up to __ months for the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	TBA	To be indicated in the BoQ
Embankment crest and slope	Temporary sandbags placed in risky areas to avoid erosion	Yet to be proposed	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the	Contractor liability period Site inspections Pictures	Rehabilitated walls and adequate	In BoQ

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
stability risks	Risks: Erosion hazard and embankment stability Overtopping causing embankment weakening		end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Sand, quantities ____ Rock, quantities _____ Crusher runner from a commercial quarry , quantities ____ Equipment Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* Up to ___ machine operators and ___ laborers as per above and up to ___ months for the equipment	Continuous maintenance	gabion presence	
Rock toe risks	Poor seepage control Risks: Weakening of side slope	TBA	*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*	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated walls and adequate gabion presence	In BoQ

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
			Rock, quantities _____ Equipment backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* Up to ___ machine operators and ___ laborers as per above and up to ___ months for the equipment			
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 20mx20m) and another one further upstream almost in line with the first one, in the eastern direction. This one meanders a bit but	Include earthworks, rehabilitation of the sites to promote drainage, aesthetic uniformity, and revegetation by seeding and natural succession vegetation, slopes and safety. 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	*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 Supervisor: UNOPS Remedial works will include earth ripping to enable regrowth of natural vegetation. Assisted vegetation (seeding and soil	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Contouring Drainage Stabilized slopes Desired landform	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
	approx. dimension would be 50mx30m) Coordinates: 200m or more east of dam area - eastwards -12.842691°S, 27.679512°E; -12.843900°S, 27.679832°E; -12.844422°S, 27.681040°E; Images: Section 5.3.2 Risks: community health and safety, biodiversity loss	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	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 Fertilizers/ 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.			

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
		area which requires rehabilitation				
Access routes	Location and Condition of the sites: 1 existing narrow gravel roads (about 2m wide) leading to the dam from the main road This is about 500m. Also short distance access roads to the borrow pits) (Extents shown in google map under section 5.3) 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,	Implement reinstatement by natural succession with assisted vegetation seeding interventions, which will require intense monitoring	*Timing:* day works- Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period	Contractor liability period Site inspections Pictures	Soil stabilization and livestock watering points	In provisional sum

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
	Risk: dam basin siltation, poor water quality contribution, limiting water use, soil movements and loosening	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 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.	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 Tractor dumpers; and haul truck for materials *Workmanship and timeline:* 10 laborers and 1 month use of the equipment	Continuous maintenance		Day works
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	*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	Contractor liability period Site inspections Pictures Continuous maintenance DMC regulation	Training records in all stipulated topics Existing correct signage Signage method statement	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
		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...	Signage installation *Workmanship and timeline:* One trainer persons Signage installation 3 laborers			
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, DMC Supervisor: UNOPS *Workmanship and timeline:* 1 operator and 4 laborers Equipment: concrete mixer and poker vibrator equipment	Contractor liability period Site inspections Pictures Continuous maintenance and biodiversity monitoring	Installed monitoring gauges Training records	In provisional sum Day works

Implementation Role: contractor, DMC
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 Katembula 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 the table below has been proposed for capacity building of district government staff, DMC members and community members in the vicinity 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, during construction and operation. UNOPS will supervise the training on behalf of IDSP. Identified trainers include: staff of local health center, District department representatives, UNOPS E&S Team, UNOPS Dam safety Team, IDSP and the contractor.

In addition, the contractor will include in its work plans and carry out training of workers on the required safeguards measures 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.

Monitoring of the training 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 plans.

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) and GBV
- 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 19[20]:

Table 15: Training plan

Training content	**Number of days**	**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, GBV, 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	UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist Government: Local Health Post representative IDSP: Dam Safety Specialist Environmental and Social Specialist	100 community members 15 District DMMU members DMC
Estimated budget	USD 2,000 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	2	UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist	18 District Officers 2 officers from each of the following Departments:

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

Training content	Number of days	Trainers/Supervision	Participants
Dam Safety-Emergency preparedness, and Community health and safety			
		IDSP: Dam Safety Specialist Environmental Specialist	• 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 Budget	USD 1,500		
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 Specialist	100 community members
Estimated Budget	USD 1,000 per session		

9. Stakeholder Engagement

The Stakeholder Engagement Plan (SEP) seeks to define a structured, purposeful, and culturally appropriate approach to consultation and disclosure of information. UNOPS and IDSP recognise 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 Katembula Dam. It is set up to respond to concerns and grievances from the local community 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.

DMC 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 the 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 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 and to acme potential 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 Katembula dam communities are stated below:

Table 16: Summary of the stakeholders meeting

Item No.	Department/ organization/ Community members/ Councilor	Concerns/ input	Responses Provided to the Community
1	Agness Mwishiba	As regards the use of the dam currently, the community indicated their animals come through to access water downstream of the dam, and that the local community itself does some fishing in the dam. There is no agricultural activities observed in the area, 1km upstream, downstream and around the dam.	Response: It is hoped that the community will make use of the dam once completed, and after receiving the relevant training especially in the agricultural sector.
2	Mainess Kumeka	Indicated that they do collect water from the dam for use in their homes and did wish that they would pump this water to their settlement so they do not have to walk all the way to the dam.	Response: The local council working with government and a water utility company plan to abstract water from the dam, treat it and supply to various homesteads within the urban area of Lufwanyama, at a small fee.

Item No.	Department/ organization/ Community members/ Councilor	Concerns/ input	Responses Provided to the Community
3	Goodson Kachingwe	The community is looking forward to actual rehabilitation of the dam so they could commence their agriculture activities. One community member clarified why they are not utilizing the dam for agricultural purposes by stating that they were directed not to use water from the dam because the dam was not yet completed.	Response: The group was assured that the dam will be rehabilitated and commissioned for their use, as earlier planned.
4	Fridah Mashimango	As regards, compensation of the affected persons, some two members of the community submitted that they were not compensated because at the time of compensation, the two were not available to collect what was due to them.	Response: IDSP handled the question and informed the meeting that all were compensated. IDSP indicated that maybe one was not counted among those affected during the census.
5	Sidney Chishimba	Access bridges do get submerged in water during rainy season and this does affect the school children. The bridges affected in this manner are ▪ Katuba bridge ▪ Mateo bridge ▪ Kamacheke bridge The community is requesting for this project to look into the issue of access and provide appropriate mitigation measures.	Response: The meeting was informed that the request was noted for consideration.
6	Joyce Chishala	The community expressed concern on the dug out pits or borrow pits (commonly known as Ifimbotela), which they indicated are death traps for their children especially the school children. The community requested that appropriate measures are employed to mitigate their fears and to simply make the area safe.	Response: It is planned and budgeted for that the dugout pits will be taken care of by the contractor.
7	Andrew Michelo	The community implored UNOPS and IDSP to engage contractors that were serious with people's welfare, contractors that would have the responsibility and care for	Response: The institutions will be careful in selecting the contractor.

Item No.	Department/ organization/ Community members/ Councilor	Concerns/ input	Responses Provided to the Community
		their employees. The community stated that the previous contractors did not care for their employees with respect to safety and monthly wages. It was mentioned that in most cases the employees would not get their monthly dues on time.	
	Grace Chaluka	The community also observed inequality in the area of employment, as most women were left out during the construction of the dam. They requested that consideration for women is made in the next phase, which is the rehabilitation of the dam.	Response: Measures have been integrated in the management plans that compel the contractor to take care of women as well.

Plate 23: Community engagement meeting held at Katembula dam site

9.3 Stakeholder Communication Plan

Information disclosure will rely on the following key methods: community meetings in coordination with local authorities (headmen, DMC, 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 and in the local language for effective communication. Local authorities, such as the District Administrator, local headmen, the Katembula DMC will be requested to inform communities in community meetings and through disclosure on social media where feasible.

Table 17: 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, DMC, District Disaster Committee, community members – with social distancing Community notice boards Radio announcement / broadcast Email – national level stakeholders	IDSP Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message
	ESMP	Community meetings with local headmen, DMC, 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 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, DMC, 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, DMC 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, DMC, District Disaster Committee, community	UNOPS Social Safeguards Specialist	Minutes of meeting

during remedial works		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, DMC, 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, DMC, District Disaster Committee, community members – with social distancing Community notice boards Radio announcement / broadcast Email – national level stakeholders	IDSP Social Specialist	Minutes of meetings Messages produced for notice boards Message sent to radio broadcaster Email message
Information Dissemination in regard to the long-term use	GRM	Community meetings – with social distancing Community notice boards	Damc 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	DMC; 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 communities 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).

Project stage	Topic of consultation	Suggested Method	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, DMC and district authorities	local headmen, DMC and district authorities	UNOPS
Consultations during remedial works	Sub-project Activities / E&S Mitigation Measures	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	DMC and district level stakeholders	UNOPS
		email	National level stakeholders	UNOPS
		Telephone hotline	All stakeholders, including vulnerable groups	IDSP Social Specialist
		DMC, 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 remedial designs for the Katembula Dam already developed, UNOPS will prepare bidding documentation to procure a contractor to implement the project works at the Katembula 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 DMC 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 Katembula 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:

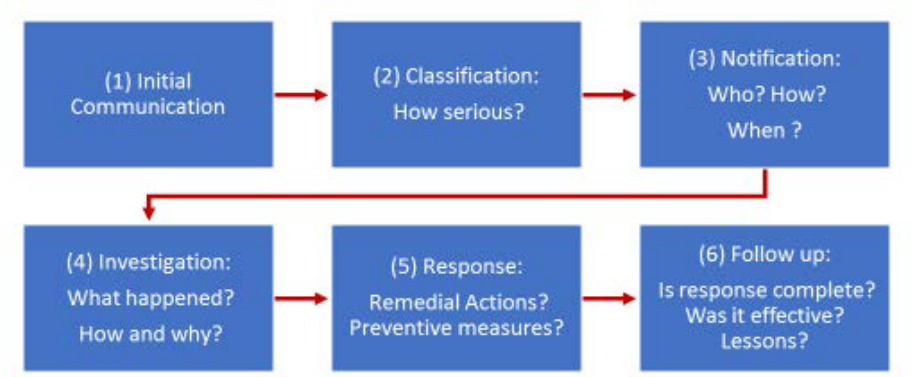


Plate 24: Incident reporting process

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 Katembula 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.

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Appendices

Appendix A: Completed Checklist

IDENTIFICATION OF ENVIRONMENTAL AND SOCIAL RISKS RELATED TO THE REMEDIATION OF TEN - LEGACY DAM - IN ZAMBIA: Katembula 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: Katembula Dam		
Location Lufwanyama	**Region** Copperbelt Province	**District** Lufwanyama
Villages /communities	Shimukunami	
Geographical location	**Coordinate South** -12.824215°	**Coordinate East** 27.688308°
3-Remediation works- please indicate the main proposed works that could cause environmental and social impacts		
Borrow Pit	Material sourcing	Access routes
Embarkment crest and slop	Erosion/ soil loosening	

Introduction of toe drain for seepage control	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 the Community	
Aggregates	Within the Community	
Sand/ clay	Within the Community	
Wood	Not Applicable	
Diesel for transportation	Mwinilunga Town	
Water source for the construction	Within the Community	
Water source for drinking for workers	Within the Community	

Contractors/builders		and Mwinilunga 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, access roads and around the Dam Preserve flora in the area.
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 Contractor will have to engage local forestry department to seek guidance on the type of trees to plant.
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)**	To be managed in accordance with the instructions in the management plan

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
o **Unfinished crossing points for communities**	Crossing point over the spillway not safe. Either completely prohibit or make better Construction of animal watering points around the basin Embankment fencing
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: Not known yet. (indicate below species)** However, the initial assessment using IBAT indicates presence of species that may be endangered or may require special attention. The full biodiversity assessment yet to be concluded.
Are people using the water below the dam? What for?	It was reported that some of the community members access the water downstream for gardening, though this was not very evident.
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 (BDMP) **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 (BDMP)**	
10-Final recommendation	
Name Titus Chilongo,	**Date: 31/07/2021**
Signature P.C	
Comments for the preparation of the ESMP and BDMP incl. Ecological flow measures. Detailed environmental and social studies and inclusion of such matters in the designs. Further Ecological surveys	
Field visits registration	

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[21]

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

[21] 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

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

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

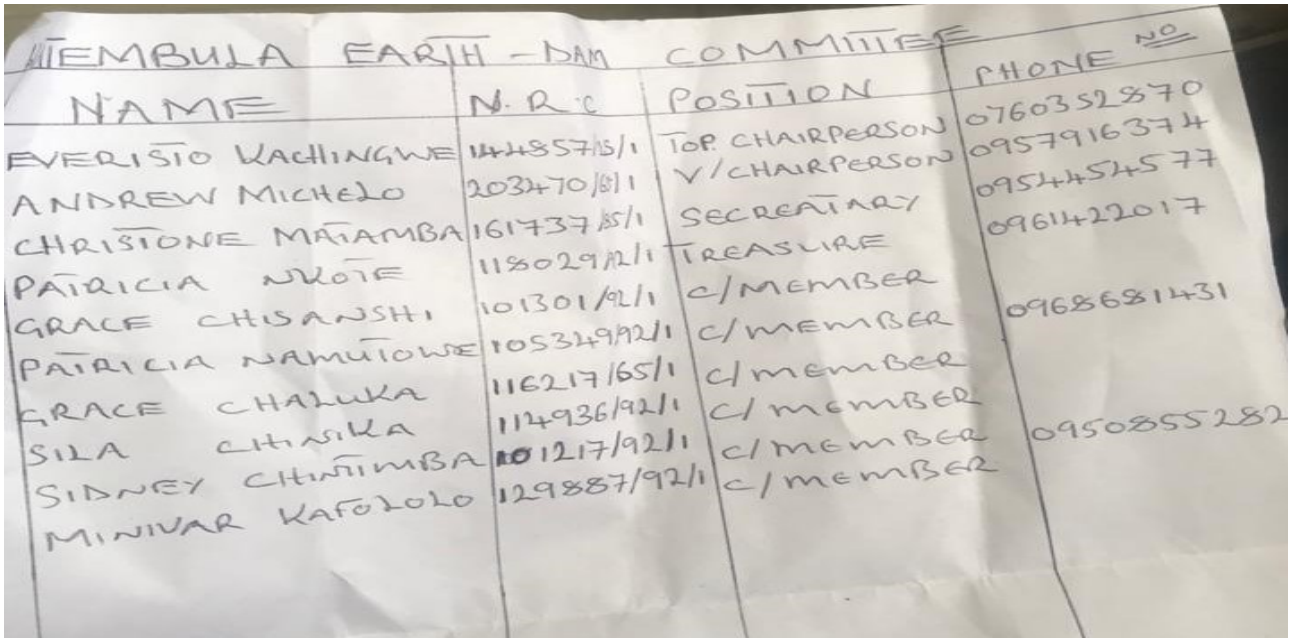
NAME OF SITE KATEMBUKA DAM - LUFWANYAMA DATE 13/07/2022

VILLAGE

S/N	NAME	GENDER	DESIGNATION	~~ORGANISATION~~	CONTACT DETAILS	SIGNATURE
1	EVERISTO KACHINGWE	M		KATUBA		
2	CHRISTOPH MATAMBA	M		KATUBA		
3	FRIDAH MASHIMANGO	F		KATUBA		
4	TITUS MANDA	M		KATUBA		
5	NELO MWELEMUKA	~~M~~ F		KATUBA		
6	AGNESS BANDA	F		KATUBA		
7	AGNESS MWISHIBA			KATUBA		
8	MAINESS KUMEKA			KATUBA		
9	JOYCE CHABALA			KATUBA		
10	RAKABI MOSA			KATUBA		
11	GRACE CHALUKA			KATUBA		
12	GOODSON KACHINGWE			KATUBA		
13	ANDREW MICHELO			KATUBA		
14	SETI BENARD			KATUBA		
15	SYDNEY CHINTIMBA			KATUBA		
16	ENESI KACHINGWE			KATUBA		
17	PEPHIAS KACHINGWE			KATUBA		
18	TITUS MANDA			KATUBA	X	
19	NERO mwelemuka	f		katuba		
20	AGENESS BANDA	f		katuba		
21	Agness MWISHIBA					

MAINESS

Appendix G: Katembula Dam Management Committee



KATEMBULA EARTH - DAM COMMITTEE

NAME	N.R.C	POSITION	PHONE NO
EVERISTO KACHINGWE	144857/15/1	TOP CHAIRPERSON	0760352870
ANDREW MICHELO	203470/61/1	V/CHAIRPERSON	0957916374
CHRISTONE MAIAMBA	161737/85/1	SECREATARY	0954454577
PATRICIA NKOTE	118029/92/1	TREASURE	0961422017
GRACE CHISANSHI	101301/92/1	C/MEMBER	
PATRICIA NAMUIOWE	105349/92/1	C/MEMBER	0968681431
GRACE CHALUKA	116217/65/1	C/MEMBER	
SILA CHINSIKA	114936/92/1	C/MEMBER	
SIDNEY CHINTIMBA	101217/92/1	C/MEMBER	0950855282
MINIVAR KAFO2020	129887/92/1	C/MEMBER	

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

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, GBV, 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	Construction 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	Construction 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

The biodiversity assessment of the Katembula dam sub-project area of influence was conducted from 19th to 23rd 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 Katembula dam sub-project area of influence through observation and interviews involving community members and government officers connected to the sub-project.

Biodiversity Assessment Results

Katembula Dam is located within miombo woodlands. The terrestrial habitat is a multi-storey comprising of miombo tree species with specialized termitaria sub-habitats. Some sections of the dam area are well-vegetated while others are cleared either for homesteads or for farming purposes. In well-vegetated portions, there is a high crown cover (80% - 90%) and good organic matter accumulation (70%-80%).

Katembula sub-project site has a stocking density of 519.05 stems/ha out of which 547.94 stems/ha had a Dbh ≥ 5cm while 126.98 stems/ha had Dbh < 5cm. The species diversity/richness was high in the sub-project area of influence, with a total of 55 species enumerated and as supported by the calculated SI index of 3.11 from field data. *Isoberlinia angolensis* (IV = 34.9) was the most abundant followed by and *Brachystegia boehmii* (IV = 32.4) while *Terminalia sericea* (IV= 3.2) was the least abundant. Analysis of stand level size distribution exhibited a normal forest formation indicated by a *reverse – j* shaped graph obtained when Dbh size classes are plotted. Further analysis of stand level distribution of the regenerates (Dbh < 5cm) showed a normal distribution which is indicative of massive regeneration potential.

Faunal diversity was very low in the sub-project area of influence and no large mammals were sighted. Local community members reported the presence of waterbucks, monkeys and baboons among other smaller animals.

The assessment of the Katembula aquatic habitat showed that the in-stream habitat is largely unmodified while slight modifications were apparent on the riparian habitat. Seventeen fish species occur in Katembula Dam, with *Pseudocrenilabrus philander* as the most abundant. A good diversity of primary producers (plankton) supports the aquatic food chain. These are not species of conservation concern.

Katembula Dam is a small dam built on a perennial River. Ecological flows are therefore continuous over the spillway which spills throughout the year.

Predicted Sub-Project Impacts

The sub-project impacts on flora and fauna are mainly due to clearing activities for access roads, workers' 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;
- Flow modifications;
- 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 impacted over many years by human activity. The habitat in the Katembula dam sub-project area of influence is composed of secondary forest of the miombo woodland. In some parts of the area, the forest shows some high levels of intactness while in other areas signs of human disturbances. Part of the dam is within a protected area called Lamba Headwaters Block A National Forest. Within a 30 km radius there are also other protected areas (national forests) and they include Lamba Block B, and C National forests, Chisangwa Forest Reserve, Chati Forest Reserve and the Chembe Bird Sanctuary. This proximity to a large population and Lufwanyama town exposes the area to anthropogenic pressure such as settlements, crop cultivation, charcoal burning and firewood collection among many others.

The area around the around the dam is characterized by vegetation of high density and the forest is in a good condition with massive ability to re-establish despite external disturbances. The in-stream assessment shows that it is unmodified and the riparian zone has few modifications. This is unlikely to change because of the remedial works on the dam. Since the stream is 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. In addition, the dam does not inhabit fish species listed on the IUCN Red List. The major threat to fish species, the Nile tilapia, introduced into the Kafue River system, does not appear 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, settlements and general habitat degradation in the surrounding areas due to bush clearing and settlements 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 and fishing control.

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;
- 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 shallow 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 DMC to maintain the dam wall by removing woody vegetation, encouraging grass growth and controlling access by stock to minimize 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, 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 Katembula 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 BMP for the affected dams under the project.

METHODOLOGY

This section presents the methods and instruments that were employed in the collection of relevant data including the criteria for determining habitat and vegetation condition of the study area. Additionally, the chapter outlines the criteria for determining threatened/endangered species.

Assessment Methodology

Spatial Scale-Procedures to Determine Sub-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 flow back of water from the dam embankment. Therefore, basing on findings during the reconnaissance survey, the survey team established a radius of 1 km surrounding the boundary of the edges of the inundation area as the project area of influence. ArcGIS software 10.4 was used to spatially come up the area of influence to guide sampling of the vegetation assessment (see Figure 20)

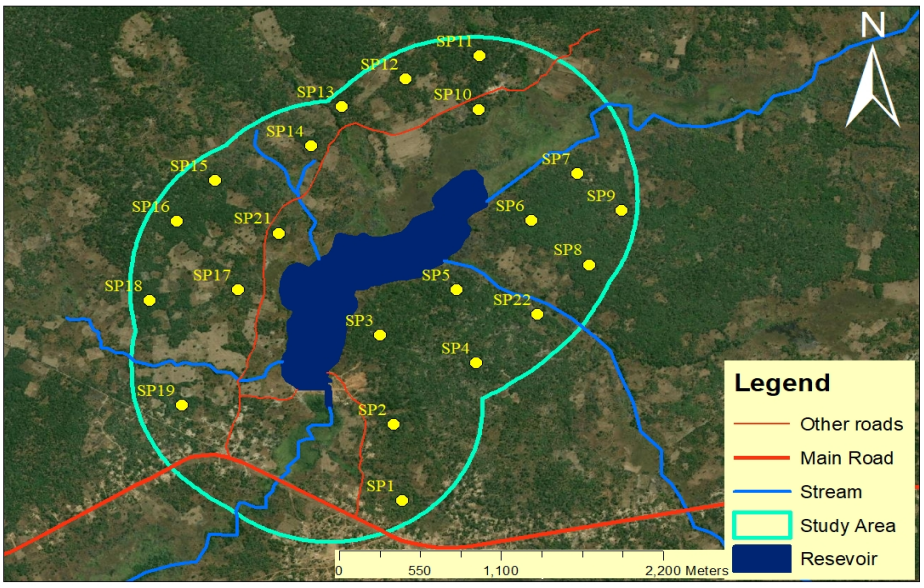


Figure 20 Project area of influence for the biodiversity assessment

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 down-stream was especially necessary to assess the impact in an event

that the dam wall failed. This stretch was also considered adequate to understand the down-stream impact of the impoundment.

Value of Ecological Resources and Vulnerability of Receptors

For terrestrial resources the valuation was based on the criteria given in Table 3-1 and 3-2 after (Latimer, 2009) while the valuation for aquatic and riparian ecosystems was based on the criteria developed by Kleynhan[22]s (1996) – see Tables 18 to 21. The IUCN Red List of endangered species was used to assess the vulnerability of receptors.

Criteria for vegetation integrity

Table 18 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.

Criteria for terrestrial habitat integrity

Table 19 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:

[22] Kleynhans developed his habitat integrity index by using it on riparian and in stream habitats. Katembula 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 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). • 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 20 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. Allochthonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.

Table 21 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 22 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 integrity assessment.

The scores are then placed into the intermediate habitat integrity assessment categories (Kleynhans, 1996) as seen in Table 23.

Table 23 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 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 24 below presents the terminology used to describe and rank environmental and social impacts according to the categories defined above.

Table 24 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 sub-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 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.

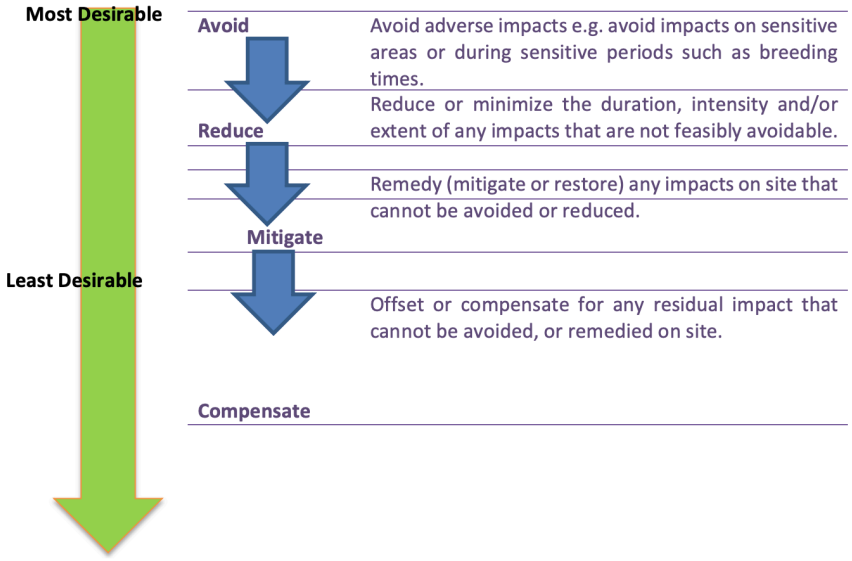


Figure 20 Mitigation hierarchy

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 Katembula 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

Reconnaissance survey

The team of three (lead ecologist, assistant aquatic, assistant terrestrial) conducted a reconnaissance survey of Katembula Dam on 19th April, 2021 in the company of officers' from various government departments. This was useful as it offered an overview of the assessment 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 on 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 20 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 2.73ha while the sampling intensity used was 0.02 percent. The sampling intensity gave a total of 21 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 on 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 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)].

Figure 21 Field team collecting floral attributes

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 1 km area 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) w**hat 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 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 (see Figure 22).

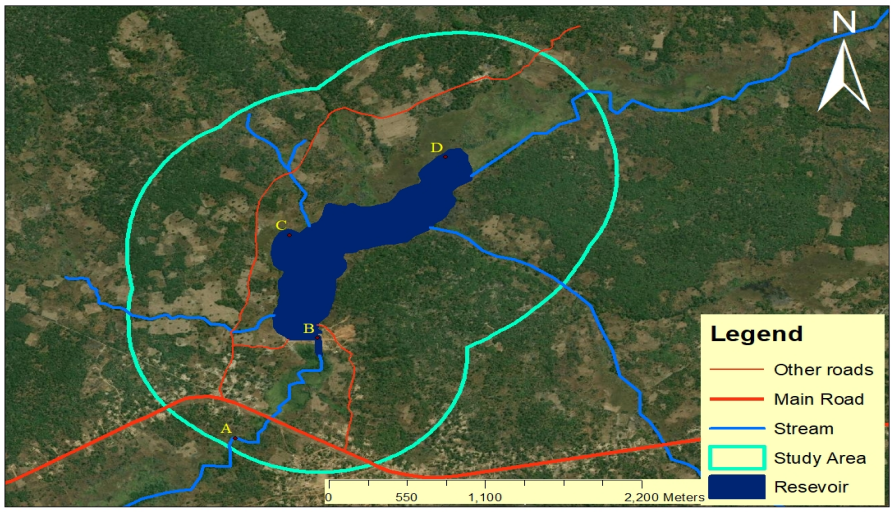


Figure 22 Sampling points for the aquatic biota (Field team, 2021)

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

Sampling Point	**Coordinates**
A	**E: 27.673 S:-12.85**
B	**E: 27.678 S:-12.844**
C	**E:27.676 S:-12.836**
D	**E:27.686 S:-12.83**

Figure 23 Downstream of the dam

Figure 24 Sampling point A (Dam wall)

Figure 25 Sampling point B (Mid-point)

- 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 26 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 27 Field and lab equipment used for plankton analysis

- Macro-invertebrates survey

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 for 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 transparency) 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 habitat in the Katembula dam sub-project area of influence is composed of secondary forest of the miombo woodland. In some parts of the area, the forest shows some high levels of intactness while in other areas signs of human disturbances. Part of the dam is within a protected area called Lamba Headwaters Block A National Forest. Within a 30 km radius there are also other protected areas (national forests) and they include Lamba Block B, and C National forests, Chisangwa Forest Reserve, Chati Forest Reserve and the Chembe Bird Canctuary. The habitat is dominated by miombo species such *as Isoberlinia angolensis, Brachystegia boehmii, Anisophyllea boehmii, Albizia adianthifolia, Ochna pulcra,* etc (see table 26).

Table 26 Description of habitat and vegetation condition

Type of Habitat		Classification Value (importance)	Reasons for Classification
1.	Wet miombo Woodlands	Moderate	• Relatively well forested in many places due to it being a protected forest area. • Natural vegetation cleared for agricultural purposes in some parts. • High regenerative potential. • Moderate abundance of faunal species. • Many mature hollow bearing trees.
2.	Riparian	Moderate	• Dominated by *Syzygium* spp mainly downstream and *Acacia* spp in many places. • Covered by dense *Phragmites* spp, *Hyparrhenia* spp, *Cynodon* spp, and many other grasses. • Impacted by agriculture activities in the upstream.
3.	Termitaria	High	• Largely intact with many holes. • Dominated by *Diospyros* spp, *Strychnos* spp, *Oxytenanthera abyssinica*

The main disturbances in the area consist of charcoal burning, firewood collection, agriculture activities (see Figure 28) and fire occurrences. The habitat was found to be very resilient to forest disturbances as plants easily regenerate typical of the nature of miombo woodland. The area around the around the dam is characterized by vegetation of high density with moderate basal area and volume, and despite the scarcity of very large diameter trees, this indicates that the forest is in a good condition with massive ability to re-establish despite external disturbances (Figures 29-30).

Figure 28 Densely vegetated areas around Katembula Dam

Furthermore, riparian vegetation was observed to be present in the area along the stream that flows into the dam. Most of the riparian vegetation along the stream covering about 2.1 km backflow had been destroyed by the inundation years ago resulting from the constructed dam.

Figure 29 Riparian vegetation downstream just after the dam

Figure 30 Standing dry stems of riparian vegetation remnants

Generally, the habitat for the area is mainly miombo woodland with massive ability to grow and re-establish after human disturbances such as agriculture activities by the local members of the community (Figure 31).

Figure 31 Agricultural activities within the sub-project area of influence

The vegetation is significant in the area because (i) it is part of the Kafue Headwaters (ii), it's close to a protected forest (Lamba Headwater, No. P17 A), which is important for conservation of important plant species (iii), it is close to Chembe Bird Sanctuary, which is located approximately 73.4 km from the dam. Chembe Bird Sanctuary receives a lot of migratory bird species, hence, the vegetation around the project area of influence plays an important role in the ecosystem maintenance.

Flora

Field enumeration of plant species indicated higher composition and diversity with a total of 55 species (see table 4.2). Out of the total sampled area of 2.73ha, the average Dbh was 14.31cm and vegetation density is indicated by a total number of 519.05 stems/ha. Of these, there were 477.29 stems/ha with Dbh ≥ 5cm and 41.86 stems/ha with Dbh < 5cm. Importance value indices show *Isoberlinia angolensis* (IV = 34.9) as the most dominant in the area followed by *Brachystegia boehmii* (IV = 32.4) while *Terminalia sericea* (IV = 3.2) is the least abundant. Table 4.2 also indicates the relative frequency, relative dominance, and relative density. These parameters show the distribution of individuals of a species in the area (relative frequency); the numerical strength of each species in relation to a definite unit area (relative density); and the cover of each species based on basal area (relative dominance). The overall species diversity as measured by the Shannon Index (SI) was high as indicated by the calculated SI index of 3.114 (see Appendix 5).

Table 27 Importance values and IUCN status of tree species

Botanical name	**Relative frequency**	**Relative density**	**Relative dominance**	**Importance value index**	**IUCN Status**
Isoberlinia angolensis	90.9091	11.0092	2.89876	34.939	LC
Brachystegia boehmii	90.9091	4.16373	2.18863	32.4205	LC
Anisophyllea boehmii	77.2727	3.88144	0.84237	27.3322	LC
Albizia adianthifolia	72.7273	5.85745	1.89319	26.826	LC
Ochna pulchra	59.0909	2.75229	0.54723	20.7968	LC
Monotes africanus	59.0909	1.69372	0.58998	20.4582	LC
Brachystegia spiciformis	54.5455	3.88144	0.8549	19.7606	LC
Pericopsis angolensis	54.5455	3.24629	1.19943	19.6637	LC
Marquesia macroura	54.5455	1.27029	0.95412	18.9233	LC
Albizia antunesiana	50	3.10515	0.52114	17.8754	LC
Markhamia obtusifolia	50	0.91743	0.31401	17.0771	LC
Albizia versicolor	40.9091	3.52858	2.09664	15.5114	LC
Albizia amara	40.9091	0.77629	0.17322	13.9529	LC
Strychnos spinosa	36.3636	1.69372	0.2288	12.7621	LC
Parinari capensis	36.3636	0.63514	0.31136	12.4367	LC
Julbernardia paniculata	31.8182	2.39944	0.59957	11.6057	LC
Combretum zeyheri	31.8182	1.41143	0.32875	11.1861	LC
Piliostigma thonningi	31.8182	1.19972	0.44005	11.1527	LC
Annona senegalensis	31.8182	0.56457	0.14167	10.8415	LC
Pterocarpus angolensis	27.2727	3.17572	1.19515	10.5479	LC
Phyllocosmus lemaireanus	27.2727	2.75229	0.68315	10.2361	LC
Sterculia quinqueloba	27.2727	1.19972	0.32875	9.6004	LC
Dyplorhynchus condylocarpon	27.2727	1.12915	0.2375	9.54646	LC
Hymenocardia acida	27.2727	1.05857	0.09892	9.47674	LC
Brachystegia manga	27.2727	0.63514	0.23882	9.38223	LC
Bobgunia madagascariensis	27.2727	0.70572	0.16718	9.38187	LC
Syzygium guineense	18.1818	6.56316	1.31618	8.68705	LC
Acacia polyacantha	22.7273	1.482	0.3205	8.17659	LC

Rothmannia englerana	22.7273	0.84686	0.31696	7.9637	LC
Uapaca nitida	22.7273	0.77629	0.37003	7.95786	LC
Phyllanthus muellerianus	18.1818	1.62315	0.79608	6.86701	LC
Vitex doniana	18.1818	1.69372	0.22998	6.70184	LC
Parinari curatellifolia	18.1818	1.55258	0.31563	6.68334	LC
Uapaca Kirkiana	18.1818	1.27029	0.22821	6.56011	LC
Strychnos cocculoides	18.1818	1.19972	0.22556	6.5357	LC
Brachystegia longifolia	18.1818	0.84686	0.1859	6.40486	LC
Burkea africanus	18.1818	0.70572	0.24104	6.37619	LC
Erythrophleum africanus	18.1818	0.35286	0.15008	6.22825	LC
Diospyros batocana	18.1818	0.35286	0.0973	6.21066	LC
Erythrina abyssinica	13.6364	1.90543	0.15008	5.23062	LC
Pseudolachnostylis maprouneifolia	13.6364	1.27029	0.39362	5.10009	LC
Trema orientalis	13.6364	1.12915	0.20993	4.99181	LC
Strychnos innocua	13.6364	1.19972	0.04865	4.96158	LC
Uapaca sansibarica	13.6364	0.70572	0.18619	4.84276	LC
Terminelia stenostachya	13.6364	0.56457	0.32433	4.84176	LC
Oxytenanthera abyssinica	13.6364	0.494	0.07268	4.73435	LC
Combretum molle	9.09091	2.39944	0.43372	3.97469	LC
Parkia filicoidea	9.09091	1.19972	0.90591	3.73218	LC
Oldfieldia dactylophylla	9.09091	1.27029	0.53455	3.63192	LC
Ficus sycomorus	9.09091	1.05857	0.37887	3.50945	LC
Ficus wakefiedii	9.09091	0.70572	0.32595	3.37419	LC
Olax obtusifolia	9.09091	0.70572	0.12781	3.30815	LC
Ochna schweinfurthiana	9.09091	0.494	0.20639	3.26377	LC
Hexalobus monopetalus	9.09091	0.56457	0.06914	3.24154	LC
Terminalia sericea	9.09091	0.42343	0.07076	3.19503	LC

The forest composition and vegetation structure of the area is indicated by Dbh size class distribution at stand level. Generally, the analysis of Dbh distribution at stand level for size classes of all the stems indicated that the forest (study area vegetation) has a *reverse – J* distribution of tree diameters, in which the number of trees declines rapidly with increasing size class (see Figure 32). This coincides with the field findings that part of the area is in a protected forest (Lamba Block A National Forest), where such a stem structure is expected.

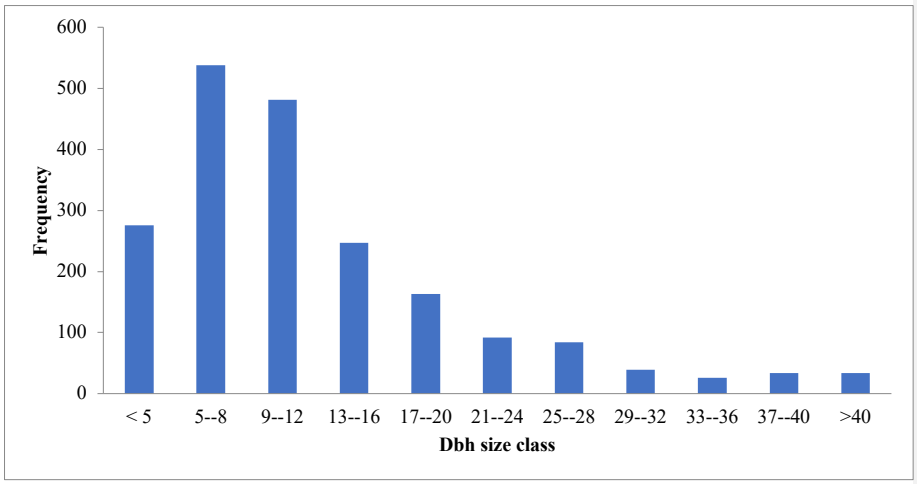


Figure 32 Size class distribution

The sub-project area of influence was found to contain very good cover (above 95 percent) of native species. A lot of coppicing stems are present in the area, which shows the ability of the miombo to regenerate after being cut and to a large extent prevent invasion of non-native species (see Figure 33).


Figure 33 Young stems resulting from the regeneration of native species

A healthy shrub layer was found growing in combination with tree regenerates especially in areas with recent human disturbances

Figure 34 Shrubs mostly found around ant hills

The forest tree crown cover is approximately 75 percent in some parts while other areas exhibited crown cover relatively about 50 percent. This coverage of the tree crowns is enough to allow sunlight reach young growing plants under the crowns. This explains why parts of the area had a lot of plant regenerating and a healthy secondary forest.


Figure 35 Above 75 percent crown cover in high tree density areas

Those areas with crown cover of less than 50 percent had fewer trees with medium diameters. This also leaves out spaces within which light can pass and be accessed by the undergrowth although such low levels of crown cover are signal of forest disturbances in the project area of influence. Canopy structure is an important reflection of ecosystem dynamics and the distribution of total cover, and crown diversity reflects natural disturbance regimes across the landscape and affects the maintenance of biological diversity, particularly of species dependent upon specific stages.

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 Figures 36 and 37) was captured (edible and non-edible mushrooms species). This is due to availability of a litter layer that provide areas for primary production and decomposition necessary for maintaining functioning food chains. They nurture fungi essential to the growth of rooted plant organisms.

Figure 36 Litter accumulation in the study area

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 37 Litter accumulation supports caterpillar and fungi survival

In most vegetated parts, the project area of influence contains very good soil biological crust (see Figure 38). A mosaic of cyanobacteria, green algae, lichens, mosses, micro-fungi, and other bacteria were seen to be obtaining and forming the important biological crusts. The 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 38 Green algae, ferns and lichens making up biological soil crust

There is a heavy presence of human settlements in some areas close to the sub-project site and the vegetation around the settlements was characterized by the remnants of miombo species. The vegetation pattern is influenced mainly by small scale agriculture and related activities which has impacted negatively on the forest composition and cover. Furthermore, community members reported that forest areas experience frequent bush fires usually set up by people clearing bushes for farming activities, and those extracting honey. The uncontrolled bush fires have affected the flora regeneration potential for much of the area (Figure 39 and 40).

Figure 39 Remnants of miombo trees (with undergrowth cleared) around settlements

Figure 40 Soybeans cultivation near settlements with vegetation cleared

Fauna

A few faunal species (Tables 28, 29 and 30) were reported to exist in the area mainly due to encroachment of their space by humans. Secondly, Miombo woodland is associated with low faunal richness which partly explains why the ecological survey did not yield much positive results. This may be attributed to the consequence of the extreme harshness of the dry season, with a virtual seven-month drought, often accompanied by intense bushfires and other anthropogenic activities (Rodgers et al. 1996). These are not species of conservation concern.

Table 28 List of Mammals found and their status on the IUCN Red List

Common name	**Scientific name**	**IUCN STATUS**
Water buck	*Kobus ellipsiprymnus*	LC
Giant mole rat	*Cryptomys mechowi*	LC
Hare	*Lepus victoriae*	LC
African ground squirel	*Xerus inauris*	LC
Bush Pig	*Potamochoerus larvatus*	LC
South African Bush baby	*Galago moholi*	LC
Thick-tailed bush baby	*Otolemur crassicaudatus*	LC
Vervet monkeys	*Chlorocebus aethiops*	LC
Chucma baboons	*Papio ursinus*	LC
Rat	*Rattus norvegicus*	LC
Common Duiker	*Cephalophus natalensis*	LC

Figure 41 Marks of fauna and their hiding holes


Figure 42 Signs (saliva) of snakes in the project area of influence

Table 29 List of reptiles and their status on the IUCN Red List

Common name	**Scientific name**	**IUCN Red List status**
Crocodile	*Crocodylus niloticus*	LC
Python	*Phyton sebae*	DD
Chameleon	*Chamaeleo dilepis*	LC

Brown house snake	*Lamprophis capensis*	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
Leopard tortoise	*Stigmochelys pardalis*	LC

Some birds, butterflies, and many other small creatures (insects) were seen. The birds were quite plentiful and continuous bird sounds were heard by the survey team. Table 30 gives a list of birds that are said to occur in the area surrounding the Katembula Dam.

Table 30 List of birds and their status on the IUCN Red List

Common name	**Scientific name**	**IUCN status**
The African Fish Eagle	*Haliaeetus vocifer*	LC
White Stork	*Ciconia ciconia*	LC
Pied Crow	*Corvus albus*	LC
Barn Swallow	*Hirundo rustica**	LC
Black shouldered Night Jar	*Caprimulgus nigriscapularis*	LC
Coucal	*Centropus Burchelli*	DD
Great Egret	*Egretta alba**	LC
Owl – Grass Owl	*Tyto capensis*	LC
Wax bill	*Serinus striolatus*	LC
Laughing Dove	*Streptopelia senegalensis**	LC
White-necked Raven	*Corvus albicollis*	LC
Golden-tailed Woodpecker	*Campethera abingoni*	LC
Miombo Double-Collared Sunbird	*Cinnyris manoensis*	LC
Amethyst (Black) Sunbird	*Chalcomitra amethystina*	LC
Scarlet-Chested Sunbird	*Chalcomitra senegalensis*	LC
Western Violet-Backed Sunbird	*Anthreptes longuemarei*	LC
Forest weaver	*Ploceus bicolor*	LC
Village (Spotted-Backed) Weaver	*Ploceus cucullatus*	LC
Red-headed weaver	*Anaplectes melanotis*	LC
Masked Weaver	*Ploceus velatus*	LC
Senegal Coucal	*Centropus senegalensis*	LC
Red-billed Quelea	*Quelea quelea*	LC
Southern Red-bishop	*Euplectes orix*	LC
Yellow-Crowned (Golden) bishop	*Euplectes afer*	LC
Yellow Bishop	*Euplectes capensis*	LC
Bronze Mannikin	*Spermestes cucullata*	LC
Blue Waxbill	*Uraeginthus angolensis*	LC
Common Waxbill	*Estrilda astrild*	LC
Pin-tailed Whydah	*Vidua macroura*	LC
African Mourning Dove	*Streptopelia decipiens*	LC
Dark-Capped (Black- Eyed) Bulbul	*Pycnonotus tricolor*	LC

Red-Eyed Dove	*Streptopelia semitorquata*	LC
Cape Turtle (Ring-Necked) Dove	*Streptopelia capicola*	LC
Emerald-Spotted Wood-Dove	*Turtur chalcospilos*	LC
Namaqua Dove	*Oena capensis*	LC
African Green Pigeon	*Treron calvus*	LC
Cattle Egret	*Bubulcus ibis*	LC
Grey-Headed Parrot	*Poicephalus suahelicus*	LC
Meyer's (Brown) Parrot	*Poicephalus meyeri*	LC
Pennant-Winged Nightjar	*Macrodipteryx vexillarius*	LC
Little Bee-Eater	*Merops pusillus*	LC
Lilac-Breasted Roller	*Coracias caudatus*	LC
Grey-Headed Kingfisher	*Halcyon leucocephala*	LC
Fork-Tailed Drongo	*Dicrurus adsimilis*	LC
African Dusky Flycatcher	*Muscicapa adusta*	LC
Barn (European) Swallow	*Hirundo rustica*	LC
Long-Billed Crombec	*Sylvietta rufescens*	LC
Grey-Backed Camaroptera	*Camaroptera brevicaudata*	LC
Schalow's Turaco	*Tauraco schalowi*	LC
Tawny-Flanked Prinia	*Prinia subflava*	LC
Greater Striped Swallow	*Cercropis cucullata*	LC
Cabanis's Bunting	*Emberiza cabanisi*	LC
Olive Woodpecker	*Dendropicos griseocephalus*	LC
Cardinal Woodpecker	*Dendropicos fuscescens*	LC
Common Moorhen	*Gallinula chloropus*	LC
Black Crake	*Amaurornis flavirostra*	LC
Yellow-Billed Kite	*Milvus aegyptius*	LC
Orange-Winged (Golden-Backed) Pytilia	*Pytilia afra*	LC
Brown Firefinch	*Lagonosticta nitidula*	LC
African (Blue-billed) Firefinch	*Lagonosticta rubricata*	LC

Key: * = Migratory

Several colonies of different types of insects i.e. red ants, black ants and grasshoppers (e.g. *Gymnobothrus lineaalba, Gymnobothrus temporalis, Acrida acuminate*), common house flies and assorted butterflies were seen in the project site.

Figure 43 Butterflies observed in the field

Aquatic Survey Results

Results of the aquatic and riparian zone surveys for the Katembula project areas of influence 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 project impacts.

Habitats

Three main habitats were created with the damming of the Katembula Stream. These are outlined in Table 31.

Table 31 Main habitat types

Habitats	Characteristics	
Upstream	The banks are lined with vegetation, mostly acacia and other riparian vegetation. Water flow velocity is quite significant and the volume of water quite plentiful.	

Reservoir	Mostly open waters with innundated stems. Water flow maintained through the spillway. Banks covered with grass and isolated trees. The bank around the spillway is eroded.	
Downstream	Covered with dense vegetation. Mostly dominated by *Acacia* spp, *Syzygium* spp and grasses such as *Phragmites* spp, *Hyparrhenia* spp.	

Although damming of the Katembula Stream has resulted in creation of a lacustrine environment, most of the habitat remains in it natural condition. Slight modifications have occurred in the instream habitat while the main alteration in the riparian zone is the flow rate, channel and erosion of the bank around the spillway. Using the habitat assessment index, the in-stream assessment shows that it is unmodified and the riparian zone has few modifications.

Table 32 The in-stream assessment for Katembula Dam

Instream	**Average score**	**Score**
Water abstraction	0	0
Flow modification	0.5	0.18
Bed modification	1	0.52
Channel modification	4	2.0
Water quality	0	0
Inundation	2	0.8
Exotic macrophytes	0.5	0.18
Exotic fauna	0	0
Solid waste disposal	0	0
Total Instream	**96.3 (Unmodified)**	
Category	**Class A**	

Table 33 The riparian assessment for Katembula Dam

Riparian Zone	**Average score**	**Score**
Indeginous vegetation removal	6	3.12
Exotic vegetation encroachment	0	0
Bank erosion	8	4.8
Channel modification	9	4.3
Water abstraction	0	0

Inundation	5	2.2
Flow modification	12	5.76
Water quality	0	0
Total Instream	**80 (Few modifications)**	
Category	**Class B**	

Water Quality

The results of four water quality parameters taken in-situ and those analyzed ex-situ are presented in Table 34. Laboratory results for pH are included in Table 4.8 in brackets. The ex-situ water quality results are also shown in Appendix 4.

Table 34 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 Mid point**	**C Dam tail**	**D Upstream**
1	pH	6.5-8.5	7.7 (6.29)	8.2 (6.46)	7.6 (4.83)	7.9	7.13 (5.99)
2	Dissolved Oxygen (mg/L)	5-7.5	7.5	5.8	8.7	6.5	8.0
3	Temperature (°C)	25-30	27.9	23.6	25.3	25.8	26.9
4	Transparency (Secchi disc) (m)	0.25-0.6		0.4	0.35	0.45	0.43
5	Nitrates (as NO_3 –N mg/l)	<0.2	<0.01	<0.01	<0.01	<0.01	<0.01
6	Conductivity (µs/cm)	100-150	138	140	165		62
8	Total Suspended Solids (mg/l)		<1.0	5.3	<1.0		<1.0
9	Phosphates (mg/l)		0.9	0.7	0.7		0.4
10	Chemical oxygen demand (as mg O_2/l)		7	5	10		2
11	Alkalinity (as $CaCO_3$ mg/l)		80	80	90		20
12	Total Dissolved Solids (mg/l)		67	70	83		32
13	Ammonia (as NH_4-Nmg/l)		<0.01	<0.01	<0.01		<0.01

Survival of aquatic biota depends on quality of their habitat and water is a significant component of aquatic habitat. AAAS (1983) recommends that the following physicochemical parameter of water should always or often be tested: temperature, turbidity, dissolved gases, inorganic nutrients, organic nutrients, pH, conductivity, benthic organisms, and fish. These measures are useful for understanding impacts of various pollutants on aquatic ecosystems.

A comparison of the monitoring values with reference values (Table 4-8), indicates the following: Generally, most water quality parameters for Katembula Dam fall with acceptable ranges for survival of aquatic biota. The ex-situ pH shows acidic conditions in the mid section of the dam. These results will have to be further confirmed during baseline testing. There was a significant variation in conductivity for the upstream compared to the rest of the sampling points. The low conductivity value for the upstream is consistent with the low TDS value for the same point.

The expected pollution of this reservoir through dust emissions, possible oil and fuel spills from machinery and removal of vegetation during remedial works has the potential to negatively affect the aquatic biota and consequently surrounding community members through the food chain.

Fish survey

A total of 17 species were recorded as occurring by the biodiversity assessment team; 12 of which were observed during sampling and the other 5 recorded from oral reports. Both reported and observed species are presented in the table below. Environmental flows are continuous over the spillway enabling upstream and downstream flows (Appendix 7).

Table 35 Fish species composition during the hot wet season

Common Name	**Latin name**	**IUCN Status**	**Migratory (Yes/No)**
Mudsuker	*Labeo altivelis*	LC	Yes
Squeaker	*Synodontis nebulosus*	LC	No
Pink happy	*Sargochromis giardi*	LC	No
Dwarf bream	*Serranochromis macrocephalus*	LC	No
Red barb	*Serranochromis angusticeps*	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
Purplemouth bream	*Serranochromis macrocephalus*	LC	No
Pink Happy	*Sargochromis giardi*	LC	No
Dwarf bream	*Pseudocrenilabrus philander*	LC	No

Pseudocrenilabrus philander was the most abundant fish species in the Katembula Dam followed by *Coptodon rendalli* and *Sargochromis giardii*. *O. Niloticus* was not reported or found to be present. Species of conservation concern were not identified.

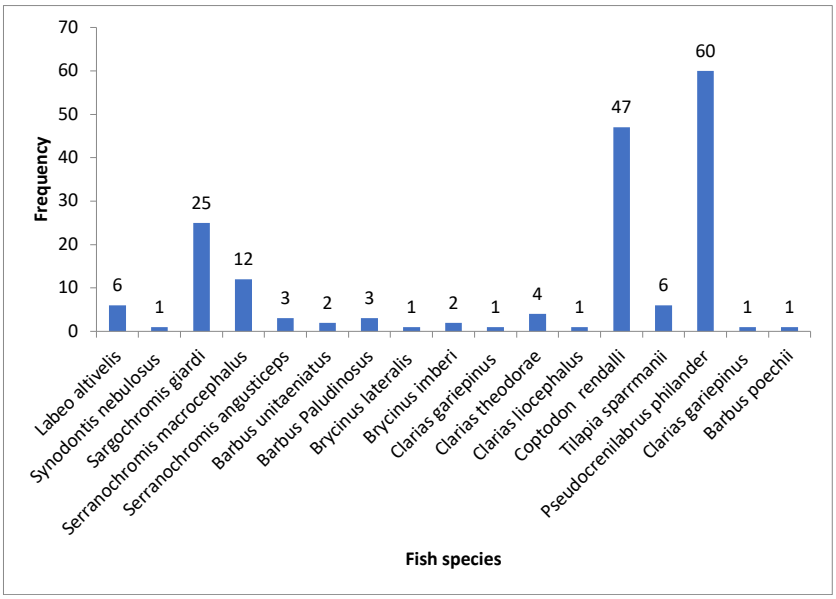


Figure 44 Species abundance for samples of fish in Katembula Dam

Table 36 Average total fish catch (kg) per sampling point

Description	Point A	Point B	Point C	Point D
Catch in KGs	0.0kg	4.3 kgs	2.1kgs	**0.0kgs**

Figure 45 Sample fish at Katembula Dam (Source: field team, 2021)

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 Katembula dam is given in Table 4.12.

Table 37 Fishing activity rate averages for the hot wet season

Description (AR/RE)	Point A	Point B	Point C	Point D	River Average
AR for Katembula	0.0	0.4	0.3	0.0	0.18
No. of fishers	0	9	7	0	
Canoes	2	4	3	0	
Plank Boats	0	0	0	0	
Fiber Boat	0	0	0	0	
Dingi	0	0	0	0	
Aluminum	0	0	0	0	
Gillnets	0	0	0	0	
Baskets	0	10	4	0	
Seine Nets	0	6	5	0	
hooks	0	0	0	0	
No. of villages	1	1	1	1	

A significant number of fishing activity was observed on Katembula Dam. Dugout canoes were seen traversing the dam with fishers either going to set up their nets or to collect the fish caught in the nets. Baskets and seine nets are the commonly used gear and the fish caught is sold in Lufwanyama.

Invertebrates, plankton and macrophytes

A number of macroinvertebrate species were observed (Table 38). 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 Katembula water system are presented in able 38.

Table 38 List of macro-invertebrates

Common Name	**Scientific Name**	**Number observed in the sampling points**
Whirligig beetle	*Gyrinidae*	Multiple groups
Fry	*Assorted*	Multiple
Crab spider	*Thomisidae*	2
Round worm	*Nematoda*	5
Fishing spider	*Dolomedes*	6
Freshwater slater	*Asellus*	6
Water strider	*Gerridae*	7
Crawling water beetle	*Haliplidae*	Seen in cycles on the surface

Table 39 Plankton and macrophytes for Katembula Dam

PHYTOPLANKTON	**ZOOPLANKTON**	**MACROPHYTE**
Scientific name	**Scientific name**	**Common name**
Euglena sp.	*Anabaena smithii*	Duckweed

Closterium sp.	*Monostyla sp.*	Water lily
Colurella obtusa	*Brachionus calyciflorus*	Lotus
Diaptom spp	*Diurella stylata*	
Microcystis novacekii	*Trichocerca pusilla*	
Brachious spp	*Brachionus angularis*	
Pediastrum simplex	*Cyclops sp.*	
Staurastrum pseudosebaldi	*Copond sp.*	
Ceriodaphnia cornuta	*Asplanchna herricki*	
Cyclops spp	*Simocephalus vetuloides*	
Distigma spp	*Brachionus angularis*	
Centritratus bruneus	*Keratella valga*	
Lepocindlis ovum	*Monostyla bulla*	
Navicula sp.	*Kerratella valga*	
Anabaena smithii	*Brachionus angularis*	
Moina micrura	*Sphaeroplea annulino*	
Semocephalus vetuloides	*Cydorus sphaericus*	

Evaluation of Impacts

Using the criteria explained in this report, the potential impacts that the proposed sub-projects may have on the biodiversity in the area were evaluated and reported in Table 40. The unmitigated values are shown below. It is anticipated that the impact significance will be lower once the proposed mitigation measures in the BMP are applied.

Table 40 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 Disturbance of the protected forest	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	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

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
	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	Rare	Likely	Local	Long	Low	Negative	Direct	Low	Low
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	Medium	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	Medium	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

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
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	Likely	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	Likely	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	Long	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/Indirect	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
	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	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low
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	Rare	likely	Local	Medium	Medium	Negative	Indirect	Medium	Medium
Air, Water and Soil pollution	Contamination of the biophysical environment	Biophysical environment contamination may arise from: • Mismanagement of domestic and industrial waste on site;	Rare	Likely	Local	Short	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
	Injury or mortality of fauna	• Spillages and leakages of chemicals on site such as fuels, oils and other liquid and solid based substances • Exhaust emissions from machinery • 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	Short	Low	Negative	Indirect	Medium	Low
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 Katembula 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											

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Site Preparation and Construction											
Compromised aquatic habitats for fauna and loss of breeding areas	Clearing vegetation Unprotected water bodies such as the river	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 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. The area already has a pressure on fisheries	Rare	Likely	Provincial	Medium	Medium	Negative	Indirect	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Increased demand for water	Compromised aquatic habitat	Construction is a task demanding water. Further, the construction workers will need water for personal use	Rare	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low
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. Consequently, habitat integrity is enhanced. This could ultimately impact positively on the populations of flora and fauna The dam provides enough water all year round and an environment for species to thrive. The water body has more life forms than the stream	Rare	Certain	Local	Medium	Medium	Positive	Direct	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Habitat pressure caused by the dam	Over grazing, irrigation and fishing activities around the dam	Human population increase attracted by the dam's works and improvements may lead to overfishing and contribute to the depletion of the fish resources. 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 Katembula is an active fishing ground with an established fishing camp. Use of wrong fishing gear and uncoordinated fishing effort are common	Frequency	Certain	Local	Medium	Low	Negative	Direct	Low	Low
Maintained environmental flows downstream and protected dam habitats	The downstream flows shall continue in relation to the design and the stream's flow regime	The dam is on a perrenial water body. The flows will be maintained as per the MAR/storage ratio. Habitats protection is part of the training programme for DMC. Once these are protected the biodiversity in the dam will be sustained. Species shall be protected and will have conducive habitats to live in.	Rare	Certain	Regional	Longterm	Medium	Positive	Direct	Medium	Medium

Commented [MW1]: This is not a positive impact from a biodiversity point of view

Commented [L2]: Changed to a negative impact- increased habitat pressure

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Decommissioning											
Increased ecological integrity	Increase in the life forms populations in the dam	The maintenance of the dam shall 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	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Removal of weir could lead to severe losses of water, fish, other lifeforms from the dam compromising livelihoods especially for those using the dam for fishing and agriculture	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

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

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
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens

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
- Altered flow regime limiting flows

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.
- Fisheries pressure and resource depletion

Concluding Impact Statement

Katembula Dam provides a large water body on the Katembula stream a perennial stream which is a tributary of the Lufwanyama River which in turn flows into the Kafue River. Terrestrial and aquatic habitats in the area of influence of the dam have been moderately impacted over many years by human activity. This project area of influence is quite close to the main town centre of Lufwanyama district. This proximity exposes the area to anthropogenic pressure such as settlements, crop cultivation, charcoal burning and firewood collection among many others. There are some densely

vegetated areas in some places around the dam while other places are heavily impacted by farming activities and borrow pits created by previous construction works (Figure 4.19). The presence of many villages around the project area of influence has caused the depletion of wildlife both through overhunting and encroachment into the wildlife space. The habitat in the Katembula dam sub-project area of influence is composed of secondary forest of the miombo woodland. In some parts of the area, the forest shows some high levels of intactness while in other areas signs of human disturbances. Part of the dam is within a protected area called Lamba Headwaters Block A National Forest. Within a 30 km radius there are also other protected areas (national forests) and they include Lamba Block B, and C National forests, Chisangwa Forest Reserve, Chati Forest Reserve and the Chembe Bird Canctuary. This proximity to a large population and Lufwanyama town exposes the area to anthropogenic pressure such as settlements, crop cultivation, charcoal burning and firewood collection among many others. The area around the around the dam is characterized by vegetation of high density and the forest is in a good condition with massive ability to re-establish despite external disturbances. The in-stream assessment shows that it is unmodified and the riparian zone has few modifications. This is unlikely to change because of the remedial works on the dam. Since the stream is at the upper end of the catchment, there are no migratory fish movements of significance, though the spillway structure design (with steps forming a ladder) and continuous flows allow for migrations to occur. The dam does not pose a barrier effect to the fish population. In addition, the dam does not inhabit fish species listed on the IUCN Red List. The major threat to fish species, the Nile tilapia, introduced into the Kafue River system, does not appear to be present near the dam's impoundment.

There is high fishing activity at the dam and in the stream. Katembula Dam receives quite a high volume of water from the Katembula Stream and several other streams. It is an active fishing ground with an established fishing camp. There is use of wrong fishing gear and uncoordinated fishing at the dam and the streams. The main reason for poor aquatic and terrestrial habitat integrity downstream appears to be the general habitat degradation in the surrounding areas and not attributed to the dam's impoundment.

Since the dam was first built 4 years ago it is unlikely that the remedial works may encourage additional cultivation through increased irrigation activities and will not change the current patterns of stock use that have existed since construction because the stream is perennial and has always been in existence all year round. Key management requirements are to continue efforts to improve catchment conditions, particularly around the perimeter of the dam, by managing overfishing and discouraging cultivation in the riverine areas. Due to these observations, there is need to enhance the fish farming objective of the dam, this will increase its conservation value amongst the community members and contribute to enhance the aquatic biodiversity. This will be the responsibility of the nominated DMC, with assistance and support from the Ministry of Agriculture, Forestry and Fisheries and DMC. Irrigation farming methods that protect the land and water resources shall 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.



Figure 46 Katembula area

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 6 –Habitat management. 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 section 4.3 and implement mitigation measures for those impacts.

Table 41 Biodiversity Management Plan

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
1.0. SITE PREPARATION AND CONSTRUCTION PHASE						
1.1. TERRESTRIAL						
Indigenous Flora						
1.1.1	Increase in flora clearing activities for site preparation and access roads Increase of activities in the protected forest leading to depletion of vegetation	To avoid and where not feasible minimize the loss of indigenous vegetation	The contractor shall 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 shall not be disturbed (Appendix 4- dam and dambo management). Flora management shall be included in the sites' method statements (refer to ESMP).	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			The contractor shall 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 shall not be close to riparian buffer zones/ water bodies (Appendix 4- dam and dambo management). The contractor shall avoid activities and vegetation clearing in the forest	Mobilization	End of construction works	Contractor Supervision- UNOPS
			Whenever possible e.g. at camp sites, the contractor shall ensure that trees will be cut at knee height to promote coppicing at the end of the sub-	Mobilization	End of construction works	Contractor Supervision- UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
			project			
		Avoid use of indigenous wood/timber	The contractor shall 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 shall 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 shall 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 shall 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 shall 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

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
Fauna						
1.1.3	Injury and/or loss of fauna	To preserve fauna in and around the project site	The contractor shall 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 shall be included in the sites' method statements (refer to ESMP).	Beginning of construction works	Project Closure	Contractor, ZAWA, Traditional Authorities and DMC Supervision - UNOPS
			The contractor shall 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 shall 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

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
1.1.4	Injury or mortality of fauna due to accidents	Avoid collisions of vehicles with fauna on site	The contractor shall • 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 shall 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 nocturnal and crepuscular fauna observed on site. Strong lightning sources may also disturb migration or night movement of certain species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			When there is need to use lighting at night, the contractor shall 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

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
		To avoid disturbance of fauna on site during day time	To reduce noise on site, the contractor shall: • 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 shall: • 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	Destruction of existing habitats on site	Avoid further fragmentation of habitats	The contractor shall not create new access roads on site. Instead old ones will be rehabilitated for continued use	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
		To maintain the natural extent of the water bodies in sub-project	The contractor shall not carry out any construction and related sub-project activities within dambos.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor shall set the	Beginning of	Project	UNOPS and DMC

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
			construction camp site at least 150m from the nearest water body and the riverine. It is strongly recommended that the old camp site areas	construction works	Closure	
			The DMC and UNOPS shall 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 shall 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 shall: • 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	Fire outbreaks	To avoid outbreaks of bush or forest fires	UNOPS and the contractor shall 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

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
			The contractor shall 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
Training or Capacity Building						
1.1.10	Increased capacity building activities by training	To capacity build the contractor's employees in BMP implementation	The contractor shall sensitize or train all its key employees on the importance of this BMP, its contents and how best to implement it and their roles.	Project mobilization	Project closure	UNOPS
		To sensitize or train employees and local community members on Biodiversity management	UNOPS shall offer biodiversity management training to contractor employees and the locals. This training will include sensitization on: • flora and fauna present in the area • Importance of flora and fauna present within in the sub-project site • Contents of this BMP, its implementation and roles of community and employees • Sustainable management of the water dam on site • Identification and Handling of key invasive species • Roles of community members on biodiversity management	Project mobilization	Project closure	UNOPS
1.2. AQUATIC (SITE PREPARATION AND CONSTRUCTION PHASE)						

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
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 shall 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	The contractor shall carefully handle materials that have a potential to cause pollution. Work sites will control soil erosion and prevent soil loosening activities. Solid waste shall be disposed of in a matter prescribed by ZEMA and the local town council. The contractor shall maintain buffer zones (Appendix 4- 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) shall 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	Project mobilization	On -going	• DMC • Traditional leaders • Fishers • Department Of Fisheries • Ministry of Livestock and Fisheries • Supervision UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
			capturing immature fish.			
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 shall adhere to best practices recommended by ZEMA when handling such materials. The waste shall be kept in bunded facilities. The final handlers shall be licensed waste management handler. Hydrocarbons shall not be allowed in water. Any spill shall be handled using spill kits and isolation methods. These shall be disposed of in a matter prescribed by ZEMA. The contractor shall maintain water quality monitoring including establishing baslines water quality. This shall include the pH investigations which were inconclusive during the study (see above).	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 shall 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 bodies development

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
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) shall 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
2.0. OPERATIONS PHASE						
2.1. TERRESTRIAL						
Flora						
2.1.1	Increase in vegetation restoration	To revegetate the area in the vicinity of the dam To promote catchment management (Appendix 4)	DMC and IDSP shall 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 4- dam and dambo management). The MoA, Department of Forestry and Fisheries shall implement catchment management with DMC and	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS Forestry, WARMA, Agriculture, Fisheries etc.

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
			traditional leaders for upstream protection and dam conservation needs. Catchment management is detailed in Appendix 4.			
Fauna						
2.1.2	Increase in conservation/management of fauna on site	To conserve/manage fauna within the dam's area of influence	DMC in collaboration of the Local authorities shall 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 water bodies 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
Rehabilitation of Legacy and New Borrow Pits						

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
2.1.3	Promotion of habitats by the rehabilitation of legacy and present borrow sites	To rehabilitate both New and Old Borrow Pits on site	At the end of construction works (during operation phase of the dam), the contractor shall rehabilitate both new and old borrow pits. This will be done by: • Re-sloping the edges of the pits to a gradient equal to or less than 45^0; • Creating a drainage system so has to avoid stagnation of water at the borrow pit sites; and • Tilling the area to a depth of 30cm and revegetating with indigenous tree species and grass seeds	Operations Phase of the project	Completion of rehabilitation works	Contractor and UNOPS Supervision - UNOPS
Training (Capacity Building)						
2.1.4	Increase in capacity building activities among DMC and local community members	To train or sensitize DMC and local communities	Before handing over of the dam, UNOPS shall sensitize and train the DMC and key members of the local communities such as traditional authorities, and selected influential individuals on: • Dam management and safety; • Emergency Preparedness in an event of dam failure • Continued biodiversity conservation; • Continued implementation of this BMP; and their roles in all this.	Project Operation Phase	Completion of training	UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
Invasive Species						
2.1.5	Increase in invasive fauna and flora species management	To prevent colonization of project area of influence by invasive species	UNOPS and forestry shall train the DMC and selected local community members on the implementation of invasive species management Communities shall not introduce invasive species. Any spotted invasive species shall be controlled by the DMC from the start.	Project Operation Phase	Completion of training	UNOPS DMC
Demobilization						
2.1.6	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 shall • 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 shall rehabilitate all borrow pits on site as described under section 2.1.3 of this BMP	End of construction works	Demobilization	Contractor Supervision - UNOPS
2.2. AQUATIC (OPERATIONS PHASE)						

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
2.2.1	Increase in populations of flora, fauna; when habitat integrity is enhanced	Providing a conducive habitat for aquatic biodiversity	The contractor shall rehabilitate the dam which is a habitat for aquatic biodiversity and will protect habitats during works. DMC shall be trained in proper sustainable fishing methods and dam protection. Protection of the water bodies 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 water bodies	The UNOPS design shall ensure and promote ecological flows over the spillway according to the dam's storage ratio and the stream's flow regime. The flows should be continous. The IDSP and UNOPS shall train the DMC on flow monitoring and its importance. The DMC and IDSP shall monitor flows. DMC shall ensure protection and maintenance of. The dam shall be protected by conserving the features, avoiding gardens around them and siltation, using proper fishing methods, preventing invasive species, and prevention of soil erosion.	End of construction works	Demobilization	• DMC IDSP

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
			Protecting these habitats shall ensure continuous protection of life forms and their flow during runoff seasons			
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 shall not allow grazing close to the dam and vegetation shall be maintained. Preventing cattle and human activity to intervene in riparian/wetland areas would be important to avoid further degradation (Appendix 4- 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 shall take part in catchment management and protection of buffer zones (Appendix 4) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC shall 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

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
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/ MoA shall 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 shall take part in catchment management and protection of buffer zones (Appendix 4) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC shall allocate specific livestock watering points that have some erosion control vegetation and rock features to minimize soil loosening.	End of construction works	Demobilization	• DMC • Traditional leaders • IDSP Forestry
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, shall ensure that awareness and education executed as regards sustainable	End of construction works	On-going	• DMC • Ministry of fisheries & Livestock • Traditional leaders

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
			harvesting of the 2 threated tilapia species. DMC and fisheries shall ensure controlled catching and breeding season breaks will be enforced. Fishing methods shall be regulated by DMC with sustainable methods to prevent catching and destruction of eggs, invertebrates, plankton, and small fishes. Biodiversity shall be protected by sedimentation control and pollution prevention by the communities; and catchment management. The DMC and Fisheries shall not introduce invasive species on the water			
2.2.8	Increased education and awareness on threatened tilapia species Capacity building- Increased knowledge and	To create awareness and educate the communities concerning the 2 threatened *tilapia* species (Green headed bream (*Oreochromis machrochir* and Three spotted tilapia	The DMC collaborating with traditional leaders, Min. of Fisheries and Livestock, to ensure that awareness and education executed as regards sustainable harvesting of the 2 threated tilapia species. Catch and release recommended for these 2 species.	Project mobilization	On-going	Supervision • DMC • Ministry of Agriculture • Ministry of Fisheries and Livestock • Traditional leaders

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
	ability among locals	(*Oreochromis andersonii*) to ensure sustainability	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.			
2.2.9	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, shallensure 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
2.2.10	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, shall 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

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
2.2.11	Increased infrastructure failure and sedimentation due to lack of maintenance activities In case of maintenance failure and dam failure, settlements/infrastructure 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 shall 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 shall also implement catchment management activities over a period of time (Appendix 4).	Project mobilization	On-going	• DMC • Ministry of Agriculture • Ministry of Fisheries and Livestock • Traditional leaders • Water resources development department

Follow-up and Monitoring

The monitoring plan for the sub-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 42 Biodiversity Management and 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 shall use already cleared areas where possible. Where there is need to clear, clear boundary or working area shall be defines and fenced off as the only defined area where vegetation clearing shall 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 shall 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	To ensure availability of diverse habitats for various forms of insects and animals.	The contractor shall 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.	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	The contractor shall restock affected areas with miombo vegetation to allow for re-colonization of the associated biodiversity.	At completion of remedial works.	• Contractor • Forestry Department	Affected areas restocked with miombo vegetation.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
		equipment and machinery during remedial measures.			• Dam management committee.	
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 shall 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 shall 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 shall develop a dam operation manual and selected relevant sections to capacity build in the DMC. The contractor with stakeholders shall 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 the MoA and local council	No. of trainings/sensitization meetings held
Operation phase						

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
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 Dept. of Forestry with the catchment management Committee shall conduct reforestation of the impacted areas. They shall: 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, 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	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. One community sensitization meeting report per quarter.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			Catchment management (Appendix). DMC shall control and monitor any invasive weed infestation.			
2.	Loss of flora in the stream catchment areas has the potential to degenerate water bodies	To ensure continued availability of water for animal watering and vegetable gardening.	The DMC and Dept. of Forestry shall protect the Katembula 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 • Dept. of Forestry • Local traditional leadership. • DMC	Catchment area protection sensitization programme.
2.0 Aquatic						
Construction phase						
1.	Loss of feeding and breeding grounds	Loss of feeding and breeding grounds	The contractor shall maintain any feeding and breeding grounds for aquatic life during works.	During rehabilitation works.	• Contractor • UNOPS • DMC • Dept. of Fisheries	Protected breeding grounds
2.	Loss of natural water bodies	Loss of habitats	The DMC and contractor shall 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.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
4.	Increased fish abundance in the dam due to favorable breeding and feeding grounds	To ensure sustenance and improved fish stock abundance in the dam.	The DMC and fisheries shall regulate fishing activities to protect the stock from overfishing.	After rehabilitations works	• Fisheries department • DMC • Local traditional leadership	Dam management by-laws drafted by completion of rehabilitation works
5.	Increased impacts on the species of conservation concern	To avoid any mortalities of these species	The contractor shall conduct robust visual observations before undertaking any works The DMC and fisheries shall 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 shall protect the breeding grounds for fish by ensuring no fishing activities take place in shallow waters. DMC and Fisheries shall protect fish species by monitoring the quantities and using safe fishing methods DMC shall 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 shall maintain riparian vegetation around the dam by prohibiting cutting and farming close to the dam.	During and after rehabilitation works.	• Forestry Department • Fisheries Department	Dam management by-laws drafted by completion of rehabilitation works.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			DMC, Depts. Of Forestry and Fisheries and other stakeholders shall conduct catchment management (see Appendix)		• Local Traditional Leadership • DMC	
3.	Increase in solid waste disposal in the reservoir compromising water quality and thus affecting aquatic species due to decomposition of organic matter, depleting oxygen in the reservoir	To keep the dam free from solid waste disposal to ensure good water quality. No debris to obstruct sunlight for photosynthetic processes guaranteeing oxygen generation in the water column for aquatic species	DMC shall 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 DMC to the District Management Committee on solid waste disposal submitted every month. 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 43Roles 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 Katembula 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 Katembula dam. The IDSP-PIU shall retain the primary responsibility for ensuring that environmental and social commitments for the Katembula 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 Katembula Dam site. • The IDSP shall have an environmental specialist who shall 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 Katembula dam site 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, DMC 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 DMC. • IDSP will implement its own monitoring and supervision activities as they apply for all activities, including the remediation of Katembula Dam. IDSP has the overall responsibility for monitoring and reporting, but is supported by UNOPS' monitoring and quality assurance activities. IDSP and UNOPS shall

	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 Katembula 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 shall 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 shall 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 shall 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 Katembula 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 shall be responsible for and will oversee, supervise and monitor the works of the contractor, including the contractor's E&S performance. • UNOPS shall 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 shall 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 shall 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 shall take measures in the case of non-compliance. It will immediately liaise with the contractor, assess the risk level, significant and severe risks shall 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 shall 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 shall inform the relevant offices for catchment management. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP shall be communicated to relevant ministries indicated.
Contractor	UNOPS shall contract the contractor after preparation of bidding documents. The selected contractor shall 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 shall 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 shall 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 shall 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 shall work within the requirements of legislative requirements and standards • Contractor shall carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor shall 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 shall 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 DMC and local authorities.
Local community and DMC	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 DMC 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 Katembula DMC 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 Katembula 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; 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 DMC and local authorities. MoA has representatives at the dam site 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 shall form the incident investigation team and shall provide incident reporting on a monthly basis to UNOPS, and UNOPS shall 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 Katembula DMC 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 terrestrial ecological assessment was conducted in compliance with local and international guidelines in determining the baseline terrestrial and aquatic conditions in the project area of influence. The mitigation measures for the rehabilitation project impacts on the ecosystem (flora and fauna) have been devised as documented in section 5 of this report. The rehabilitation and subsequent operation of the Katembula Dam will significantly improve water supply to the New Lufwanyama Township. However, as is the case with many development projects, Katembula Dam may impact the environment negatively through increased anthropogenic activities attracted by presence of an assured water supply which also my lead to overfishing.

One of the environmental impacts include clearing vegetation to open up areas for crop production. This may result in increased pressure to the existing fragmentation of and affect the Katembula Stream through increased sediment load resulting from erosion of cleared land and consequently, the Kafue river system.

Human population increase attracted by the dam's works and improvements may lead to overfishing and contribute to the depletion of the fish resources.

In order to reduce the impacts of dam construction and operations phases, mitigation measures have been proposed in section 5.

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APPENDICES

Appendix 1:Terrestrial Data Collection Forms

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

Fauna data collection sheet

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

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

Appendix 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			

Macroinvertebrates survey

Order	**Sub/Family**	**English name**	**Comments**
Odonata	Libellulidae	Dragonflies	
	Aeshnidae	Dragonflies	
Diptera	Tabanidae	Horseflies	
	Culicidae	Mosquito	
	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			

Appendix 3 Tree Species Quantities

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:

$$\text{Importance value Indices (IVI)} = \frac{RF + RD + RBA}{3}$$

Where:

- RF = Relative Frequency;

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

- RD = Relative Density; and

$$\text{Relative density} = \frac{\text{Number of stems recorded for species} * 100}{\text{Number of stems recorded for all species}}$$

- RBA = Relative Basal Area

$$\text{Relative basal area} = \frac{\text{Basal area of a species in a community} * 100}{\text{Total basal area of all species in the community}}$$

Appendix 4: Importance Values Calculations of Tree Species

Botanical name	Units in which species Occurred	Frequency (n)	Density	Basal area	Relative frequency	Relative density	Relative dominance	Importance value	IUCN Status
Isoberlinia angolensis	20	156	0.11009	1544.53	90.9091	11.0092	2.89876	34.939	LC
Brachystegia boehmii	20	59	0.04164	1166.15	90.9091	4.16373	2.18863	32.4205	LC
Anisophyllea boehmii	17	55	0.03881	448.835	77.2727	3.88144	0.84237	27.3322	LC
Albizia adianthifolia	16	83	0.05857	1008.74	72.7273	5.85745	1.89319	26.826	LC
Ochna pulchra	13	39	0.02752	291.578	59.0909	2.75229	0.54723	20.7968	LC
Monotes africanus	13	24	0.01694	314.357	59.0909	1.69372	0.58998	20.4582	LC
Brachystegia spiciformis	12	55	0.03881	455.511	54.5455	3.88144	0.8549	19.7606	LC
Pericopsis angolensis	12	46	0.03246	639.0828	54.5455	3.24629	1.19943	19.6637	LC
Marquesia macroura	12	18	0.0127	508.376	54.5455	1.27029	0.95412	18.9233	LC
Albizia antunesiana	11	44	0.03105	277.674	50	3.10515	0.52114	17.8754	LC
Markhamia obtusifolia	11	13	0.00917	167.312	50	0.91743	0.31401	17.0771	LC
Albizia versicolor	9	50	0.03529	1117.14	40.9091	3.52858	2.09664	15.5114	LC
Albizia amara	9	11	0.00776	92.2963	40.9091	0.77629	0.17322	13.9529	LC
Strychnos spinosa	8	24	0.01694	121.91	36.3636	1.69372	0.2288	12.7621	LC
Parinari capensis	8	9	0.00635	165.898	36.3636	0.63514	0.31136	12.4367	LC
Julbernardia paniculata	7	34	0.02399	319.463	31.8182	2.39944	0.59957	11.6057	LC
Combretum zeyheri	7	20	0.01411	175.167	31.8182	1.41143	0.32875	11.1861	LC
Piliostigma thonningii	7	17	0.012	234.472	31.8182	1.19972	0.44005	11.1527	LC
Anonna senegalensis	7	8	0.00565	75.4866	31.8182	0.56457	0.14167	10.8415	LC
Pterocarpus angolensis	6	45	0.03176	636.805	27.2727	3.17572	1.19515	10.5479	LC
Phyllocosmus lemaireanus	6	39	0.02752	364.001	27.2727	2.75229	0.68315	10.2361	LC

Sterculia quinqueloba	6	17	0.012	175.167	27.2727	1.19972	0.32875	9.6004	LC
Dyplorhynchus condylocarpon	6	16	0.01129	126.544	27.2727	1.12915	0.2375	9.54646	LC
Hymenocardia acida	6	15	0.01059	52.7071	27.2727	1.05857	0.09892	9.47674	LC
Brachystegia manga	6	9	0.00635	127.251	27.2727	0.63514	0.23882	9.38223	LC
Bobgunia madagascariensis	6	10	0.00706	89.0757	27.2727	0.70572	0.16718	9.38187	LC
Syzygium guineense	4	93	0.06563	701.294	18.1818	6.56316	1.31618	8.68705	LC
Acacia polyacantha	5	21	0.01482	170.768	22.7273	1.482	0.3205	8.17659	LC
Rothmannia englerana	5	12	0.00847	168.883	22.7273	0.84686	0.31696	7.9637	LC
Uapaka nitida	5	11	0.00776	197.161	22.7273	0.77629	0.37003	7.95786	LC
Phyllanthus muelleranus	4	23	0.01623	424.17	18.1818	1.62315	0.79608	6.86701	LC
Vitex doniana	4	24	0.01694	122.538	18.1818	1.69372	0.22998	6.70184	LC
Parinari curatellifolia	4	22	0.01553	168.176	18.1818	1.55258	0.31563	6.68334	LC
Uapaca Kirkiana	4	18	0.0127	121.595	18.1818	1.27029	0.22821	6.56011	LC
Strychnos cocculoides	4	17	0.012	120.182	18.1818	1.19972	0.22556	6.5357	LC
Brachystegia longifolia	4	12	0.00847	99.0516	18.1818	0.84686	0.1859	6.40486	LC
Burkia africanus	4	10	0.00706	128.429	18.1818	0.70572	0.24104	6.37619	LC
Erythrophleum africanus	4	5	0.00353	79.9639	18.1818	0.35286	0.15008	6.22825	LC
Diospyros batocana	4	5	0.00353	51.843	18.1818	0.35286	0.0973	6.21066	LC
Erythrina abyssinica	3	27	0.01905	79.9639	13.6364	1.90543	0.15008	5.23062	LC
Pseudolachnostylis maprouneifolia	3	18	0.0127	209.729	13.6364	1.27029	0.39362	5.10009	LC
Trema orientalis	3	16	0.01129	111.855	13.6364	1.12915	0.20993	4.99181	LC
Strychnos innocua	3	17	0.012	25.9215	13.6364	1.19972	0.04865	4.96158	LC
Uapaka sansibarica	3	10	0.00706	99.2087	13.6364	0.70572	0.18619	4.84276	LC
Terminelia stenostachya	3	8	0.00565	172.81	13.6364	0.56457	0.32433	4.84176	LC
Oxytenanthera abyssinica	3	7	0.00494	38.7252	13.6364	0.494	0.07268	4.73435	LC

Combretum molle	2	34	0.02399	231.094	9.09091	2.39944	0.43372	3.97469	LC
Parkia filicoidea	2	17	0.012	482.69	9.09091	1.19972	0.90591	3.73218	LC
Oldfieldia dactylophylla	2	18	0.0127	284.822	9.09091	1.27029	0.53455	3.63192	LC
Ficus sycomorus	2	15	0.01059	201.874	9.09091	1.05857	0.37887	3.50945	LC
Ficus wakefieldii	2	10	0.00706	173.674	9.09091	0.70572	0.32595	3.37419	LC
Olax obtusifolia	2	10	0.00706	68.1029	9.09091	0.70572	0.12781	3.30815	LC
Ochna schweinfurthiana	2	7	0.00494	109.97	9.09091	0.494	0.20639	3.26377	LC
Hexalobus monopetalus	2	8	0.00565	36.84	9.09091	0.56457	0.06914	3.24154	LC
Terminalia sericea	2	6	0.00423	37.704	9.09091	0.42343	0.07076	3.19503	LC

Appendix 5: Tree Species Diversity by Shannon and Simpson Index and Water quality results

Botanical name	Frequency (n)	pi	pi2	ln (pi)	pi ln pi
Acacia polyacantha	21	0.0119	0.000141563	-4.4313835	-0.05272
Albizia adianthifolia	83	0.04703	0.002211397	-3.0570654	-0.14376
Albizia amara	11	0.00623	3.88415E-05	-5.0780107	-0.03165
Albizia antunesiana	44	0.02493	0.000621464	-3.6917163	-0.09203
Albizia versicolor	50	0.02833	0.00080251	-3.563883	-0.10096
Anisophyllea boehmii	55	0.03116	0.000971037	-3.4685728	-0.10809
Anonna senegalensis	8	0.00453	2.05443E-05	-5.3964644	-0.02446
Bobgunia madagascariensis	10	0.00567	3.21004E-05	-5.1733209	-0.02931
Brachystegia boehmii	59	0.03343	0.001117415	-3.3983685	-0.1136
Brachystegia longifolia	12	0.0068	4.62246E-05	-4.9909993	-0.03393
Brachystegia manga	9	0.0051	2.60013E-05	-5.2786814	-0.02692
Brachystegia spiciformis	55	0.03116	0.000971037	-3.4685728	-0.10809
Burkia africanus	10	0.00567	3.21004E-05	-5.1733209	-0.02931
Combretum molle	34	0.01926	0.000371081	-3.9495454	-0.07608
Combretum zeyheri	20	0.01133	0.000128402	-4.4801737	-0.05077
Diospyros batocana	5	0.00283	8.0251E-06	-5.8664681	-0.01662
Dyplorhynchus condylocarpon	16	0.00907	8.2177E-05	-4.7033172	-0.04264
Erythrina abyssinica	27	0.0153	0.000234012	-4.1800691	-0.06394
Erythrophleum africanus	5	0.00283	8.0251E-06	-5.8664681	-0.01662
Ficus sycomorus	15	0.0085	7.22259E-05	-4.7678558	-0.04052
Ficus wakefieldii	10	0.00567	3.21004E-05	-5.1733209	-0.02931
Hymenocardia acida	15	0.0085	7.22259E-05	-4.7678558	-0.04052
Isoberlinia angolensis	156	0.08839	0.007811956	-2.42605	-0.21443
Julbernardia paniculata	34	0.01926	0.000371081	-3.9495454	-0.07608
Markhamia obtusifolia	13	0.00737	5.42497E-05	-4.9109566	-0.03617
Marquesia macroura	18	0.0102	0.000104005	-4.5855342	-0.04676
Hexalobus monopetalus	8	0.00453	2.05443E-05	-5.3964644	-0.02446
Monotes africanus	24	0.0136	0.000184898	-4.2978521	-0.05844
Ochna pulchra	39	0.0221	0.000488247	-3.8123443	-0.08424
Ochna schweinfurthiana	7	0.00397	1.57292E-05	-5.5299958	-0.02193
Olax obtusifolia	10	0.00567	3.21004E-05	-5.1733209	-0.02931
Oldfieldia dactylophylla	18	0.0102	0.000104005	-4.5855342	-0.04676
Oxytenanthera abyssinica	7	0.00397	1.57292E-05	-5.5299958	-0.02193
Parinari capensis	9	0.0051	2.60013E-05	-5.2786814	-0.02692
Parinari curatellifolia	22	0.01246	0.000155366	-4.3848635	-0.05466
Parkia filicoidea	17	0.00963	9.27702E-05	-4.6426926	-0.04472
Phyllanthus muellerianus	23	0.01303	0.000169811	-4.3404118	-0.05656
Phyllocosmus lemaireanus	39	0.0221	0.000488247	-3.8123443	-0.08424
Piliostigma thorninji	17	0.00963	9.27702E-05	-4.6426926	-0.04472
Pseudolachnostylis maprouneifolia	18	0.0102	0.000104005	-4.5855342	-0.04676

Pterocarpus angolensis	45	0.0255	0.000650033	-3.6692435	-0.09355
Rothmannia englerana	12	0.0068	4.62246E-05	-4.9909993	-0.03393
Sterculia quinqueloba	17	0.00963	9.27702E-05	-4.6426926	-0.04472
Strychnos cocculoides	17	0.00963	9.27702E-05	-4.6426926	-0.04472
Strychnos innocua	17	0.00963	9.27702E-05	-4.6426926	-0.04472
Strychnos spinosa	24	0.0136	0.000184898	-4.2978521	-0.05844
Pericopsis angolensis	46	0.02606	0.000679245	-3.6472646	-0.09506
Syzygium guineense	93	0.05269	0.002776364	-2.9433065	-0.15509
Terminelia stenostachya	8	0.00453	2.05443E-05	-5.3964644	-0.02446
Terminalia sericea	6	0.0034	1.15561E-05	-5.6841465	-0.01932
Trema orientalis	16	0.00907	8.2177E-05	-4.7033172	-0.04264
Uapaca Kirkiana	18	0.0102	0.000104005	-4.5855342	-0.04676
Uapaka nitida	11	0.00623	3.88415E-05	-5.0780107	-0.03165
Uapaka sansibarica	10	0.00567	3.21004E-05	-5.1733209	-0.02931
Vitex doniana	24	0.0136	0.000184898	-4.2978521	-0.05844
				s	55
				N	1417
				sum (pi ln pi)	-3.11374
				sum (pi2)	0.0234612
				Shannon index	3.1137401
				Simpson index	42.623517

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	Katembula Dam Downstream	Katembula Dam Middle	Katembula Dam Borehole	Katembula Dam Upstream
Sampling date	**19.04.2021**	**19.04.2021**	**19.04.2021**	**19.04.2021**
Parameter				
pH	6.46	4.83	6.29	5.99
Conductivity (µs/cm)	140	165	138	62
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)	80	90	80	20
Total Dissolved Solids (mg/l)	70	83	67	32
Ammonia (as NH_3-Nmg/l)	<0.01	<0.01	<0.01	<0.01
Phosphates (mg/l)	0.70	0.70	0.90	0.40
Total Suspended Solids (mg/l)	5.3	<1.0	<1.0	<1.0
Chemical oxygen demand (as mg O_2/l)	5	10	7	2
Chlorides (mg/l)	25.0	15.0	30.0	18.0
Turbidity (NTU)	6.89	27.20	5.27	3.50
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 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[23]. 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 have lee modification of the habitats. 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 Katembula 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 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

[23] WARMA Act

- 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 Katembula 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 shall 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.

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 shall be implemented:

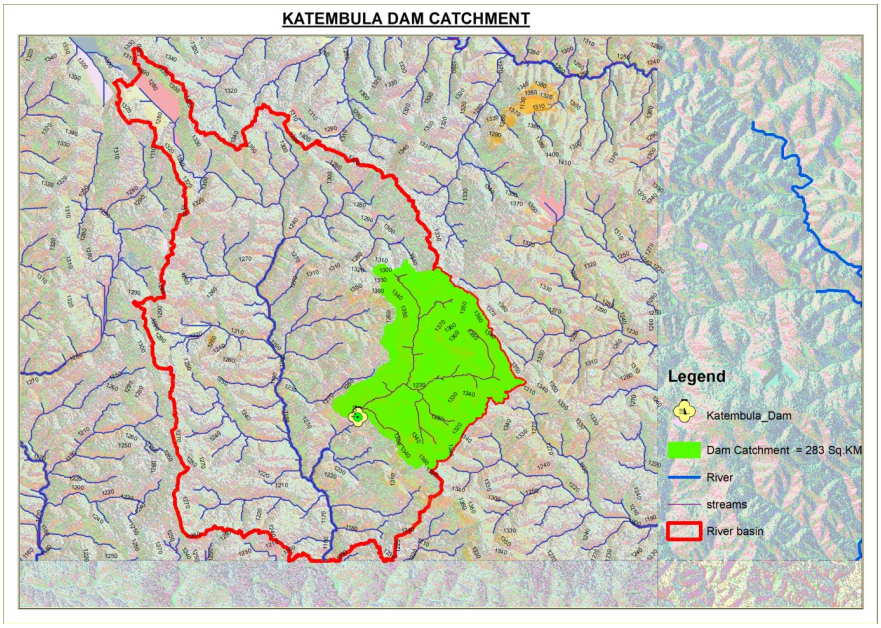
- Vegetation retention of existing undisturbed local provenance native plants should be standard practiced by the contractor and locals
- Restoration of native vegetated sites and buffers which have been degraded or removed, re-vegetation of slopes, should (where practical be restored) with native vegetation 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.
- 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 shall 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.

Appendix 7 Hydrology and Ecological Flows

Dam Catchment area



Photos (a-f) showing Katembula Dam flows in the cold dry season, July 2020

Photo a

Photo b

Photo c

Photo d

Photo e

Photo f