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 Ndondi Dam

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Prepared by UNOPS for the Government of the Republic of Zambia

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AF	Additional Financing
BDA	Biodiversity Assessment
BMP	Biodiversity Management Plan
CBD	Convention on Biological Diversity
CITES	Convention on International trade in Endangered Species
CoC	Code of Conduct
COD	Chemical Oxygen Demand
COVID-19	Corona Virus Disease 2019
CpUE	Catch Per Unit
CR	Critically Endangered Status
DMC	Dam Management Committee
DWRD	Department of Water Resources Development, previously Department of Water Affairs, WRDP implementer
E&S	Environmental and Social
EHS	Environmental, Health and Safety Guidelines
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
EPB	Environmental Project Brief
FAO	Food and Agriculture Organization of the United Nations
FD	Department of Forestry
fsl	Full Surface Level
GBV	Gender Based Violence
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

IV	Important Values
KBA	Key Biodiversity Area
LC	Least Concern Status
LMP	Labor Management Plan
MAR	mean annual runoff
MWDSEP	Ministry of Water Development Sanitation and Environmental Protection
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
PIU	Project Implementing Unit
RBA	Relative Basal Area
RD	Relative Density
RF	Relative Frequency
SEF	Safety Evaluation Flood
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
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
VU	Vulnerable Status
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

Ndondi Dam is located in Pemba District in the Southern 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), implemented by the Ministry of Agriculture and effective since 2011. The Ndondi dam site is about 36 km from the Pemba urban centre. Ndondi is an earth fill dam, which was newly constructed in 2008. The dam was built for aquaculture, irrigation and stock watering. However, the dam breached on the right bank in 2009 and was repaired the same year. Further remedial works were carried out in 2017 on the existing spillway sill. The drop structure downstream in the spillway return channel was completely replaced, and repairs on the spillway return channel training walls were undertaken.

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

The World Bank has provided Additional Financing (AF) to the IDSP to support remedial works on 10 of the dams constructed or rehabilitated by the WRDP. The 10 dams include Ndondi Dam. The United Nations Office for Project Services (UNOPS) is tasked with overseeing the works and with preparing this Environmental and Social Management Plan (ESMP), together with the Biodiversity Assessment and Management Plan (BMP), on behalf of the Government of the Republic of Zambia. The BMP is annexed to this ESMP. The objective of the ESMP is 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 Ndondi Dam include downstream seepage and downstream rock toe ineffectiveness; embankment slope damage due to livestock; no defined abutments; possible training wall overtopping; and spillway structure failure and leaks.

UNOPS has developed detailed designs for the remedial works on Ndondi Dam. The works will not change the nature and scope of the existing dam operation activities. They will be implemented in two ways: a) construction and demobilization, and b) remediation of the existing site.

Institutional Arrangements: The sub-project works on Ndondi Dam will be managed and implemented by the Ministry of Agriculture of Zambia, under the IDSP. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the IDSP-PIU will manage and implement the broader AF activities, it has contracted UNOPS to oversee and implement the remediation works on the ten selected dams. 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 contractor personnel to the IDSP-PIU through the AF Project Grievance Redress Mechanism (GRM). Upon completion of the works, the management, operation and maintenance of the

dam will be handed over to the Ndondi dam committee. In order to successfully operate the dam, and limit its negative impacts on people and environment, the dam committee members and the communities will receive capacity building and training.

The ESMP addresses the environmental and social risk and impacts, which were identified through extensive field assessments. It includes a construction works management plan with mitigation measures and performance indicators for non-hazardous waste; hazardous waste; soil; land use and aesthetics; surface and groundwater pollution; air quality and noise; sanitation; traffic; biodiversity assessment and management plan; community health and safety; gender equality and Gender Based Violence (GBV) and Sexual Exploitation and Abuse (SEA); labor and working conditions; decommissioning and rehabilitation measures and maintenance and monitoring.

It further includes a separate rehabilitation and remediation plan 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.

Further to the structural risks indicated above, health and safety and non-structural risks related to legacy issues of the dam include unrehabilitated contractor sites that pose health and safety issues for the communities; inability to monitor and assess downstream ecological effects of dam operation; lack of access across the spillway return channel; as well as injury and drowning risks for community members related to lack of awareness.

Social concerns include a failure to use the irrigation system, which poses risks of food insecurity; uncontrolled stock watering; and a lack of capacity / training for community members to benefit fully from fishing and irrigation water supply.

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

1. Introduction

Ndondi Dam is located in Pemba District in the Southern Province of Zambia. It is one of 10 dams that have been selected for remedial works under the World Bank funded Irrigation Development Support Project (IDSP). According to OP 4.37, the dam is classified as a small dam because its height is less than 15m. Since the initial works, the structural integrity of Ndondi Dam has been heavily compromised over the years. This has become a threat to the safety of the local community and downstream users. 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 environmental, social and dam engineering studies based on desk reviews, interviews and consultations with key sub-project stakeholders, and collection of field data at the dam site using field specific equipment. Initial field screening visits by the team revealed that an in-depth biodiversity assessment of the dam site was required. The biodiversity assessment was undertaken, the data analyzed and a Biodiversity Management Plan was developed.

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

Ndondi is an existing earth fill dam that was built in 2008. Right after construction, in 2009, it breached on the right bank and was repaired the same year. In 2017, remedial works were carried out on the spillway. The works were undertaken by the World Bank-funded Zambia Water Resources Development Project (WRDP) (P114949). The dam was initially built for livestock watering, fisheries and irrigation. It has an outlet, but the pipes are faulty and some were vandalized, therefore the irrigation system does not work.

The Water Resources Development Project (WRDP)

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

***WRDP E&S Safeguard*s:** The WRDP was classified as a 'Category B' project under the World Bank safeguards policies, and several policies were triggered. As a result, the following instruments were prepared, consulted and agreed upon: i) Environmental and Social Management Framework with a provision for cultural resources management and protection; ii) Pest Management Plan; and iii) Resettlement Policy Framework. The World Bank Integrated Safeguard Data Sheet (ISDS) indicated that

the project would not finance the construction of large dams and required only the generic dam safety measures contained in existing operational procedures and the application of the 2010 Food and Agricultural Organization (FAO) Technical Guide for Small Earth Dams for compliance with safeguards on dam safety.

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

Irrigation Development Support Project (IDSP)

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

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

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

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

IDSP Additional Financing (AF)

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

Phase 2 of the 2019 agreement and activity 2 of the AF provide remedial activities to reduce the risks/impacts related to construction and operation of the Ndondi Dam and provide support through training and capacity building, which is required to safely operate the dams and reduce the downstream environmental impacts. It is envisaged that the activities associated with the works will not change the nature and scope of the existing scheme and will not increase the dam's existing capacity. With this, it is projected that the remedial measures will not adversely change the quality or quantity of water flows downstream to other areas.

The scope of Phase 2 for Ndondi Dam consists of:

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

1.2. Objectives of the ESMP

This ESMP has been prepared to guide all the works on Ndondi Dam during Phase 2 of the IDSP AF. The main objectives of this ESMP are to implement remedial works to mitigate imminent identified risks to the environment, safety of communities, and their associated livelihoods, and to bring the dam's 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 Ndondi dam community, representatives of local government authorities, representatives of the GRZ, and members of the World Bank and IDSP teams. Field visits were conducted to the Ndondi dam site for detailed on-site assessments of the environmental and social impacts of the sub-project. This ESMP has been guided by the Zambian Environmental Management Act EIA Regulations (1997), as well as by the World Bank's OPs. Reference is made to the initially prepared and approved EPBs (DWRD 2017), the Remedial ESMP for 8 dams (COWI 2018), the Environmental and Social Audit (ESA) (April 2020), and recent dam assessments in order to determine environmental and social requirements for rehabilitation and restoration measures. The EMSP follows the format, which is laid out in the Environmental and Social Audit (April 2020).

In summary the following activities were undertaken by UNOPS:

- Literature review, including data and documentation provided by the IDSP to UNOPS:
    - Remedial Environmental and Social Management Plans of Eight (8) Dams Under the Water Resource Development Programme (2018)

        - Approval Decision letters by Zambia Environmental Management Authority (2017)
        - Environmental Project Briefs (EPB) prepared under WRDP (2017)
        - Environmental and Social Audit (ESA) of 10 Dams (IDSP, 2020)
    - Field studies by the UNOPS environmental and social (E&S) safeguards and engineering teams in July 2020, accompanied by IDSP team members.
        - Site environmental and social assessments
        - Site and analytical geotechnical studies
        - Site surveying
        - Site and desk terrestrial and aquatic biodiversity studies
        - Site and desk hydrological studies
    - Public participatory interviews, focus group discussions and community consultations.
    - Environmental quality monitoring – water quality sampling and analysis.
    - Ad hoc filling in of matrix and checklists based on impact assessment.

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

- Policy, legal and institutional framework
- Baseline conditions
- Remedial design with
    - Geotechnical information
    - Survey information
    - Hydrology information
- Safety reports-operations and maintenance/ emergency preparedness plan
- Basic biodiversity management plan (to be updated through a separate Biodiversity Assessment and 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

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 dam safety and integrity are likely to have environmental impacts. Provisions for mitigation measures for identified sub-project impacts are in place in order to eliminate or reduce the effects of these impacts. The measures are consistent with the requirements in the Environmental Management Act of 2011. As an example, some of the works to be undertaken may result in environmental discharges that will require ZEMA licenses for compliance and monitoring. Relevant pieces of regulations have been included in this ESMP and contractor's compliance with the regulations during the rehabilitation of the dam will be ensured.
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 the		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.

	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 a biodiversity assessment and a Biodiversity Management Plan, detailing specific conservation and mitigation measures to ensure sub-project activities promote the conservation and protection of both natural and cultural heritage in the sub-project affected areas, in compliance with the regulation.
Fisheries Resources Management			
Fisheries Act, Cap 200, 1974	Provides for development of commercial fishing and the registration of fishermen and their boats and the protection of endangered fish species.	IDSP Monitoring: Ministry of Agriculture and Livestock	The proposed dam will be used for fishing; commercial fishing may be eventually developed by communities. The provisions of this Act will be complied with in the management of these fish resources. Fishing will be conducted according to the regulations and the Department of Fisheries will be involved to train the community on relevant activities. UNOPS, on behalf of the GRZ, has included actions to ensure species are protected with the involvement of the Department of Fisheries in the District.
Lands Management			

The Lands Act, 1995 (CAP 292, CAP 289, CAP 288)	The Department of Lands administers the Land Act, 1995 (CAP 292, CAP 289, CAP 288) and the Lands Acquisition Act, 1995 for the allocation and alienation of land under statutory leaseholds. The Department is also responsible 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 will on behalf of the GRZ comply with the requirements of this Act for measures related to pollution control and environmental protection functions which are handled by the local council. It will ensure that the council and stakeholders are involved in the planning, rehabilitation and operation activities.
Agricultural Lands Act No 13 of 1994 (Cap. 187)	The Act establishes the Agricultural Land Board and provides for its functions which inter alia includes; keeping under review the use that is being made of state land, outside urban and peri-urban areas and to make	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Agriculture	The sub-project construction work and dam operation activities may be carried out on agricultural lands and thus assessment of the impacts of these activities on the agricultural areas in the sub-project area was undertaken. UNOPS, the contractor and stakeholders will comply with this law in relation to rehabilitation and operation of the dam.

	recommendation to the Minister responsible for agriculture. The Act provides for tenant farming schemes.		
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 the development must comply with provisions of the Act. UNOPS and contractors will comply with all the regulations under this Act, traffic safety rules for communities, and traffic management. This ESMP includes a traffic management plan.
Tourism Management			
Zambia Wildlife Act No. 14 of 2015	Management and Protection of National Parks and Wildlife respectively	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Tourism	The dam is located in a remote rural area; hence all activities by UNOPS, on behalf of the GRZ, will comply with the requirements of this regulation, if the protection of wildlife is required. The ESMP determines appropriate actions to ensure preservation of national parks and protected areas, wildlife, and protected and endangered species by including ecologists on the team. A biodiversity assessment was conducted and a BMP was prepared.
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 complies with the provisions of these regulations during the course of employment.
Occupational Health and	Provides for the health and safety of persons at work and	Contractor, UNOPS	UNOPS will, on behalf of the GRZ, ensure that the contractor complies with the occupational health and safety requirements of

Safety Act	for the health and safety of persons in connection with the use of plant and machinery.	Monitoring: Ministry of Labour	the Act, and promotes safety by ensuring all measures required to ensure the well-being of the workers are in place.
Worker's Compensation Act No. 10 of 1999	Establishment and administration of a Fund for the compensation of workers disabled by accidents to, or diseases contracted by such workers in the course of their employment, and for the payment of compensation to dependants of workers who die as a result of such accidents or diseases.	Contractor, UNOPS Monitoring: Ministry of Labour	This Act is relevant to the sub-project because workers are at higher risk of suffering from injuries that could lead to disabilities or contracting diseases due to the nature of their work environment. In the event of work-related accidents, the provisions of this Act will be triggered. UNOPS and its contractor will comply with regulations under this Act by registering with the Workers Compensation Board and by providing safe working sites.
Community Health and Safety			
The Public Health Act of 1995	Prevention and suppression of diseases and regulation of all matters connected with public 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 will, on behalf of the GRZ, take measures to prevent diseases and pollution dangerous to human health by ensuring that there are good sanitation and waste disposal systems on the working premise (prevention of vectors etc…).
The Gender Equity and Equality Act, 2015	Taking of measures and strategic decisions to ensure gender equity, equality and integration of both sexes in	Contractor, UNOPS Monitoring: Ministry of Gender	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

	society; promotes gender equity and equality as a cross cutting issue in all spheres of life and stimulate productive resources and development opportunities for both sexes; prohibits harassment, victimization and harmful social, cultural and religious practices; provides for public awareness and training on issues of gender equity and equality; provides for the elimination of all forms of discrimination against women, empowers women and achieve gender equity and equality	Ministry of Community Development and Social services	under this Act. This ESMP includes a gender equality and GBV action plan.
The Anti-gender-based Violence Act, 2011	The Act provides for the protection of victims of gender-based violence; constitutes the Anti-Gender-Based Violence Committee.	Contractor, UNOPS Monitoring: Ministry of Gender 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	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.

	Unit (DMMU).		
Zambia Coronavirus Disease (COVID-19) Statutory Instruments Public Health (Infected Areas) (Coronavirus Disease 2019) Regulations, No. 22 of 2020; Public Health (Notifiable Infectious Disease) (Declaration) Notice, No. 21 of 2020; The Employment Code (Exemption) Regulations, 2020; The Public Health (Infected Areas) (Coronavirus Disease 2019) (Amendment) Regulations, 2020	Construction and operational activities will involve workers and the community on site. Zambia is currently experiencing the COVID-19 pandemic according to the national notifiable infectious disease declaration notice of March 2020.	UNOPS to ensure enforcement during preparation and construction phase	COVID-19 prevention and management measures are included in this ESMP.

2.2. World Bank Operational Policies

This sub-project will 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 Notes on 'Addressing Gender Based Violence in Investment Project Financing Involving Major Civil Works'[1] and 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 listed 6 triggered policies for the project, but the Ndondi Dam subproject has not triggered OP 4.12 **(**Involuntary Resettlement), because there is no anticipated resettlement for the subproject.

Table 2: Relevant World Bank Operational Policies (OP)

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 Ndondi 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 Ndondi Dam, UNOPS has prepared this ESMP, following the requirements defined in the ESA. The sub-project will implement all measures described in both instruments to mitigate all identified negative impacts.
OP 4.04	Natural Habitats:	This policy is triggered because the construction of the dam has caused impacts in natural and modified habitats. Also, the impact of the operation of the dam on the downstream flow and the induced impacts of increasing human

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

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

		populations on both aquatic and terrestrial ecosystems were identified in the ESA as an area of weakness in the previous safeguard instruments that must be rectified. The previous ESMP was prepared for 8 dams (including Ndondi Dam) and listed some of the ecological impacts associated with Ndondi Dam and flow regulation but argued in favor of the dam as a means of guaranteeing flow in the downstream system in the dry season and during times of drought. This presupposes that flows will be managed to benefit downstream ecology, which, given capacity limitations and cost, is far from certain; and while there may be benefits in supplementing ecological base flows in dry periods, this does not necessarily outweigh other negative considerations. Cumulative changes brought about by the dam may negatively affect the downstream aquatic and wetland environment, including creating a barrier to the movement of aquatic species. The opportunity to properly address these above issues, as required by OP 4.01, has to some extent passed. The dam is already built. There are, however, some options for impact minimization, as well as actions to make the most of the potential benefits of flow regulation. It should be noted, however, that Ndondi Dam was constructed on a seasonal stream and therefore the downstream ecology is cut off from the overflow via the spillway in dry season. The downstream and upstream ecology survives on the water dambos that remain existing in the river bed. 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). UNOPS has conducted a biodiversity assessment and a BMP is annexed to this ESMP to enhance conservation of flora and fauna during and after the remedial works.
OP 4.09	Pest Management	The policy is triggered because of the potential negative impacts that the activities of the IDSP could generate in agriculture expansion (through the use of agrochemicals), as a result of the remediated dam and its potential for irrigation. The IDSP Pest Management plan will be adhered to.
OP 4.37	Safety of the dam	This policy is triggered because the remediation works at the dam are necessary to ensure dam safety. The dam is considered a small dam because it has a height less than 15m. UNOPS and its contractors will follow Good International Industry Practice (GIIP) to determine and implement corrective actions that mitigate dam safety issues. For the sub-project a *Plan for construction supervision and quality assurance*, *Operation and Maintenance (O&M) Plan*, and an *Emergency Preparedness Plan (EPP)* have been prepared.

OP 7.50	Project on International Waterways	The policy is triggered because the remediation of the dam site was not previously part of the IDSP umbrella, and Ndondi Dam is a tributary of the Zambezi river. Under the AF, IDSP has been requesting for an exception to notification according to paragraph 7a[3] of the policy. The project qualifies for an exception given that works and activities would not exceed the original scheme, change its nature, or alter or expand its scope and extent as to make it appear a new or different scheme. The dam remedial works consist of strengthening and stabilizing existing dam embankments and completing and reinforcing existing spillways to ensure dam safety. The activities will not change the nature and scope of the existing schemes and will not increase the dam's existing capacity. Therefore, these remedial measures will not adversely change the quality or quantity of water flows to the other riparian users; and will not be adversely affected by the other riparian users' possible water use. Further, the sub-project also includes measures identified in this and other ESMPs (for the other nine dams), which will help mitigate impacts on flows and water quality.

2.3. The World Bank Environment, Health and Safety General Guidelines

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

- Environment- air emissions and quality; energy conservation; wastewater and ambient water quality; water conservation; hazardous materials management; waste management; noise and contaminated land.
- Occupational health and safety- facility design and operation; communication and training; hazards; PPE and monitoring.
- Community health and safety- water quality and availability; infrastructure structural safety; life and fire safety; traffic safety; transport of hazardous materials; disease prevention and emergency preparedness and safety.
- Construction with decommissioning – environment, occupational health and safety and community health and safety.

[3] The following exceptions are allowed to the Bank's requirement that the other riparian states be notified of the proposed project: (a) For any ongoing schemes, projects involving additions or alterations that require rehabilitation, construction, or other changes that in the judgment of the Bank (i) will not adversely change the quality or quantity of water flows to the other riparians; and (ii) will not be adversely affected by the other riparians' possible water use. This exception applies only to minor additions or alterations to the ongoing scheme; it does not cover works and activities that would exceed the original scheme, change its nature, or so alter or expand its scope and extent as to make it appear a new or different scheme. In case of doubt regarding the extent to which a project meets the criteria of this exception, the executive directors representing the riparians concerned are informed and given at least two months to reply. Even if projects meet the criteria of this exception, the Bank tries to secure compliance with the requirements of any agreement or arrangement between the riparians.

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

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

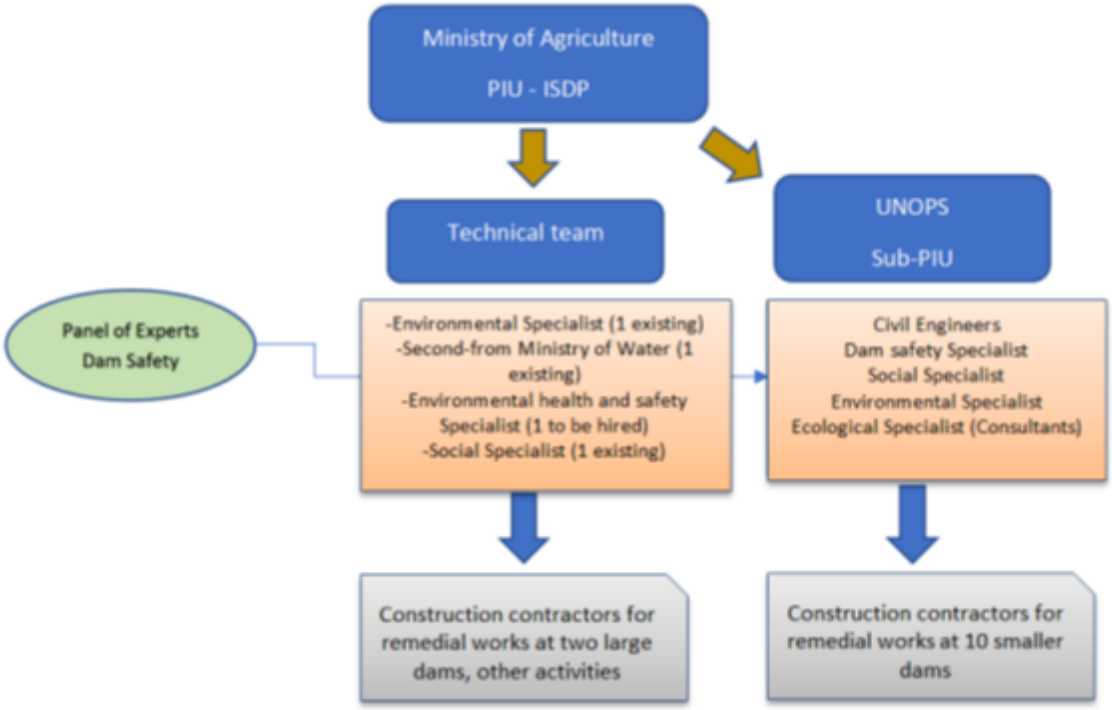


Figure 1: Institutional arrangement for sub-project implementation

3.1. Ministries / IDSP-PIU

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

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

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

The IDSP-PIU will retain the primary responsibility for ensuring that environmental and social commitments for the Ndondi 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 Ndondi 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 sub-project lies specifically with the environmental specialist, the environmental health and safety specialist and the social specialist (Figure 1). Furthermore, at least one additional MoA field staff member with health, safety and environmental responsibilities will be located at Ndondi dam site for continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP.

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

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

3.2. United Nations Office for Project Services (UNOPS)

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

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

The environmental specialist, ecologist and the social specialist will be involved in the environmental and social management of Ndondi 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 Health, Safety, Security and Environmental (HSSE) Officer to serve at the construction site throughout the entire period and ensure implementation of the ESMP. Among other obligations, the contractor will comply with all labor and gender equality requirements on site, as specified in the ESMP, and will brief the Ndondi dam committee and relevant government officials through regular meetings.

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

3.4. The Dam Community

As 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 personnel to the IDSP-PIU through the GRM which has been designed for the AF activities. The dam committee 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 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 dam management committee (DMC), which consists of 3 women and 7 men, and all are community members. The Ndondi DMC composition and positions are shown in Appendix F. The DMC is a locally developed, decentralised organisation where user communities have been ceded rights and have responsibilities for managing their own resources, typically using a mix of traditional or more formalised 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 involved during planning and will be continuously active during construction and operation phases. Its role will include involvement in stakeholder engagement, auxiliary sites selection, employment, ESMP implementation, operation guidelines and monitoring, operation maintenance and dam safety. The level of involvement in the maintenance and management will depend on the type of technology, the range of maintenance activities and capacity building

offered to the committee. Therefore, UNOPS and IDSP have and will further inform communities of their expected obligations and contributions during consultations and training.

In Ndondi, the headmen and the dam committee conduct the monitoring and sensitization around dam issues. The committee has set rules, which are communicated to the users. These include tree and vegetation conservation rules around the dam, which has resulted in a good number of trees being protected. Cultivation around the dam is limited to minimize soil erosion, especially upstream. The dam has no security measures in place except dam committee constitutional regulations, which have been adhered to so far.

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

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

4. Environment and Social Baseline Conditions

4.1. Physical Conditions

4.1.1. Geology

The geology of the Ndondi dam site comprises of metamorphic (essentially undifferentiated schist and quartzite) rocks of the Basement Complex from the Precambrian age. The Ndondi dam is located on the Choma-Kalomo block, which is one of the three major topographical features of the Southern Province. Soils around the dam are fine, sandy and loamy, with alluvial soils along the stream. These are susceptible to wind and water erosion. This can be seen at some of the exposed slopes along the basin, which are prone to erosion (Figure 2).

Figure 2: Open slopes along the basin

4.1.2. Topography

The area around Ndondi is a typically undulating plateau. The altitude at the dam is 1,158 masl. Land use in the area is characterized by forest, grassland, agriculture, rural settlements and water bodies. Local communities practice mixed farming with cattle and crop production as the most important economic activities.

Figure 3: Topography observed from Ndondi Dam

4.1.3. Hydrology

The dam is located on the Ndondi stream, which drains to the Kaunga river and ultimately the Kalomo river, a tributary to the Zambezi river. The catchment size is 8.2 km^2 (Figure 4). Most streams in the area are seasonal, including the Ndondi stream. The dam has become an important source of fish and water for livestock and gardens. It is not used for household drinking water.

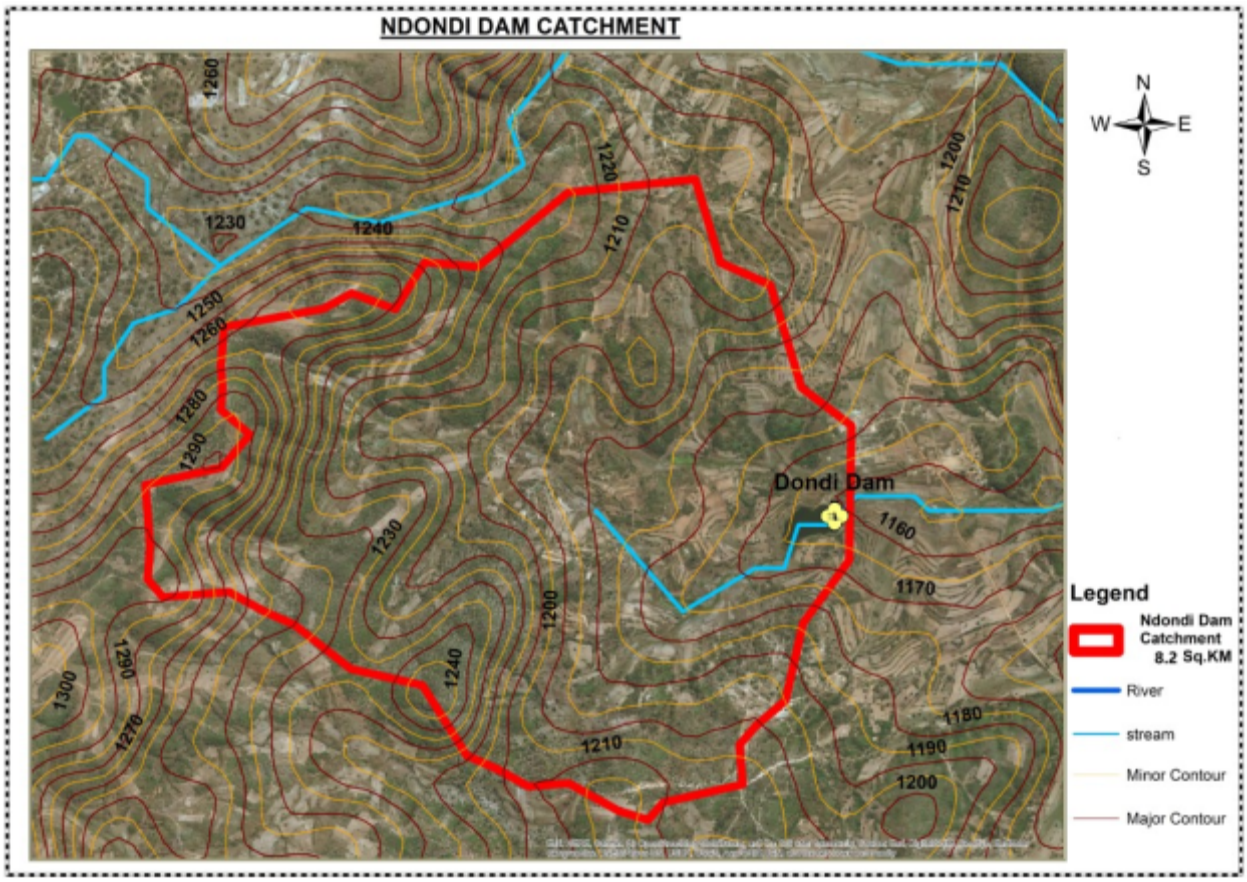


Figure 4: Dam catchment area

The main aquifer is within Muva schists and minor quartzites, in which groundwater flow is mainly in fissures, channels and other discontinuities. This aquifer provides limited sustained water yields for the local Ndondi community, which depends on ground water for drinking water.

Drinking water is collected from boreholes and willow wells downstream (Figure 5).

Figure 5: Woman fetching water from a well downstream (left), turbid source well (middle), and clearer dam water (right)

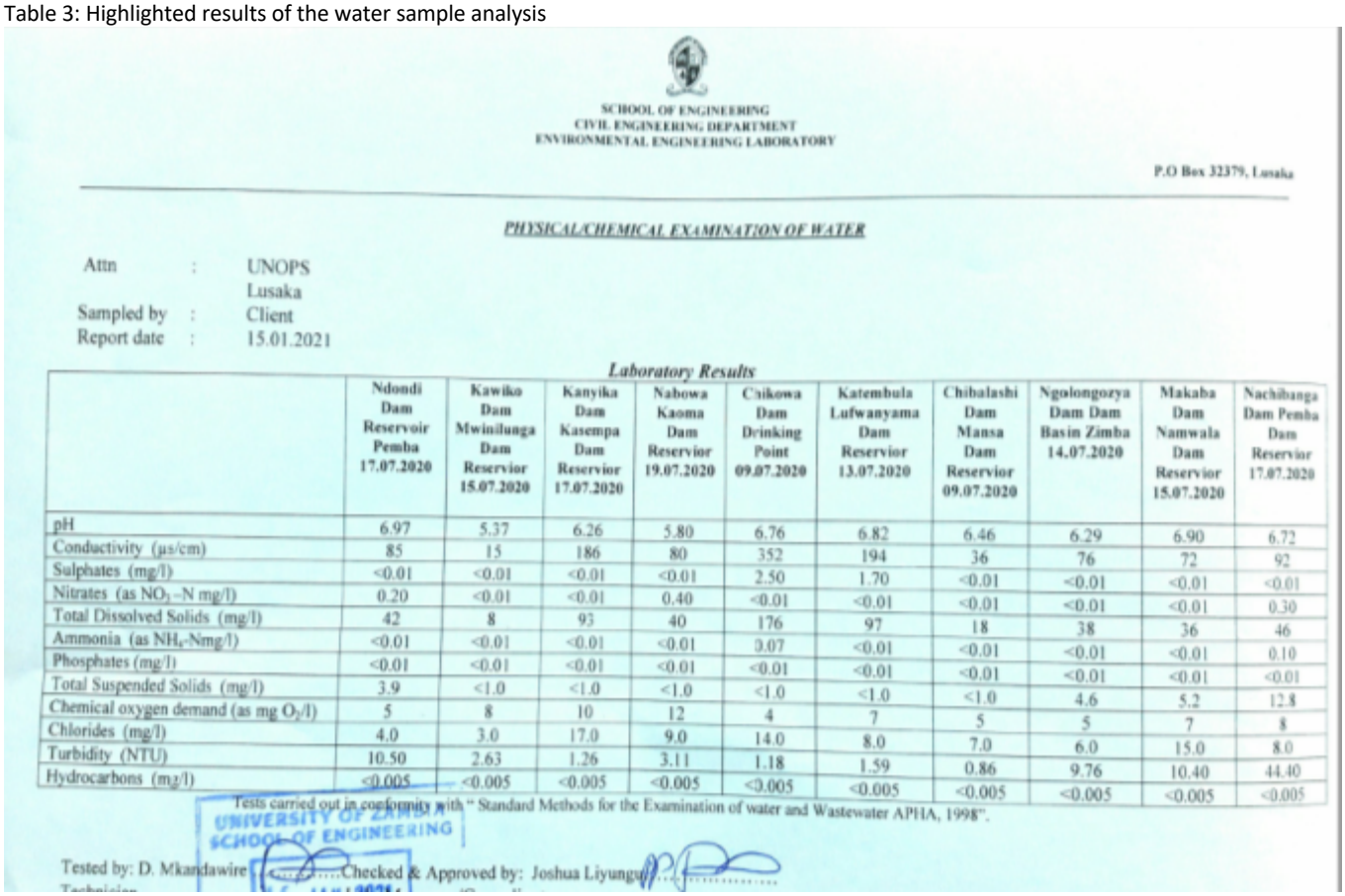
The climate section (4.1.7) describes the seasonal climatic patterns in the area. Local communities indicate that the area mostly experiences low rainfall. The benefit of the dam is that it retains water for their animals throughout long periods of the year during which the Ndondi river is largely dried up.

4.1.4. Surface Water and Groundwater Quality

Water samples were collected by UNOPS in 2020, close to the dam embankment at coordinates 16°44'4.70"S; 27°23'8.25"E and analyzed at the University of Zambia. Table 4 below shows the water quality in Ndondi Dam in comparison to other dams of the project. It demonstrates that all tested parameters fall within the permitted levels of the WHO drinking water guidelines[4]. Total or fecal coliforms were not tested at the time of the study. Their presence may be a sign of contamination and possible waterborne diseases. Possible major sources of fecal coliforms for surface water in this area would be livestock droppings during watering and human fecal matter from open defecation and pit latrines.

[4] UNOPS did not test for coliforms due to tight continuous site work resulting in the long duration between collection and testing which would have compromised the bacteriological results

Table 3: Highlighted results of the water sample analysis



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	Csikowa Dam Drinking Point 09.07.2020	Katembula Lufwanyama Dam Reservior 13.07.2020	Chibalashi Dam Mansa Dam Reservior 09.07.2020	Ngolongozya Dam Dam Basin Zimba 14.07.2020	Makaba Dam Namwala Dam Reservior 15.07.2020	Nachibanga Dam Pemba Dam Reservior 17.07.2020
pH	6.97	5.37	6.26	5.80	6.76	6.82	6.46	6.29	6.90	6.72
Conductivity (µs/cm)	85	15	186	80	352	194	36	76	72	92
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01	2.50	1.70	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3 –N mg/l)	0.20	<0.01	<0.01	0.40	<0.01	<0.01	<0.01	<0.01	<0.01	0.30
Total Dissolved Solids (mg/l)	42	8	93	40	176	97	18	38	36	46
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01	3.07	<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

Tested by: D. Mkandawire ..... Checked & Approved by: Joshua Liyungu .....

Element	Ndondi Dam	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard[56]
pH	6.97	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	85	1500	
Sulphates (mg/l)	< 0.01	250	
Nitrates (as NO_3-N mg/l)	0.20	500	
Total Dissolved Solids (mg/l)	42.00	1000	
Ammonia (as NH4-Nmg/l)	< 0.10	1.5	10

[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.

Phosphates (mg/l)	< 0.01	-	
Total Suspended Solids (mg/l)	3.9	-	50
Chemical Oxygen Demand (as mg O2/l	5.00	-	250
Chlorides (mg/l)	4.00	250	
Turbidity (NTU)	10.50	5	
Hydrocarbons (mg/l)	< 0.005	-	10

Comparing the analytical results of Ndondi Dam (Table 3) with the existing WHO drinking water guidelines and the World Bank Irrigation Water Quality Standards, the water quality generally meets the required standards. However, the turbidity level is above the permissible drinking water levels.

The turbidity at the dam could be a result of the transfer of silt from the area within the dam catchment, given the open areas left behind by crop farming activities, and the loss of soil due to overgrazing. High turbidity in the dam reservoir may chock the dam, and may limit its water use and negatively impact the sustenance of the aquatic ecosystem due to potential limitations in photosynthetic processes.

A sample of the proposed contractor drinking water was collected from the community Food Reserve Agency Shed borehole and tested at the University of Zambia's Laboratory. Comparing the analytical results (Table 4) with the WHO and Zambia Bureau of Standards guidelines on permissible levels for drinking water, the water quality meets the required standards.

Table 4: Water quality results for Ndondi shed boreholes, UNOPS, 2021

SCHOOL OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
ENVIRONMENTAL ENGINEERING LABORATORY

P.O Box 32379

PHYSICAL/CHEMICAL EXAMINATION OF WATER

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

Laboratory Results

Sample ID	**Ndondi Shed Borehole**
Sampling date	**06.04.2021**
Parameter	
pH	6.61
Conductivity (µs/cm)	266
Sulphates (mg/l)	8.90
Nitrates (as NO_3 –N mg/l)	<0.01
Alkalinity (as $CaCO_3$ mg/l)	256
Total Dissolved Solids (mg/l)	131
Ammonia (as NH_4-Nmg/l)	<0.01
Phosphates (mg/l)	<0.01
Total Suspended Solids (mg/l)	<1.0
Chemical oxygen demand (as mg O_2/l)	2
Chlorides (mg/l)	15.0
Turbidity (NTU)	
Hydrocarbons (mg/l)	<0.005

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

Element	**Analytical result**	**WHO Guidelines maximum permissible levels for drinking water**
pH	6.61	6.5-8.5
Conductivity (µg/cm)	266	1500
Sulphates (mg/l)	8.90	250
Nitrates (as NO_3-N mg/l)	< 0.01	500
Alkalinity	256	
Total Dissolved Solids (mg/l)	131	1000

Ammonia (as NH4-Nmg/l)	< 0.01	1.5
Phosphates (mg/l)	< 0.01	-
Total Suspended Solids (mg/l)	< 1.0	-
Chemical Oxygen Demand (as mg O2/l	2.00	-
Chlorides (mg/l)	15.0	250
Turbidity (NTU)	-	5
Hydrocarbons (mg/l)	< 0.005	-

Element	**Ndondi Dam**	**WHO Guidelines maximum permissible levels for drinking water**	**WB Irrigation Water Quality Standard**
pH	6.97	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	85	1500	
Sulphates (mg/l)	< 0.01	250	
Nitrates (as NO_3-N mg/l)	0.20	500	
Total Dissolved Solids (mg/l)	42.00	1000	
Ammonia (as NH4-Nmg/l)	< 0.10	1.5	10
Phosphates (mg/l)	< 0.01	-	
Total Suspended Solids (mg/l)	3.9	-	50
Chemical Oxygen Demand (as mg O2/l	5.00	-	250
Chlorides (mg/l)	4.00	250	
Turbidity (NTU)	10.50	5	
Hydrocarbons (mg/l)	< 0.005	-	10

4.1.5. Seismology

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

For Zambia, previously conducted studies on seismic hazard assessments estimate the Peak Ground Acceleration (PGA), which is the maximum ground acceleration during an earthquake shaking at a location, between 0.3 to 0.9g[7] (equal to magnitudes 2.943 to 8.829m/s^2). This poses a very low risk. Only three major occurrences have been recorded in Southern Zambia between 1910 and 2016. Two of them took place around Lake Kariba and one in Southern Province (Table 5).

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

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

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

According to the US Geological Survey, the seismic hazard level is very low around the area of Ndondi Dam. It is falling within the range of 0.4-0.8 m/s^2 (with 10% excess probability in 50-year PGA) (Figure 6)[8]. Unlike large dams, small dams do not induce seismicity.[9] Furthermore, historical data on the performance of previously studied dams have shown that embankment dams perform well even under strong ground motions. Well-built and well compacted embankment dams improve dam safety and can withstand moderate earthquake shaking with a PGA above 0.2g or 1.96m/s^2.

[8] Zambian seismic network country report, US geological survey, 2017

[9] Tasan Hosun, Earthquakes and Dams, 2015, accessed at: https://www.intechopen.com/books/earthquake-engineering-from-engineering-seismology-to-optimal-seismic-design-of-engineering-structures/earthquakes-and-dams

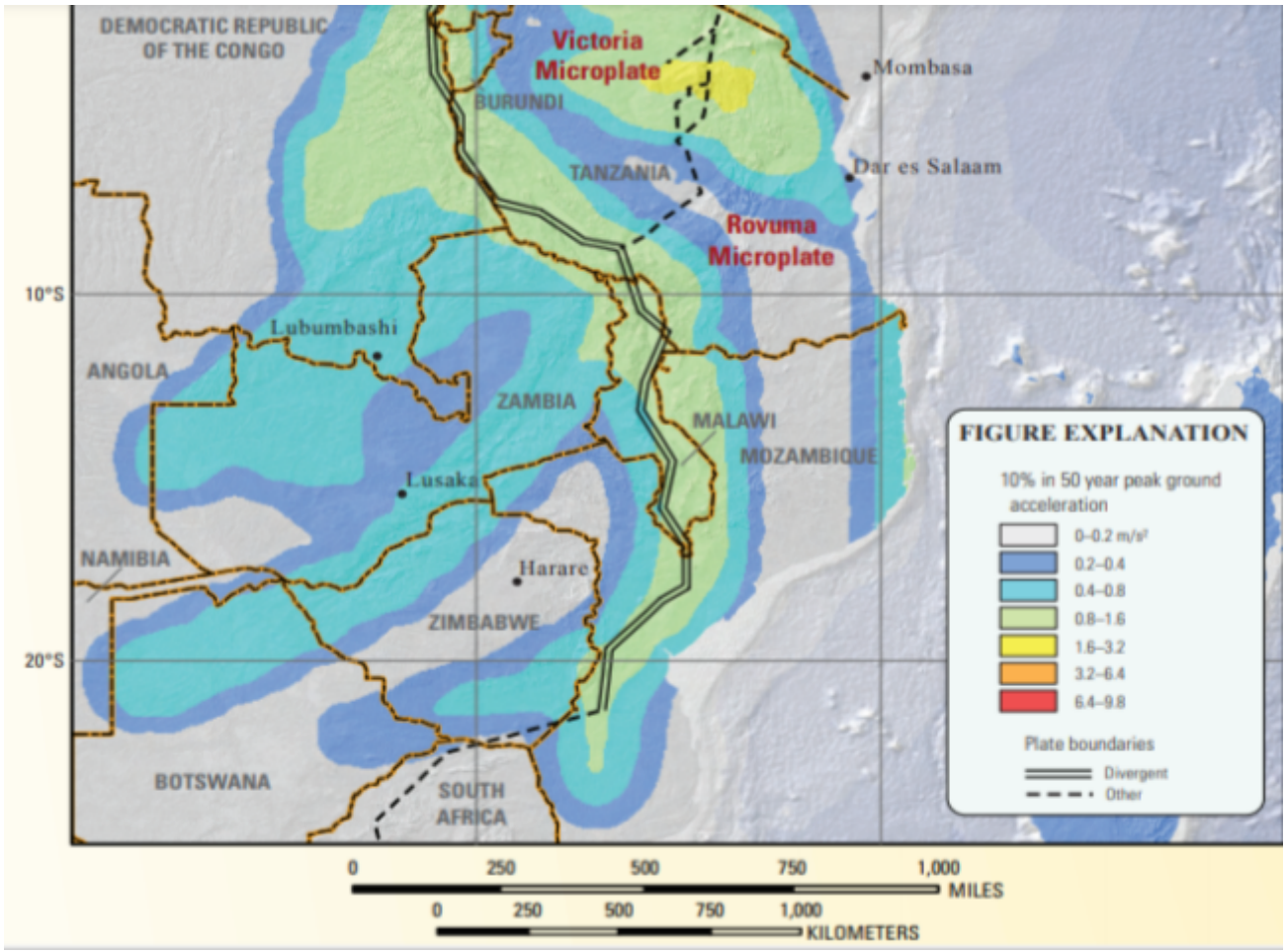


Figure 6: Seismic hazard in Zambia, US Geological Survey 2013

4.1.6. Climate and Climate Change

The climate in the Southern Province of Zambia can be described as humid subtropical, with dry winters and hot summers. Three distinct seasons can be observed:

- a rainy season - a warm wet season from October to May
- a cold season - a mild to cool dry season from May to August
- a hot season - a hot and dry season from September to November.

Rainfall: The Southern Province is located in the Agro ecological zone[10], which is characterized by an annual average rainfall of less than 800mm. According to data obtained from four Zambia Meteorological Department (ZMD) stations in Southern Province, the mean seasonal rainfall between October and May varies between 700 and 800 mm. The graph below shows values of average monthly rainfall and average temperatures for Choma, which is the nearest station to Ndondi Dam, 40 km to the west.

[10] These are 3 zones based on rainfall amounts in Zambia, but also incorporate soils and climatic characteristics. Zone I receives less than 800mm annual rainfall, Zone II receives between 800-1000mm of annual rainfall and Zone III receives between 1000-1500mm of annual rainfall.

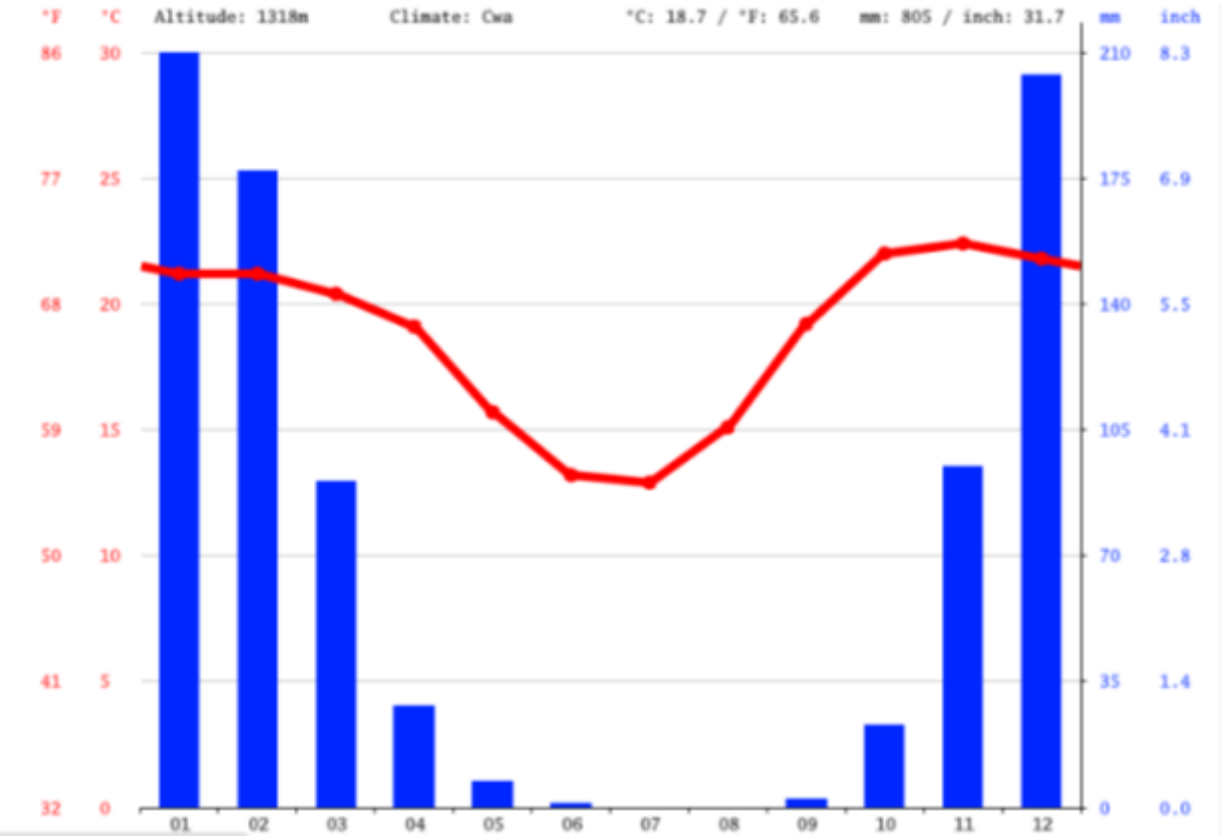


Figure 7: Average monthly rainfall and temperature in Choma (Source: Climate-data.org)

Temperature: The mean annual temperature measured at Choma is 18.7°C. The average monthly temperature throughout the year is shown in Figure 8. The hottest month is November and the coldest is July.

Humidity: Choma experiences an annual average of 73% humidity and 40% cloud cover.[11]

[11] Choma, Southern, Zambia Weather Averages | Monthly Average High and Low Temperature | Average Precipitation and Rainfall days | World Weather Online

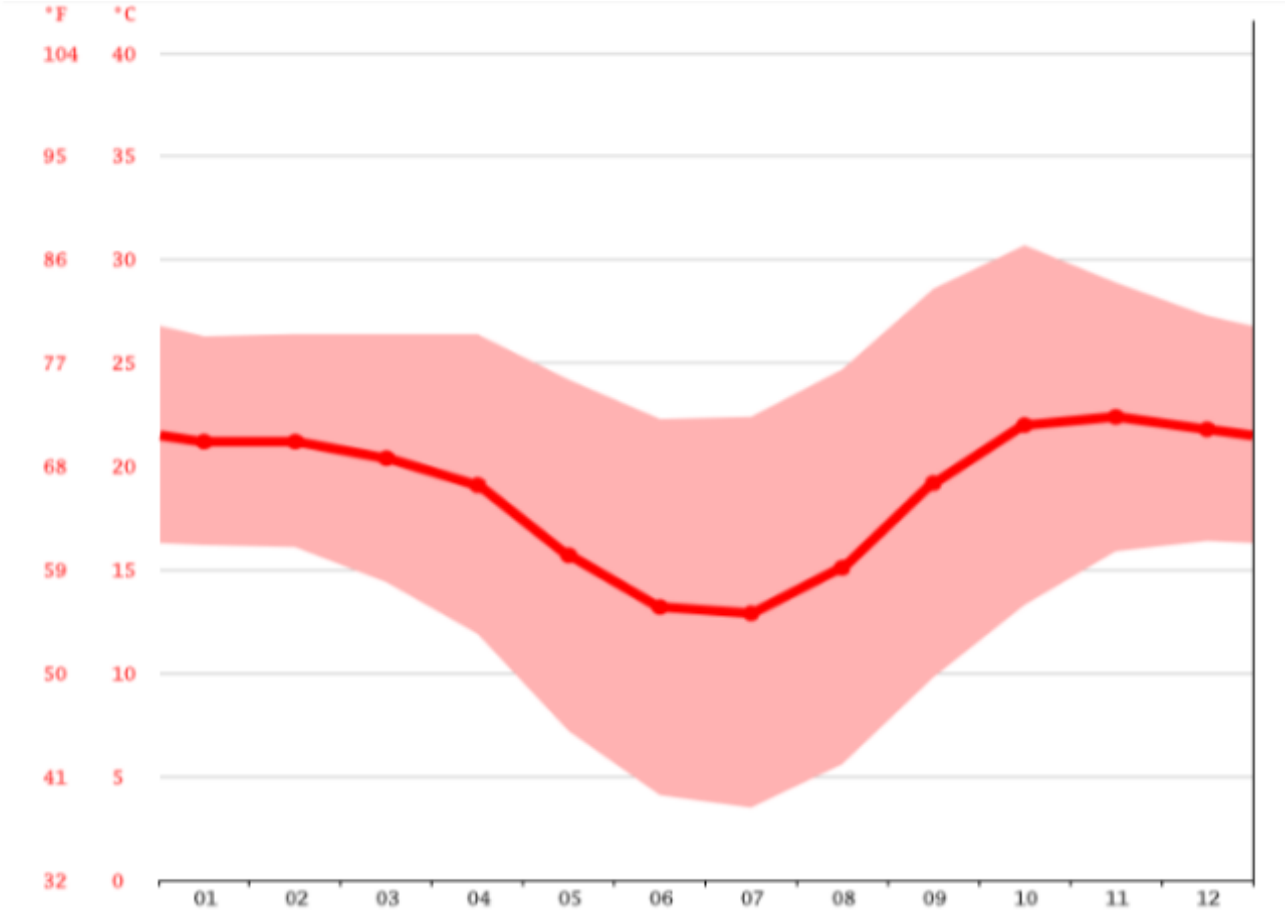


Figure 8: Choma average temperature per month (Source: Climate-data.org)

According to the World Bank[12], Zambia's climate is highly variable and in the last few decades it has experienced a series of climatic extremes, e.g. droughts, seasonal floods and flash floods, extreme temperatures and dry spells, many of these with increased frequency, intensity and magnitude. Their impacts on the country are evident in climate-induced changes to physical and biological systems which increasingly exert considerable stress on the country's vulnerable sectors. Climate change has had adverse impacts on food and water security, water quality, energy and the sustainable livelihoods of rural communities. Coupled with poverty, these factors also limit economic development.

According to a study by UNDP[13] from 2008, climate change is set to increase food insecurity in agro-ecological zones I and II in Zambia. Agro-ecological zone I, which stretches along the southern border, has the least rainfall. Since the late 1980s, this zone has been subject to a tendency for a later onset and earlier withdrawal of rains, as well as more frequent droughts. In the last seven years of this decade, Zambia has had droughts in the rainy seasons of 2000/01, 2001/02 and 2004/5. Floods become more widespread too: over half of Zambia's districts were affected in the last few years – 2005/6, 2006/7 and 2007/8 being the most recent - some for the first time.

With very little infrastructure for water collection, Zambia is overwhelmingly dependent on rainfall. Water

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

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

needs are met through boreholes and wells, where available, or alternatively through rivers. The Ndondi Dam is 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. Agro-ecological zone I is already a marginal area for the cultivation of crops due to its low annual rainfall. 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's sustainability. The communities in Southern Province depend mostly on cattle for their livelihood.

Climate projections for Zambia[14] are shown in Figure 9, for which the World Bank has used the Coupled Model Intercomparison Project, Phase 5 (CMIP5) models, included in the IPCC's Fifth Assessment Report (AR5). Key projected climate trends are summarized below:

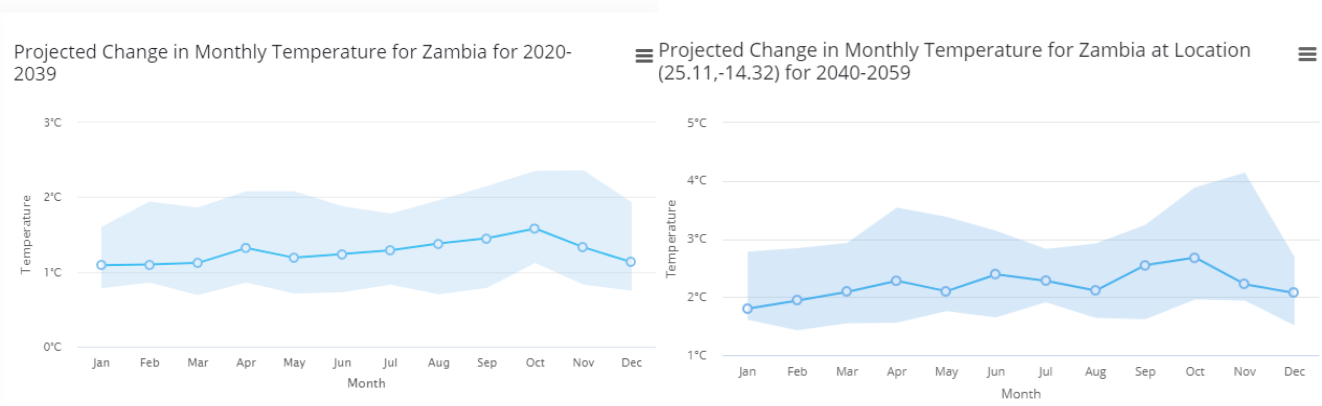
Temperature

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

Precipitation

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

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



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

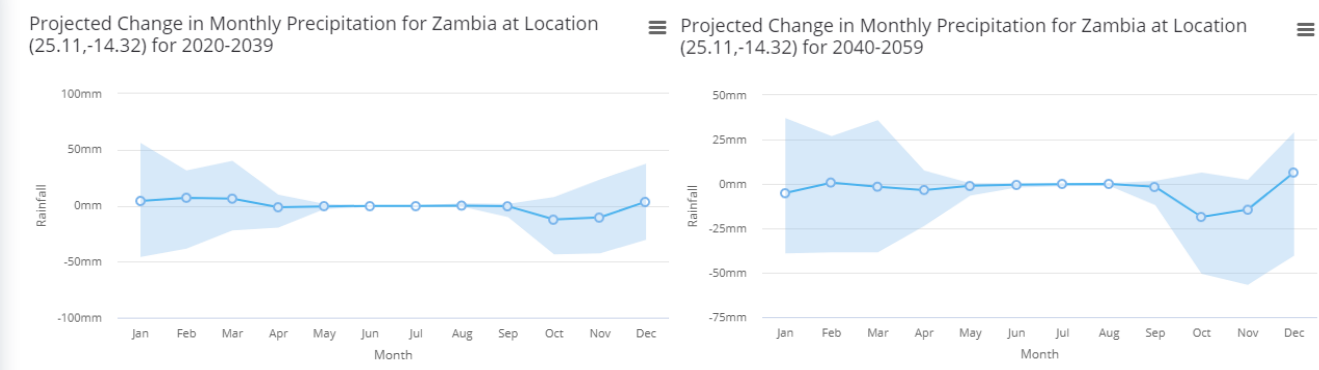


Figure 9: Projected changes in monthly temperatures and precipitation for Zambia 2020-2059

4.1.7. Land Use

The main land use around Ndondi Dam is characterised by agriculture and rural settlements (Figure 10). Local communities practice mixed farming with cattle and crop production as the most important economic activities. The communities use simple canals and buckets for the irrigation of downstream gardens, because the areas downstream are not serviced by the failed irrigation system.

Figure 10: Google map of Ndondi showing neighboring infrastructure and sites that require rehabilitation

4.2. Biological Conditions

A detailed biodiversity assessment was undertaken for Ndondi Dam and a BMP was prepared, which is annexed to this ESMP.

4.2.1. Terrestrial Flora and Fauna

Ndondi Dam is situated in modified habitats that have been significantly transformed by cultivation, bush clearing for charcoal and firewood, and overgrazing. The dam is located in a Munga woodland area. This is a woodland with scattered trees and tall grass. The dominant tree species are *Acacia*, *Combretum* and *Terminalia* spp. The team observed temporal dynamics of disturbance and succession. Termitalia in the area signify scarce or absent dry evergreen forests. The most common species include Jackalberry (*Diospyros mespiliformis),* Boscia *(Boscia angustifolia),* African caper *(Capparis tomentos),* Egyptian plane *(Sterculia quinqueloba)* and Rough kinned bush cherry (*Maerua juncea)*. Ground cover is sparse and dynamics of disturbance and succession are evident, as caused by grazing pressure.

The area of influence can be divided into 3 parts (Figure 11):

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

- Part 2-In the dam basin area: disturbed area with moderate vegetation. Habitat integrity is low. There is stunted growth of grass at the U/S and D/S of the embankment. The moist and disturbed area around the dam has drying Rhodes grass (*Chloris gayana),* Common russet grass *(Loudentia simpex),* Feather fingergrass *(Chloris Virgata)*, Sprouting digit-grass (*Digitaria eriantha)*, Rat's tail grass (*Sporomburus africanus),* Tassel grass (*Aristida congesta)*, Tangleheads (*Heteropogan)* and Buffelgrass (*Cenchrus ciliaris)* - which are all seen scattered around the site. The first storey around the dam has a minimal grass cover with a negligible number of regenerated trees. The second storey is almost non-existent, as shown on the land use map. The deterioration is attributed to agricultural activities, animal grazing and human settlements. Mature *Acacia* and Monkey bread (*Piliostigma thonningii)* vegetation is observed downstream on the left side, immediately after the embankment wall.

- Part 3-Downstream of the dam basin: this section of the dam has seen vegetation clearing due to gardens and fields with several household units and other social service infrastructure. Habitat integrity is low to moderate.

Figure 11: Forest cover around the site, Google earth

The occurrence of mammals is not significant due to the intensive anthropogenic pressure in the area and the transformation of habitats. The species of conservation concern, indicated in the ESA, have not been confirmed to be present on site. According to the community, the site contains some snake species: green mambas are mainly found on the right side of the basin, cobras are found around the former campsite area (left side of the dam) and vipers such as the Puff adder are found around the site. Other observed fauna is shown below in Table 6.

Table 6: Terrestrial Fauna

Common name	Scientific name	IUCN Status and some Species of conservation concern
Lizards	*Squamata*	LC
Butterflies	*Rhopalocera*	*LC*
African Savanna Hare	Lepus victoriae	LC
Duiker	*Sylvicapra grimmia*	*LC*
Tortoise	*(Geochelone pardalis)*	*LC*
Frog	*Hyperolius pyrrhodictyon*	*LC*

Cobra	*Ophiophagus hannah*	*VU*
Boomslang	*Dispholidus typus*	*DD*
Puff adder viper	*Bitis arietans*	*LC*
Hissing sand snake	*Psammophis sibilans*	*LC*
Green Mamba	*Dendroaspis viridis*	*LC*
Gaboon viper	*Bitis Gabonica*	*LC*

Many bird species inhabit the reservoir area and the riparian areas along the river. Most of these birds are found in the willow waters of the dam, along the embankment, along the river bank, and on bare or poorly vegetated mud habitats. The trees along the dam and the remains of drowned trees in the dam also provide perches for birds, most of which are occasional visitors or are migratory. Table 7 provides a list of birds seen at the dam.

Table 7: Bird species found around Ndondi Dam

Common Name	Scientific name	IUCN Status- Conservation concern
Spotted Flycatcher	*Muscicapa striata*	*LC*
African Pied Wagtail	*Motacilla aguimp*	*LC*
Black-collard Barbet	*Lybius torquatus*	*LC*
Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*	*LC*
Bearded Woodpecker	*Dendropicos namaquus*	*LC*
Flappet Lark	*Mirafra rufocinnamomea*	*LC*
European Swallow	*Hirundo rustica*	*LC*
Black-headed Oriole	*Oriolus larvatus*	*LC*

Overall, the occurrence of terrestrial fauna around the dam has been heavily impacted by habitat loss, and by intensive hunting and (in the case of reptiles) persecution. The observed avifauna is of least concern status- it is not threatened. There is unlikely to be any threatened species in the near vicinity of the dam. Further afield, the IBAT listing of species of conservation concern, within a 50 km radius of the dam, provides an indication of their possible occurrence mainly in protected forest reserves. Two reserves extend from near the dam towards the upper end of Lake Kariba, covering a combined area of around 892 km^2. The IBAT shows 25 potentially occurring terrestrial fauna species of conservation concern, including six mammals and fifteen birds. The large mammals and most of the birds are unlikely to occur in the vicinity of the dam site, where habitats are heavily transformed by cultivation and rural settlement, but may be found to the south. The detailed Biodiversity Assessment and the BMP are annexed to this ESMP to provide guidance on fauna classified for conservation.

Bird species of conservation concern may also be found in one Key Biodiversity Area (KBA), which falls within the 50 km buffer – the Nkanga River Conservation Area, located some 40 km north west of the dam. It is made up of three private farms, which are well known birding destinations with over 400 species of birds recorded.

4.2.2. Natural and Critical Habitats

Zambia has protected national and local forests in designated areas. There is no protected area in the vicinity of the sub-project, except for the Ndondi Local Forest (local forest no. P181 on 5,143.737 hectares), which is located about 12km west of the Dam. Part of the forest has been illegally encroached by community members with settlements and crop fields.

4.2.3. Aquatic and Semi-Aquatic Fauna and Flora

Aquatic species in Ndondi Dam, as confirmed by the site assessment, local authorities and communities are shown below.

Table 8: Fish recorded in Ndondi Dam and/or the local river system

Common Name	Scientific name	IUCN Status
Red breasted Bream	*Tilapia rendallii*	LC
Three spot Tilapia	*Oreochromis andersonii*	VU
Green headed bream	*Oreochromis macrochir*	LC
Barbel Fish	*Clarias gariepinus*	LC
Bottle nosed fish	*Mormyrus sp*	LC
Freshwater crabs	*Potamonautes*	LC
Painted Snipes	*Rostratula benghalensis*	LC

One vulnerable cichlid was recorded in the local river system. *Oreochromis andersonii* is of conservation concern, listed as 'Vulnerable' by the IUCN. The population decline of this species occurs mainly due to the crossbreeding with *Macrochir* and competition with the *Oreochromis niloticus*. However, the presence of the *O. niloticus* was not confirmed. The cross breeding with the *Macrochir* was noticed. The detailed Biodiversity Assessment and the BMP provide guidance on aqua-fauna classified for conservation..

4.2.4. Fishing Practices

The Ndondi reservoir has fish stocks, which are a source of food for the local community. Three Cichlids are recorded in the dam by the ESA, namely *Oreochromis niloticus, Tilapia rendallii* and *Oreochromis andersonii,* but despite ongoing fishing activities by the community over the years, there are no accurate catch statistics. Test fishing surveys to determine catch quantities and dam quantities have not been conducted by the Department of Fisheries.

4.2.5. Ecosystem Threats

Threats to the local aquatic resources include overfishing and harvesting, although this does not appear to be a

serious problem in Ndondi Dam. Eventhough the *O. niloticus* was not observed in the waters, the existing species are crossbreeding, which negatively impacts the pure breeds. Any further introduction of alien species will cause further threats.

The barrier created by the dam may impact on the upstream and downstream integrity of the river system, inhibiting the natural movement of species, restricting flows and causing negative changes in water quality. The extensively farmed areas in the dam catchment, accompanied by the clearing of most of the natural forest cover are likely to be increasing sediment loads into the dam and river. Details of the threats to the river system and the threatened aquatic fish species have been discussed in the Biodiversity Assessment, annexed to this ESMP.

4.3. Social Conditions

4.3.1. Social Conditions around the Dam

The Ndondi dam is located about 36 km from the urban center in Pemba District in Southern Province. It is well serviced by the Choma-Pemba road, which links the Great North Road and the national railway line. Ndondi Dam is accessed by a 13km long feeder road.

The main vehicle route from Pemba to the dam is made from gravel. It is in a bad condition after the clinic turn (about 1km) to the dam.

Upstream of the dam, there are 3 beneficiary communities. They consist of 210 people, 492 people and 849 people respectively. Two communities are located downstream, consisting of 497 people and 509 people respectively. The Pemba constituency has a total population of 64,918. Pemba District has one constituency and 7 wards. Ndondi Dam is located in the Nachibanga ward, which has ca. 1,500 households and a total population of 9,036 (4,278 female and 4,758 male).[15] Since dams and other water sources are limited in the area, the population using the dam is high.

Most community members have access to the dam through routes and paths that go over the embankment and through the return channel. However, the route through the drop structure becomes inaccessible during the rainy season. The communities then have to wait for the water to subside in order to cross. Since schools are on the other side of the embankment, during the rainy season it can be difficult for some school children to cross and access their respective school. Similarly, the health clinic is on the same side. The vulnerable, such as the elderly, very young, and disabled, have crossing difficulties.

The livestock has access to the dam for watering purposes. There is locally restricted access to the embankment by a fence made from tree trunks and branches, which was erected by the community to protect the wall. The fence also restricts ox carts from crossing on the wall. However, the fence is in a bad condition and a more permanent and sustainable solution will be required. Currently, the wood used for the fence from time to time requires trees from the forest.

The main economic activity in the area is subsistence farming. Subsistence farmers make up most of the population. Only a few people are engaged in formal employment, mainly as teachers, agricultural or health

[15] ESA 2020, p. 162.

workers and NGO staff. Cattle rearing is the most important economic activity, followed by crop production. Trust land and traditional land make up the two main forms of land tenure in the district.

The land use around the dam includes gardens, fields, paths, unused hills, residential areas, hammer mills, and roadside trading. There is no telecommunications network available in the area. The administrative part of the district consists of commerce with small scale farms in peri-urban areas. Cattle rearing and then crop production are the two most important economic activities.

Communities mainly use the dam for livestock watering, bathing water, baptism church activities, laundry, brick molding and house construction. There are some willow hand dug wells in the river bed downstream for gardening.

Communities use hand-dug wells downstream to water their gardens, as there is barely any water flowing in the downstream area of the dam. Women are thereby most affected by the lack of water, as they do most of the watering of gardens. Single or widowed women face challenges, as it is difficult for them to dig wells – which is usually the job of men.

There is one clinic and two schools within 1km of the dam. Pemba District has six clinics: Pemba main clinic, Kasiya Clinic, Kanchomba clinic, Muzoka clinic, Mooya clinic, and Ndondi clinic. The district has 64 schools, out of which 61 are primary schools, and 3 are Secondary schools. The latter consist of Pemba Secondary school in Pemba ward, Jembu mission school in Hamaundu ward, and Ndondi secondary school in Nachibanga ward.

4.3.2. Administration of Water and Dam

A Dam Committee is currently in place, consisting of 3 women and 7 men. However, the committee indicated that it requires further guidance and training in various issues. While the committee is active, it is still to finalize its constitution. Some unwritten regulations are already developed and implemented, including around fisheries.

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

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

Traditionally, both men and women can own land, including gardening land. Procedures and rules for allocation are the same for men and women. Generally, in view of gender roles, men are dominant in most income generating activities, including employment.

Gender-Based Violence (GBV) exists among the dam communities, but it usually is 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.[16] 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.[17]

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

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

Alcohol and living in high-density areas have been identified as key issues contributing to higher rates of GBV.[18] 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.[19] 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.[20]

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.[21] 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).[22] 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.

One Stop Centers offer medical services with qualified health professionals, psycho-social counseling, legal services, information dissemination, shelter. While there is a Centre in Pemba at the hospital, there is still need for more shelter opportunities.

In the dam communities around the Ndondi Dam, stakeholders stated that GBV is rarely reported, as GBV reporting leads to stigmatization The Department for Community Development and the international NGO World Vision have been educating women on how to handle GBV cases, but there is a deeply engrained cultural fear of

[18] 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.

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

[20] Ditto, p. x

[21] Ditto

[22] Chidoori Rumbidzai, 2011, p. 32

discrimination, which prevents most women from reporting cases. Even more so, women fear that reporting domestic violence will make the marriages fail.

For reporting purposes, the referral services in the area are limited. For example, there are no counseling services available. GBV cases are reported to the local clinic, where they receive medical treatment. However, they are usually not reported as 'GBV', given the stigma of the topic. Furthermore, as in other areas, the Police's Victim Support Unit (VSU) is responsible for the handling of GBV cases. World Vision is also available for support in the district.

4.3.4. Cultural Environment

For the preparation of this ESMP, stakeholders were consulted, including the members of the Ndondi dam committee, dam users and district stakeholders (District Commissioners, representatives from Social Welfare Department, Arts and Culture Department, Forestry, Agriculture). Consultations were held in regards to the upstream and downstream communities around the dam.

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

Stakeholders indicated that graveyards are located at the respective homes and that there are no distinct community graveyards. No potential cultural environment and cultural heritage impacts are therefore expected as impact of the proposed works and the operational phase.

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

The dam basin, however, is sometimes used for baptism by 3 churches in the area (Pilgrim Church, Seventh Day Adventist, Seventh Day Sabbath Church). There is some concern that the construction works could disturb the baptism.

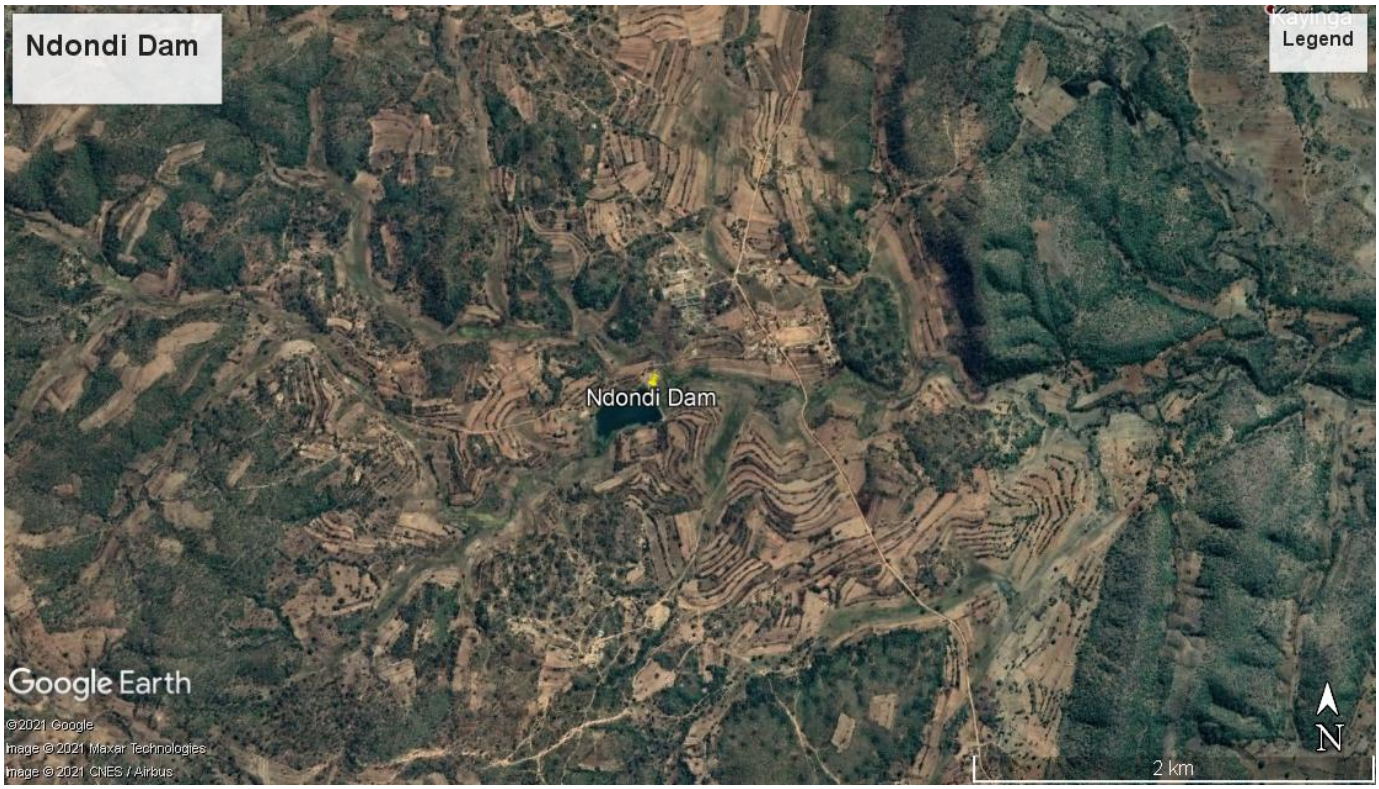
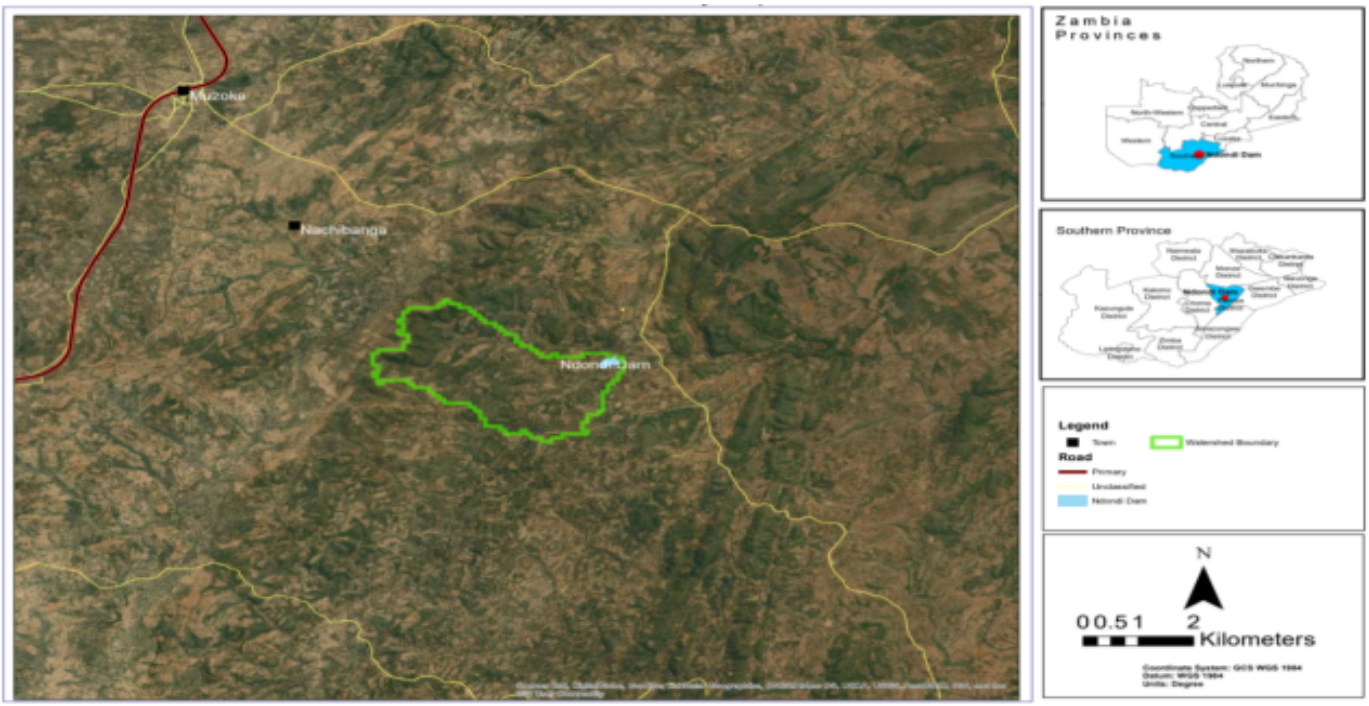


Figure 12: Ndondi stakeholder engagement schematic coverage

5. Sub-Project Characteristics

5.1. Dam Characteristics



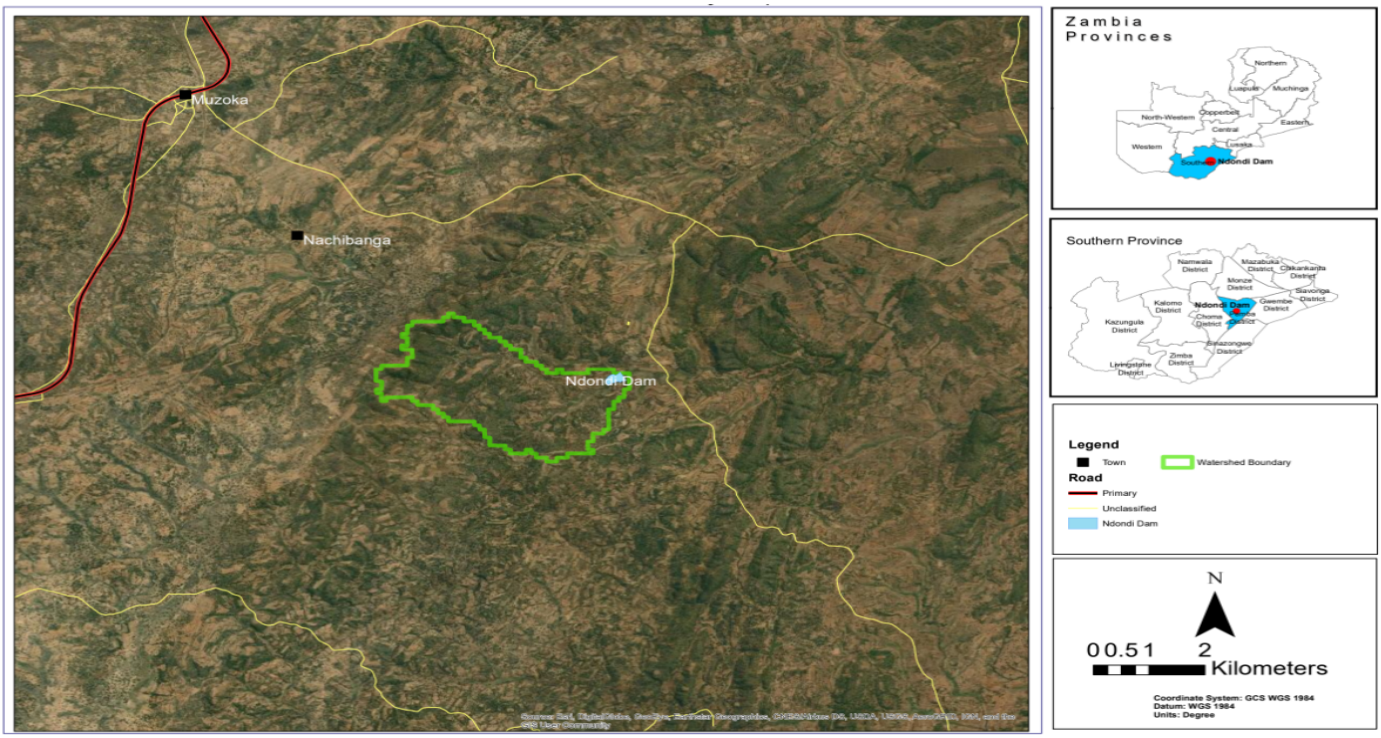


Figure 13: Google maps showing location of Ndondi Dam, UNOPS 2020

Table 9: Main characteristics of Ndondi Dam

Dam Catchment Data

Catchment Area

Source Document	Year	km²	Method of calculation
Ministry of M E & WD	2015		
COWI (initial report)	2018	10	Taken Ministry of M E & WD figures
COWI - Aurecon	2018	7.86	Worked from survey undertaken in 2018
Ministry of Agriculture	2020	7.86	Taken from COWI - Aurecon submission
UNOPS	2020	8.2	STRM 3D DEM (NASA) and ArcGIS

For calculation purposes for the remedial design works, the UNOPS 2020 value of **8.2 km²** for the ***catchment area*** has been adopted.

MAP, MAR, Inflow:
The Mean Annual Precipitation MAP - for this area is 760 mm.
The Mean Annual Runoff - MAR - for the area is 65 mm.

The MAR used is in accordance with the Zambia National Water Resources Master Plan. Also taken into consideration is work done by Imagen Hydrological Consultants on the Luezi Dam near Zimba in 2014, which calculated a runoff of MAR 70mm per year. Based on the above data, the average annual inflow at the dam site is 8,200,000*0.065 = 533,000m³

Dam Capacity

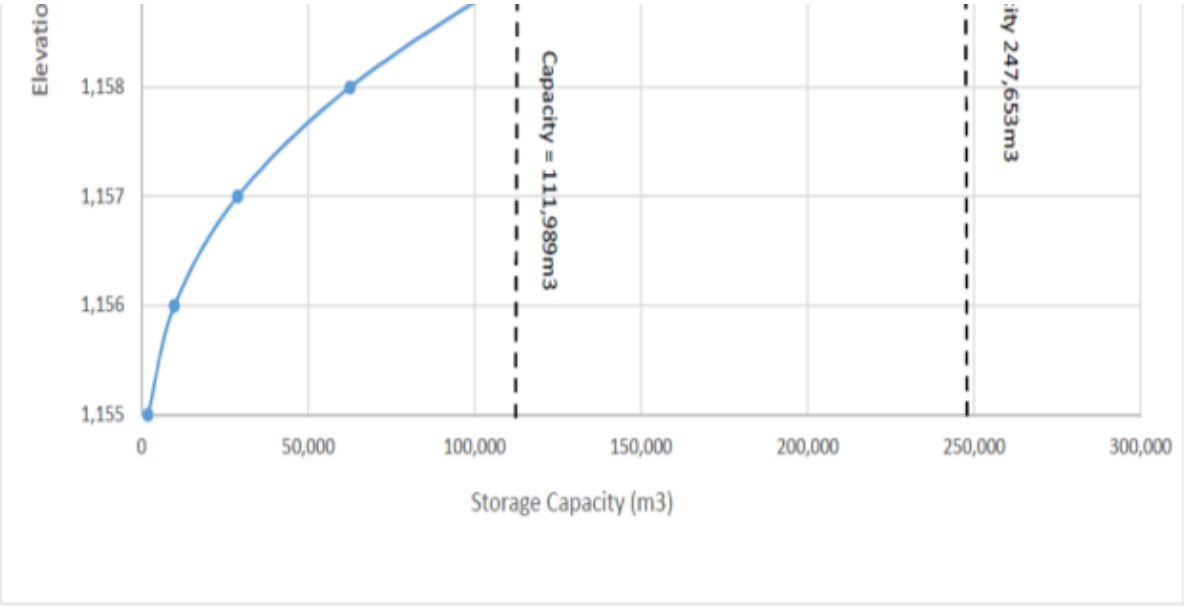
Source Document	Year	m³	Method of calculation
Ministry of M E & WD	2014		Desk study
COWI - Aurecon	2018	111,989	Full basin survey - topographic, UAV and bathymetric
Ministry of Agriculture	2020	1,000,000	Environmental and Social Audit Report and Remedial Action Plan for Ten Dams

For calculations, the 2018 value of 111,989 m³ has been adopted.

Assuming a 65mm MAR the average annual inflow is	533,000 m³
Current estimated capacity of the dam is	111,989 m³

The site has been developed to only 21.01% of its capacity. This is 4.76 times the current dam capacity.

The Depth – Capacity Curve for the dam as generated by the 2018 COWI survey:



Sedimentation

The catchment size is 8.2 km^2 and assuming a sedimentation yield of 5000ppm (a poorly conserved catchment) with an assumed 100% trap efficiency of the dam, the dam will lose approximately 2000 m^3 of water per year or approximately a third of the storage in 19 years.

Geotechnical Investigations[23]: Samples were taken from the embankment at the location of the SPT test and can be reviewed under 'Geotechnical Investigations Results' in the review folder. The relevant samples are: 1, 2, and 3. Boreholes. The SPT results indicate that the compaction was consistent with steadily increasing bearing capacities. Regarding the Atterberg Limits Result, all the materials sampled were CL, i.e. sandy silts. As a rapid guide in assessing the suitability of soils for shoulder material reference is made to the Plasticity Product (PP, if the PP is above 600 it is considered suitable as a core material. Shoulder material is considered good between 400 and 200. Lower than 200 is either very coarse, but still usable depending on the grading). The results below indicate that the soil samples are predominantly silts and not ideal material.

Sample	Plasticity Index (PI)	% passing the 75 µ	Soil Classification	Plasticity Product (PP)
1	18%	8%	CL	144
2	17%	13%	CL	221

[23] The purpose of the limited geotechnical investigations was to primarily assess the materials used in the construction of the embankment and to assess the quality or consistency of the compaction in the embankment. In addition it was to assess possible borrow materials for possible remedial works.

3	18%	21%	CL	378

However, observation show that the embankment is clearly made up of the tested material, which although not ideal has not exhibited any signs of slope failure over a number of years. The SPT results on the embankment indicate a consistent compaction with steadily increasing bearing pressure.

Embankment Crest and Slopes

The overall condition of the main embankment, and to a large extent the whole structure is good. The Ndondi dam committee has been taking care of it maintenance. Regrowth of shrubs and small trees on the embankment indicate that they were previously only cut back and not completely removed. Ant workings are also evident in several places on the embankment and the training walls of the spillway return channel.

Community fencing attempts to restrict access to livestock to the embankment are proving largely ineffective, considering the animal pathways on both faces and the crest and the trampling in the seepage spots downstream. It is evident that the embankment does not have a uniform cross section along its length. Near the two ends of the embankment, the upstream and downstream slopes appear to be much steeper than those through the main body of the embankment. It is unlikely the current profile is a danger to the stability of the embankment (see figure below).

Embankment profile

Embankment Crest: It is generally in fair condition, but with an uneven surface and with a fairly narrow width of 3m - 3,5m, though there are not really clearly defined upstream and downstream crest lines. The crest width does widen slightly between the two siphon boxes (across the deepest section of the dam), in conjunction with a flattening of the upstream and downstream embankment faces. There is some rutting on the crest from the

pedestrian and bicycle traffic and animal tracking over the embankment. Ant workings were evident in several places along the crest edges (see figure below).

Embankment crest

Embankment Upstream Face: It is of varied slope across its length. It is steeper towards the embankment ends and flatter through the deepest section of the embankment (this is clearly visible in the figure below).

Front face from right bank showing variation in embankment slope

While grass cover is generally good, there is some gullying caused by animal tracks down the face, but mainly from the breakaway of the upstream crest (again, caused mainly by livestock movement). A few small trees and several ant workings are visible. The relatively small catchment area of the Ndondi Dam and the short "fetch" to the front face waterline indicate that wave action will not be critical. The current grassing is reasonably good.

Spillway

The service spillway is located at the left-hand end of the embankment and empties into a return channel, which is grass-lined with a training wall along the full length, its right bank and the lower half of its left bank. Some 70m downstream of the spillway sill is a concrete drop structure, which leads into the final portion of the return channel before discharging into the natural drainage system coming in from the left of the channel. This drainage system, in turn, empties into the dambo downstream of the main embankment (see figure below). The concrete spillway sill and the concrete drop structure towards the end of the return channel were both are subject to remedial works.

Service spillway and return channel

The Service spillway is a straight spill section dropping into a small energy dissipator before flowing out into the return channel. The length of the spill section is 35m, which is also the effective length at the sill level. This increases slightly with depth of flow over the sill as there are no defined abutments to the sill, as it simply keys into the embankment on its right hand end and the left bank of the channel on its left hand end (see figure below). The spillway abutment design does not seem to allow for anything but a willow depth of flow over the sill without the real possibility of erosion around where it keys into the left bank of the return channel and the end of the embankment.

Service spillway

Service spillway showing sill, dissipator and minimal left-hand abutment

There is evidence of some undercutting of the energy dissipator/outflow section of the spillway.

Service spillway showing signs of undercutting

Service Spillway Return Channel and Drop Structure**:** The spillway return channel is relatively well levelled-off across its width with little evidence of gullying indicating a fairly uniform flow down the channel. The grassing is reasonable with the obvious exception of the footpaths crossing the channel. The channel width is on average 35m with a length from spillway to drop structure of 70m (see figure below). The drop structure itself is 35m wide and 1,5m deep with a 2m wide apron at its base.

Spillway return channel and drop structure from outfall end

Training Wall*:* The right hand training wall of the spillway return channel extends the full length of the channel and the left hand training wall from about halfway down the channel with the top section of the channel being the bank left from the excavation of this portion of the channel (see figure below) Both training walls are well constructed with a substantial crest width and are in reasonable condition generally. The two embankments' side slopes are around 1.5:1, which is adequate for their purpose and the grass cover is reasonable There are a few ant workings, but their effect is not as significant as those on the main embankment.

Right-hand return channel training wall - section above drop structure

The right hand embankment tapers down in width towards where the right hand abutment of the drop structure keys into it. Close to the abutment there is a chance of high floods washing through this section of training wall (see figure below).

Right bank training wall and drop structure abutment

Embankment at Service Spillway Entrance: The 90-degree bend in the embankment leading into the spillway return channel training wall is part of the river crossing point for the community on the right bank of the dam. The heavy foot and bicycle traffic at this point has eroded pathways into the front face of the embankment as well as the crest immediately off the end of the spillway sill.

The stone pitching placed around this end of the embankment leading into the spillway has been significantly washed away to the point of being almost non-existent. This is not an ideal situation with the potential for serious wash damage during flooding (see Figure below).

Embankment bend at spillway – paths and minimal stone pitching.

There is no secondary spillway.

Flood Design

A 1:100 year flood of 48,7m^3/sec, with a Safety Evaluation Flood (SEF) 0f 57,0 m^3/sec was used in the remedial design by COWI in 2018. It is not known what method was used in obtaining the design flood in the initial design.

The adopted design criteria for this sub-project is based on the Mitchell Formulae, used extensively in Zimbabwe for the PMF estimation. The return periods have been checked in comparison with results obtained from the VKE and Pitman. Based on the design criteria and current surveys the below is a summary of the spillway details:

Catchment Area.	8.2 km^2
Max Probable Flood	242 m^3/sec
100-year Flood Estimate	109 m^3/sec
Fetch	0.360 km
Dry Freeboard	0.340 m
Service Spillway Width	35.0 m
Current Crest Level	1162 m
Spillway Level	1160.4 m
Current Freeboard	1.60 m
Riverbed Level	1154.5 m
Maximum Embankment Height	6.75 m
Maximum Depth of Water	5.63 m

5.2. Overall Legacy Issues at the Dam

The legacy issues are illustrated below and mitigation measures are shown in Chapter 7 Section 7.2.

5.2.1 Structural risks:

Spillway risks:

- Spillway structural failure and inadequacy
- Downstream community safety

Return channel drop structures and training wall risks:

- Abutments inadequate and can be impacted by a flood
- Gullying and erosion in the return channel
- Downstream community safety

Embankment and slope stability risks:

- Embankment instability
- Heavy livestock traffic impacts on integrity of the embankment.
- Signs of termites on the embankment
- Seepage and structure integrity
- Downstream community safety

Rock toe risks:

- Obvious seepage from the dam
- Seepage and embankment instability – downstream community safety

The photos illustrating these conditions are shown in section 5.1.

5.2.2 Environmental, Health and Safety risks

Construction phase

Demobilization and Restoration Plan absence risks:

- Unrehabilitated contractor sites- Campsite
- Safety and health hazards for the community

Rehabilitation of disturbed works areas risks:

- Erosion and sedimentation

Rehabilitation of community roads risks:

- Loss of community access
- Loss of biodiversity

Community health and safety risks:

- General serious or fatal incidents/drowning
- Hazardous waste management-sewer
- Non-hazardous waste management

Access across the river risks;

- Lack of a bridge/crossing with increased risk of community injury and drowning

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.
- Lack of downstream drainage infrastructure on the main road leading to the dam.
- Increased prevalence of water borne diseases
- Lack of a bridge/crossing with increased risk of community injury and drowning

Photos illustrating some of the conditions above:

Figure 14: Former contractor campsite housing and pit latrine used by local pupils as a boarding facility

Figure 15: Concrete rubble along the return channel

Figure 16: Vehicle access route with the suggested location for the drainage infrastructure where the return channel directs water

5.2.3 Social risks

Community development risks

- Food security – inadequate fish training for communities, communities do not fish but fish stocks are available

Erosion and sedimentation in the dam:

- Uncontrolled stock watering
- Lack of catchment management
- Lack of a functional irrigation infrastructure

Figure 17: Dry irrigation canal and a downstream garden using willow wells for watering due to having dry canals

5.3. Potential Communities Affected by Works

The rehabilitation of the dam will benefit all dam communities, as well as distant farmers coming to use the dam for livestock watering. Since the access to water in the area is limited, the use of the dam is intensive. Irrigation, livestock and fishing activities could be increased with the works at the dam.

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 50 people. 15 of these are likely to be externally recruited, including an engineer, a foreman, sitemen, specialized construction workers, a storekeeper, and the ones to handle heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the Pemba communities. Approximately 35 workers will be recruited from the Pemba communities. Their tasks

will comprise concrete works, work on the embankment, and any other manual tasks. Construction works will approximately take 6 months.

Since the sub-project activities are temporary in size and the amount of externally recruited workers will be small, there is no significant labor influx expected, including impacts on local resources and services. However, communities recounted that contractors' workers would lure little girls and marry women for money. Fear of such, in turn, causes men to lock their women up at home. This means that a GBV risk through labor influx does exist. Risk of exacerbation of local existing conflicts is low. Also, the potential that a workforce interferes with local communities from different political or factional backgrounds is small.

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

The contractor will have to build a campsite for the 12-15 workers, who are not transported to the site on a daily basis and who are not locally recruited, as well as for storage or materials; and will have to provide convenience facilities for the whole workforce.

5.4. Dam Safety

The dam safety reports for Ndondi Dam include the Emergency Preparedness Plan (EPP) and the Operation and Maintenance document, which will be shared with stakeholders. The primary goals of an EPP are as follows:

- 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 mitigates 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 evaluated for safety, 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 Dam Committee 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
- Dam Committee 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. Embankment Remedial Design[24]

6.1.1. Slope Stability

A full slope stability analysis for the downstream embankment slope would require considerably more tests than are warranted for this size of dam. The geotechnical investigation undertook limited SPT, grading samples and a triaxial test, these provided selected information as to the c and Ø value from one area of point on the already constructed embankment. In terms of the ICOLD Manual on Small Dam Design, it is not envisaged that there will be any stability issues, particularly as this dam stores less than 6m of water above riverbed level at the Full Supply Level. Furthermore, most possible issues are addressed by the inclusion of properly constructed toe drains and substantial rock toe to add weight to the downstream toe.

Current Upstream slope approximately	1:2.5
Current Downstream slope approximately	1:2.0

Slope Stability analysis documentation and results are included in a separate report. The following is a summary of the slope stability analysis:

- A stability assessment was carried out on Ndondi Dam for both upstream and downstream slopes using Rocscience slide v6.0
- Factors safety meets acceptance criteria with and without seismic loading after the End of construction.
- The dam meets the acceptance criteria on both slopes at full supply and maximum water levels under when seismic loading is not applied.
- Under seismic loading, the upstream slope meets the acceptance criteria. On the downstream slope, the FOS is slightly lower than 1.6 and it's in the rockfill material at the toe of the slope. The lowest FOS through the embankment material is greater than 1.6. The slope is stable.
- Under rapid drawdown from full supply, the up-stream slope is stable, and it meets the acceptance criteria.
- Under rapid drawn from maximum water level, the slope is stable, but it does not meet the acceptance criteria FOS 1.46)

6.1.2. Rock Toe

The original downstream rock toe in the deepest section of the embankment currently consists of a few scattered rocks and is completely ineffective. A more extensive rock toe will have to be placed in this area, extending at least 2.0m vertically up the embankment face. It will incorporate a reverse filter on its upstream side to cater for any seepage passing through or surfacing at the downstream toe of the embankment. In addition to controlling seepages, the rock toe will provide additional weight against the embankment thereby increasing the overall stability (see figure 18).

[24] Ndondi Dam Remedial Design Reports and Studies

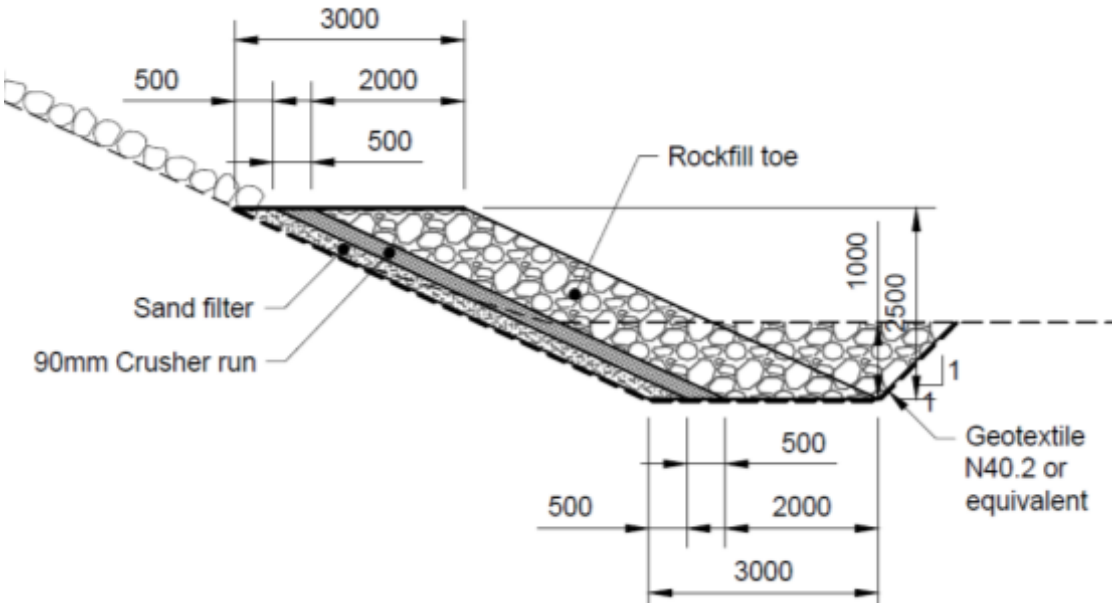


Figure 18: Typical section of rock toe and filter in the riverbed section

Concrete/stone pitched open toe drain: This will collect the outflow from the seepage spots at or beneath the embankment toe as well as runoff from embankment slope. This should be an open concrete-lined or stone-pitched drain that can be regularly cleaned out when necessary as the open earth drains that are filled with stone invariably soon clog up with silt and become ineffective. The upstream slope of the drain should match that of the downstream embankment slope - in this case 2.5:1 - and the downstream slope can be cut at 1:1 (18 13).

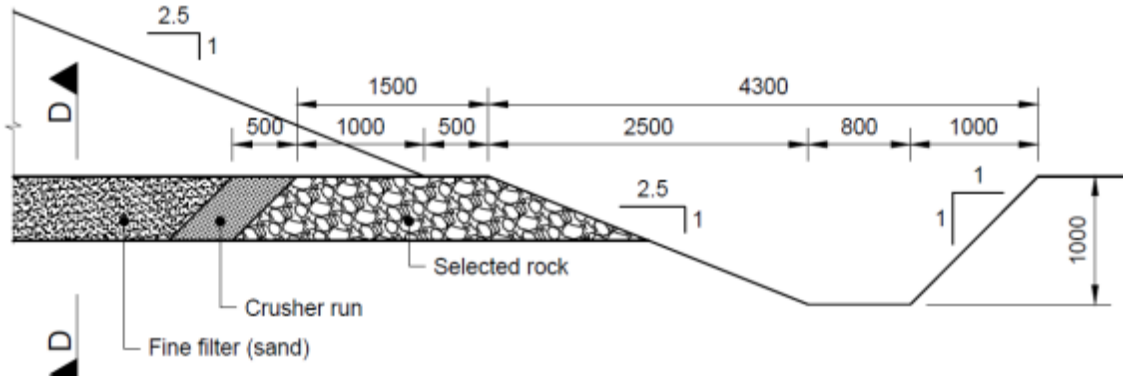


Figure 19: Typical section of toe drain and embankment internal filter

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

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

6.2. Service Spillway, Drop Structures and Training Wall

6.2.1. Spillway

In the initial and remedial construction carried out, no defined abutments were provided (with wing walls or cut back walls) to prevent erosion of the end of the embankment and the left-hand channel bank. The ends of the spillway merely merged in with the slope of the end of the embankment and the slope out on the left bank of the spillway channel. Gabion basket abutments, with wing walls and cut off walls are to be constructed at both ends of the current spillway structure. Gabion baskets will also be required along with Reno Mattresses or stone pitching as protection for the abutments on both banks of the spillway channel. This protection will link in with the grouted stone pitching to be placed along the bend in the left-hand end of the embankment where it leads into the spillway (figure 20).

Figure 20: Service spillway showing need for abutment protection

The main spillway structure is a masonry construction with plastering on the top 30cm of the upstream face and over the sill down into the small stilling basin. This has several sections with quite bad leaks when there is standing water against the structure, due to the poor quality of the masonry work (Figure 21).

Figure 21: Condition of upstream face of service spillway sill section

Proposed remedial works are the excavation of a trench along the length of the upstream face of the current spillway to a depth of 1m below current ground level and 1.5m wide. The base of this trench should be compacted and a layer of geofabric placed before placing 250mm of concrete reinforced with a 100 x 100 x 2.15mm mesh as a foundation layer. An additional masonry wall 1m wide should then be constructed against the existing wall up to the current level of the sill. This should be finished with a suitable cement plaster.

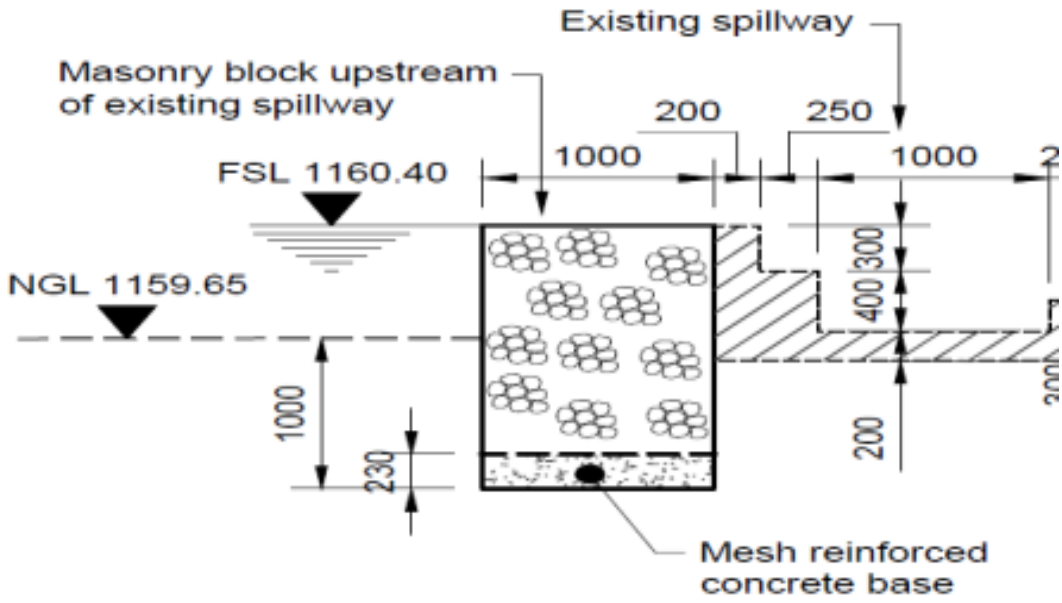


Figure 22: Schematic of spillway upstream remedial works

This will not only resolve the leakage issue, but significantly improve on the overall strength of the structure. It will also provide a 1.2m pedestrian access to the right bank of the dam for the local population who currently have only a 20cm wide crest to walk on when the dam is spilling (Figure 23).

Figure 23: Crossing difficulties for local population

The stilling basin outfall sloped section from the stilling basin to the return channel is being slightly undercut by the flood flow and the proposed remedial works here are to excavate along the undercut edge of the length of the structure to a depth of 30cm by 50cm wide - extending this excavation slightly under the existing structure. Hand compact the base of the excavation and backfill to the level of the channel with suitable sized rock compacted into place to create a transition zone that will allow the water passing over the spillway to enter the return channel without any erosion or undercutting (Figure 24 and 25).

Figure 24: Undercutting of service spillway outfall sections across full length.

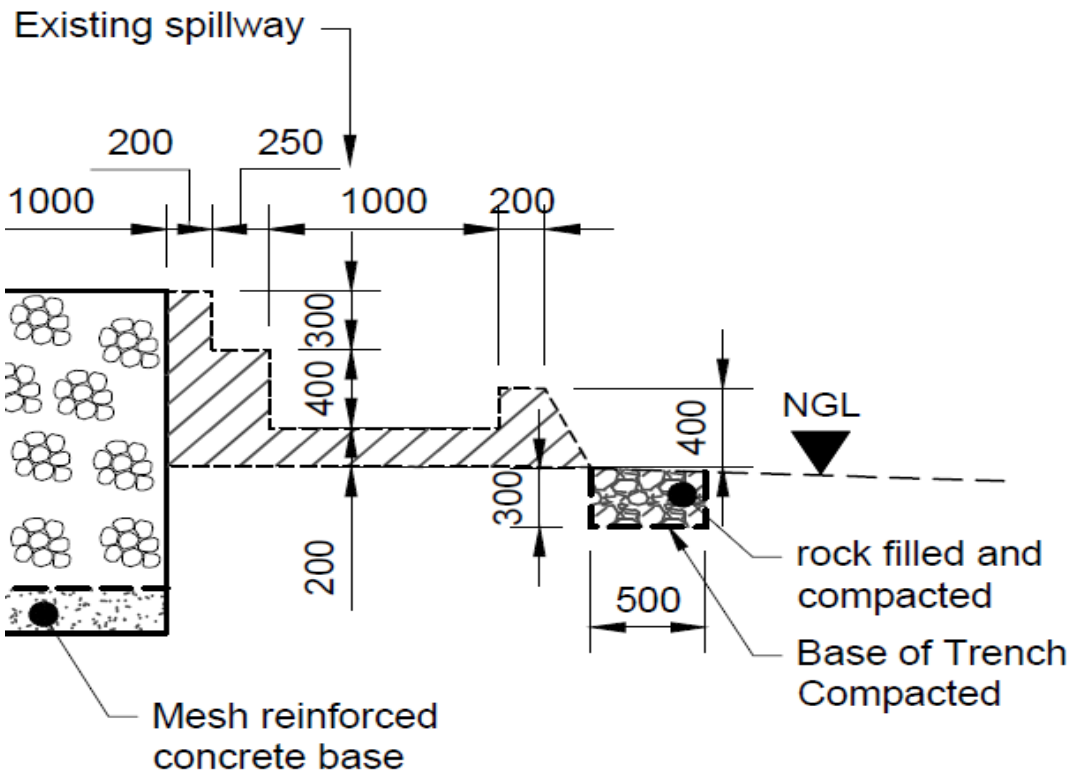


Figure 25: Schematic of spillway outfall protection - downstream remedial works

Further remedial works that are required to ensure the integrity of this upgraded spillway structure relate to the protection of its two ends and are as follows:

- Construction of suitable abutments at either end of the spillway, keyed into the embankment and the left bank of the spillway channel to allow the safe passage of flood flow without damage to the spillway or bypassing the ends.
- Construction of suitable protection - in the form of stone pitching of the left bank up to embankment crest height for a distance of 10m upstream and 15m downstream of the spillway abutment
- Construction of suitable protection - in the form of stone pitching of the training wall up to crest height for 15m downstream of the right-hand spillway abutment.
- The corner of the left hand end of the embankment where it links with the right hand service spillway abutment will need to be trimmed to the correct slope and fully stone pitched for at least 10m with cement grouting all the way to the front of the spillway sill as it has currently very little in the way of erosion protection.

6.2.2. Return Channel and Training Wall

There is only the one drop structure in place 73m along the return channel from the service spillway to the stream and its sill section is approximately 2.12m below the exit sill from the stilling basin of the service spillway. This structure is still in particularly good condition (figure 26).

Figure 26: Drop structure condition as at August 2020

The return channel width, the design flood, the channel slope, the material type of the channel floor and the relatively good grass cover are the factors considered when deciding it would not be necessary to put in a second drop structure between the current structure and the spillway.

The return channel between the spillway, downstream drop structure and its eventual exit into the stream coming in from the left of the channel to join the mainstream is generally of a very uniform floor grade across its width and in good condition.

Apart from a few livestock and pedestrian pathways it needs very little work other than some strategic maintenance – mainly the infilling of the livestock and pedestrian pathways that could lead to channeling of flow and the start of gully formation. Unfortunately, the training wall construction upstream and downstream of the new drop structure was done with a TLB and only a small double-drum walk behind the compactor so there has been significant settlement in these areas. This has led to the current situation where there is a significant risk of the training wall being overtopped by channel flow just upstream of the right-hand drop structure abutment or the abutment being bypassed entirely (Figure 27).

Figure 27: Right hand drop structure abutment showing potential for bypassing

There is also evidence of several ant workings becoming established on both training walls and these need to be completely removed. Remedial works required will consist of:

- Building up of the training walls – with suitable compaction of the placed material – to prevent any chance of overtopping- especially by the drop structure abutments.
- Infilling of pathways crossing the channel floor to prevent channeling and possible gully formation
- Excavation and complete removal of ant workings – mainly on the right-hand training wall.
- Stone pitching of the training wall immediately upstream and downstream of the service spillway abutments.
- Stone pitching protection both upstream and downstream of the drop structure abutments after their remedial earthworks repairs.

6.3. Outlets

There is a low flow/scour pipe through the Ndondi embankment which releases water back into the stream. The valve is currently operational although its chamber is a small circular masonry structure currently surrounded by seepage (Figure 28).

Figure 28: Circular masonry valve chamber in seepage area

It is not known at this stage whether the length of discharge pipe between the embankment and the valve chamber has been encased in concrete or if it was simply backfilled with earth once laid. Extreme caution must be exercised by the contractor in locating and opening up around this pipe - particularly in the area close to the embankment toe - where the new toe drain to be constructed will be passing over the pipe. If it is not found to be concrete encased, it should be opened up along its length from the end of the current concrete casing (presumably close to the current toe) to the valve chamber to enable a full inspection to ascertain its current condition. If it is still in good condition, a filter layer of sand should be placed around the pipe while backfilling. The two irrigation channels are supposed to be fed by siphon pipes over the embankment, but these have been stolen and the only irrigation downstream of the embankment currently is by means of pumps or buckets out of the stream.

Remedial works to get the two siphons and the irrigation scheme operable are not part of the brief of the current works. However, it is proposed that there are two siphon “sleeves” incorporated in the upper level of the embankment - once it has been cut down by 0,5m and before it is refilled back to the corrected crest level. This will allow access for future siphon arrangements to be installed without creating obstacles to the future maintenance of the embankment crest (Figure 29).

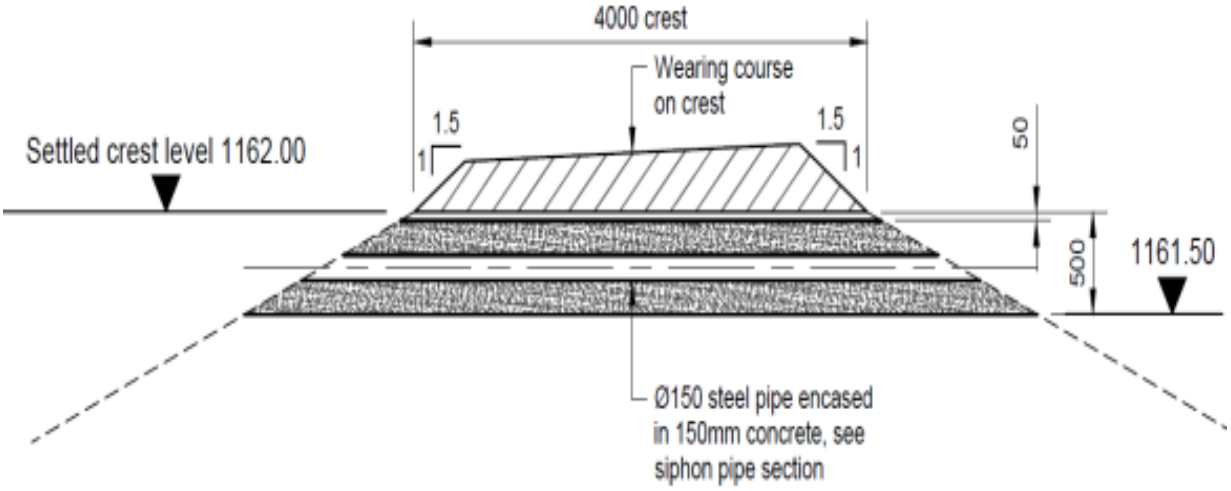


Figure 29: Schematic of proposed siphon sleeve through embankment

6.4. Construction Materials and Amenities

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

- Sand and stone for concrete for toe drains - within 5km of the dam locality
- Stone for gabion basket filling - from within 5km of the dam locality
- Rock for riprap and downstream rock toe - from within 5km of the dam locality
- Sand and Stone for reverse filter at rock toe - from within 5km of the dam locality
- Common fill material for embankment maintenance and spillway training wall repairs.
- Wearing coarse gravel for pedestrian way on crest - local ZNS gravel pits.

Preferred locations are within 5km of the dam. However some of the sites identified are as follows:

Stones, sand and rock and fill material are found along Muzoka-Mooya road, which leads to the dam. These materials are extracted for sale by the local communities' small scale unregulated miners and heaped along a 10km stretch between Nachibanga and Ndondi dams' turn offs. Location Lat. -16700244; Long. 27.344081. Sand is extracted from the local streams crossing the road; rocks and stones are crushed from collected larger stones in the community and fill material are dug from different sites around the community settlements.

There is a commercial quarry- Universal Quarries Ltd. located at Lat -16.533141; Long. 27.322817 along Muzoka-Pemba Road. These provide commercial quantities of all sizes to clients. They are regulated and environmentally approved miners.

The contractor and the engineer will work together to determine the exact locations of the selected materials. Where there are no licensed suppliers, permits will be obtained once the sites are agreed on. Accompanying method statements with environmental protection measures will be prepared by the contractor. The environmental and social mitigation measures detailed in the ESMP table will also apply during sourcing, extraction and decommissioning. The permits required include land acquisition agreements and ZEMA permits/ management plan.

Guidance on identification of sites will be as follows:

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

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

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

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

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

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

Earthfill: Suitable material for use in the rolled earthfill of the dam has not been extensively located. No materials will be taken for any purpose from within 200 meters upstream or downstream of the dam centerline, nor within 50 meters of the flood embankment, except for those materials won from necessary excavations as directed by the engineer's representative.

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

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

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

The social amenities required by the contractor include:

Water supply: The contractor will provide temporary potable water storage facilities and connection to the existing local borehole that is within 2Km downstream of the dam at the Food Reserve Agency shed without compromising community access to the water. The shed is along the dam access route. Water from this well was tested (refer to water quality section 4.1.4). It is safe for drinking and can be used by the contractor and its staff. The hand pump borehole location is at Lat. -16.729232; Long. 27.391108.

Campsite: A campsite for 12-15 external workers will be structurally constructed within the site off the access road around coordinate 16.734102 S; 27.385593 E. The campsite will be located at least 150m from the surface water body. The community will be involved in the siting.

The Contractor will provide the following at the site:

- Washing and sanitation facilities- incl. VIP latrines to be constructed within the site for ca. 50 workers (at least 2 latrines, 2m x 3m per toilet with opposite/alternate access and a privacy screen, one for men and one for women). Each toilet will have a hand wash basin.
- Cooking facility at the campsite- all the cooking activities will only be conducted at the designed facility. Waste management (non-hazardous waste) - collection from waste receptors within the site, and disposal at council designated site located in Pemba urban at Lat. -16527384; Long. 27.375608.
- 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 bunded walls according to the stipulated ESMP table requirements. Any recyclers and re-users of waste must be licensed and monitored according to ZEMA guidelines.
- Temporary accommodation facilities for his staff. The temporary facility will be made up of local building materials or tents and with a minimum spacing requirement of 4.5sqm living space per staff.
- Office facility, a minimum space of 3m x 3m internal dimensions complete with air conditioning, an office table, at least 2 chairs, a common sink, internet, power connection with at least 1 dedicated power point.
- Vehicle and machinery parking area.

Additionally, the contractor will ensure to the extent possible that the camps are constructed from materials that can easily be constructed and dismantled. Other than those listed above, supporting facilities such as drop-down toilets, generators 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 and the contractor will make his own arrangements for a suitable site for his camp, after engaging the relevant persons for that piece of land. The contractor is expected to indicate where

they intend to set up their site camps. The contractor will ensure that the identification and subsequent operation of the camps meet local and international environmental and social safeguards.

Access roads: Access to Ndondi Dam is by a 13.5 km Muzoka-Mooya feeder road, Lat. -16.711013; Long. 27.394180 Ndondi school junction. The access road which is the current access road is shown on the land use map.

Labour force: The total workforce will be approximately 50 people. 15 of these are likely to be externally recruited, including an engineer, a foreman, site construction workers, a storekeeper, and heavy machinery and equipment operators as it is not expected that specialized or skilled workers will be available in the Pemba communities. Approximately 35 workers will be recruited from the Pemba communities.

6.5. Construction Programme

Considering the Scope of Works and possible sources of materials as listed under Item 10 - Materials, the rehabilitation works will be completed within 4 months.

6.6. Drawings List Available to the Contractor

No.	Description	Drawing No.
1.	Embankment Layout	ZM/DAMS/ND/C01
2.	Embankment Cross Sections	ZM/DAMS/ND/C02
3.	Spillway and Drop Structure Details	ZM/DAMS/ND/C03

7. Risk and Impact Mitigation Plan

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

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 500/month
Hazardous Waste Management						

Construction activities **Vehicular operation** **Sanitary facilities**	Hazardous waste generation and releases into the environment such as hydrocarbons and sewer Public health and safety hazards	• The contractor will screen the proposed storage areas and prepare a plan for the site preparation, construction, operation and decommissioning, as part of a Site-Specific Hazardous Waste Management Plan. This will be reviewed and approved by UNOPS. • The contractor will employ the waste management hierarchy in the management of waste at all the work sites, including a) waste prevention, and b) waste reduction strategies, waste segregation with reuse and appropriate disposal methods. A record of waste generated and disposal methods will be kept on site. The contractor is prohibited by law to burn or bury any type of waste. The contractor will produce site specific waste management plans and conduct regular waste segregation 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 sealed drums.	Construction Phase Daily	• Properly designated waste storage, collection and disposal points • Tempor ary storage areas for hazardous wastes concrete-lined and bunded • Treated contaminated sites, 100 % • Training / sensitization records, 100% of workers • Waste disposal records and logs available • 100 % of sites are cleaned up • 100% of sites specific waste management plans exist	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 500/month

		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 road rehabilitation, material sources extraction, rehabilitation works	Excavation resulting in release of dust, gas and particulate emissions Public nuisance and health and safety risks Soil destabilizatio n leading to erosion and land subsidence Road surface instabilities	● The contractor will prepare borrow pit method statements and management plans for each site to detail the operation of the site and compliance with the ESMP. ● The contractor will limit excavations and clearing to necessary worksites. ● The contractor will ensure that site installation, excavations and any other soil movement activity will not be done during the rainy season to avoid erosion of material and gully formation. ● The contractor will methodically conduct site assessments, selection, and operation of the sites as indicated: A depth of utmost 2.5m will be excavated from borrow areas for safety reasons. The excavated slopes will be reduced to a stable slope, and indicated in the method statements. ● The contractor will create and maintain topsoil stockpiles. Topsoil depth ranges will be between 150 mm and 500 mm. The exact depth will be determined from the geotechnical site assessment.	Construction Phase Daily	● Minimiz ed land and soil disturbances at the work sites ● Suppres sed dust levels and soil movement / erosion ● All sites are soil stabilized sites ● Separat e soil stockpiles to specification ● Drainag e and run off control ● Site restoration, 90% for regeneration ● Site Method Statements and management plans prepared	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Dam Committee	HSSE Officer Cost 1000/month

		Topsoil will be stripped and stockpiled away from other materials. Topsoil will be only used 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 works. This will include rehabilitating disturbed work areas and restoring as close as possible to original contours. Restore topsoil from stockpiles. Replant with native plant seed mixes, and combine with natural revegetation. Overburden soil can be used for landscaping.				
Land Use and Aesthetics Management						
Infrastructure rehabilitation works, Disturbance of sites, campsite construction	Changes in aesthetics, scenic view, visual character and land use	• The Contractor will maintain consistency with existing land-use features and designs.	Construction Phase Monthly	• Minimized aesthetic impacts • Rehabilitated and restored sites, 100% • Blending land-use	Contractor Engineer and HSSE Officer UNOPS/IDSP	HSSE Officer Cost
Surface and Groundwater Pollution Management						

Activities and Works around and on water bodies	Poor water quality Public health and safety risks	• The contractor will control siltation, minimize unchanneled runoff and soil erosion by constructing drainage channels. • The contractor will provide sanitary facilities in the form of 2 VIP toilets for the workers at the campsite (1 for females and 1 for males). These will be monitored and properly decommissioned by adding lime. • The contractor will inspect machinery and vehicles for spillages and leakages on a daily basis, before use. • The contractor will dispose of construction debris and any wooded debris in legally designated site at the council dumpsite. Disposal in the reservoir or water bodies will be prohibited. • The contractor will ensure that the location of the campsite is located at least 500m from the school and 150m from the water. The community will be involved in the siting. • 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.	Construction Phase Monthly Or as required in case of an emergency/ incident	● Refer to water quality results in the ESMP ● Water quality results, monthly ● The monitoring parameters will include biological, physical and chemical drinking water quality parameters. These will include parameters 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) additionally with total and fecal coliform tests. If	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 1000/month

				hydrocarbon contamination is suspected, the test will be included. The testing will be done at certified/ approved laboratories after proper sampling methods. ● Pollution control structures ● Training records, 100% of workers trained ● Inspections reports, weekly		
Air Quality and Noise Management						
Transportation, rehabilitation works at all 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 minimize 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 sensitized on working sites and routes. Equipment noises below acceptable limits. ● The contractor will continually water sites and limit soil movements during works by stone pitching sites or vegetation. However, care must be taken to ensure that water used for this	Construction Phase Daily	● Complaints records ● Inspection sheets ● Receptor sites protection	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 300/month

		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 unregulated sources	● The contractor will source materials from reliable, regulated sources with ZEMA approved operations or will conduct the mining themselves using the approved environmental and social mitigation and decommissioning measures using a detailed method statement prepared by the contractor. ● The contractor will refer to the relevant management plans in the table; traffic, labor, air, noise, water, biodiversity, BMP, soil, land, health and safety. ● The contractor will not practice blasting ● The contractor will obtain local agreements/ permits and ZEMA permits prior to extraction activities. ● The contractor will ensure that sand mining does not affect biodiversity and flows- a method statement should be developed for the sites.	Construction phase Daily	● Refer to the remedial design report ● Use of approved and regulated mining process ● Refer to the relevant plans' performance indicators	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000
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 groundwater 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. ● The contractor will ensure that the location of the campsite will be at least 150m from the water. The community will be involved in the siting.	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
Traffic Management						
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. ● The contractor will liaise with	Construction Phase Daily	● Safety inclusion ● Existing community access infrastructure ● Training records for communities and workers ● Inspecti	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Dam committee	HSSE Officer Cost 2000

		the dam committee when developing the plan and identifying the road taking safety and awareness into consideration. ● The 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 plan will include the need to cover the raw material with a tarpaulin to ensure there is no pollution caused to the local community. Additionally, once the source of raw materials are known, the contractor, working in consultation with the Engineer and the local authority will define a route to use during the transportation of the raw material. ● The contractor will include hazard identification, risk assessment, safety measures such as signage, routes, parking areas, loading, unloading, reversing, crossings, sensitizations, fencing, competent drivers, working hours, operating low speed (about 10 to 20km/h). ● In summary the contractor traffic management plan will include: the desired flow of pedestrian and vehicle movements, the expected frequency of interaction of vehicles and pedestrians, illustrations of the layout of barriers, walkways, signs and general arrangements to warn and guide traffic around, past, or through a work site or temporary hazard, and how short term, mobile work and traffic situations will be		on reports ● Complaints records ● Traffic Management Plan in place		

		managed. ● Responsibilities of people managing traffic in the workplace, responsibilities of people expected to interact with traffic in the workplace, and instructions or procedures for controlling traffic including in an emergency will also be included by the contractor.				
Biodiversity Management						
Aquatic biodiversity **Works within habitats**	Biodiversity loss and ecological flow limitations	● The contractor will implement the BMP (Appendix J). ● The contractor will minimize impacts on notable species and loss, fragmentation, alteration, disturbance and disruption of sensitive habitats, as guided in the BMP. ● The contractor will avoid introduction of alien species that may affect other resident species in the waters. ● The contractor and communities will avoid exploiting biological use of resources and invasive methods by following regulations and training. ● The contractor will make reference to the BMP and prepare an aquatic biodiversity site/ habitat specific method statement for works which the Contractor will communicate to the contractor workforce. This will include: ○ Location of the specific works; ○ Any details obtained in the pre-works services; ○ Explicit details of mitigation	Construction Phase Daily	● Number and extent of undisturbed areas ● Species register ● Water quality results ● Training registers and species protection regulations	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Fisheries Forestry	HSSE Officer Cost 1000 UNOPS ecologist consultant costs

		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, the contractor will maintain ecological services and ecologically rich areas, protect vulnerable and endangered species, and protect nests. ● The contractor will report all incidents to UNOPS and to authorities.				
Terrestrial Biodiversity Works within habitats	Biodiversity and habitat loss	● The contractor will adhere to the mitigation measures as guided in the BMP annexed as a separate report to this ESMP ● As guided in the BMP, the contractor is required to ensure that all employees receive appropriate training in relation to biodiversity issues, so that the activities do not generate impacts on biodiversity ● The contractor will take	Construction Phase Daily	● Rehabilitation records and extents ● Extents and number of disturbed sites and species ● Maintain a fauna sighting and fatality register. Conduct	Contractor Engineer and HSSE Officer UNOPS/IDSP/ Fisheries Forestry	HSSE Officer Cost 1000

		measures to avoid wildfires, and any use of firewood from the cutting of trees around the dam. The contractor must organize alternative energy sources. ● The contractor's works, rehabilitation of roads, operation of material sites and campsites should minimize on destruction of terrestrial biodiversity. ● Contractor to prepare an aquatic biodiversity site/ habitat specific method statement which will include: ○ Location of the specific works; ○ Any details obtained in the pre-works services; ○ Explicit details of mitigation measures which should be applied in the area; ○ Details of any specific construction practices which should be applied in the area to protect biodiversity; ○ Details of any timing restrictions which apply to works in the area; ○ Restoration details for the habitats within the area where the method statement applies. ● The contractor will report all incidents to authorities and UNOPS		regular monitoring of works to ensure compliance ● Training records and fauna register		
Community Health and Safety						
Lack of safety measures	Community health risks, which include accidents, injury	● The contractor will install safety signage around the dam reservoir, embankment, crossings, material sources, roads, depressions, pits and	Construction Phase	● Adequacy of safety signage ● Training records	Contractor Engineer and HSSE Officer	HSSE Officer Cost 1000

	and drowning in open sites such as a borrow pit.	other sensitive sites. ● The contractor will monitor traffic and road safety throughout the operations in order to maintain a safe working environment, including that workplaces, machinery, equipment and making sure processes under their control are safe and without risk to health. ● The contractor will sensitize communities on safety and response, including sensitize communities on vector and waterborne diseases prevention and management. ● The community living close to the dam and especially those living upstream of the dam will be informed of the importance of having own convenience to avoid open defecation. This practice can otherwise impact on the surface water quality and consequently may cause water borne diseases among the local community accessing this water. ● The contractor will prepare the site emergency preparedness response plan which will be in a report and process flow format. This will include training, emergency personnel such as the DMC / contacts, emergency numbers, hazards identified (chemical, biological, physical or natural disasters), risk levels, evacuation and routes mapping, response-emergency reporting and evacuation procedures, critical operations.		● Refer to the technical safety reports ● Water quality free of coliforms and essentially within the WHO limits. ●	UNOPS/ IDSP Ministry of Health	

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 OHS issues of their employees, extending the application of the hazard management activities through formal procurement agreements. Preventive and protective measures should be introduced according to the following order of priority: ● Eliminating the hazard by removing the activity from the work process. Examples include using an alternative that is less harmful, etc. ● Controlling the hazard at its source through use of engineering controls. Examples include machine guarding, acoustic insulating, etc; ● Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, 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	Construction phase	● Training of workers, record in place ● All workers in rightful PPE ● Good housekeeping	Contractor Engineer and HSSE Officer	HSE Officer Costs

		comprehensive job General EHS Guidelines.				
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	● Contract or 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 to 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 reporting), if the survivor agrees, based on informed	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	Contractor UNOPS / IDSP	Gender Consultant UNOPS, 16.000/year

		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.		sessions have been implemented at least once ● 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 CoC are disclosed through appropriate means and will also be conveyed in the local language, for easy comprehension. ● The contractor will ensure that all sub-project-relevant cases are reported to UNOPS (establish agreements with relevant entities, distribute contacts for reporting), if the survivor has agreed based on informed consent.	Construction Phase	● Field monitoring missions are implemented at least once every month ● All CoCs have been disclosed through appropriate means ● 100% of all workers have been trained in the CoC and GBV/SEA risks and obligations	Contractor/UNOPS	Gender Consultant UNOPS, 16.000/year
Labour and Working Conditions						

Labour and Working Conditions	General Risks and Impacts	• The contractor 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
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 sanitisers and face masks.	Contractor Engineer and HSSE Officer	In rehabilitation cost
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.	Construction Phase	• Monthly reports received on consultations and key issues identified • Information on CoC has been translated in local language • 100% of workers from	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

		• The Contractor will provide information on CoC (in local languages). • Contractor to conducts cultural sensitization of workers.		outside have received training		
Conflicts	Conflicts between workers, based on cultural or other differences Risks of disagreements between local workers and employers	• The contractor will design and implement a workers' GRM. • The contractor will operate workers' GRM.	Construction Phase	• Monthly reports on Workers' GRM received • Reports received on Workers' GRM	Contractor UNOPS	Contractor budget Staff costs and travel budget
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. • The Ministry of Health and the district council (environmental health office) will be involved during prevention programmes.	Construction Phase	• Every workers has received training	Contractor UNOPS	Contractors' budget (training costs, awareness raising in community costs, translation costs for COC) 5.000 USD / 6 months
Occupational Health and Safety	Occupational Health and Safety Risks	• Occupational health and safety requirements will include hazard identification-elimination, substitution, controls, communicate risks, training, emergency preparedness and response, adequate and relevant personal protective equipment, incident investigations, monitoring. • COVID-19 spread at the	Construction Phase	• Emergency preparedness and response plan for occupational emergency situations • Report on COVID-19 mitigation plan	Contractor UNOPS	HSSE Officer costs

		construction site to be mitigated through attached plan (see appendix D).		implementation		
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 work required under the contract**	Residue impacts Aesthetic impacts Safety hazards	● The contractor will review the types of activities carried out on the site, including material extraction, machinery, buildings erected, waste handling and recovery operations. ● The contractor will conduct identification of potential hazards, including an evaluation of the raw materials and waste products typically stored on-site, site hydrogeology, ecological effects, control measures for dam safety to prevent incidents, all items of plant and other materials, including buildings that may be decommissioned, rendered safe or removed from site for disposal or recovery in the event of demobilisation and closure. ● The detailed rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	HSSE Officer costs
Disturbed work areas, material sites and Borrow pits	Soil erosion, aesthetics, drainage, safety hazards	● The contractor will conduct detailed site inspections, define and map disturbed areas where rehabilitation/erosion control is required. ● The contractor will develop costed method statements for each area, including problem statement, method of rehabilitation, resources needed and responsibilities. ● The contractor will	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

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

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

		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 /dam committee (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 will be disposed of as waste, some of which may be deemed hazardous waste due to their composition e.g. oils. Such materials will be disposed of off-site in accordance with appropriate waste management regulatory requirements and facility waste management	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer Supervisor/ PIU	In rehabilitation cost

		procedures. Soil contaminated with hydrocarbons will be excavated up to clean material beneath the base of 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 areas that were used as workstations will be re-vegetated. The rehabilitation plan will be in the contractor's site method statement.	Construction Phase After conclusion of works	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Stock piling	Land use and aesthetics safety hazards	● The contractor will ensure that all heaps of overburden material should be used to back-fill the borrow pits and the sections properly levelled to	Construction Phase After conclusion of	● Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

		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.	works			
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
Environmental Flow	Ecological flows	● The contractor will install the user friendly durable flow gauge for regular flow measurements during runoff season. ● Ensuring balancing of flows and ecosystem needs, as suggested in the BMP. ● UNOPS will conduct training for the Dam Committee on flow reading and management.	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 dam committee will be trained on household waste management. There will be no disposal or storage of waste at the Ndondi 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	Dam Committee/ Water User Committee Ministry of Agriculture DWRD	

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. • Refer to IDSP Pest management plan.	Operation Phase Monthly	• Non-polluting farming, animal watering and fishing methods (e.g. farmers not to push nitrate-based fertilizers into the surface water/dam) are applied • Training/ sensitization records, 100% • Water quality monitoring records	Dam Committee/ Water User Committee Ministry of Agriculture DWRD IDSP	
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	Operation Phase Quarterly	• Water quality results from the dam and main tributaries in the catchment • Pollution control structures • Training and sensitisation records	Dam Committee Ministry of Agriculture Forestry IDSP	

		management scheme. • Communities will continue sensitizing the farmers on catchment management practices, stock watering control and soil conservation. • Refer to IDSP Pest management plan.				
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	Dam committees Ministry of Health	
	Breakout of water borne disease as a result of poor sanitation practices by communities living upstream of the dam	• Sensitzation of the local community both those living upstream of the dam and those living around the dam, using a programme called Community Led Total Sanitation Programme (CLTS). This programme compels the members of the community to have at least 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	
Pedestrian Infrastructure Management						

Maintenance of access infrastructure	Deterioration of access infrastructure, increased chronic sediment delivery, disturbed hill slope hydrology, and impacts to aquatic, riparian, and terrestrial ecosystems of roads crossings Safety hazards	• IDSP will sensitize the community on appropriate use of the infrastructure to avoid and minimize failure. It will carry out regular inspection and maintenance of the infrastructure, and maintain the infrastructure and safety measures. • IDSP will train dam committee on use, maintenance and monitoring requirements.	Operation Phase Quarterly	• Training records • Inspection records • Maintenance records	Dam committee IDSP	
Biodiversity Management						
Aquatic biodiversity Operational activities	Biodiversity loss and ecological flow limitations, population increases	• The BMP will be implemented accordingly to ensure appropriate measures are put in place for biodiversity conservation purposes where feasible. • Maintain ecological flows all year round and integrity of the ecological function. • UNOPS to increase basin water holding capacity by rehabilitating the structure in order to enable constant downstream flows and basin	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 • Training records	Dam Committee Fisheries Forestry UNOPS IDSP	

		water levels. Otherwise the basin may run dry. This would also relocate the aquatic species from the dam. A system for equitable allocation of water is based on available supply. ● Include gauge levels monitoring facilities. dam committee to strictly monitor inflows, retention water and outflows in order to have a balanced system. ● UNOPS to include outlet infrastructure for downstream flows. ● Dam committee to monitor the erosive capacity of the streams downstream for sediment barrier occurrence upstream ● Dam committee to monitor flow level changes downstream. Natural flows and dam controlled flows. ● Communities to protect vulnerable and endangered species. ● Avoid exploiting biological use of resources and invasive methods. ● MoA working with Department of Fisheries to train the community and DMC that benefit from the ecological value of the dam so they can learn sustainable fishing skills and preserve the fish juveniles in the				

		willow waters. ● Secondary developments to take aquatic biodiversity into consideration.				
Terrestrial biodiversity, operational activities	Biodiversity and habitat loss	● The BMP will be implemented. ● Active control of invasive and alien species after training by government departments. ● The community will incorporate catchment management measures to habitats around the dam. Avoid displacements and over exploitation of species.	Operation Phase	● Biodiversity conservation measures in place	Fisheries Forestry Ministry of Agriculture	
Communication and Community Engagement						
Communication to Stakeholders	During operational phase, dam is not managed well by local communities	● IDSP to train dam committee in E&S issues indicated in the UNOPS and contractor training plans.	Operations Phase	● Dam committee exists ● Dam committee has been trained	IDSP local authorities	
Catchment Management						
Catchment management	Increased erosion and sedimentation	● The IDSP will ensure the dam committee and officers from the departments of forestry, water resources and agriculture are oriented to appreciate the contents of the 0&M manual, use and benefits for sustainable management of	Operation Phase	● Training of the following in the implementation of O&M: ● Dam committees ● Water resources development ● Agriculture	IDSP DWRD Dam committee	In training costs

		the dam catchment area.		• Campsite officer • Forestry		
Community Health and Safety						
Lack of safety measures **Dam use Crossings**	Public health risks and diseases Drowning Injury Dam failure	• The communities will be trained by IDSP and government departments in maintenance of safety signage around the dam reservoir, embankment, crossings, material sources, roads. • The contractor safety signage plan, location and type will be presented for approval to the supervisors and PIU by the contractor. Safety areas will include undesignated or risky crossing points or activities around the dam, community warning prior to opening any valves, flooding, health, safety, planning, prevention and response, reporting faults and security measures at the dam.	Operation Phase	• Inspection reports • Training records • EPP revisions and reviews • Safety signage Plan and records • Refer to the technical safety reports	Dam Committee Ministry of Agriculture DWRD IDSP	
Gender Equality and GBV Action						
Gender Mainstreaming	Dam Committees do not have female members	• UNOPS will define gender parity in constitution of the dam committee and include gender equality training in the training of dam committees	Operation Phase	• Dam Committees have 50% female members	Ministry of social services	Included in training costs above
Maintenance and Monitoring Management						

Dam maintenance	Structural deterioration Dam Management	• The IDSP will conduct further dam committee trainings on dam maintenance and dam safety. • The dam committee will ensure incidents are reported to the resident IDSP staff and responded to. • UNOPS and IDSP will conduct maintenance and flow inspections trainings for communities and district officers. • IDSP will conduct periodical dam safety assessments. • IDSP will employ record keeping for the Dam maintenance works done by the department and by the community.	Operation Phase Bi annual	• Dam committee Quarterly meetings and resolutions • Flow measurements and action plans • Training records • Dam maintenance records and monitoring records • Refer to technical safety reports	IDSP DWRD Dam Committee	500/ 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. Catchment management to be implemented by the community and the relevant government institutions. • The Ministry of Fisheries and Forestry will conduct biodiversity monitoring as indicated in the BMP.	Monthly	• Refer to the biodiversity assessment and BMP • Monitoring records • Pictures • Training records • Flow measurements • Water quality results, monthly The monitoring parameters will include biological, physical and chemical drinking water	IDSP DWRD Dam Committee	500/ year

				quality parameters. These will include parameters analysed in this ESMP: pH, conductivity (µg/cm), sulphates (mg/l), nitrates (as no3-n mg/l), total dissolved solids (mg/l), ammonia (as nh4-nmg/l), phosphates (mg/l), total suspended solids (mg/l), chemical oxygen demand (as mg o2/l, chlorides (mg/l), turbidity (NTU), hydrocarbons (mg/l) additionally with total and fecal coliform tests. If hydrocarbon contamination is suspected, the test will be included. The testing will be done at certified/ approved laboratories after proper sampling methods.		

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

This section discusses aspects requiring rehabilitation before the contractor demobilizes from the project area. The remediation plan is to a larger extent covered in the actual design works for remedial works, and hence limiting the discussion in this section to those aspects which are non-structural. This plan is prepared in reference to the ESA Table 9-2 'Requirements for rehabilitation plan' which requires that rehabilitation specifications for embankments, access roads / tracks created during past construction/ and any areas of downstream erosion / embankment destabilization that has been caused by the previous construction works and the initial operation of the dam are prepared.

The main purpose of this plan is to:

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

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

The rehabilitation works are elaborated in the table below.

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
Structural risks						
Slope stabilization	Location: Embankment slopes, piping, eroding/ gullying return channel and training wall Images: Section 5.2 'Dam characteristics' Open unstable and/ or eroding slopes Risks: structure failure, soil loss	Refer to the dam design reports Conduct slope stabilization maintenance Place a more extensive rock toe will have in this area, extending at least 2.0m vertically up the embankment face and incorporate a reverse filter on its upstream side to cater for any seepage passing through or surfacing at the downstream toe of the embankment. In addition to controlling seepages the rock toe will provide additional weight against the embankment thereby increasing the overall stability	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Sand- quantities 260m^3. Rock quantities 500m^3. Crusher runner from a commercial quarry , quantities 260m^3 The equipment required includes: backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator *Workmanship* Up to 10 machine operators and 15 laborers as per above and up to 4 months for the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	Trimmed, extended and stabilized slopes Gullying and erosion protection	In BoQ
Spillway and drop structures	The structures have temporary sandbags to control erosion	Refer to the dam design reports Construct gabion basket abutments with wing walls and cut off walls at both ends of the	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period	Contractor liability period Site inspections Pictures Continuous	Rehabilitated walls and adequate gabion presence	In BoQ

	Risks: structure failure, soil loss, continuous water loss from the basin	current spillway structure. Include babion baskets along with Reno Mattresses or stone pitching as protection for the abutments on both banks of the spillway channel. This protection will link in with the grouted stone pitching to be placed along the bend in the left-hand end of the embankment where it leads into the spillway Excavate a trench along the length of the upstream face of the current spillway to a depth of 1m below current ground level and 1.5m wide. The base of this trench should be compacted and a layer of geofabric placed before placing 250mm of concrete reinforced with a 100 x 100 x 2.15mm mesh as a foundation layer. Construct additional masonry wall, 1m wide, against the existing wall up to the current level of the sill. Finish with a suitable cement plaster This will not only resolve the leakage issue but greatly improve the overall strength of the structure. It will also provide a 1.2m pedestrian access to the right bank of the dam for the local population who currently have only a 20cm wide crest to walk on when the dam is spilling Build up of the training walls –	Implementation Role: Construction Contractor Supervisor: UNOPS *Materials and equipment* Rock, quantities 150m^3 Equipment backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* up to 3 machine operators and 25 laborers as per above and up to 4 months	maintenance		

		with suitable compaction of the placed material – to prevent any chance of overtopping- especially by the drop structure abutments. Infill pathways crossing the channel floor to prevent channeling and possible gully formation Excavate and completely remove ant workings – mainly on the right-hand training wall Introduce stone pitching of the training wall immediately upstream and downstream of the service spillway abutments Introduce stone pitching protection both upstream and downstream of the drop structure abutments after their remedial earthworks repairs				
Non-structural risks						
Waste and rubble snag list	Construction rubble along the spillway return channel	Stock pile of the inert concrete rubble for subsequent usage away from the return channel; use of material as fill at decommissioned worksites	*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 *Materials and equipment* Excavator, haul truck, dumper	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Decommissioned site	In provisional sum, BoQ Day works

Hazardous waste snag list	Former campsite has a pit latrine now used by the resident pupils	Decommissioning –too close to the basin Disinfection and burying with assisted vegetation	*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 *Materials and equipment* Lime -200kg Water tests Fill material	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Decommissioned site	In provisional sum BoQ Day works
Access routes	Location and Condition of the sites: one access route to the dam (700m) (extents shown on the Land use Map). And a low flooding point downstream of the dam on the access road (about 30 m from the spillway). Images: Section 5.2 Risks: biodiversity loss	Detailed site specific method statements will be prepared by the contractor with methods and quantities 1.2m access route will be provided on the dam as indicated under structural measures above Rehabilitate and close the roads, which will not be used by the current contractor or community but were used by the prior contractor An access is proposed over the spillway. Engineering designs for remedial measures will assist in this Culverts will be included on the access route were the stream crosses the road and the downstream flows are evident.	*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 *Materials and equipment* Earthworks Drainage works-2 culverts 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 Assisted Revegetation	In provisional sum Day works BoQ

		Include earth ripping to enable possible regrowth of natural vegetation even as assisted vegetation on full coverage of the areas. The unnecessary roads should be closed by scarifying the roadway, ripping and recontouring. Creating an environment supporting over ground with natural regeneration is encouraged to support the assisted vegetation. Assisted vegetation will be included seeding, watering and maintenance of locally adapted vegetation. Re-establish natural drainage patterns on the closed roads.				
Eroded and disturbed areas	Open areas around the basin, material area slopes, campsite Livestock watering contributes to soil loosening and siltation of the basin Risk: dam basin siltation, poor water quality contribution, limiting water use, soil movements and loosening	Detailed site specific method statements will be prepared by the contractor with methods and quantities Implement reinstatement by natural succession with assisted vegetation seeding interventions, which will require intense monitoring and maintenance within the 3 years maintenance period. This will include sub-base preparation, top-soiling, fertilizing and seeding for each area which requires rehabilitation. The contractor will develop a costed method statement for disturbed sites Designate livestock watering points and promote soil	*Timing:* day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction 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:*	Contractor liability period Site inspections Pictures Continuous maintenance	Soil stabilization and livestock watering points	In provisional sum BoQ Day works

		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	10 labourers and 1 month use of the equipment			
Community health and safety	Lack of safety signage around the dam Lack of safety and health sensitization over the dam Risk: accidents and waterborne diseases due to lack of knowledge and signage warning	Include a method statement for the design of signage and location mapping. To be approved by the supervisor. Apply design approved standard dam safety signage around the dam and contractor sites for construction and operational phases Finalize and administer the community sensitizations and training planned in the ESMP - by the contractor. These include drinking water health, water borne diseases, avoidance of dangerous spillway crossings, swimming risks, emergency preparedness in floods or dam failure, EPP, safety signage, etc...	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction Contractor Supervisor: UNOPS *Materials and equipment* Training plans Signage design and subcontractor Signage installation *Workmanship and timeline:* One trainer persons Signage installation 3 laborers	Contractor liability period Site inspections Pictures Continuous maintenance Dam committee regulation	Training records in all stipulated topics Existing correct signage Signage method statement	In provisional sum, BoQ Day works
Livestock watering and irrigation infrastructure	Location and condition of the sites: Tree log fenced embankment ends to avoid animal access on the embankment. This method is unsustainable	Include stone pitching and gabion design options Training in livestock management and watering, and irrigation infrastructure security and sustainability Irrigation infrastructure to be rehabilitated for dam use	*Timing:* operation phase Implementation Role: Dam committee, MoA MoA for irrigation infrastructure Supervisor: MoA *Materials and equipment* Gabions	Contractor liability period Site inspections Pictures Continuous maintenance Dam committee Livestock regulation and control	Existing permanent structure protection from livestock movements Watering planning	In IDSP ESS budget Day works

	Irrigation piping was vandalised Risk: embankment damage/ failure due to crossing Biodiversity loss due to the continuous use of tree logs		Stones *Workmanship and timeline:*			
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: Construction Contractor, dam committee 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, BoQ

Implementation Role: construction 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 Ndondi Dam. Capacity building will be the process used by which individuals and departments obtain, improve, and retain the skills, knowledge, tools, and other resources needed for dam safety and environmental management at the dam. The training plan in Table 12 has been proposed for capacity building of district government staff, dam committee members and community members (upstream and downstream). The implementation and execution of the sub-project will include additional training of relevant staff and communities, stationed in the various sites, in environmental and social due diligence during construction and operation. UNOPS will supervise the training on behalf of IDSP. Identified trainers include: staff of local health centre, district department representatives, UNOPS E&S Team, UNOPS Dam Safety Team, IDSP and the contractor.

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

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

The training topics include:
For District Officers;

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

For Communities;

- Policy and legal framework
- Dam safety management including Emergency Preparedness and Response
- Community health and safety, including drinking water and water borne diseases, avoidance of dangerous spillway crossings, emergency preparedness in floods or dam failure, swimming and drowning risks, first aid in the event of potential drowning, risks of crossing at the dam spillways, management of livestock around the dam, malaria prevention and management, bilharzia prevention and management, management of other water borne diseases, use of dam water for drinking and emergency preparedness interactions with wild animals
- Grievance Redress Mechanism (GRM) 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 10:[25]

Table 10: Training plan

Training Content	Number of Days, Time, Frequency	Trainers / Supervision	Participants
Dam Safety-Emergency preparedness, and Community health and safety			
Emergency preparedness: Key Training Concepts: Hazards, floods and dam failure, roles and responsibilities, emergency preparedness, emergency response procedures and grievance redress mechanism Community health and safety: Key Training Concepts: Pedestrian access infrastructure, Construction safety, Gender based violence, swimming risks, drowning risks, dam security, spillway crossing risks, management of livestock around the dam, use of dam water for drinking, wild animals, malaria prevention and management, bilharzia prevention and management, water borne diseases, dam maintenance and ESMP monitoring First aid: First aid basics and response	5 After ESMP disclosure prior to construction works Repeated after 3 months and at completion	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 Dam committee
Estimated Costs: 2,000 USD per session			
Grievance Redress Mechanism and ESMP monitoring requirements			

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

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

9. Stakeholder Engagement

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

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

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

9.1. Grievance Redress Mechanism

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

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

Dam committee members thereby play a key role in the GRM, as they receive grievances or feedback from community members in person; hold the keys to suggestion boxes and regularly empty them; assess and clarify grievances; provide feedback to 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 in order to gain understanding of the needs of the dam communities, and potential risks and impacts as well as mitigation measures of the planned rehabilitation activities.

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

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

- To provide information about the previous and current sub-project and to get stakeholder information on key environmental and social baseline information at the sub-project site;
- To receive information on legacy site impacts of the previous project in relation to non-rehabilitated sites;
- To provide opportunities to stakeholders to discuss their opinions and concerns;
- To identify specific interests 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 Ndondi dam communities are stated below:

Department/ organization	Concerns/ input	Response
District commissioner	The priority criteria must consider that Ndondi is in an area vulnerable to climate change and is water-stressed	Vulnerable groups have been considered in the assessment (social section and under the rehabilitation of the spillway crossing) Ndondi Dam will be rehabilitated Seepage that affect water storage has been considered
Department of Social welfare	Vulnerable persons must benefit from the infrastructure – female headed households, chronically ill, child headed households, aged and disabled. Ensure it is usable by all persons e.g. access routes, irrigation and water points	Vulnerable groups have been considered in the assessment (social section and the rehabilitation of the spillway crossing) Both women and men must be employed as indicated in the ESMP

	Take part in most income generating activities including employment and women are left out Women and the vulnerable benefit more than men from the government's resource park through the department for gender equality The sub-project should involve employment of both, men and women The Zambia Police's Victim Support Unit VSU, Government Community Development and World Vision NGO deal with gender matters in the district There have not been many local initiatives or programs due to lack of funding	GBV and SEA have been included for the sub-project
Department of Arts and Culture	Engage locals during rehabilitation so that they adopt ownership of the dam and empower themselves. Use the local structures in all the programs	Employment of locals is included in ESMP
Department of Forestry	Afforestation and reforestation are vital for dam sustainability Locals have to embrace tree planting and should undergo training Southern Province and Pemba in particular are facing deforestation at a rapid pace and that threatens such projects and infrastructure The department has a number of indigenous seedlings for tree planting The line ministries must be involved in the dam activities including site visits as they have not been to the dam sites. That way they will better contribute to the mitigation measures of the sub-project	Vegetation initiatives and catchment management is included in ESMP The Department of Forestry will be involved in habitat restoration and site revegetation during construction and operation phases.
Department of Agriculture	Rhe sites have sparse vegetation with significant disturbance to the natural ecosystem	The Ministry of Agriculture and communities will be involved in catchment management during

	Cut off drains, silt traps and contour bands around the reservoir must be considered	the operation phase.
	The communities should be involved all the way to sustain the dam as their activities matter in the protection and conservation of nature	
Community members	The Dam has been beneficial to most communities, even distant and unanticipated ones	Dam rehabilitation and access over the dam has been included in the ESMP
	Dam's structural problems have to be sorted out- spillway capacity, drop structures integrity, erosion along drop structure surface, riprap and re-grassing, siltation in the basin, fishes leaving the basin due to low spillway structure, seepage	Dam safety is included in the ESMP The irrigation canal remedial measures have been included for dam use
	Access route requires rehabilitation	Training program has been prepared
	The dam's water holding capacity is low	Employment of locals-men and women has been included in the ESMP
	It is the main water reservoir in the area	
	Irrigation is needed as a livelihood source, canals must included	
	Dam safety is not in place	
	Training is needed for the dam committee	
	Employment should involve the local community members	

9.3. Stakeholder Communication Plan

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

Table 11: Stakeholder communication plan

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

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

Dissemination in regards to the long term use		Community Notice Boards	Disaster Response Team; local headmen	Messages produced for notice boards
	Information on dam safety concerns	Community Meetings – with social distancing Community Notice Boards	Dam committee; District Disaster Response Team; local headmen	Minutes of meeting Messages produced for notice boards

9.4. Stakeholder Consultation Plan

In addition to information dissemination, the sub-project will ensure consultations of PAPs 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).

Consultations during ESMP preparation

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

Consultations planned for the implementation stage

Project stage	Topic of consultation	Suggested Method	Target stakeholders	Responsibilities
Consultations during remedial works	Sub-project Activities / E&S Mitigation Measures ESMP Disclosure Venue: community meeting venue in the village or the school District council hall Time: to be agreed with the community and other stakeholders After document clearance and before construction works commence	Community meetings (all interested community members)	Community level stakeholders	UNOPS
		Suggestion box at district office, school, church	Community members, including vulnerable groups	IDSP Social Specialist
		Stakeholder meetings – with social distancing	Dam committee and district level stakeholders	UNOPS
		email	National level stakeholders	UNOPS
		Telephone Hotline	All stakeholders, including vulnerable groups	IDSP Social Specialist
		Dam committee, local headmen, and District Disaster Committee to receive feedback in person	Community level stakeholders, including vulnerable groups	IDSP Social Specialist
		email	National level stakeholders	UNOPS

9.5. Proposed Strategy to incorporate the Views of Vulnerable Groups

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

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

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

9.6. Reviews of Comments

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

10. ESMP Implementation Process

Step 1: Procurement and Bidding Process

Based on this ESMP and the designs for the Ndondi Dam works developed, UNOPS will prepare bidding documentation to procure a contractor to implement the project works at the Ndondi 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 stockpiling
- 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 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 the 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 training and other required activities.
- UNOPS will use the indicators of 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, PPE use, 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, training, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local Dam Committee and local authorities. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP will be communicated to relevant ministries indicated.

IDSP will implement its own monitoring and supervision activities as they apply for all AF activities, including the remediation of Ndondi 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 30:

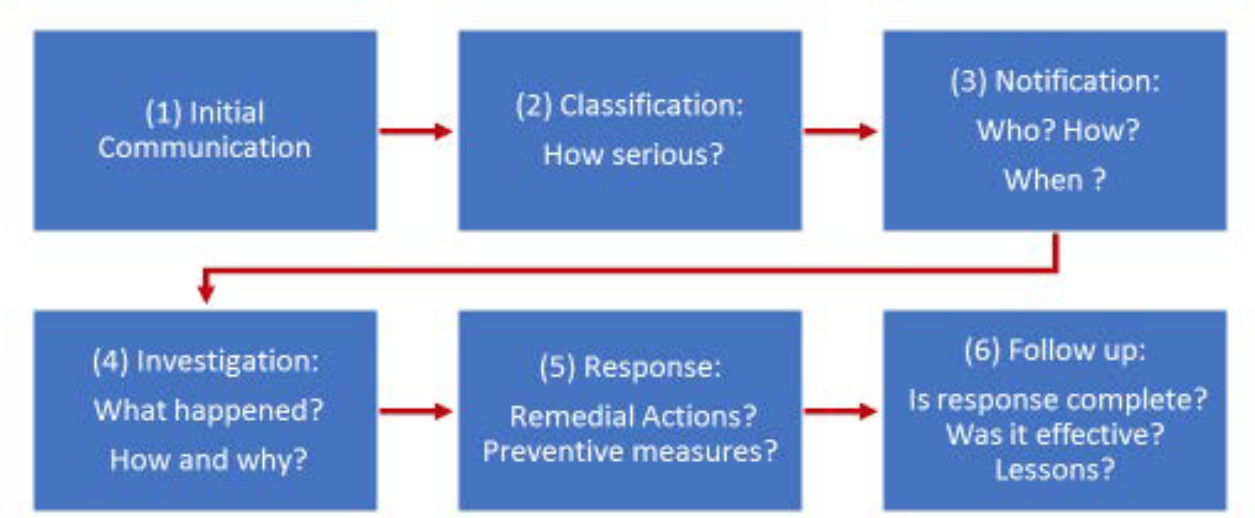


Figure 30: Incident reporting process

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 training are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Ndondi dam committee 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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Appendix A: Completed Checklist

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

1-Date of the visit: 16th and 17th July 2020		
Name of the Environmental Specialist filling this checklist: Pilila Chongo		
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: Ndondi Dam		
Location Pemba	**Region** Southern Province	**District** Pemba
Villages /communities	Ndondi	
Geographical location	**Coordinate South** 16.73486°	**Coordinate East** 27.38571°
3-Remediation works- please indicate the main proposed works that could cause environmental and social impacts		
Slope works	Material sourcing	Access routes
Outlets	Campsite	
Infiltration	Site preparations/ clearing	
Other	Waste management	
4.MATERIALS NEEDED		

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

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

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

6-Evaluation of impacts and mitigation measures to be included in the ESMP (you can use additional paper)	
Main environmental and social impacts: describe	**Possible mitigation measures**

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

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

o **Borrow pits**	none
o **Unsafe paths**	Rehabilitation of former contractor roads
o **Unfinished crossing points for communities**	Crossing point over the spillway and embankment is not safe Construction of animal watering points around the basin
o **Other: Environmental flows and outlets**	Inclusion of outlets, flow monitoring gauges

8- Ecological Flow. Have you to coordinate with the technical team the options to improve ecological flows below the dam Yes No (you need to coordinate) Yes	
What is the flow below the dam (m^3/s)	To be confirmed-
Are wetlands below the dam No	**Are critical species present in the wetland or rivers: Yes (indicate below species)** The initial assessment using IBAT indicates presence of species that may be endangered or may require special attention. The full Biodiversity Assessment was conducted and a BMP prepared.
Are people using the water below the dam? What for?	Not all year round. Only in rain season when there are downstream flows
Based on these findings, please indicate if it is possible to install a structural solution to improve the ecological flow **No** **Explain:**	**Yes Explain:** Though inlet flows upstream are low in the dry months **Structural measures** Outlets, gauges, spillway rehab **Operational measures** Flow measurements, training

9) Biodiversity. It is expected that you performed survey to the area or collect data with experts on diversity of the area for each dam. Please indicate what groups have been investigated in the project area and preliminary observations.	
Plants	Mammals
Fish	Amphibians
Macroinvertebrates	Other groups
Please indicate issues of poaching, illegal trade, and other issues affecting the area	
Presence of sensitive species:	
Critically Endangered species:	**Endangered species:**
Vulnerable species	**Migratory species:**
Protected species in Zambia:	**Endemic/rare/globally important species:**

Based on the results of the field observation, data collected and the OP 4.04 definitions	This project has natural habitat YES / NO The project area has critical habitats YES /NO
Based on the project area and the risk and potential impacts, you have identified for biodiversity –	

1-Please indicate the recommend measures to protect these species and Prepare in a separate document a Biodiversity Action Plan (BAP) **2.In the area contains critical habitat and there is ecological flow needs please request to Prepare in a separate document as a Biodiversity and Ecological Management Plan (BMP)**	
10-Final recommendation	
Name Pilila Chongo,	**Date: 20 July 2020**
Signature P.C	
Comments for the preparation of the ESMP and BAP incl. Ecological flow measures. Detailed environmental and social studies and inclusion of such matters in the designs. Further Ecological surveys **undertaken and are presented in the annexed BMP**	
Field visits registration	
Photo	Photo ‘
Photo	Photo

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[26]

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.

[26] 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.

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
    - 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 and Dam Committee

Attendance sheet

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE NDONDI $ NACHIBANGA DAMS DATE 16/07/20

PEMBA STAKEHOLDERS

S/N	NAME	GENDER	DESIGNATION	ORGANISATION	CONTACT DETAILS	SIGNATURE
	REGINALD H. MULOBA	M	District Comm	Shoose Dist. Admin	0977 383054	
	ZULU MODESTO	M	TECHNICAL OFFICE	MOA	0977-960408	
	MAFWABO ANDREW GIFT	M	A-T-O	MOA	0977622756	
	CATHERINE HANG'ANDU	F	DACO	MOTA	0979133642	
	KASONDE JAMES	M	TECHNICIAN	FD	0972-304648	
	MATAKALA BISCHOFF	M	DWDO	DWRD	0975364774	
	JACOB MWAKUNYUMBE	M	Ag DAO	D. Admin	0977-350197	
	LUCKY MUSONDA KASAKA	F	DSWO	Social Welfare	0977-318767	
	Mwene Mumba	M	DWS	Buildings	0956830755	
	Mwila Chasaya	F	D. labour officer	Labour	0976-061873	

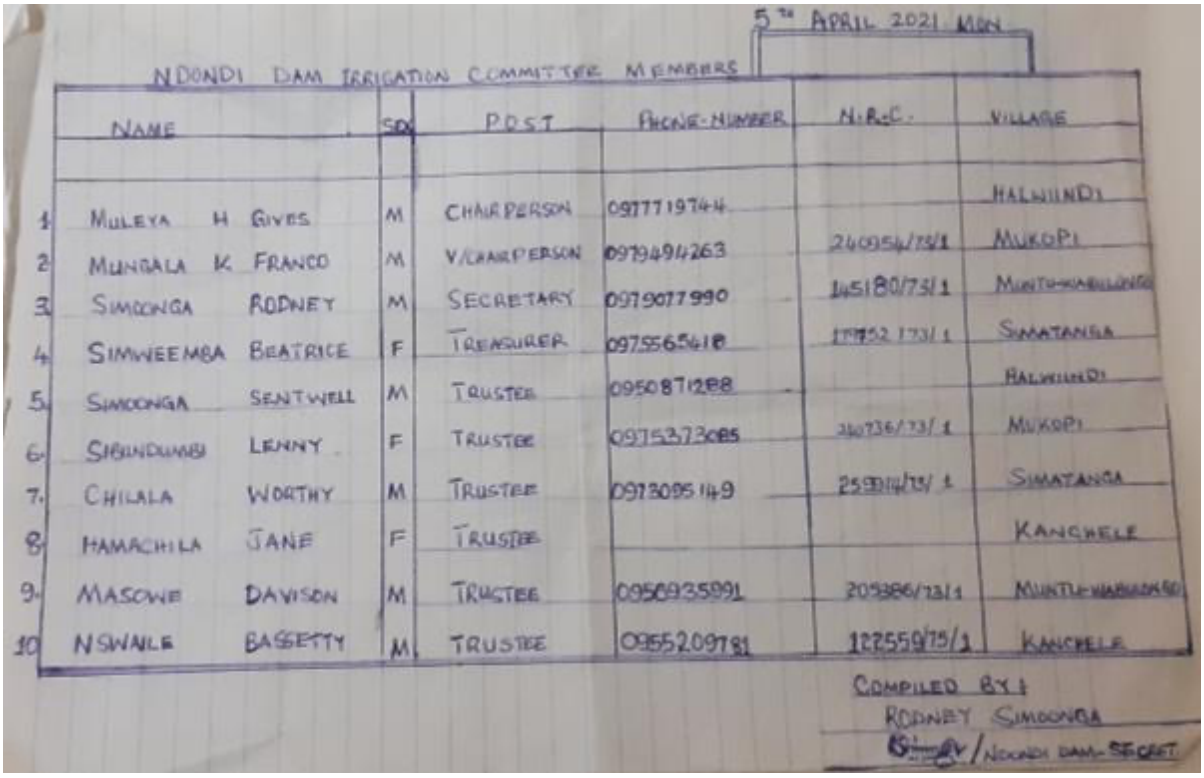
IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

NAME OF SITE: NDONDI DAM   DATE: 16/07/20

S/N	NAME	GENDER	DESIGNATION	ORGANISATION	CONTACT DETAILS	SIGNATURE
01.	Gives Muleya	M	Ch/man	Ndondi Commit	0977719744	[signature]
02.	Cornelius Maambo	M	H/man	Headman	0976930436	[signature]
03.	Franco Mungala	M	Dam Com.	Ndondi D. Comm.	0979494263	[signature]
04.	Sintwell Sikoonga	M	"	"	0950871288	[signature]
05.	Stewart Maambo	M	CAC		0978108292	[signature]
06.	Barnabas T. Muleya	M	"		0975775770 42	[signature]
07.	Lister Hamaanda	F	Farmer		0975939541	L.H
08.	Mutinta Simoonga	F	"		N/A	M.S
09.	Carol Mukonka	F	"		"	C.M.
10.	Elep Maambo	F	"		"	E.M.
11.	Linah Hamuunga	F	"		"	L.H
12.	Claudine Michelo	F	"		"	C.M.M.
13.	Agnes Mudenda	F	"		"	A. Mudenda
14.	Milton Michelo	M	"		0973082737	[signature]
15.	Benister Muleya	F	"		N/A	B.M
16.	Edith Chiimba	F	"		"	[signature]
17.	RODNEY SIMOONGA	M	DAM COMMITTEE			[signature]
18.	Fred Mulimo	M	Farmer		0972031189	[signature]

Dam Committee List



5TH APRIL 2021 MON

NDONDI DAM IRRIGATION COMMITTEE MEMBERS

	NAME		SEX	POST	PHONE-NUMBER	N.R.C.	VILLAGE
1.	MULEYA	H GIVES	M	CHAIRPERSON	0977719744		HALWIINDI
2.	MUNGALA	K FRANCO	M	V/CHAIRPERSON	0979494263	240954/75/1	MUKOPI
3.	SIMOONGA	RODNEY	M	SECRETARY	0979077990	145180/75/1	MUNTUHABILONGO
4.	SIMWEEMBA	BEATRICE	F	TREASURER	0975565418	177752 173/1	SIMATANGA
5.	SIMOONGA	SENTWELL	M	TRUSTEE	0950871288		HALWIINDI
6.	SIBUNDUMBU	LENNY	F	TRUSTEE	0975373085	260736/73/1	MUKOPI
7.	CHILALA	WORTHY	M	TRUSTEE	0973095149	259314/75/1	SIMATANGA
8.	HAMACHILA	JANE	F	TRUSTEE			KANCHELE
9.	MASOWE	DAVISON	M	TRUSTEE	0950935991	209386/73/1	MUNTUHABILONGO
10.	NSWALE	BASSETTY	M	TRUSTEE	0955209781	122559/75/1	KANCHELE

COMPILED BY:
RODNEY SIMOONGA
NDONDI DAM SECRET

Appendix G: 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 H: 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	Contractor Supervision UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental Specialist	All staff Community members Contractor's first aiders
Grievance Redress Mechanism and ESMP requirements			
Sharing of the Environmental and Social Management Plan (ESMP) by Contractor to site accessing persons *Environmental management plans* *Grievance redress mechanism*	Throughout	Contractor Supervision UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental Specialist	All staff Community members

Appendix J: Biodiversity Assessment and Management Plan

EXECUTIVE SUMMARY

Biodiversity Assessment Results

The project area of influence has three main types of terrestrial habitats: Miombo Woodlands, Riparian/Riverine Vegetation (habitats) and Dambos (willow wetlands). Miombo woodlands are by far the most extensive habitat type on site.

A total of 20 terrestrial tree species were observed in the sampled area (26,392.8m2) around Ndondi Dam. In this area, a total of 873 stems were recorded. *Julbernardia globiflora* had the highest number of stems with 204 followed by *Brachystegia boehmii* with 151 and *Uapaca kirkiana* with 120 stems.

Combretum species are wide-spread on the project site. Common among this species are: *Combretum imberbe, Combretum celastroides, Combretum fragrans* and *Combretum molle.*

Further, the results showed that *Julbernardia globiflora* had the highest Importance Value (IV) with 28.6% followed by *Brachystegia boehmii* (23.2%) and *Uapaca kirkiana* (19.7%). This is an indication that the three species are the most dominant within Ndondi Dam area. All of the recorded terrestrial flora species in the project area of influence are listed as Least Concern under the IUCN Red List.

Concerning fauna, no large species occur in the project area of influence. The main mammals observed in the area included: Dwarf Mongoose, *Helogale parvula*; Common Genet, *Genetta genetta*; African Civet, *Civettictis civetta*; Scrub hare, *Lepus saxatilis*; Bush squirrel, *Xerus inauris*; Vervet monkey, *Cercopithecus aethiops*; Bush pig, *Potamochoerus porcus*; and African wild cat, *Felis lybica*. All of these species are listed as Least Concern on the IUCN Red List.

The main reptiles observed within the project area of influence were chameleons, lizards, and snakes. These included: Flap-Necked Chameleon, *Chamaeleo dilepis*; Striped Skink, *Trachylepsis striata*; Bushveld Lizard, *Heliobolus lugubris*; Southern Rock Agama, *Agama atra*; Common File Snake, *Gonionotophis capensis*; African Rock Python, *Python sebae*; African Puff-adder, *Bitis arietans*; Twig or Vine Snake, *Thelotornis capensis*; Olive Grass Snake, *Psammophis mossambicus*; Monitor Lizard, *Varanus exanthematicus*; and Marsh Terrapin, *Pelomedusa subrufa.*

Because of the presence of water and dambos, the sub-project site hosts an array of birds. The study recorded 83 bird species within the project area of influence. Of these, none is listed as Near Threatened, Threatened, Endangered, or Critically Endangered under the IUCN Red List.

During the survey, a total of seven (7) amphibian species were encountered or observed. These were all frogs and toads. All the recorded amphibians are listed as Least Concern under the IUCN Red List.

Based on Kleynhans (1996) tool for habitat integrity assessment, which considers changes as regards instream and riparian characteristics, modifications have occurred at Ndondi Dam. The downstream area has been largely modified with respect to the aforementioned characteristic due to being starved of environmental flows.

A total of 15 phytoplanktons and 22 zooplanktons were identified in the water samples obtained at Ndondi. These planktons are key components of the trophic status. Further, they are biological indicators of water quality as they respond quickly to the environmental changes. A number of water quality parameters (temperature, pH, transparency, dissolved oxygen) investigated in-situ, generally registered readings within the normal ranges.

With respect to fish species, seven of them, belonging to three families namely *cichlidae*, cyprinidae *and clariidae* are present at Ndondi. These include *Straight fin barb (Barbus palundinosus), Three spotted tilapia (Oreochromis andersonii, Red breasted tilapia (Coptodon rendalli) Banded tilapia (Tilapia sparmanii), Green headed Tilapia (Oreochromis machrochir*), Sharptooth catfish (*Clarias gariepinus)* and a *cross (Oreochromis machrochir & Oreochromis andersonii)*. As regards to IUCN conservation status, all the species are of Least Concern except: *Oreochromis andersonii* (VU) and *Oreochromis machrochir (VU)*.

Ten invertebrates were encountered. Namely Dragon Flies (*Anisoptera sp*,) Horse Fly (*Tabanus bovinus*), Mosquitoes (*Aedes sp)*, Midges (*Chironomus sp.)*, Whirligig Beetles (*Gyrinus natator),* Water Boatman (*Corixidae sp.)*, Water Strider (*Gerridae sp),* Mayfly (*Baetidae),* Crab (*Potamonautidae sp)* (, Snails (*Gastropod sp)*.

Aquatic plants encountered included bullrush (*Typha angustifolia),* starglass (*Cynodon plectostachyus*) water primrose (*Ludwigia peploides*), water lily (*Nymphaeaceae sp)*, cattail, reeds (*Phragmites sp*.), and smartweed *(Polygonum pensylvanicum*).

With respect to IUCN conservation status, all the invertebrates and aquatic plants are of least concern.

Predicted Sub-Project Impacts

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

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

These impacts constitute relatively minor risks that can be managed by well-known and proven construction impact methodologies. Overall, the rehabilitation of unremediated areas from the previous construction is expected to stabilize the environment around the dam wall and other areas of project

disturbance, resulting in a reduction in erosion and sedimentation into the dam and the local drainage line. Provision is made for the management of these risks in the project ESMP and in this BMP.

Subject to the recommended mitigation, the continued operation of the dam is not expected to have material negative biodiversity impacts in the long term. Terrestrial and aquatic habitats in the area of influence of the dam have been significantly impacted over many years by subsistence cultivation, clearing of woodlands for firewood and charcoal and grazing for cattle. Habitat integrity in the area of influence of the dam is generally low due to decades of human activities. This is unlikely to change because of the remedial works on the dam. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The dam does not pose a barrier effect to the fish population. The two fish species listed on the IUCN Red List that were found during the study occur primarily because of the permanent water provided by the dam. The major threat to these two 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 in the seasonally wet parts of the dambos and general habitat degradation in the surrounding areas due to bush clearing and overgrazing and not attributed to the presence of the dam's impoundment. Key management requirements are to continue efforts to improve catchment conditions to protect the water resource.

Proposed Mitigation Measures

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

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

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

- Sensitizing the local community to sustainable fishing methods and the importance of conserving aquatic resources;
- Training the dam committee to maintain the dam wall by removing woody vegetation, encouraging grass growth and controlling access by stock to minimise erosion paths;
- Supporting the local community to determine and implement sustainable farming practices in the dam catchment, by prohibiting cultivation in the riverine areas and around the perimeter of the dam, 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.

INTRODUCTION

Ndondi Dam is an Earth fill dam located in Pemba District of Southern Province. The exact GPS coordinates for the dam are S16.73486° and E27.38571°. The main purpose of the dam is to provide water for aquaculture, irrigation and stock needs. Ndondi is one of ten dams that have been selected for remedial works under the World Bank (WB) funded IDSP. According to OP 4.37, the dam is classified as a small dam because its height is less than 15m.

The integrity of the existing structures at the dam has been compromised. This situation makes Ndondi Dam a potential threat to the safety of the local community, the downstream users and the environment at large. This situation has necessitated remedial works on the dam. UNOPS has been tasked to prepare this BMP as part of the ESMP on behalf of the GRZ to guide the remedial works including mitigation of identified potential risks to the environment, safety of communities, and their associated livelihoods. Remedial works, ESMP and associated BMP are also aimed at ensuring compliance with WB safeguards policies.

UNOPS has already conducted environmental, social and dam engineering studies based on desk reviews, interviews and consultations with key sub-project stakeholders. Initial field screening visits by the UNOPS team revealed that an in-depth biodiversity assessment of the project area of influence is required. In-depth Biodiversity Assessment (BA) of the site has been done. The BA is presented in this report together with the Biodiversity Management Plan (BMP).

Remedial dam construction works will commence after ESMP and BMP approval by the World Bank. Those two documents will be publicly disclosed. Stakeholders will be informed/ consulted on the content of these two plans prior to the commencement of remedial works. Dam construction is anticipated to take 6 months.

Objectives of the BDA

Overall Objective

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

Specific Objectives for Terrestrial Assessment

Specific Objectives of the Flora Assessment

i. To identify the botanical attributes of the sub-project site, including:
    - Compilation of species lists of all observed flora species;
    - Description of the extent and type of native species present;

- Verification of the presence of threatened species or vegetation communities (per the IUCN Red List) ;

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

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

Specific Objectives of the Fauna Assessment

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

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

Specific Objectives for Aquatic Assessment

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

METHODOLOGY

This section of the report outlines the methods adopted for the assessment of existing ecological habitats, flora and fauna.

Assessment Methodology

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

Terrestrial

This dam is considered as a 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. For the purpose of this study, the dam's area of influence was determined using its estimated throwback. The estimated throwback used, 1.8Km was

adopted from studies done by COWI in 2018. Taking the dam's throwback as a radius of a circle whose center is the middle point of the dam wall, a circle was drawn to determine the spatial extent of the dam's influence. Google Earth images were used in this regard. Using this method, the determined area of influence for Ndondi Dam is shown in Figure 01. Sampling was done within the determined area of influence.

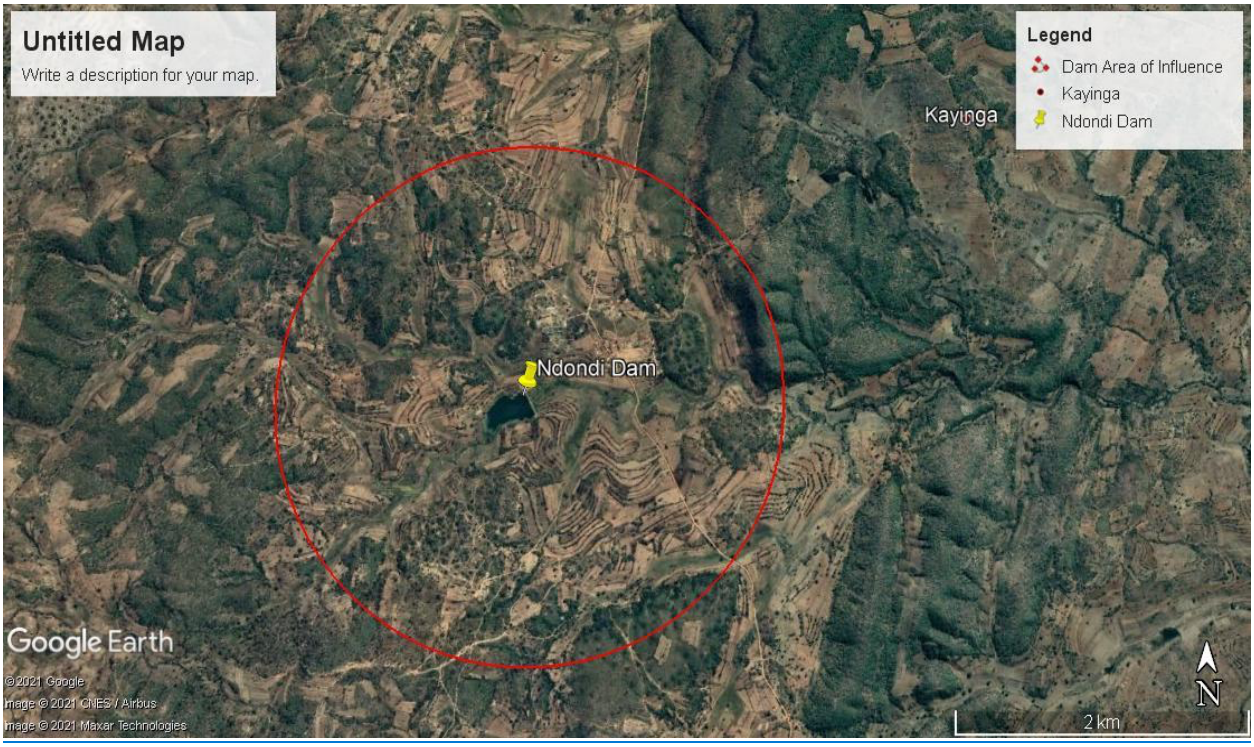


Figure 01 Ndondi Dam area of influence

Aquatic

This dam is considered as category B project, the direct area of influence for the aquatic 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 project area of influence for aquatic biodiversity assessments was determined by the extent of the water in the reservoir plus a 1km stretch upstream and downstream. A 1km 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. Further, a 10-20m radius from the edges of either side of the dam and also the river was covered to understand riparian vegetation/flora.

Value of ecological resources and vulnerability of receptors

Terrestrial

To determine the value or integrity of terrestrial habitats, the criteria shown in Table 3-1 were adopted. Vulnerability of receptors was determined by employing the IUCN conservation status/value.

Table 01 Criteria for habitat integrity (William Latimer, 2009)

Criteria for defining habitat quality

High quality:

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

Moderate quality:

- Moderate degree of intactness (i.e. floristically and structurally diverse), containing several important habitat features such as ground debris (logs, rocks, vegetation), mature hallow-bearing trees, and a dense understory component.
- Moderate species richness and diversity (i.e. represented by a large number of species from a range of fauna groups).
- 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.

Regarding the determination of the quality or value of vegetation, the adopted method or criterion is given in Table 02.

Table 02 Criteria for vegetation integrity

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.

Photographs were used to show the condition of the site, structures and surrounding habitats.

Aquatic

This section explains the criteria used in quantifying aquatic ecological resources in the project area of influence of influence. To evaluate instream and riparian ecosystems, the methodology developed by Kleynhans[27] (1996) was employed. Vulnerability of receptors was determined by employing the IUCN conservation status/value. Table 03 shows the criteria used for aquatic habitat integrity assessment.

Table 03 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	Originates from point and diffuse point sources. Measured directly, or

[27] Kleynhans developed his habitat integrity index by using it on riparian and in stream habitats. Ndondi 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

modification	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 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.

Descriptive classes for the assessment of modifications to habitat integrity were adopted from Kleynhans, 1996. These are shown in Table 04.

Table 04 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 modification is 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 05 Criteria and weights used for the assessment of habitat integrity (Kleynhans, 1996)

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

***NB**: Scores are then calculated based on ratings received from the assessment. The estimated impacts of the criteria are then summed and expressed as a percentage to arrive at a provisional habitat provisional habitat integrity assessment. The scores are then placed into the intermediate habitat integrity assessment categories (Kleynhans, 1996) as seen in Table 06.*

Table 06 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

In the criteria for the evaluation of impacts adopted for this study, 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 2km of site boundary, outside the 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 sub-project), medium term impacts (equal to the lifetime of the sub-project) and long term impacts (greater than the lifetime of the sub-project);
- **Magnitude:** Impact magnitude defined in relation to the limit criterion specified by ZEMA or international standards where available.
- **Type of impact:** Positive or negative effect; direct or indirect action.
- **Potential significance:** A combination of all the factors described in the preceding bullet points is used to determine the type and significance of potential impact prior to mitigation. This is defined as low, medium or high.

Table 07 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	Impact possibility estimated to be 100% Impact possibility estimated as between 50% and 99%

	Unlikely No impact	Impact possibility estimated as < 50% Zero estimated possibility of impact
Extent	Local Provincial Regional National International	Within 2 km of the sub-project site Outside the sub-project site but <20 km away Outside the sub-project site but < 200 km away Within Zambia Outside Zambia
Duration	Short Medium Long	Less than the life of sub-project The life of project Greater than the life of sub-project
Magnitude[(2)]	Very low Low Medium High Very high	Defined in relation to the limit criterion where available, e.g.: ● Very low: Parameter < 10% limit criterion ● Low: Parameter 10 to <50% limit criterion ● Medium: Parameter 50 – 100% limit criterion ● High: Parameter 100 – 200% limit criterion ● Very High: Parameter > 200% limit criterion. Or, for qualitative assessments: ● Very low: No degradation/adverse alteration to resource/receptor ● Low: Minor degradation/adverse alteration to resource/receptor ● Medium: Moderate degradation/adverse alteration to resource/receptor. ● High: Significant degradation/adverse alteration to resource/receptor. ● Very High: Permanent degradation/detrimental alteration to resource/receptor.
Type of Impact		
Effect	Positive Negative	Beneficial impact Adverse impact
Action	Direct Indirect	Impact caused solely by activities within scope of sub-project Impact which does not result directly from 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)	All terms are characteristics of the impact(s). For example, duration refers to duration of impact, not the activity causing it.
(2)	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.

Photographs were used to show the condition of the site, structures and surrounding habitants.

Approach to mitigation of impacts

The conservation objectives and management actions in the BMP have been developed to ensure that the mitigation hierarchy is consistent with the WB's approach i.e. anticipate and avoid risks and impacts; where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels; once risks and impacts have been minimized, mitigate; and, when significant residual impacts remain, compensate for, or offset them when technically and financially feasible.

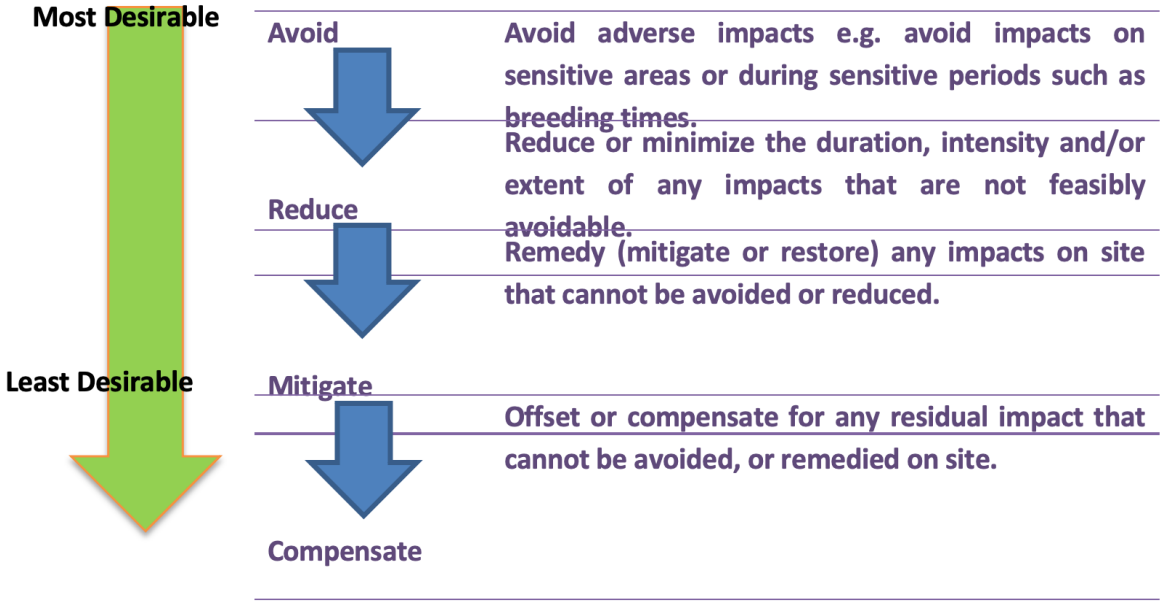


Table 02 Impact Mitigation Hierarchy adopted

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 Ndondi 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

Terrestrial field surveys

The field surveys aimed at providing a broad understanding of the terrestrial ecology values of the study area, including vegetation composition, the presence or potential presence of conservation of significant flora and fauna, and habitat suitability for fauna.

Terrestrial field surveys for flora and fauna were done concurrently for 3 days, i.e. on 2nd, 5th and 6th April 2021.

Flora surveys

A combination of sampling methods was used to study flora in the sub-project site. These methods were Stratified Random Sampling and Purposive Sampling or Point Counts.

Stratified Random Sampling was preferred because it was observed during desktop review using satellite images that the site was highly fragmented. This was confirmed by the reconnaissance survey which was done on 2nd of April, 2021. First, the project area of influence is split by the dam into the up and downstream as well as the East and West banks or sides. Additionally, Agricultural activities (maize, groundnuts, sunflower fields and vegetable gardens) and settlements within the project area of influence have further fragmented the site.

Further, it was observed that the site had a number of diverse vegetation types or habitats such as Miombo woodlands, riparian, termitaria, and dambos.

In order to assess vegetation in all the areas (upstream and downstream as well as sides of the dam), across all vegetation types (habitats), and in the available fragmentations, strata were made following these groups. Sampling within these strata was randomly done.

Purposive Sampling or Point Count was used in instances were species of interest are observed singularly or in a group at the point not marked for sampling. These were recorded and coordinates keyed in.

In total, 21 sampling plots were established. These plots were circular and had a radius of 20m translating into an approximate area of 1,256m^2 per plot. The radius of 20m was chosen because studies have shown that circular plots with 12 to 20m radius capture adequate data in the inventory of the

Zambezian phytoregion (Geldenhuys, 2004; Densanker, Frost, Justice, & Scholes, 1997; Zimba, 1991). Another advantage is that the circular plots are easier to establish in the field compared to square plots.

The coordinates for the locations of the sample plots is given in Appendix 1.

Table 08 shows the parameters that were taken from the main plots. All the measurements taken on the tree parameters from the main plot were recorded on the main plot data collection form (Appendix 2).

Table 08 Parameters measured from the main plot

Parameter	**Comment**
Diameter at Breast Height (DBH)	Taken on each tree in cm
Bole height	Taken in m
Total Height	Measured in m
Tree condition	Crooked, moribund, etc…
Tree species	Identified by use of check lists and KYT
Crown size	In m
Evidence of fire	
Health of canopy	In %
Vegetation type	Marquesia, Parinari forest etc.

The data collection team was comprised of 6 individuals divided into 2 groups. Each group had an Ecologist, Assistant Ecologist and a local person. The 20m radius plots were subdivided into semi-circle plots with each team handling one half of the plot. To ensure consistency in the data collection, a protocol was followed (Table 09).

Table 09 Flora data collection protocols

Flora Data Collection Protocols	
1	*Measuring tree diameter* ● For trees with diameters greater than 5cm, measure diameter of the tree at 1.3 m from the ground ● Record diameter to the nearest 0.5 cm ● A leaning tree should always be recorded on the lower or underneath side ● If the tree forks or there is some deformity at 1.3m, get diameter below the fork and above the deformity respectively and indicate the “forked” or “deformed” in the remarks column of the main form. ● If the tree breaks into two or more stems at or near ground level record measure diameter at 1.3m of the biggest tree
2	*Measuring tree height* ● Height is read to the nearest 1 meter ● Ensure that the horizontal distance to the centre of the tree from the observer is accurately taken ● Ensure reading the correct scale ● Ensure that the effect of lean on any measurement is corrected by taking readings from diametrically opposite points and average calculated or measurement to be taken at right angles to the plane of the lean. ● Ensure that the device or instrument is in good working condition before use. ● Always stand on the same level of ground as the tree, i.e. do not measure from up or down a slope but across the slope

	● If your vision is obstructed to the tip or top most branches of the tree either take a different baseline or estimate where the top is and record the height as estimated ● If possible, always check the height using more than one baseline taken in different directions from the tree ● If a tree is dead in its upper crown or dying back, the height recorded should be to the highest live branch, although the height it had reached will be of interest if not recorded before ● For leaning trees get height from both sides (leeward and leaning)
3	*Regeneration* ● Count all the tree species with diameter <5cm and height <50cm ● Identify the tree species
4	*Health of canopy cover* ● Measure the health of the canopy in percentage ● Observe the canopy cover using the visual guide provided

In each main plot, six (3m x 3m) regeneration sub-plots were established. On these plots all seedlings below 5cm diameter and 50cm height were recorded. Regeneration measurement involved counting and identifying the species in the 3m x 3m plots. Regeneration data was recorded on the regeneration data collection form (see Appendix 3). Weeds were also identified.

Fauna assessment

Fauna assessments were undertaken in all different types of habitats (vegetation) observed in the project area of influence. In this regard, the number of fauna survey sites closely reflected the number of vegetation communities present within the study area.

The locations of the fauna survey sites were determined from vegetation the community identified during the reconnaissance survey and from available maps prior to the commencement of detailed surveys.

Terrestrial fauna habitats in the project area of influence include Riverine Vegetation (Riparian), Miombo woodlands and specialised habitats such as Anthills (Termitaria). Occurring habitat types were defined based on the findings from the vegetation investigations. The different types of vegetation or habitats present in the sub-project are shown in the Figure below.

Litter in the sampling plots was turned over in search of terrestrial macro invertebrates, amphibians and reptiles. All species encountered were identified based on morphological features using field guides. Encountered fauna species were recorded on the Fauna Data Sheet shown in Appendix 4.

The fauna survey involved direct observation (during daylight hours) of signs of activity which included prints, tracks, hairs, droppings, odour, digging and evidence of feeding.

To survey small mammals, standard Sherman traps were used (Figure 3-4). These traps were laid in strategic areas that were established following the nature of the habitats and sightings as testified by the locals. The traps were exposed for over 12 hours from 17:00 hours to 07:00 hours the following day. The trapped specimens were identified based on their morphological features using field guides. The Sherman Traps were baited with small balls of peanut butter mixed with maize meal and in some cases just Jungle Oats.

For birds, observations were made from 06:00 – 08:00 hours in the morning and 15:00 - 17:00 hours in the afternoon. Birds were identified based on their morphological features described by Sinclair et al. (2002) and Sinclair and Ryan (2010). They were further assessed through droppings; vocal availability; footprints; roost, flock and nesting structures. The data collected were recorded in the data recording form (Appendix 4).

Other survey techniques employed to assess the baseline fauna (including birds, mammals, reptile, amphibians and invertebrates) present in the project area of influence include:

- Point count and play back calls
- Field walks
- Direct search and observations
- Indirect method (noticing the presence of foot prints, tracks, droppings, burrows or digging and evidence of feeding)

a) Low Lying miombo

b) Hill miombo

c) Dambo (willow wetland)

d) Riparian vegetation

Figure 03 Main habitats on site in which fauna surveys were done

Figure 04 Small mammal trapping using (a) Standard Sherman trap

To enhance the chances of observing various fauna in the project area of influence, camera traps were set in all observed habitat. The camera traps were left in the field for two days and nights. Figure 05 shows the cameras set in the field. The cameras were set at knee height so that even small fauna can be captured.

Figure 05 Field camera trap for fauna observation

Regarding invertebrates, observations were made directly while in the field. Litter in the sampling plots was turned over in search of terrestrial macroinvertebrates. Further, to enhance the chances of

observing insects that are active on the ground, pit fall traps were set in the field. Two types of pitfall traps were used. These were cup sized traps (500ml) and bucket sized traps (10 litres) as shown in Figure 06.

a) 500ml Pit fall trap

b)10 Litres Pitfall trap

Figure 06 Pitfall traps for ground insects

Interviews: Community members, mainly members of the Ndondi DMC were interviewed for the purpose of collecting data on the type of animals; location, distribution and frequency of occurrence. Community members were also asked if any of the plants that were initially available in the area are now non-existent. Figure 3-7 shows a focus group discussion held with members of the DMC regarding wildlife in the area.

Figure 07 Group interview with members of the Ndondi DMC on terrestrial and aquatic wildlife in the area

The following key interview questions were used to collect data on wildlife resources in the area:

- What types of animals (mammals, birds, reptiles, amphibians and insects) were once present in the area?
- What animals are found in the area today? and

- What has caused the changes in animal population structures?
- For bird species, checklist of questions included:
- What type of migratory birds you usually see in the area?
- Do you notice any strange or extraordinary birds during certain seasons?
- Do you know their names?
- When do they appear and leave each season?

Aquatic field surveys
Data were collected at Ndondi for 3 days. That is on the 2nd, 5th and 6th of April, 2021. On the first day, aside from collecting data on water quality, plankton, fish, invertebrates, aquatic flora and habitats, a reconnaissance survey was conducted.

Reconnaissance survey: The team of two (lead ecologist, technician) undertook a reconnaissance survey of Ndondi Dam on 2nd April, 2021 in the company of some community members. This exercise was cardinal as regards having an in-depth knowledge of the area. Further, it guided sampling protocols.

Selection of sampling points: Stratified and purposive sampling was employed in a bid to generate data required for the study. The reservoir and the stream were stratified into five strata. Namely: upstream, the point where the stream enters the reservoir, midpoint of the reservoir, dam wall and downstream. This sampling design enhances chances of obtaining representative data on fauna, flora, water quality, planktons and habitats for the area under review. The coordinates for sampling points are indicated in table 3-10. Data captured at each one of the sampling points were recorded on the attached data sheets (Appendix 6).

Figure 10 Coordinates for the points sampled

Coordinates		**Location Description**
Devoid of water		Downstream
S 16.73529 degrees	E027.38604 degrees	At the weir
S16.73574 degrees	E027.38466 degrees	Mid-section of reservoir
S16.73704 degrees	E027.38381 degrees	Point of entry of stream into reservoir
S16.73782 degrees	E027.38332 degrees	Upstream

Water Quality: A calibrated multi-water parameter checker was employed to measure water quality. In situ parameters considered in this study included temperature, pH, dissolved oxygen, conductivity and transparency. The sampling points were accessed by use of an inflatable boat.

Plankton: Water samples were collected in the field from sampling points using a plankton net In total, two water samples were collected at each sampling point. The collected water samples were fixed with 90% ethanol. The water samples were taken to the laboratory for analysis of plankton; and chemical parameters which were not addressed in-situ.

Fish: A variety of sampling gears were applied to sample fish species. The fishing gear used depended on the characteristics of the sampling station. The fishing gear included gill nets, long lining and seine net. On average, fishing for samples was conducted for 2 hours during day time at a particular station. This being the case, it's possible to compute Catch per unit of effort (CpUE), which is an index of biomass.

Each individual fish captured at any sampling station was weighed and its length taken. Captured fish were identified to species level by using field guides developed by Skelton (2001) and Utsugi & Mazingaliwa (2002).

Macroinvertebrates survey: Invertebrates on the surface of water were captured using a scoop net and identified using a guide developed by Sims & Blaylook (2002). For those invertebrates occupying the streambed, the streambed was deliberately disturbed by use of a stick in a bid to dislodge them. As the plume of the silt rose, the scoop net was employed to capture any dislodged invertebrates; which were identified using a magnifying glass and a field guide (Sims & Blaylook, 2002).

Aquatic flora: At each particular sampling station and within its vicinity, all aquatic plants were identified using a field guide developed by Carruthers (2016).

Habitat integrity: Since the area under review had 3 distinctly different components, namely upstream, reservoir and downstream, observational walks were undertaken along the length and breadth of each component to study the general attributes. Further, in the case of the reservoir, offshore observational excursions were taken by use of an inflatable boat.

Criteria for aquatic habitat integrity developed by Kleynhans (1996) were employed to ascertain the habitat integrity of each component (upstream, reservoir, downstream). This involved assessment of the instream and riparian components.

Interviews with community members: The DMC members were interviewed (Fig.3-7). The interview was guided by following questions:

- What aquatic fauna/flora is found in the dam and the stream?
- What gear is employed in harvesting fish by fishers?
- What are the notable challenges with respect to securing the dam and its constituents?

Data Analysis

Terrestrial Data Analysis

Microsoft Excel was used to analyze the data on flora. The species data was used to determine species importance values (IV) and species richness. IVs were calculated as adopted from DWAF (2005). Species IV are useful in determining the performance of the species in a given area.

For plants with dbh ≥ 5 cm

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

Where:

- RF = Relative Frequency;
- RD = Relative Density; and

- RBA = Relative Basal Area

IV measure the relative dominance of species in a forest community (Curtis & Mcintosh, 1959). IV rank species within a site based upon three criteria:

1. How commonly a species occurs across the entire forest area
2. The total number of individuals of the species and
3. The total amount of forest occupied by the species

Before calculating the IVs, Relative Frequency (RF), Relative Density (RD), Relative Basal Area (RBA), and Abundance of each tree species encountered was calculated. To calculate RF, RD and RBA, the following formulae were used:

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

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

$$\text{Abundance} = \frac{\text{Total Number of stems recorded for species}}{\text{Total number of quadrants in which the species occurred}}$$

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

Regarding fauna, field guides were used to identify the encountered species based on morphological features. Paw prints were compared against those in field guide books for fauna identification. Animal droppings observed were identified based on shape and constituents. In this case, field guide book was also used.

Aquatic data analysis

During this survey, data was collected on fish, invertebrates, flora, water quality, plankton and habitats. This section provides a breakdown of how the data was analyzed.

Microsoft excel (2008) was used to analyze fish data. Further, Catch Per Unit Effort (CpUE) for a particular gear was computed using the formula:

Catch Per Unit Effort (CpUE) = Total catch of fish (Kg)/Fishing Effort (Time in hrs).

Additionally, the IUCN red list of threatened species was employed to guide on the conservation status of fish. With respect to flora and invertebrates, here too the IUCN red list of threatened species was employed to ascertain their conservation status.

Reference values for pH, dissolved oxygen, conductivity and water transparency were used to explain the water quality values obtained in-situ.

In order to ascertain whether the direct area of influence is modified/converted or natural, a habitat integrity analysis was conducted using a tool designed by Kleynhans (1996).

Water samples containing planktons were taken to the Department of Fisheries for identification. Analysis of chemical parameters of water samples not measured in-situ was conducted at The University of Zambia.

RESULTS AND DISCUSSION

Terrestrial Survey Results

Habitats

It was established that the sub-project site has three main habitats or vegetation types. These are: Miombo Woodlands, Riparian/Riverine Vegetation (habitats) and Dambos (willow wetlands).

Miombo woodlands are by far the most extensive habitat type on site. Basically, Miombo woodlands present on site have three main specializations or characteristics based on the terrain or location. These specializations are Low Lying Miombo, Hill Miombo and Termitaria. Typical habitats on site are shown in Figure 3-3. Low Lying Miombo is dominated by *Julbernadia globiflora*, *Uapaca kirkiana* and *Combretum* species while Hill Miombo is dominated by *Brachystegia bohemii* and *Julbernadia* species. The main trees in these habitats that provide fruits (food) for both humans and fauna on site are *Uapaca kirkiana* and *Parinari Curatellifolia* trees. Areas of concentration for these tree species have been marked for conservation purpose and are presented in Table 011.

Table 011 Specialized fruit forests on site

Description	**Elevation (m)**	**Coordinates**	
		South	**East**
Uapaca Kirkiana Forest	1195	S 16.73755^0	E 027.36355^0
Parinari Curatellifolia	1165	S 16.74364^0	E 027.38680^0
Uapaca Kirkiana Forest	1165	S 16.73194^0	E 027.38445^0
Uapaca Kirkiana Forest		S 16.72885^0	E 027.38527^0

The Riparian vegetation is dominated by Acacia species with *Acacia polyacantha* being the commonest. This type of habitat is punctuated with sporadic occurrences of *Piliostigma thoningii and Bauhima petersiana.*

For conservation purposes, important Dambos in the Ndondi Dam catchment area have been surveyed, their coordinates recorded and presented in Appendix 5 for conservation purposes.

In terms of value or importance, the three main habitats are classified in Table 012, with reasons for the classification given.

Table 012 Values of habitats on site

Type of Habitat	**Classification Value**	**Reasons for Classification**

		(importance)	
1.	Miombo Woodlands		
	a. Low Lying Miombo	Low	● Highly fragmented by human activities such as: crop agriculture – mainly maize and sunflower; settlements; livestock grazing; and charcoal production (Fig 4-1) ● The vegetation in the area lacks a definitive structure due to heavy exploitation. The area is generally a secondary forest area with small and sparsely populated trees. Most trees in the area have diameters less than 10cm. ● The area has been highly invaded by *Euphobia*, *Lantana camara* and *Helianthus tuberosus* (Figure 4-2)
	b. Hill Miombo	Medium	● The habitat is relatively intact with most trees having diameters greater than 15cm, though there are signs of minimal exploitation mainly because almost all trees in Low Lying Miombo have been exhausted (Fig 3-3b) ● Many signs of fauna presence observed on site were mainly under Hill Miombo ● No invasive species were observed in Hill Miombo habitats ● No settlements were observed in these specialized Miombo Woodlands
	c. Termitaria	Low	Because of exploitation of soils for brick making, these types of habitats have been heavily degraded. This is more so in areas close to settlements.
2.	Riparian or Riverine	Low	● Most gardening in the sub-project area of influence is done along the banks of streams and dam. This has greatly contributed to the reduction in the integrity of riverine vegetation; ● To deter livestock (cattle and goats) from eating the garden crops, gardens are fenced with thorned tree species with *Acacia* being the main one. Since *Acacia* is the dominant tree species in this habitat, the result is reduction in integrity of Riverine/Riparian Vegetation; and. ● There are sporadic occurrences of *Lantana camara,* an invasive species in most riverine habitats (Figure 4-2a)
3.	Dambos	Low	The quality of dambos (Appendix 5) in the area has been compromised because of consistent use as cattle and goats grazing grounds. This has also compromised the ability of the dambos to retain or collect as per its ecosystem service provision (Figure below)

From the survey and analysis of results, it is very clear that the **quality or value of habitats** in the area of influence for Ndondi Dam is **Low** except for Hill Miombo. The low quality of habitats is attributed to anthropogenic issues such as Charcoal production, agricultural activities, settlements and heavy grazing by cattle (see figure below).

a)Farming within the project area of influence

b) Charcoal production on site

c) Livestock grasing in Dambo area

e) Farming along the riverine

f) Settlement within project area of influence

e) Trees cut for charcoal – Hill miombo

Figure 4-1: Land uses contributing to habitats' degradation in the project area of influence

a)*Lantana camara* observed on site

a) Euphobia observed on site

c) Settlement within sub-project area of influence

Figure 08 Invasive alien species observed on site

Flora

For the purpose of flora survey, a total of 21 circular plots with a radius of 20m were established. This means the total area sampled was 26,392.8m^2 or 2.64ha. In the sampled area, the total number of species recorded was 20. This shows that the area has a low diversity in terms of flora species.

The overall number of stems recorded was 873 representing a fairly vegetated area. Despite this being the case, the size of individual stems was small with the average DBH being 9.4cm. This is attributed to the fact that trees are heavily exploited for charcoal production, fencing of kraals and gardens as well as household construction works. The high number of stems is attributed to the fact that Hill Miombo habitats in the area are semi-intact hence were fairly forested. Low lying Miombo have been extensively exploited and fragmented by settlements and agricultural activities.

Julbernardia globiflora had the highest number of stems with 204 followed by *Brachystegia boehmii* with 151 and *Uapaca kirkiana* with 120 stems.

Combretum species are wide-spread on the project site. Common among this species are: *Combretum imberbe, Combretum celastroides, Combretum fragrans* and *Combretum molle.*
Other notable species in the area include: *Piliostigma thoningii, Bauhima petersiana, Acacia polycantha, Diplorhynchus cone the dylocarpon, Parinari curatellifolia,* and *Albizia versicolor.*
Full flora results from thsurvey are given in the Table below.

Important values (IV) measure the relative dominance of species in a forest community (Curtis, 1959). IV rank species within a site based upon three criteria:

a) How commonly a species occurs across the entire forest area,
b) The total number of individuals of the species and
c) The total amount of forest occupied by the species

From Table 4-4, *Julbernardia globiflora* had the highest IV (28.6%) followed by *Brachystegia boehmii* with 23.2% and *Uapaca kirkiana* with 19.7%. This is an indication that the three are the most dominant species within the Ndondi Dam area.

No Threatened, Endangered or Critically Endangered fauna species were encountered in the project area of influence during the survey.

Table 013 Relative frequency, relative density, relative basal area and IV

Species Name	No. of stems	Relative Frequency	Relative Density	Abundance	Relative Basal Area	Importance Value	IUCN Status
Combretum celastroides	13	10	1.5	6.5	0.8	4.1	LC
Bauhima petersiana	43	25	4.9	8.6	2.6	10.8	LC
Albizia versicolor	16	15	1.8	5.3	6.9	7.9	LC
Grevillea robusta	5	5	0.6	5	0.3	2	LC
Faurea intermedia	13	10	1.5	6.5	0.9	4.1	LC
Brachystegia boehmii	151	35	17.3	21.6	17.2	23.2	LC
Uapaca kirkiana	120	30	13.7	20	15.5	19.7	LC
Julbernardia globiflora	204	45	23.4	22.7	17.6	28.6	LC
Combretum imberbe	67	45	7.7	7.4	4.5	19.1	LC
Recinodendron restanenii	4	5	0.5	4	0.4	2	LC
Faurea speciosa	4	5	0.5	4	0.7	2.1	LC
Parinari curatellifolia	23	15	2.6	7.7	0.9	6.2	LC
Pterocarpus angolensis	4	10	0.5	2	0.2	3.6	LC
Bafia bequaetii	45	25	5.2	9	2.6	10.9	LC
Erythrophleum africanum	3	5	0.3	3	0.1	1.8	LC
Piliostigma thonningii	55	20	6.3	13.8	9.9	12.1	LC
Combretum fragrans	12	10	1.4	6	0.9	12.3	LC
Acacia polyacantha	63	25	7.2	12.6	7.6	13.3	LC
Diplorhynchus condylocarpon	21	15	2.4	7	15.1	10.8	LC
Albizia harveyi	7	10	0.8	3.5	0.9	3.9	LC
Totals	**873**						

Julbernardia globiflora and *Combretum imberbe* had a highest frequency of 45%. Frequency refers to the degree of dispersion in terms of percentage occurrence (Shukla and Chandel 2000). The species that is not well distributed will occur in few quadrants and as such their frequency will be low. Higher frequency implies that the species is widely spread in the area. The abundance of the species was determined and assigned to abundance classes such as Rare (1≤F≤4); Occasional (5≤F≤14); Frequent (15≤F≤29); Abundant (30≤F≤90) and Very Abundant (100+) per square meter quadrant. Full frequency results and corresponding abundance classes is shown in Table 014.

Table 014Abundance classes for sampled tree species

Species Name	Relative Frequency	Abundance classes
Julbernardia globiflora	45	Abundant
Combretum imberbe	45	Abundant
Brachystegia boehmii	35	Abundant
Uapaca kirkiana	30	Abundant
Bauhima petersiana	25	Frequent
Bafia bequaetii	25	Frequent
Acacia polycantha	25	Frequent
Piliostigma thoningii	20	Frequent
Albizia versicolor	15	Frequent
Parinari curatellifolia	15	Frequent
Diplorhynchus condylocarpon	15	Frequent
Combretum celastroides	10	Occasional
Faurea intermedia	10	Occasional
Pterocarpus angolensis	10	Occasional
Combretum fragrans	10	Occasional
Albizia harveyi	10	Occasional
Grevillea robusta	5	Occasional
Recinodendron restanenii	5	Occasional
Faurea speciosa	5	Occasional
Erythrophleum africanum	5	Occasional

Stocking or number of stems per given area is direct proportion to the number of stems observed in a given area. Using extrapolation, the total number of stems per hectare for all the observed tree species is estimated at 331 Stems/ha. Extrapolated number of stems for all observed tree species is shown in Table 015.

Table 015 Stems per hectare for all tree species observed

Species Name	No. of stems	Stems/Hectare
Julbernardia globiflora	204	78
Brachystegia boehmii	151	58
Uapaca kirkiana	120	46

Combretum imberbe	67	26
Acacia polycantha	63	24
Piliostigma thoningii	55	21
Bafia bequaetii	45	18
Bauhima petersiana	43	17
Parinari curatellifolia	23	9
Diplorhynchus condylocarpon	21	8
Albizia versicolor	16	6
Combretum celastroides	13	5
Faurea intermedia	13	5
Combretum fragrans	12	5
Albizia harveyi	7	3
Grevillea robusta	5	2
Recinodendron restanenii	4	2
Faurea speciosa	4	2
Pterocarpus angolensis	4	2
Erythrophleum africanum	3	2
Totals	**873**	**331**

Regarding flora regeneration, a total of 27 species were recorded in the sampled area. The total number of regeneration stems across the 27 species was 776. *Jubernadia globiflora* had the most wildlings with 162 representing 20.88% followed by *Brachystegia bohemii* which had 68 representing 8.76%. The two flora species with the lowest regeneration rates were *Cassia singueana* with 3 stems representing 0.39% and *Combretum Celastroides* with 2 stems representing 0.26%.

Generally, the poor regeneration rates can be attributed to high crop agricultural activities in the area as well as grazing by cattle. Repeated use of fertilizers may have also contributed to depletion of soil nutrients making it difficult for sampling survival. Additionally, poor cover by mature plants and lack of sufficient mulch, could be one of the factors making it challenging for seedlings/wildlings to establish themselves.

The distribution in terms of numbers for all species observed under regeneration survey is shown in Table 016.

Table 016 Regeneration in sampled area

Species Name	No. of regeneration stems	IUCN Status
Jubernadia globiflora	162	LC
Brachystegia boehmi	98	LC
Uapaca iirkiana	96	LC
Acacia polyacantha	86	LC
Combretum imberbe	45	LC
Diplorhynchus condylocarpon	39	LC
Piliostigma thonningi	31	LC
Podocarpus milanjianus	29	LC
Trema orientals	20	LC
Albizia harveyi	17	LC
Bauhimia petersiana	17	LC
Brachystegia floribunda	16	LC
Bafia bequaetii	14	LC
Albizia versicolor	13	LC
Combretum fragrans	12	LC
Markhamia obtusifolia	10	LC
Parinari curatellifolia	10	LC
Pterocarpus angolensis	10	LC
Acacia sieberana	9	LC
Combretum collinum	8	LC
Steganotaenia araliacea	8	LC
Lonchocarpus capassa	6	LC
Albizia antunesiana	5	LC
Faurea speciosa	5	LC
Ozorda reticulata	5	LC
Cassia singueana	3	LC
Combretum celastroides	2	LC
TOTAL	**776**	-

In ratio terms, the percentage of the total for each species encountered under regeneration is shown in Figure 09.

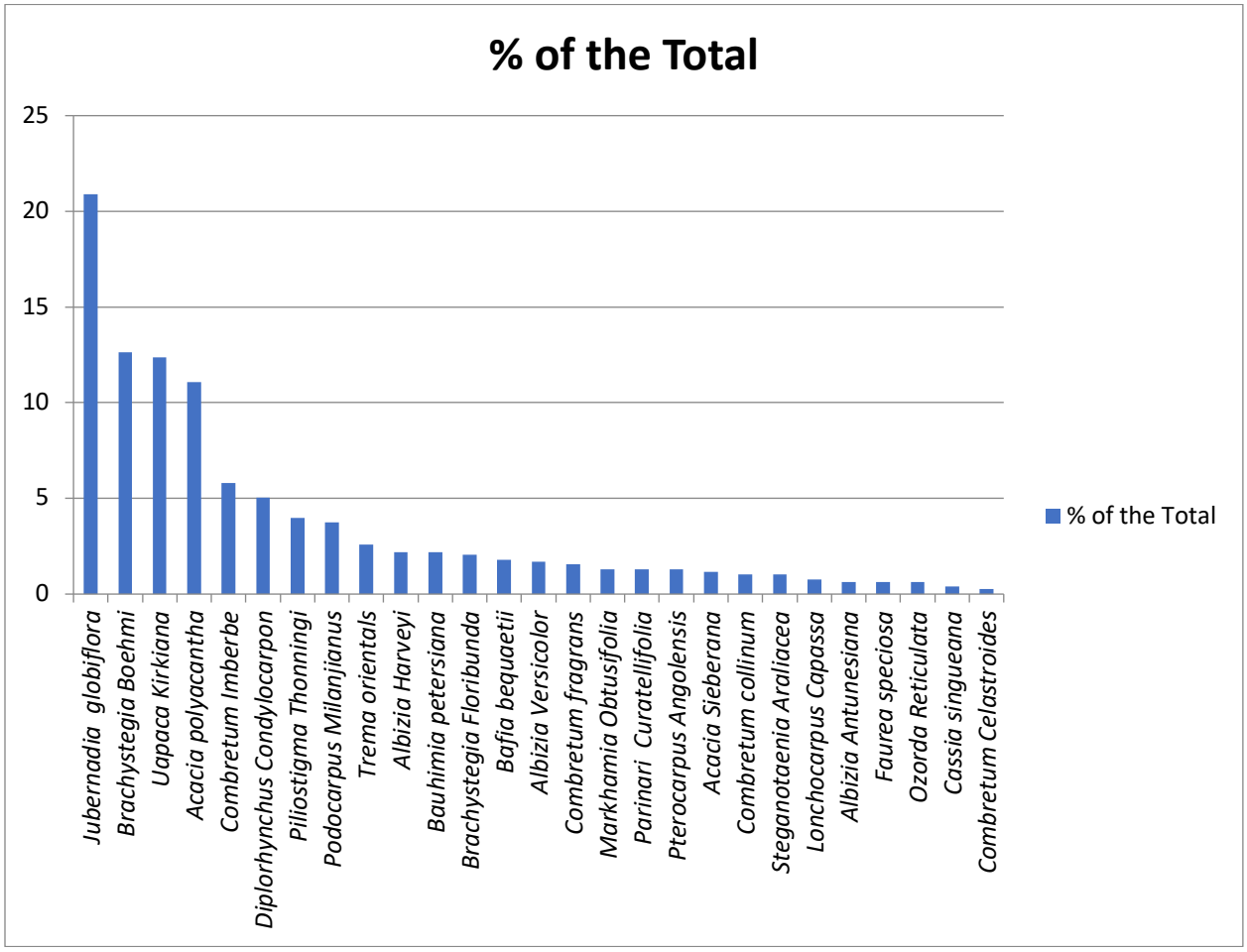


Figure 09 Regeneration in percentage terms

Fauna

Mammals in the project area of influence

During the field surveys, no mammals were actually encountered either physically or by use of camera traps that were set in the field. However, signs of occurrence of mammals in the area were observed. These signs included droppings, burrowing and paw prints. Further, locals were interviewed on what type of animals they have encountered in the area.

Based on survey encounters, signs of occurrence observed in the project area of influence as well as detailed interviews with communities and use of field guide books, the list of animals found in the project area of influence was generated and is shown in Table 017. Signs of mammal occurrence observed during the site survey are shown in the Figure below.

Table 017 Mammals likely present in the project area of influence

No.	Scientific Name	Common Name	IUCN Status

1	*Helogale parvula*	Dwarf mongoose	LC
2	*Genetta genetta*	Common genet	LC
3	*Felis lybica*	African wild cat	LC
4	*Cryptomys hottentotus*	Common mole-rat	LC
5	*Otolemur crassicaudatus*	Thick-tailed Bush-baby	LC
6	*Sylvicapra grimmia*	Common duiker	LC
7	*Lepus saxatilis*	Scrub hare	LC
8	*Xerus inauris*	Bush squirrel	LC
9	*Paraxerus cepapi*	Tree squirrel	LC
10	*Cercopithecus aethiops*	Vervet monkey	LC
11	*Potamochoerus porcus*	Wild pig	LC
12	*Phacochoerus aethiopicus*	Warthog	LC
13	*Thryonomys swinderianus*	Greater cane rat	LC
14	*Vulpes chama*	Fox	LC
15	*Hystrix cristata*	Porcupine	LC
16	*Rattus rattus*	Black rat	LC
17	*Cryptomys mechowi*	Giant mole rat	LC
18	*Cryptomys hottentotus*	Common mole Rat	LC
19	*Philantomba monticola*	Blue duiker	LC
20	*Canis adustus*	Side-striped Jackal	LC
21	*Papio ursinus*	Chacma baboon	LC
22	*Civettictis civetta*	African civet	LC
23	*Mellivora capensis*	Honey badger	LC

a)Scrub hare pellets

b) Dwarf mongoose scat

c)Sign of common mole burrowing

d)Common duiker pellets

e) Common genet scat

f) African wild cat scat

Figure 010 Signs of mammals' occurrence in the sub-project area of influence

Reptiles

The reptiles directly encountered during the field survey were; Flap-Necked Chameleon, *Chamaeleo dilepis*; Striped Skink, *Trachylepsis striata*; Bushveld Lizard, *Heliobolus lugubris*; Southern Rock Agama, *Agama atra* and Tree Agama, *Acanthocerus atricollis* (Figure 011). The fact that not much of the reptile species were observed during the survey does not mean that there are fewer reptiles in the area. This is because reptiles are a group of organisms that is very difficult to spot in the field. They are usually well camouflaged and hide from predators and/or humans alike.

Figure 011 Flap-necked chameleon (Chamaeleo dilepis) encountered during field survey

The full list of reptiles encountered, signs of occurrence noted and those reported to have been encountered by the interviewed local people is presented in Table 018.

Table 018 Reptiles observed and those reported to have been sighted by community members

No.	Scientific Name	Common Name	IUCN Status
1	*Chamaeleo dilepis*	Flap-necked chameleon	LC
2	*Trachylepsis striata*	Striped skink	LC
3	*Heliobolus lugubris*	Bushveld lizard	LC
4	*Agama atra*	Southern rock agama	LC
5	*Acanthocerus atricollis.*	Tree agama	LC
6	*Naja melanoleuca*	Forest cobra	LC
7	*Stigmochelys pardalis*	Leopard tortoise	LC
8	*Denroaspis angusticeps*	Green mamba	LC
9	*Chamaeleo lavigatus*	Chameleon	LC
10	*Gonionotophis capensis*	Common file snake	LC

11	*Naja nigricollis nigricincta*	Black–necked Spitting Cobra	LC
12	*Python sebae*	African rock python	LC
13	*Bitis arietans*	African Puff-adder	LC
14	*Dendroaspis polylepis*	Black mamba	LC
15	*Thelotornis capensis*	Twig or Vine Snake	LC
16	*Psammophis mossambicus*	Olive grass snake	LC
17	*Dispholidus typus*	Boomslang	LC
18	*Varanus exanthematicus*	Monitor lizard	LC
19	*Pelomedusa subrufa*	Marsh terrapin	LC
20	*Acanthocerus atricollis*	Southern tree agama	LC
21	*Psammophis mossambicus*	Olive grass snake	LC

Birds

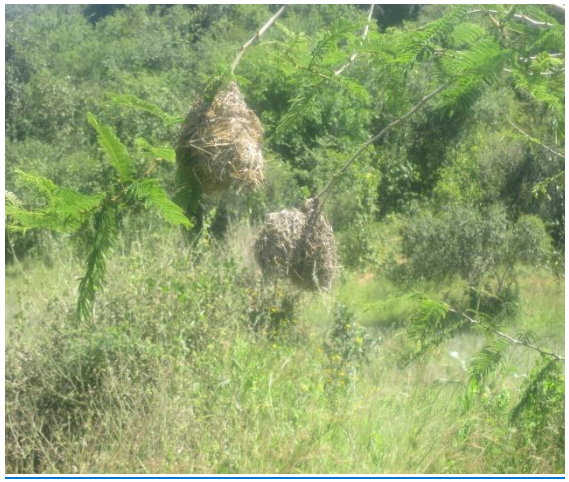
Ndondi Dam area has high avifauna diversity. This is in part attributed to the presence of water in the dam. In line with this, numerous bird species were observed and/or their calls (sounds) heard. Figure 012 shows some of the signs of presence of birds observed in the project area of influence during the three (3) days of the survey.

The full list of avifauna or birds observed, heard, whose signs of occurrence were noted and those that have been seen by local people who were interviewed during the survey period is presented in Table 019.

a)Village weaver nests

b)Green wood-hoopoe feather

c)Weaver bird nest



d)Cape weaver nests

e)Hamerkop (*Scopus umbretta*) nest

f)*Pterocles bicinctus* (Double-banded

sandgrouse)

Figure 012 Signs of bird species occurrence noted on site

Table 019 List of birds observed and sounds heard in the area. The list also includes birds reported by community members

No	Scientific name	Common name	IUCN Status
1	*Scopus umbretta*	Hamerkop	LC
2	*Phoeniculus purpureus*	Green wood-hoopoe	LC
3	*Ploceus capensis*	Cape weaver	LC
4	*Ploceus subaureus*	Golden weaver	LC
5	*Cinnyris manoensis*	Miombo double-collared sunbird	LC
6	*Chalcomitra amethystina*	Amethyst (black) sunbird	LC
7	*Chalcomitra senegalensis*	Scarlet-chested sunbird	LC
8	*Anthreptes longuemarei*	Western violet-backed sunbird	LC
9	*Ploceus bicolor*	Forest weaver	LC
10	*Muscicapa striata*	Spotted flycatcher	LC
11	*Motacilla aguimp*	African pied wagtail	LC
12	*Lybius torquatus*	Black-collard Barbet	LC
13	*Pogoniulus chrysoconus*	Yellow-fronted Tinkerbird	LC
14	*Dendropicos namaquus*	Bearded woodpecker	LC
15	*Mirafra rufocinnamomea*	Flappet lark	LC
16	*Hirundo rustica*	European swallow	LC
17	*Oriolus larvatus*	Black-headed Oriole	LC
18	*Corvus albus*	Pied crow	LC
19	*Turdoides jardineii*	Arrow-marked Babbler	LC
20	*Phyllastrephus terrestris*	Terrestrial brownbul	LC
21	*Sylvia borin*	Garden warbler	LC
22	*Cisticola juncidis*	Zitting (Fan-tailed) Cisticola	LC
23	*Terpsiphone viridis*	African paradise-flycatcher	LC
24	*Lanius collaris*	Common fiscal shrike	LC
25	*Laniarius aethiopicus*	Tropical boubou	LC
26	*Dryoscopus cubla*	Black-backed Puffback Shrike	LC
27	*Cinnyricinclus leucogaster*	Violet-Backed (Plum-coloured) Starling	LC
28	*Zosterops senegalensis*	African yellow white-eye	LC
29	*Cinnyris venustus*	Variable (yellow-bellied) sunbird	LC
30	*Cinnyris talatala*	White-bellied sunbird	LC
31	*Cinnyris cupreus*	Copper (coppery) sunbird	LC
32	*Ploceus cucullatus*	Village (spotted-backed) weaver	LC
33	*Anaplectes melanotis*	Red-headed weaver	LC
34	*Ploceus velatus*	Masked weaver	LC
35	*Centropus senegalensis*	Senegal coucal	LC
36	*Quelea quelea*	Red-billed Quelea	LC
37	*Euplectes orix*	Southern Red-bishop	LC
38	*Euplectes afer*	Yellow-Crowned (Golden) bishop	LC
39	*Euplectes capensis*	Yellow Bishop (Cape/Yellow-Rumped widow)	LC
40	*Spermestes cucullata*	Bronze mannikin	LC
41	*Uraeginthus angolensis*	Blue waxbill	LC
42	*Estrilda astrild*	Common waxbill	LC
42	*Vidua macroura*	Pin-tailed Whydah	LC
44	*Urocolius indicus*	Red-faced Mousebird	LC

45	*Colius striatus*	Speckled mousebird	LC
46	*Halcyon senegalensis*	Woodland kingfisher	LC
47	*Halcyon albiventris*	Brown-headed Kingfisher	LC
48	*Halcyon chelicuti*	Striped kingfisher	LC
49	*Streptopelia decipiens*	African mourning dove	LC
50	*Pycnonotus tricolor*	Dark-capped (black- eyed) bulbul	LC
51	*Streptopelia semitorquata*	Red-eyed dove	LC
52	*Streptopelia capicola*	Cape turtle (ring-necked) dove	LC
53	*Turtur chalcospilos*	Emerald-spotted wood-dove	LC
54	*Oena capensis*	Namaqua dove	LC
55	*Treron calvus*	African green pigeon	LC
56	*Bubulcus ibis*	Cattle egret	LC
57	*Poicephalus suahelicus*	Grey-headed parrot	LC
58	*Poicephalus meyeri*	Meyer's (brown) parrot	LC
59	*Macrodipteryx vexillarius*	Pennant-winged nightjar	LC
60	*Merops pusillus*	Little bee-eater	LC
61	*Coracias caudatus*	Lilac-breasted roller	LC
62	*Halcyon leucocephala*	Grey-headed kingfisher	LC
63	*Dicrurus adsimilis*	Fork-tailed drongo	LC
64	*Muscicapa adusta*	African dusky flycatcher	LC
65	*Hirundo rustica*	Barn (european) swallow	LC
66	*Sylvietta rufescens*	Long-billed crombec	LC
67	*Camaroptera brevicaudata*	Grey-backed camaroptera	LC
68	*Tauraco schalowi*	Schalow's turaco	LC
69	*Prinia subflava*	Tawny-flanked prinia	LC
70	*Cercropis cucullata*	Greater striped swallow	LC
71	*Emberiza cabanisi*	Cabanis's bunting	LC
72	*Dendropicos griseocephalus*	Olive woodpecker	LC
73	*Dendropicos fuscescens*	Cardinal woodpecker	LC
74	*Gallinula chloropus*	Common moorhen	LC
75	*Amaurornis flavirostra*	Black crake	LC
76	*Milvus aegyptius*	Yellow-billed kite	LC
77	*Pytilia afra*	Orange-winged (golden-backed) pytilia	LC
78	*Lagonosticta nitidula*	Brown firefinch	LC
79	*Lagonosticta rubricata*	African (Blue-billed) Firefinch	LC
80	*Numida meleagris*	Guinea fowl	LC
81	*Lagonosticta rhodopareia*	Jameson's firefinch	LC
82	*Plocepasser mahali*	White-Browed Sparrow-weaver	LC
83	*Corvinella melanoleuca*	Magpie shrike	LC

Amphibians

During the survey, a total of seven (7) amphibian species were encountered or observed. These were frogs and toads. The full list of amphibians is presented in Table 020.

Most of the amphibians observed were found in the dambo areas on site. This is attributed to the fact that they (amphibians) live both in water and on land and need water to successfully reproduce.

Table 20 Amphibians observed on site

No.	Scientific Name	Common Name	IUCN Status
1	*Chiromantis xerampelina*	Grey foam-nest tree frog	LC
2	*Ptychadena anchietae*	Plain grass frog	LC
3	*Sclerophrys pusilla*	Toad	LC
4	*Pyxicephalus adspersus*	Giant bull frog	LC
5	*Strongylopus bonaspei*	Striped stream frog	LC
6	*Strongylopus fasciatus*	Striped stream frog	LC
7	*Amietophrynus gutturalis*	Guttural toad	LC

a) Chiromantis xerampelina

b) Sclerophrys pusilla

c) *Plain grass frog* d) *Plain grass frog*

Figure 013 Some amphibians observed on site

Invertebrates

Using the pitfall traps, observations and in some cases the hand capturing method a number of invertebrates' species were identified. These strategies were supplemented by the interviews with the local people.

A total of 29 species of terrestrial invertebrates were observed in the area. Table 021 lists all the invertebrates observed.

Table 021 Invertebrates encountered in the project area of influence

No.	Scientific Name	Common Name	IUCN Status
1	*Acrida acuminata*	Grasshopper	LC
2	*Gymnobothrus temporalis*	Grasshopper	LC
3	*Pnorisa squalus*	Grasshopper	LC
4	*Arachnocephalus sp*	Cricket	LC
5	*Danaus chrysippus*	African monarch	LC
6	*Leptotes pirithous*	Common blue	LC
7	*Belenois aurota*	Brown-veined white	LC
8	*Colotis danae*	Scarlet tip	LC
9	*Nephila senegalensis*	Banded legged golden orb-web spider	LC
10	*Family: Ageleni*	Nursery web spider	LC
11	*Meloidae*	Blister beetles	DD
12	*Apis mellifera*	Honey bees	DD
13	*Microtermes goliath*	Termites	DD
14	*Trithemis kirbyi*	Dragon fly	LC
15	*Julida julida*	Diplopod	DD
16	*Trichonephilia clavipes*	Spider	LC
17	*Acraea eponina*	Butterfly	LC
18	*Madateuchus viettei*	Dung beetle	DD
19	*Julus terrestris*	Millipedes	DD
20	*Caelifera*	Grasshopper	DD
21	*Eurema brigitta,*	Butterflies	LC
22	*Carabidea*	Beetles	DD
23	*Dorylus helveolus*	Ants	DD
24	*Belonogastar junceus*	Wasps	DD
25	*Musca domestica*	House fly	DD
26	*Brachytrypas membraneus*	Giant crickets	DD
27	*Halyomorpha halys*	Stink bug	DD

28	*Chinavia hilaris*	Green stink bug	DD
29	*Acanthoplus discoidalis*	Giant cricket	LC

Aquatic Survey Results

Habitats
Damming of the river has resulted in creation of 3 sub-habitats (Table 022).

Table 022 Aquatic Habitats

Habitat Type	Sub- Habitats	Characteristics
River	Upstream	Water flowing at an extremely slow pace. The banks lined with vegetation. Instream, there is emergent vegetation; and fauna. In the dry season, water remains in ponds/ dambos (Appendix 5) which form aquatic habitats. These dambos are up to about 2.5m deep.
	Reservoir	Open waters or pelagic with almost no flow at all, owing to the dam wall. The edges lined with vegetation. Instream, there is mostly emergent vegetation; and fauna.
	Downstream	Mostly dry throughout. Though water leaks through the cracks in the dam wall towards downstream. The stream is seasonal therefore flows are not notable after the rainy season. Depressions in the riverbed collect water and support life forms. These dambos are up to about 2.5m deep

Modifications have occurred within some components of the reservoir and upstream too (table 023 through to table, 027). However, it's in the downstream environments where huge modifications have taken place (see tables above). This is on account of a number of factors. The prominent one is the absence of downstream environmental flows after the runoff season. The downstream environments are usually highly dependent on the sediment dynamic.

When one considers this system holistically (upstream, reservoir, downstream), it is not far-fetched to state that it has been moderately modified considering that it has an average ranking of 73 (table above). Though, the downstream portion is considered to have been largely modified.

Table 023 The riparian assessment - upstream

Riparian	Average score	Score
Indigenous vegetation removal	5	5
Exotic vegetation encroachment	0	0
Bank erosion	5	2.8

Channel modification	0	0
Water abstraction	0	0
Inundation	5	2.2
Flow modification	0	0
Water quality	0	0
Total Riparian	**90%**	
Category		**(Unmodified, natural)**

Table 024 The instream assessment - upstream

Instream	**Average score**	**Score**
Water abstraction	8	4.48
Flow modification	8	4.16
Bed modification	3	1.59
Channel modification	5	2.5
Water quality	0	0
Inundation	5	2
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**85.27**	
Category		**B (Largely natural, few modifications)**

Table 1025 The instream assessment - reservoir

Instream	**Average score**	**Score**
Water abstraction	0	0
Flow modification	20	10.28

Bed modification	10	10.25
Channel modification	12	6.76
Water quality	0	0
Inundation	18	7.20
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**65.51**	
Category		**C (moderately modified)**

Table 026 The riparian assessment - reservoir

Riparian	**Average score**	**Score**
Indigenous vegetation removal	3	1.56
Exotic vegetation encroachment	0	0
Bank erosion	5	2.8
Channel modification	0	0
Water abstraction	0	0
Inundation	0	0
Flow modification	0	0
Water quality	0	0
Total Riparian	**95.64**	
Category		**A (unmodified, natural)**

Table 027 The instream assessment - downstream

Instream	**Average score**	**Score**
Water abstraction	0	0
Flow modification	25	13

Bed modification	25	13
Channel modification	25	13
Inundation	25	10
Exotic macrophytes	0	0
Exotic fauna	0	0
Solid waste disposal	0	0
Total instream	**51**	
Category		**D (largely modified)**

Table 028 The riparian assessment for - downstream

Riparian	**Average score**	**Score**
Indigenous vegetation removal	23	11.
Exotic vegetation encroachment	0	0
Bank erosion	20	11.2
Channel modification	20	9.6
Water abstraction	0	0
Inundation	5	2.5
Flow modification	20	9.6
Total Riparian	**56.1**	
Category		**(Largely modified)**

Environmental flows:

Dams on upper catchment sections of rivers do not have significant fish migrations. Small dams from seasonal streams only flow during the rainy season. Additionally the MAR/Storage ratio is below 0.25. Consequently, the dam will spill during the runoff season. For environmental flows, where the storages are such that annual spills are limited, when the MAR / storage ratios are greater than approximately 1, then an environmental flow should be considered. However, this is not the case for the Ndondi Dam. Further to this, if environmental flows are required where the dam has small functioning outlets and pipes, it may mean that to change the outlets requires that the dam wall be breached down to an acceptable foundation i.e. riverbed and installed. Locating a non-compressible uniform foundation over

an existing embankment will be an investigative challenge. Having high releases from the small dam will have very limited effect and further reduce its limited usage. Upstream and downstream of the dam, water collects in the depressions/ dambo structures throughout the year (Mapped in Appendix 5). This was the situation even before dam construction and is the case with other seasonal streams around the district. The remedial design will not change this regime.

Water Quality

A good water quality is indicative of a suitable environment to sustain various life forms. During this study, in- situ measurements pertaining to water quality included pH, dissolved oxygen, water transparency (turbidity) and temperature. Values of these parameters obtained in-situ are shown in Table 029.

Laboratory results for pH and conductivity are included in Table 29 in brackets. Other laboratory results are shown in Appendix 7. A comparison of the monitoring values with reference values (Table 029), indicates the following:

- Dissolved oxygen, pH, and temperature values measured in-situ values are within the normal range.
- Turbidity/ transparency values are above the reference values at the weir, mid of the reservoir and at the point where stream enters reserve (highest value) (table 029). This is indicative of low turbidity. Such a high transparency allows easy penetration of light (Tanebe et al, 2019). This is crucial with regards to primary production.
- Conductivity at all the sampled points except upstream, did not register readings falling in the normal range. Conductivity is a measure of dissolved ions which are crucial for the ecosystem functioning. A low value of conductivity is indicative of less dissolved ions and the converse is true. Conductivity is useful as a general measure of water quality. Each water body tends to have a certain range of conductivity that, once established, can be used as a baseline for comparison with regular conductivity measurements. Significant changes noted in conductivity could then be an indicator that a discharge or some other source of pollution has entered the aquatic resource.

Table 2029 Water Quality. Reference values adopted from Svobodova, Z and Machov, J. (1993). Water quality and Fish Health. FAO Manual

Sampling point	DO (mg/L)	Temp (°C)	pH	Conductivity (µS/cm)	Transparency/Turbidity (cm)
Reference values	**5-7.5**	**25-30 degree C**	**6.5-8.5**	**150-500**	**25-60**
Downstream	No water	No water	No water	No water	No water
At the weir	7.09	24.8	6.48 (6.66)	62.3 (98)	72
Midpoint of the dam	7.9	25	6.8 (6.32)	62 (77)	76
Point where river enters dam	7.86	29.5	7.88 (6.88)	63 (69)	80
Upstream	7.3	24.1	6.6 (6.65)	140.3 (99)	31

Results arising from analyzing water samples show very minute quantities of ammonia, nitrates and phosphates (Appendix 7). Suffice to mention that these are major constituents of fertilizers used in Zambia. Since there is some farming within the vicinity of the dam, this could mean that there is low usage of fertilizers or could be attributed to the high dilution capacity of the dam as at the time of conducting this study. These chemicals, if present in huge quantities in a water body, are capable of precipitating an algae bloom which could impact negatively on the whole ecosystem.

There were 15 phytoplanktons and 22 zooplanktons (appendix 7) ascertained in the water samples. Phytoplanktons form the sole base of the food chain in aquatic system as they act as energy transducers and convert the solar energy into chemical energy of food. Whilst zooplanktons pass this food energy to the higher trophic levels and thus provides a link between energy producers and the consumers. These organisms are important biological indicators of water quality and trophic status of aquatic ecosystem as they respond quickly to the environmental changes.

Fish Survey

Table 030 Fish species captured and their attributes

Family	Species	Total weight in (g) captured	Relative abundance (%)	IUCN status	Migratory species (Yes/No)
Cyrinidae	*Straight fin barb (Barbus palundinosus)*	**80**	**1.1**	**LC**	No
Cichlidae	*Redbreast tilapia (Coptodon rendalli)*	1220	**16.9**	**LC**	**No**
	Three spotted tilapia (Oreochromis andersonii)	3294	**45.7**	**VU**	**No**
	Banded tilapia (Tilapia sparmanii)	420	**5.8**	**LC**	**No**
	Green headed Tilapia (Oreochromis machrochir)	2065	**28.6**	**VU**	**No**
	Cross (Oreochromis machrochir & Oreochromis andersonii	130	**1.8**	**N/A**	**N/A**
	TOTAL	7209	**100**		

Six species were captured during experimental fishing at Ndondi (table 030) belonging to 2 families namely *cichlidae* and *cyprinidae*. During interviews with the DMC, it came to light that sharptooth catfish (*Clarias gariepinus)* (LC), belonging *to the family clariidae, is also present.* The CPUE was estimated at

0.39kg/100 m net/hour. As regards to IUCN conservation status, all the species are of Least Concern except: *Oreochromis andersonii* (VU) and *Oreochromis machrochir (VU)*.

Three spotted tilapia *(Oreochromis andersonii)*

Green headed tilapia *(Oreochromis machrochir)*

Red breasted tilapia *(Coptodon rendalli)*

Figure 014 Pictures some fish species captured during fish survey

In Zambia, *Oreochromis andersonii* occurs in the upper Zambezi, as well as the Kafue, occasionally also recorded from the Middle Zambezi (Skelton 2001). Insufficient data are available on the apparent declines in abundance, but anecdotal evidence suggests a major decline in stocks on the Barotse floodplain since the 1960s as a result of heavy fishing pressure (IUCN, 2021). The rapid spread of alien *O. niloticus* especially through the Kafue system has also been noted as a threat to this species (IUCN, 2021, Tweddle et al. 2004). With respect to its biology and ecology, adults of *O. andersonii* are found mainly in deeper pools and main river channels. Juveniles and sub-adults are found in a variety of habitats in rivers and floodplain lagoons, large open swamps, and, more rarely small tributaries of the rivers. It

feeds on detritus, diatoms and zooplankton. Males excavate large, saucer-shaped nests, females mouth brood the eggs and fry. Multiple broods are raised during the warmer months (IUCN, 2021). It lives for up to 11 years (IUCN, 2021). At Ndondi, the presence of this species was noted in the reservoir. Upon rehabilitation of the dam, its population is expected to grow in size due to enhanced habitat integrity and absence of threats emanating from *Oreochromis niloticus*. However, an upscale in fishing, which will unfold on account of increased human population around the dam area will be critical as regards to how its population evolves over time. During the runoff season, the fish migrates with the flow over the spillway into the downstream environment.

Green-headed tilapia (Oreochromis *machrochir*) is a common and widespread species in Zambia. Its presence has been registered at Upper Zambezi, Kafue River, Lake Bangweulu as well as Chambeshi river (IUCN, 2021). Found in quiet waters along river margins and backwaters, I floodplains and impoundments (Skelton, 2001, Tweddle et al., 2004). It feeds mainly on microscopic foods such as algae, especially diatoms and detritus. Females mouth brood eggs and fry. Breeds in summer, nests grounded into arenas (IUCN, 2021). This species is threatened by alien species *Oreochromis niloticus* and is displaced when the two species occur together (IUCN, 2021). At Ndondi, this species was captured in the reservoir. Just like *Oreochromis andersonii*, its population will definitely increase on account of improved habitat integrity and absence of threats emanating from *Oreochromis niloticus*. However, a sub-projected increase in fishing, which will accompany increased human population around the dam area, could be critical as regards to how its population performs over time.

Invertebrates

A total of 10 macroinvertebrates were encountered in the field (Table 031). Some of the macroinvertebrates are key by being links in the food web between the producers and higher consumers such as fish.

Table 031 Invertebrates

English name	Scientific name	IUCN status
Dragon flies	*Anisoptera sp.*	DD
Horse fly	*Tabanus bovinus*	DD
Mosquito	*Aedes sp*	DD
Midges	*Chironomus sp.*	DD
Whirligig beetles	*Gyrinus natator*	DD
water boatman	*Corixidae sp.*	DD
water strider	*Gerridae sp*	DD
Mayfly	*Baetidae*	DD
Crab	*Potamonautidae sp*	DD
Snails	*Gastropod asp*	DD

Aquatic flora

Seven species of aquatic flora were investigated during this assessment (Table 032). Aquatic flora is critical to the health of an ecosystem. It provides food, shelter and breeding sites for some fauna (Tsugi & Muzungilwa, 2002).

Table 032 Aquatic flora

English name	Botanical name	IUCN STATUS
Bullrush	*Typha angustifolia*	LC
Starglass	*Cynodon plectostachyus*	*DD*
Water primrose	*Ludwigia peploides*	LC
Water lilly	*Nymphaeaceae sp*	LC
Cattail		LC
Reeds	Phragmites sp.	LC
Smartweed	*Polygonum pensylvanicum*	LC

Evaluation of Impact significance

Using the criteria explained above report, the potential impacts that the proposed sub-projects may have on the biodiversity in the area were evaluated and reported in Table 033. 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 033 Impact evaluation and reporting

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	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	Cert	Loca	Long	Medi	Nega	Dire	Medi	Medi

	area			a i n	l		u m	t i v e	c t	u m	u m
	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	R a r e	L i k e l y	L o c a l	L o n g	L o w	N e g a t i v e	I n d i r e c t	M e d i u m	L o w
	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	R a r e	C e r t a i n	L o c a l	L o n g	L o w	N e g a t i v e	D i r e c t	M e d i u m	M e d i u m
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	R a r e	L i k e l y	L o c a l	M e d i u m	L o w	N e g a t i v e	D i r e c t	L o w	L o w
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.	R a r e	U n l i k	L o c a l	M e d i u	L o w	N e g a t	D i r e c	L o w	L o w

				ely		m		ive	t		
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	Medium	Low	Negative	Indirect	Low	Low
Increased demand for medicinal use of flora and fauna as a result of In-migration	Increased exploitation of medicinal biodiversity in the sub-project area of influence	Because of the increased population resulting from in-migration, the demand for medicines from flora and fauna is also likely to increase. This is likely to be the case because of lack of hospitals and clinics in the sub-project area of influence.	Rare	Likely	Local	Medium	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	Medium	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	Low	Low
	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
	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; ● 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
	Injury or mortality of fauna		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 Ndondi Dam, this may happen. In case of occurrence this may kill or injure flora and fauna downstream.	Rare	Unlikely	Regional	Long	High	Negative	Direct	High	High
2.0. Aquatic											
Site Preparation and Construction											
Compromised aquatic habitats for fauna and loss of breeding areas	Clearing vegetation	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	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium

Increase in water pollution	Stresses flora, fauna and habitats	Some materials used during site preparation and construction could pollute the water in the dam During construction, there will be an assortment of machinery operating, and an increased number of people. Ultimately, this could increase noise levels (pollution) in the area. This could stress some lifeforms •	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium
Increased fishing pressure	Reduced fish population	Project likely to increase number of people in the area. This could ultimately translate into increased demand for food items such as fish.	Rare	Unlikely	Provincial	Medium	Low	Negative	Indirect	Medium	Low
Increased demand for water	Compromised aquatic habitat	Construction is a task demanding water. Further, the construction workers will need water for personal use.	Rare	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, fauna including species of conservation concern	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 of conservation concern to thrive. The water body has more life forms than the dambos or streams	Rare	Certain	Local	Medium	Medium	Positive	Direct	Medium	Medium
Habitat pressure caused by the dam	Over grazing, irrigation and fishing activities around the dam	When the dam is repaired, it will operate efficiently. This could trigger an increase in fishing, irrigation and livestock activities around the dam causing an increase in grazing pressure around the dam, irrigation area and fishing activities affecting vegetation, causing siltation which will affect the dam	Frequency	Certain	Local	Medium	Medium	Negative	Direct	Medium	Medium
Maintained environmental flows downstream and protected upstream and downstream dambos and the dam habitats	The downstream flows will continue during the runoff season in relation to the design	The flows will be maintained as per the design and storage ratios. The habitats protection is part of the training programme for DMC. Once these are protected the biodiversity in the dam will be sustained. Species of conservation will be protected and will have conducive habitats to live in.	Rare	Certain	Regional	Long term	Medium	Positive	Direct	Medium	Medium

Decommissioning											
Increased ecological integrity	Increase in the life forms populations in the dam	The maintenance of the dam will ensure increased habitat integrity and populations of aquatic biodiversity	Frequent	Certain	Local	Medium	High	Positive	Direct	Medium	Medium
Loss of species of conservation concern	Overfishing	Overfishing and use of unsustainable fishing methods can deprive the waters of fauna species such as species of conservation, plankton and invertebrates	Rare	Unlikely	Local	Medium	Medium	Negative	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	Frequen	Unlikel	Local	Medium	Low	Negativ	Indirec	Medium	Low

			t	y				e	t		
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
- Possible deterioration of water quality downstream due to biocides that may be used during irrigation agriculture
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens

Aquatic Biodiversity Environment

Positive Impacts during rehabilitation works include:

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

Negative Impacts during rehabilitation works

- Compromised aquatic habitats and breeding areas for fauna through vegetation clearing
- Pollution of water which stresses flora, fauna and habitats
- Increased demand for water compromising aquatic habitat
- Loss of species of conservation concern due to construction works and illegal fishing methods by the contractor

Positive impacts during operation and maintenance include:

- Increase in populations of flora and fauna when habitat integrity is enhanced
- Maintained environmental flows downstream and protected upstream, downstream dambos, and the dam habitats - the downstream flows will continue during the runoff season in relation to the design

Negative impacts during operation and maintenance include:

- Compromised aquatic habitats for fauna due to overgrazing and increased vegetation clearing
- Pollution and sedimentation of water due to increased cattle use of the dam, which may stress flora, fauna and habitats in the dam and downstream
- 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
- Increased fishing pressure which may reduce fish populations
- Loss of species of conservation value due to overfishing and unsustainable fishing methods

- In case of maintenance failure and dam failure, downstream habitats may be inundated and damaged with loss of flora and fauna.

Concluding Impact Statement

Ndondi Dam provides a permanent water body on the Kaunga stream, which is a small seasonal tributary of the Kalomo River in the Zambezi River system. Situated towards the upper end of the catchment, the dam spills regularly in the wet season. Terrestrial and downstream aquatic habitats in the dam's area of influence have been significantly impacted over the years (decades) by subsistence cultivation and grazing of cattle. The dam itself has had little negative impact on the biodiversity of the stream and downstream river system. There are no aquatic or terrestrial species of conservation of significance that have been affected by the regulation of flow nor that are expected to be affected. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The dam does not pose a barrier effect to the fish population. The two fish species listed on the IUCN Red List that were found during the study occur primarily because of the permanent water provided by the dam. The major threat to these two species, the Nile tilapia, which has been introduced into the Kafue River system, does not appear to be present near the dam's impoundment area. 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 – 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 farming in the dambos and general habitat degradation in the surrounding areas and not attributed to the dam's impoundment.

Since the dam was first built 13 years ago it is likely that the remedial works may slightly encourage additional cultivation through increased irrigation activities if the irrigation pipes are rehabilitated by the Ministry but will not change the current patterns of stock use that have existed since construction. Key management requirements are to continue efforts to improve catchment conditions, particularly around the perimeter of the dam, by managing overstocking and discouraging cultivation in the seasonally wet dambos and riverine areas. This will be the responsibility of the nominated dam committee, with assistance and support from the Ministry of Agriculture, Forestry and Fisheries and DMC. Irrigation farming methods that protect the land and water resources will be 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.

BIODIVERSITY MANAGEMENT PLAN (BMP)

In an Effort to enhance the management of biodiversity in the sub-project area of influence, a site-specific Biodiversity Management Plan (BMP) has been developed in this section and Appendix 8 – 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 sub-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 of the BMP

The main objectives of the BMP are to provide a structure to manage impacts according to the mitigation hierarchy, and to provide a roadmap for the implementers of the mitigation measures.

Specific objectives:

- Compliance with national regulations and international guidelines and/or standards regarding biodiversity management;
- Address of biodiversity risks identified through an ecological assessment of the sub-project area of influence; and
- Remediation of impacts of the initial works on the dam

Scope of the BMP

This BMP only covers the defined area of influence for Ndondi Dam. Further, its focus is on the management of potential impacts of the proposed dam works as listed above .

Table 033 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	To avoid and where not feasible minimize the loss of indigenous vegetation	The contractor will ensure that vegetation clearing is subject to approval by the Project management team or Manager on site to avoid unnecessary flora loss. Riverine buffer zone will not be disturbed (Appendix 8- dam and dambo management). Flora management will be included in the sites' method statements (refer to ESMP).	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			The contractor will use old site access roads as they are still open. Only in instances where existing access roads need widening will the necessary clearing be done. This measure will ensure avoidance of unnecessary vegetation clearing. Roads will not be close to riparian buffer zones/ water bodies (Appendix 8- dam and dambo	Mobilization	End of construction works	Contractor Supervision- UNOPS

			management).			
			Whenever possible e.g. at camp sites, the contractor will ensure that trees will be cut at knee height to promote coppicing at the end of the sub-project.	Mobilization	End of construction works	Contractor Supervision- UNOPS
		Avoid use of indigenous wood/timber	The contractor will not use indigenous timber/wood for construction and related works on site as this will not be allowed. When timber is required, it will be procured from licensed pine and/or eucalyptus dealers.	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
			The contractor will sensitize and discourage its employees from using Charcoal and firewood on site. Instead alternatives such as gas stoves will be promoted.	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
1.1.2	Habitat loss by the introduction of Invasive flora species	Avoid and/or prevent the introduction of invasive species	The contractor will not allow the planting or seeding of alien or foreign flora species on site. To this effect, all employees on site will be sensitized.	Beginning of construction works	Project closure	Supervision- UNOPS
			The contractor will implement an alien invasive species prevention protocol to prevent the introduction and transfer of invasive plant species. This will include the avoidance of affected areas by staff and vehicles where possible and wash down procedures for Project vehicles that are suspected to have been in areas infested with invasive species.	Beginning of construction works	Project closure	Contractor and UNOPS Supervision- UNOPS
			The contractor will ensure that only non-invasive local plant species are used for revegetation efforts under the project.	Beginning of construction works	Project closure	Contractor Supervision- UNOPS

		To control the spread of *Lantana camara* and *Helianthus tuberosus* on site	UNOPS and Forestry will train the DMC who will implement (the programme for uprooting *Lantana camara* and *Helianthus tuberosus* which have infested the sub-project area of influence.	Beginning of construction works	Project closure	UNOPS and DMC
Fauna						
1.1.3	Injury and/or loss of fauna	To preserve fauna in and around the project site	The contractor will not allow or permit hunting or killing of any wildlife on site. Hunting will constitute a serious breach of contract and will be reported to relevant authorities. Fauna management will be included in the sites' method statements (refer to ESMP).	Beginning of construction works	Project Closure	Contractor, ZAWA, Traditional Authorities and DMC Supervision - UNOPS
			The contractor will avoid clearing/cutting down of Acacia trees in riparian habitats and on the edges of dambos for any purpose. This is because Acacia trees in the riparian habitats are mainly used for nesting by indigenous birds.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will ensure that active bird nests are not damaged during site preparation and construction activities. As far as possible tree and scrub clearance will not be undertaken during the breeding season (March to August inclusive). Should clearance during this time be necessary a preclearance nesting bird check of the vegetation to be cleared will be undertaken by the Biodiversity Specialists and a decision on whether to move the nest or defer the clearance will be made by the	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

			Biodiversity Specialists.			
1.1.4	Injury or mortality of fauna due to accidents	Avoid collisions of vehicles with fauna on site	The contractor will ● Provide driver awareness and training; ● Enforce speed limits; ● Restrict vehicle and machinery operation to daylight hours to avoid collisions with nocturnal and crepuscular fauna ● Report any collision, document species affected and area of occurrence for record keeping and development of better abatement strategies.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.5	Disturbance or disruption of fauna due to construction works	To avoid disturbance of nocturnal fauna on site	The contractor will restrict construction and related works to day time (6AM – 6PM). Night working and the use of excessive artificial lighting will not be permitted to avoid adverse impacts on 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 will ensure that Non-UV sources of lighting are utilized so as not to attract the nocturnal insects and thus other fauna that feed on them. This will help to avoid the risk of predation competition and high mortality of insects.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
		To avoid disturbance of fauna on site during day time	To reduce noise on site, the contractor will: ● Service all equipment and	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

			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			
1.1.6	Introduction of invasive fauna species into the project area of influence	To avoid the introduction alien fauna species	The contractor will: ● Develop Project staff conduct guidelines that would include the interdiction of transporting live or dead animals, plants or seeds in Project related vehicles; ● Inspect company vehicles for illegal fauna and flora products before access to site is granted; ● Provide Project staff with a hygiene and vaccination campaign; ● Train staff to recognize key invasive species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
Habitats						
1.1.7	Destruction of existing habitats on site	Avoid further fragmentation of habitats	The contractor will 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 dambos in sub-project	The contractor will not carry out any construction and related sub-project activities within dambos and fruit forests on site. Coordinates for these areas are given in Table 4-1 and Table 4-2	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will set the construction camp site at least 100m from the nearest dambo and the riverine. It is strongly recommended that the old camp site	Beginning of construction works	Project Closure	UNOPS and DMC

			area be utilized even this time around			
			The DMC and UNOPS will ensure that there are no agricultural activities within identified dambos, fruit forests and along the riverine	Project mobilization	On-going	Traditional Authority and DMC
1.1.8	Loss of integrity of the terrestrial habitats	To preserve the integrity of the vegetation on site	The contractor will carry out construction works such as cement mixing in already disturbed areas. Preferably those areas utilized during the initial construction works should be used whenever possible	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
			To minimise risk of pollution, the contractor will: ● Store all hydrocarbons including fuels, used oils, new and used oil filters and grease in designated places fitted with spillage protection mechanisms such as bunding and impermeable flooring ● Train employees handling these materials in material handling and spill prevention	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
1.1.9	Fire outbreaks	To avoid outbreaks of bush or forest fires	UNOPS and the contractor will not allow bush burning and or open fires in forested, riparian buffer zone or vegetated areas. Employees will be sensitised to this effect.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
			The contractor will sensitise employees on the dangers of forest fires to both humans and the ecosystem and how to avoid them.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS

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 will 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 will 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 such as *Lantana camara* and *Helianthus tuberosus* ● Roles of community members on biodiversity management	Project mobilization	Project closure	UNOPS
1.2. AQUATIC (SITE PREPARATION AND CONSTRUCTION PHASE)						
1.2.1	Increase in vegetation clearing	To ensure that clearing of vegetation is avoided at all costs or alternatively, done at a minimal level to maintain its integrity.	The contractor will avoid unnecessary clearing of vegetation. Where this is not feasible, the contractor should ensure that clearing of vegetation is kept at a very minimal scale.	Beginning of construction works	End of construction works.	Contractor Supervision - UNOPS

1.2.2	Increase in pollution and siltation of water	To ensure that pollution, soil loosening and siltation is controlled	The contractor will carefully handle materials that have a potential to cause pollution. Work sites will control soil erosion and prevent soil loosening activities. Solid waste will be disposed of in a matter prescribed by ZEMA and the local town council. The contractor will maintain buffer zones (Appendix 8- dam/ dambo management).	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS
1.2.3	Increased fishing pressure that could lead to a reduction in fish population	To avoid depletion of fish population on account of heightened fishing pressure	The DMC collaborating with other stakeholders (Department of Fisheries, Ministry of Livestock and fisheries, Traditional authorities, fishers) will issue fishing passes to fishers on rotational basis. This should be informed by research as regards the standing biomass of fish at any particular time. Further, fishers should be encouraged to harvest fish by way of employing passive gears such as hooks and lines, and gillnets. Gillnets of mesh size less than 63 mm should not be allowed to avoid capturing immature fish.	Project mobilization	On -going	● DMC ● Traditional leaders ● Fishers ● Department Of Fisheries ● Ministry of Livestock and Fisheries ● Supervision UNOPS
1.2.4	Pollution of soils and water by hazardous waste products	To ensure that these are handled and disposed of in a manner that does not cause harm to habitat and its constituents	The contractor will adhere to best practices recommended by ZEMA when handling such materials. The waste will be kept in bunded facilities. The final handlers will be licensed waste management handler. Hydrocarbons will not be allowed in water. Any spill will be handled using spill kits and isolation methods. These will be disposed of in a matter prescribed by ZEMA.	Project mobilization	End of construction works	Contractor Supervision - UNOPS

1.2.5	Increased demand for water	To ensure prudent usage of water throughout construction phase and thereafter	The contractor will ensure that construction water does not compromise aquatic biodiversity requirements and environment.	Project mobilization	On-going	● Contractor ● Supervision UNOPS ● DMC ● Traditional leaders Department of Water resources development
1.2.6	Increased demand for water could compromise aquatic habitats	To ensure prudent usage of water throughout site preparation, construction phase and thereafter	Water is such a critical commodity. Thus, the contractor and other stakeholders (traditional leaders, DMC, Departmental of Water resources development) will ensure prudent usage of this resource. Suffice to mention that the sub-project area of influence is prone to droughts.	Project Mobilization	On-going	● Contractor ● Supervision UNOPS ● DMC ● Traditional leaders ● Department of Water resources development
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 8)	DMC and IDSP will initiate the revegetation exercise to restore flora in cleared areas on the peripheral of the dam within 500m. ● Exposed areas will be tilled to a depth of 20cm and top soiled were possible. The area will be seeded with indigenous trees and grass species. This will be done between November and February during the rainy season (Appendix 8- dam and dambo	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS Forestry, WARMA, Agriculture, Fisheries etc.

			management) The Ministry of Agriculture, Forestry and Fisheries will implement catchment management with DMC and traditional leaders for upstream protection and dam conservation needs. Catchment management is detailed in Appendix 8.			
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 will continue implementing fauna management actions during the operation phase of the dam. These measures will include: ● Prohibition of hunting ● Prohibition of tree cutting within the vicinity of the dam ● Prohibition of agricultural activities within dambos 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						

2.1.3	Restoration 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 will 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 will 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
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 the Dept. of Forestry will train the DMC and selected local community members on the implementation of invasive species management Communities will not introduce invasive species. Any spotted invasive species will be controlled by the DMC from the start.	Project Operation Phase	Completion of training	UNOPS DMC
Demobilization						
2.1.6	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 will ● remove all equipment and structures from construction camp site; ● turn over the soil on site to a depth of 20cm; ● Re-slope to mimic the natural terrain; and ● Re-vegetate with indigenous flora species	End of construction works	Demobilization	Contractor Supervision - UNOPS
			At the end of remedial construction works, the contractor will rehabilitate all borrow pits on site as described under section 2.1.3 of this BMP	End of construction works	Demobilization	Contractor Supervision - UNOPS
2.2. AQUATIC (OPERATIONS PHASE)						
2.2.1	Increase in populations of flora, fauna; when habitat integrity is	Providing a conducive habitat for aquatic biodiversity	The Contractor will rehabilitate the dam which is a habitat for aquatic biodiversity and will protect habitats during works. DMC will be trained in proper sustainable fishing methods and dam	End of construction works	Demobilization	● DMC IDSP

	enhanced		protection. Protection of the dambos by the DMC and community by using allowed fishing methods and protecting their integrity.			
2.2.2	Maintained environmental flows downstream and protected upstream, downstream dambos, and the dam habitats	To enable and promote ecological flows and protection of dambos	The UNOPS design will ensure ecological flows are continuous during the rainy season according to the dam's storage ratio. The IDSP and UNOPS will train the DMC on flow monitoring and its importance. The DMC and IDSP will monitor flows. DMC will ensure protection and maintenance of. The dambos and dam will be protected by conserving the features, avoiding gardens around them and siltation, using proper fishing methods, preventing invasive species, and prevention of soil erosion. Protecting these habitats will ensure continuous protection of life forms and their flow during runoff seasons	End of construction works	Demobilization	● DMC IDSP
2.2.3	Increased habitat pressure caused by the dam leading to over grazing, increase in irrigation area, and fishing activities close to the dam	To reduce pressure on the area around the dam	DMC to ensure vegetation is maintained around the dam and animal feeding is away from the dam. Catchment management training programmes included in the training plan. The DMC will not allow grazing close to the dam and vegetation will be maintained. Preventing cattle and human activity to intervene in riparian/wetland areas would be important to avoid further	End of construction works	Demobilization	● DMC ● Traditional leaders ● Forestry ● Fisheries IDSP

			degradation (Appendix 8- Dam and dambo management).			
2.2.4	Pollution and sedimentation of water which stresses flora, fauna and habitats	To minimise contamination of water and loss of biodiversity	The DMC will take part in catchment management and protection of buffer zones (Appendix 8) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC will allocate specific livestock watering points that have some erosion control vegetation and rock features to minimize soil loosening.	End of construction works	Demobilization	● DMC ● Traditional leaders ● IDSP Forestry
2.2.5	Potential growth of algae in the dam and dambos/ wetlands upstream or downstream due to irrigation (use of chemicals) and from livestock droppings	To ensure preservation of the environment and quality of water upstream, in the dam and downstream during agriculture and irrigation activities	The IDSP/ Ministry of Agriculture will ensure that the local community are trained the best way to practice crop and animal agriculture to ensure preservation of the environment and quality of water	During project rehabilitation period	Operation phase	Ministry of Agriculture/IDSP
2.2.6	Pollution and sedimentation of water which stresses flora, fauna and habitats	To minimise contamination of water and loss of biodiversity	The DMC will take part in catchment management and protection of buffer zones (Appendix 8) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC will allocate specific livestock watering points that have some	End of construction works	Demobilization	● DMC ● Traditional leaders ● IDSP Forestry

			erosion control vegetation and rock features to minimize soil loosening.			
2.2.7	Overexploitation of fish resources which reduce fish population Loss of species of conservation concern due to overfishing and introduction of invasive species	To ensure that fish resources are sustainably utilized	The DMC and other key stakeholders (Min. of Fisheries, traditional leaders,) should exert some form of control with respect to who can fish, where, when and how. The dam should not be open access with respect to fishing. The DMC and traditional leaders, Min. of Fisheries and Livestock, will ensure that awareness and education executed as regards sustainable harvesting of the 2 threated tilapia species. DMC and fisheries will ensure controlled catching and breeding season breaks will be enforced. Fishing methods will be regulated by DMC with sustainable methods to prevent catching and destruction of eggs, invertebrates, plankton, and small fishes. Biodiversity will be protected by sedimentation control and pollution prevention by the communities; and catchment management. The DMC and Fisheries will not introduce invasive species on the water	End of construction works	On-going	● DMC ● Ministry of fisheries & Livestock ● Traditional leaders

2.2.8	Increased education and awareness on threatened tilapia species Capacity building- Increased knowledge and ability among locals	To create awareness and educate the communities concerning the 2 threatened *tilapia* species (Green headed bream) *Oreochromis machrochir* and Three spotted tilapia (*Oreochromis andersonii*) to ensure sustainability	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. 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.	Project mobilization	On-going	Supervision ● DMC ● Ministry of Agriculture ● Ministry of Fisheries and Livestock ● Traditional leaders
2.2.10	Increased irrigation farming upstream close to the riparian zone Increase in irrigation activities downstream	To ensure that the integrity of the riparian zone upstream and downstream is sustained to forestall siltation of the aquatic habitats To reduce siltation	The DMC collaborating with Min. of Agriculture, Traditional leaders, Min. of Fisheries and Livestock, willensure that no one is farming along the riverine. Those with farming plots along the same, have to be relocated/ provided with alternative pieces of land away from the riverine. Where they can continue farming.	Construction and operation phases	On-going	● DMC ● Ministry of Agriculture ● Ministry of Fisheries and Livestock ● Traditional leaders
2.2.11	Increase in populations of flora, fauna; & habitat integrity enhanced	To ensure that flora, fauna and habitat are well secured	The DMC working in collaboration with other stakeholders (Ministry of Fisheries and Livestock, Ministry of Agriculture, traditional authorities, will formulate management plan to secure these resources. The plan should be reviewed time and again in tandem with changing dynamics on the ground	Project mobilization	On-going	● DMC ● Ministry of fisheries and Livestock ● Ministry of agriculture Traditional authorities

2.2.12	Increased infrastructure failure and sedimentation due to lack of maintenance activities In case of maintenance failure and dam failure, settlements/infra structure downstream may be inundated and damaged with loss of flora and fauna. And unfortunately, there could loss of human lives	To ensure that sedimentation is controlled To ensure dam functionality To promote maintenance activities post rehabilitation works	The contractor will execute designed works with expected skill supervised by UNOPS. Afterwards, there should be regular monitoring of the dam's integrity by key stakeholders to forestall decommissioning. There will be adherence to the operations and maintenance manual by the relevant stakeholders as indicated in the manual. The stakeholders (DMC, Ministry of fisheries and Livestock, Ministry of Agriculture, Water resources development, Ministry of water, sanitation and environmental protection, Traditional leaders) should collectively invest efforts to ensure that the dam wall and other accompanying structures are always in a good condition. They will also implement catchment management activities over a period of time (Appendix 8).	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 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: determine 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 034 Biodiversity Monitoring Table

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

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

			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 ● Catchment management (Appendix 8) DMC will control and monitor any invasive weed infestation	establish and when community structures become fully functional.		not more than 3 months after completion of works. One community sensitization meeting report per quarter.
2.	Loss of flora in the stream catchment areas has the potential to degenerate water resources	To ensure continued availability of water for animal watering and vegetable gardening.	The DMC and Forestry will protect the Ndondi stream catchment area through proper management of the forest ecosystem around the area (No cutting of trees).	During and after completion of rehabilitation works.	● Contractor ● Forestry Department committee. ● Local traditional leadership. ● Dam committee	Catchment area protection sensitization programme.

2.0 Aquatic						
Construction phase						
1.	Loss of feeding and breeding grounds downstream	Loss of feeding and breeding grounds	The contractor will maintain any feeding and breeding grounds for aquatic life during works.	During rehabilitation works.	● Contractor ● UNOPS ● DMC ● Fisheries	Protected breeding grounds
2.						
3.	Soil erosion from disturbed areas causing siltation in the reservoir and parts of upstream and downstream	To arrest soil erosion from taking place which smother sediments that provide food nutrients for aquatic species.	Ensure the disturbed areas are revegetated to arrest occurrence of soil erosion	During rehabilitation works	● Contractor	No sites in the surrounding environment are opened up to soil erosion.
4.	Increased fish abundance in the dam due to favorable breeding and feeding grounds	To ensure sustenance and improved fish stock abundance in the dam.	The DMC and fisheries will regulate fishing activities to protect the stock from overfishing.	After rehabilitations works	● Fisheries department ● DMC ● 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 will conduct robust visual observations before undertaking any works The DMC and fisheries will implement a monitoring survey of this species post-construction.	During and after rehabilitation works	● Contractor ● Fisheries department ● DMC	No mortalities recorded for every 6 monthly reporting period
Operation phase						
1.	Increased feeding and breeding grounds for fish once	To main the feeding and breeding grounds for fish and ensure	DMC and Fisheries will protect the breeding grounds for fish by ensuring no fishing activities take	During and after rehabilitation works.	● Department of Fisheries ● Local	Dam management by-laws drafted by completion of

	the dams are restocked with fish	sustenance of fish production.	place in willow waters. DMC and Fisheries will protect vulnerable fish species by monitoring the quantities and using safe fishing methods DMC will monitor and control invasive weeds		Traditional Leadership ● DMC	rehabilitation works.
2.	Bed modification: Low deposition of silt	To maintain reduced siltation in the dam so as to maintain diverse habitats.	DMC will maintain riparian vegetation around the dam by prohibiting cutting and farming close to the dam. DMC, Forestry and Fisheries and other stakeholders will conduct catchment management (Appendix 8)	During and after rehabilitation works.	● Forestry Department ● Fisheries Department ● Local Traditional Leadership ● DMC	Dam management by-laws drafted by completion of rehabilitation works.
3.	Increase in solid waste disposal in the reservoir compromising water quality and thus affecting aquatic species due to 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 will protect the dam from solid waste disposal by completely arresting indiscriminate disposal of waste.	During and after rehabilitation works.	● DMC ● Local traditional leadership	Reports from dam committees to the District Management Committee on solid waste disposal submitted every month. 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 3035 Roles and Responsibilities of relevant stakeholders in in BMP implementation

Name of Authority/ Entity	Key Role and Responsibility
IDSP/ Ministry of Agriculture	IDSP under the Ministry of Agriculture (MoA) bears the overall responsibility of ensuring that the implementation of the project in its planning, rehabilitation, operational and demobilization phases follows the environmental safeguards prescribed in the BMP. The Ministry hosts a Project Implementation Unit (PIU) for the IDSP. While the PIU of the IDSP will manage and implement the broader additional financing activities, it has contracted UNOPS to oversee and implement the remediation works of the remedial dams, including Ndondi 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 Ndondi Dam. The IDSP-PIU will retain the primary responsibility for ensuring that environmental and social commitments for the Ndondi 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 Ndondi Dam. ● The IDSP will have an environmental specialist who will oversee the UNOPS staff with regards to the BMP tasks. At least one additional MoA field staff member with HSSE responsibilities will be located at Ndondi Dam for continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP. ● The safeguards supervision includes the operationalization of the dam, during which period the IDSP personnel will be working with the respective local authorities, dam committee and local communities, in preparation for smooth handover when IDSP ceases to exist as a project. ● The PIU will implement capacity building and training of local stakeholders to ensure their informed cooperation in E&S matters during the remedial works and during the operational phase of the dam as well as advising the DMC. ● IDSP will implement its own monitoring and supervision activities as they apply for all activities, including the remediation of Ndondi Dam. IDSP has the overall responsibility for monitoring and reporting, but is supported by UNOPS' monitoring and quality assurance activities. IDSP and UNOPS will jointly discuss any necessary amendments to activities, where necessary.
UNOPS/ Supervising Engineer	The IDSP-PIU has contracted UNOPS to implement the remediation sub-project of Ndondi Dam under the AF, including the day-to-day environmental and social management and implementation of the measures described in this BMP. UNOPS has been tasked with the design of the remedial works and the preparation of this BMP. UNOPS will further be responsible for the preparation of the tender document and supervision of the contractor for the remedial construction works including the implementation of safeguards mitigation measures. Specifications for safeguards derived from the BMP will be included in the tender documents. Bidders receive key documentation outlining the requirements of the ESMP, as well as BMP. The bidding documents will contain a general reference to the necessity to comply with this BMP and will detail key tasks/mitigation measures/trainings, which the contractor will be obliged to undertake as part of his deliverables. Supervision will involve the management of the contractor and liaison with and reporting to the IDSP-PIU throughout the contract period. The UNOPS Sub-PIU E&S Team is responsible for the implementation of the BMP mitigation measures laid out in this BMP. Where implementation is conducted by contractors, the UNOPS Sub-PIU E&S Team supervises and monitors all E&S related aspects of the contractor's works.

	The environmental specialist, social specialist and ecological specialist will be involved in the environmental and social management of Ndondi Dam. In addition, the team will supervise and monitor the implementation of the BMP mitigation measures by the contractor. The team will establish a regular supervision and monitoring schedule, including site visits, and will prepare and submit quarterly environmental and social monitoring reports to the IDSP-PIU. UNOPS will be responsible for and will oversee, supervise and monitor the works of the contractor, including the contractor's E&S performance. ● UNOPS will ensure regular supervision and monitoring of the implementation of all mitigation measures laid out in this BMP, as well as all trainings and other required activities. ● UNOPS will use the indicators oall mitigation measures, as listed above in this BMP, for its monitoring activities. ● A supervision and monitoring report will be prepared every month and shared with the PIU of ISDP and the World Bank. The contents of this report will include: progress of the civil works, implementation of the BMP, confirmed the supervision of the safeguards specialist on site, photos, records of works, restoration efforts, terrestrial and aquatic environments management, grievances, accidents, communication, and training, among others. ● UNOPS will monitor and review all method statements prepared by the contractor to ensure that all areas that require remediation/ rehabilitation are covered and that the proposed methodologies are appropriate. ● UNOPS will take measures in the case of non-compliance. It will immediately liaise with the contractor, assess the risk level, significant and severe risks will cause for suspension of works until the non-compliance has been resolved to the satisfaction of UNOPS. Any significant loss of time caused by the contractor's noncompliance situations will be dealt with in accordance with the set procedures in the contract.
ZEMA	To undertake enforcement, compliance, review and monitoring of environmental assessment management plans. Visit, inspect and monitor the site or specific activities at any particular time
Government ministries and other stakeholders- Pemba district	The duty of the local authorities in the project area of influence with regards to the BMP is to coordinate with the project and stakeholders (s) on BMP commitments pertaining to site assessments, habitat management, fishing methods, re-vegetation, capacity building and training, inspections and participating in the project public outreach. The stakeholders have operation responsibilities for habitat management. The IDSP will inform the relevant offices for catchment management. The monitoring roles and responsibilities of the key parties/ stakeholders regarding the implementation of the ESMP will be communicated to relevant ministries indicated.
Contractor	UNOPS will contract the contractor after preparation of bidding documents. The selected contractor will comply with all stipulations in this ESMP for the duration of the contract. These requirements equally apply to sub-contractors. It is the contractor's responsibility to ensure that subcontractors comply and demonstrate such compliance in submittals and during verification processes by UNOPS. The contractor will engage competent full time Health, Safety, Social and Environmental staff on site to carry out Environmental and Social mitigation measures set out in the ESMP/ BMP. The Officer will be responsible for implementation and monitoring the contractor's compliance with the BMP requirements and the environmental specifications. The duties of the Officer will include but not be limited to the following: a) carry out environmental including biodiversity site inspections to assess and audit the contractors' site practice, equipment and work methodologies with respect to adequacy of environmental mitigation measures implemented; b) monitor compliance with mitigation and protection measures, prevention and control measures and contractual requirements; c) monitor the implementation of environmental mitigation measures; d) prepare monthly status reports for the site environmental conditions; e) advise the contractor on environment improvement, awareness and proactive pollution prevention measures; d) recommend suitable mitigation measures to the contractor in the case of noncompliance; e) carry out additional

	monitoring of noncompliance instructed by the supervisor; f) inform the contractor and supervisor of environmental issues, submit contractor's plans to the supervisor and relevant authorities, if required; and g) keep detailed records of all site activities that may relate to biodiversity. If pre-bid meetings, site visits and / or contract commencement meetings are carried out, the biodiversity requirements and submittals should be discussed, both for day-to-day work and for environmentally critical stages or activities. ● Contractors provide details on contractor's oversight on safeguards performance; ● Contractor and sub-contractors to deploy a workers' grievance mechanism to handle the concerns of their workers; ● Contractor will prepare and affirm all plans and method statements required in this BMP and ESMP that affect biodiversity and habitats prior to construction activities ● Borrow pits and material sites ● Contractor emergency response plan ● Waste management ● Campsite activities ● Excavation works and stock piling ● Sanitation and water management ● Traffic management and access routes management ● Biodiversity management ● Training, engagement and sensitization ● Contractor will work within the requirements of legislative requirements and standards ● Contractor will carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor will carry out investigation and submit proposals on mitigation measures and implement remedial measures to reduce environmental impact. ● Non-compliance by the contractor may cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of UNOPS. The contractor must report on all HSSE matters related to this BMP to UNOPS on a monthly basis. UNOPS will administer the monthly reports from the contractor, and will prepare its own quarterly reports, based on its supervision and monitoring activities, as well as designated UNOPS activities in this BMP to IDSP. Quarterly progress reports will include the status of the implementation of risk mitigation measures, trainings, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local Dam Committee and local authorities.
Local community and Dam Committee	As owners of the dams, the dam community will be encouraged to be active partners during the construction. It will be regularly consulted on a variety of issues. It will further be asked to report any misconduct by the contractor or contractor's personnel to the IDSP-PIU, through the Grievance Redress Mechanism (GRM), which has been designed for the AF activities. Community members will be appointed by the dam committee to verify that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the Stakeholder Engagement Plan (SEP) in the ESMP, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the biodiversity mitigation measures undertaken. The dam is operated by a dam committee, which consists of community members. The Ndondi 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 DMC. In order to successfully operate the dam, and limit impacts on people and environment, the dam committee members require further capacity building and training. Training will include issues such as dam safety management/ structural deterioration; habitat management; dam usage and best practice, biodiversity protection, erosion control and conservation (see training plan is included in the ESMP). Quarterly reports will also be made available to the local Dam Committee and local authorities. MoA has representatives at the dam who will periodically report to IDSP.

Step 2: Incident Reporting

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

Incident reporting will follow the management and reporting process below:

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

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

Step 3: Handover for Operation

Once construction works and training are completed, UNOPS and IDSP will declare the works final. The dam will be handed over to the Ndondi DMC who are part of the local community and local authorities. IDSP will continually engage with the communities and local authorities throughout the lifespan of the dam.

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Appendix 1: Sample Plots Coordinates

COORDINATES FOR NDONDI DAM SAMPLING POINTS		
Sample Plot Number	**Coordinates**	
1.	S 16.73971^0	E 027.38292^0
2.	S 16.73540^0	E 027.73399^0
3.	S 16.73140^0	E 027.36423^0
4.	S 16.73535^0	E 027.36191^0
5.	S 16.74151^0	E 027.36958^0
6.	S 16.74657^0	E 027.37479^0
7.	S 16.74174^0	E 027.38059^0
8.	S 16.74379^0	E 027.38680^0
9.	S 16.74844^0	E 027.39217^0
10.	S 16.74865^0	E 027.39517^0
11.	S 16.74227^0	E 027.40034^0
12.	S 16.73769^0	E 027.39956^0
13.	S 16.73305^0	E 027.40228^0
14.	S 16.72869^0	E 027.40127^0
15.	S 16.73053^0	E 027.39631^0
16	S 16.73286^0	E 027.38483^0
17	S 16.72952^0	E 027.38479^0
18	S 16.72643^0	E 027.38846^0
19	S 16.72833^0	E 027.39288^0
20	S 16.73848^0	E 027.39328^0

21	S 16.73699^{0}	E 027.38845^{0}

Appendix 2: Main Plot data collection form

TREE PARAMETERS DATA FORM						*FORM A*
Altitude.....	Plot No.....	Date.....		Quadrant No.....		Plot Size.....
Centre of Plot (GPS Reading UTM) N..... E.....		Vegetation Type.....				
Recorder.....						
SPECIES (TREE ≥ 5CM)	HEIGHT (M)	DBH (CM)	CROWN SIZE a Width	CROWN SIZE b Length	STEM HT (M)	NOTES**

** Indicate any noticeable
damage, crookedness, fungal attack
browsing signs, form, fire occurrence etc.

Plant Species Identification Codes:

√ ? -- Genus identified, species uncertain; (Write GENUS name and ?)

+ / - -- Identification not sure; (Write SUSPECTED NAME and + / -)

?? – Plant not identified (Write: SPP, Id No. and Plot No.)

Appendix 3: Regeneration Plot Data Collection Form

TREE REGENERATION DATA FORM				*FORM B*
Altitude……	Plot No……	Date……	Quadrant No……	Plot Size……
Centre of Plot (GPS Reading UTM) N…… E……		Vegetation Type……		
Recorder……				

SPECIES	COUNT	NOTES**

** Indicate any noticeable
damage, crookedness, fungal attack
browsing signs, form, fire occurrence etc.

Plant Species Identification Codes:

√ ? -- Genus identified, species uncerta + / - -- Identification not sure; ?? – Plant not identified
(Write GENUS name and ?) (Write SUSPECTED NAME an (Write: SPP, Id No. and Plot No.)

Appendix 4: Fauna Data Collection Form

Mammals

	Species		No. Seen		Signs - write details	Other faunal species
1						
2						**Reptiles**
3						
4						
5						
6						
7						
8						
9						
10						
12						
13						
14						**Amphibians**
15						

Birds

	Species		No. Seen		Signs - write details	
1						
2						
3						
4						
5						
6						
7						**Invertebrates**
8						
9						
10						
12						
13						
14						
15						

Fire occurrence

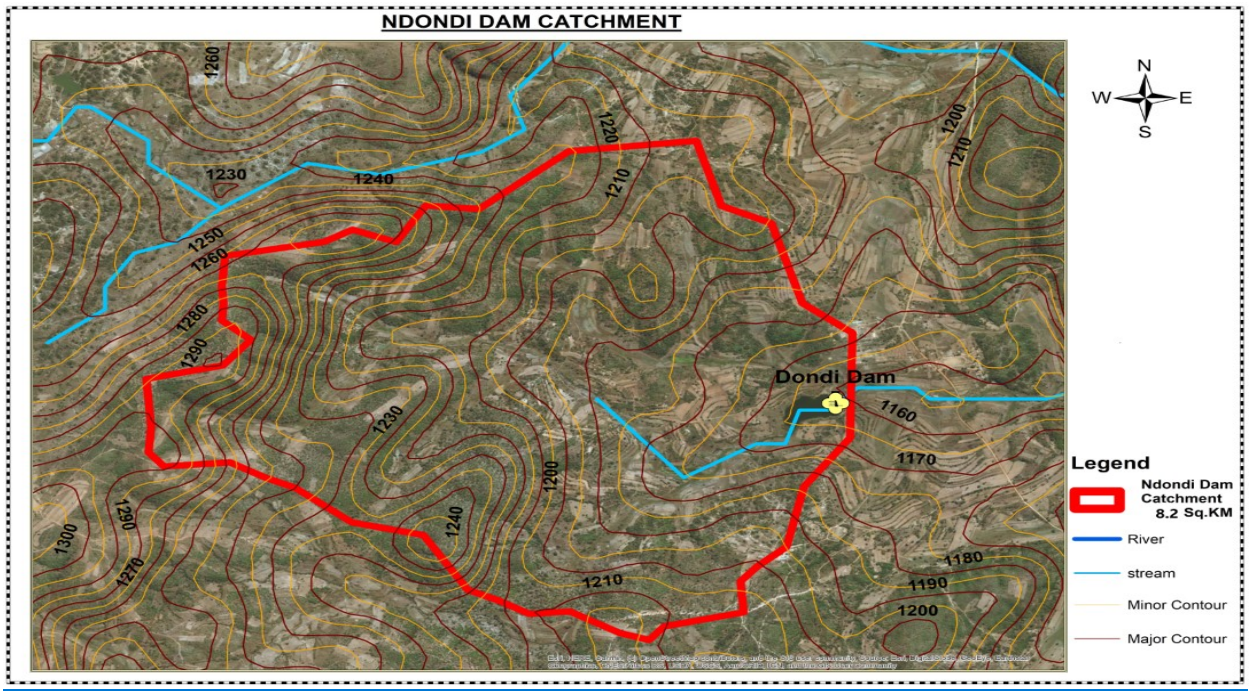
☐ Recent

☐ Old

Notes

Appendix 5: Coordinates for Dambos of interest in the area

Dambo No.	Elevation (m)	Coordinates	
		South	East
Dambo 1	1168	S 16.73694^0	E 027.37444^0
Dambo 2	1194	S 16.73057^0	E 027.36116^0
Dambo 3	1179	S 16.7462^0	E 027.37158^0




Ndondi Dam
Dambos
Legend
Dambo
Ndondi Dam
Dambo 1
Ndondi Dam
Dambo 2
Dambo 3
Google Earth
Image © 2021 Maxar Technologies
Image © 2021 CNES / Airbus
2 km
N

Appendix 6 Aquatic data collection sheet

The Aquatic Biodiversity Check List for the 10 Dams in Zambia

Biodiversity Scoping

Identification of habitats

- ✓ Is the direct area of influence considered to be modified/converted, natural, or critical habitat?
- ✓ Is the indirect area of influence considered to be modified/converted, natural or critical habitat?
- ✓ What is the legal protection regime?
- ✓ Is the direct area of influence located on indigenous land?
- ✓ What are the existing drivers of habitat loss (irrespective of the dam) ?

Identification of key biodiversity features

- ✓ Is it a priority area for conservation? (existing or proposed protected area, indigenous or local communities protected areas, Ramsar sites, area with high level of endemism, presence of aquatic corridor to ensure genetic diversity, important spawning area etc.). Note: List all sites within a 50km radius from the dam.
- ✓ Are there any Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) species and/or endemic or restricted-range species within a 50 km radius from the dam ? If so, list the species and their conservation status (based on the IUCN Red List)
- ✓ Does the area support important ecological processes? (spawning site? sediment supply to a wetland downstream? fish migratory route ? etc.)
- ✓ Are there any priority ecosystem services in the area of influence that may be affected by the dam ? If so, is it critical to the livelihoods of indigenous communities?

Identification of Aquatic species

- ✓ What is the conservation status of the vertebrate and invertebrate species?
- ✓ What is the conservation status of the macrophytes?
- ✓ Is there any migratory fish species ? List those species (if applicable) and shortly describe the migratory dynamic.

Aquatic biodiversity impact assessment and management

- ✓ What are the potential impacts and risks (direct, indirect, induced and cumulative) of the dam and how it would affect the key biodiversity features (if any)? Shortly describe impacts for each project phases (construction, operation and decommissioning)
- ✓ Would the dam lead to long term declines in population of any species listed either as CR, EN, VU or NT?
- ✓ Will the project significantly affect critical natural habitats or natural habitats?
- ✓ Would there be any significant changes in the water flow that could affect the aquatic and/or the riparian habitat and species?
- ✓ Is there any residual biodiversity impacts anticipated?
- ✓ In the case of residual impacts, is there sufficient information to plan management actions required to mitigate, or compensate for this type of impacts ? Or additional baseline studies are required?
- ✓ Is it possible to improve the project's design to avoid (and if not possible, to minimize) the project's impact?
- ✓ What are the potential options for biodiversity conservation and enhancement?

Monitoring

- ✓ Is the baseline information gathered sufficient to produce standardized biodiversity indicators useful for monitoring changes in the biodiversity overtime?

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 (common name and *Latin name*)	Number	Length (mm)	Weight (g)	Gear	IUCN Conservation status	Migratory species (yes/no)	Endemic, restricted-range specie (yes/no)
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.								

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	Total hardness	Alkalinity	Turbidity
Values of references									
downstrea m									
Upstream									
Mid of the dam									
At the weir									

Sampling Form 2

C. Aquatic plants

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

S/#	Species	Monocots	Dicots
Emergent			
Submerged			
Free floating			

D. Macroinvertebrates survey

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

Appendix 7 – Water Analysis Results for water samples collected at Ndondi Dam

Sample ID	Ndondi Dam Wall	Ndondi Dam Entry	Ndondi Dam Upstream	Ndondi Dam Mid
Sampling date	**06.04.2021**	**02.04.2021**	**05.04.2021**	**05.04.2021**
Parameter				
pH	6.66	6.83	6.65	6.32
Conductivity (µs/cm)	98	69	99	77
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)	112	85	76	80
Total Dissolved Solids (mg/l)	49	35	50	39
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01
Phosphates (mg/l)	<0.01	<0.01	0.50	<0.01
Total Suspended Solids (mg/l)	5.2	3.9	4.4	3.6
Chemical oxygen demand (as mg O_2/l)	3	5	4	3
Chlorides (mg/l)	15.0	10.0	10.0	10.0
Turbidity (NTU)	49.8	23.8	26.7	17.7
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".

Plankton composition at Ndondi Dam

No.	Phytoplankton	Zooplankton
1	*Distigma* sp.	*Ceridaphania cornuta*
2	*Anabaena*	*Macrothrix spinosa*
3	*Sphacroplea annulina*	*Brachionus angularis*
4	*Phacus triqueter*	*Brachionus calyciflorus*
5	*Trachelomonas*	*Brachionus budapestinensis*
6	*Volvocina*	*Kerratella valga*
7	*Navicula* sp.	*Anuraeopsis fissa*
8	*Pediastrum* sp.	*Hexarthra mira*
9	*Urothrix*	*Collotheca ornata*
10	*Trachelomonas*	*Colurella obtusa*
11	*Euglena* sp.	*Cyclops*
12	*Microcystis* sp.	*Diurella stylata*
13	*Synedra*	*Diaphanosoma brachyurum*
14	*Closterium*	*Trichocerca cylindrical*
15	*Sorastrum* sp.	*Nauplius*
16		*Asplanchna herricki*
17		*Simocephalus vetuloides*
18		*Cydorus sphaericus*

19		*Diaphanosoma brachyrum*
20		*Lepadella oblonga*
21		*Cydorus shaericus*
22		*Moina micrura*

Appendix 8 Habitat Management

Catchment Management and Dam/ Dambo Management Guidelines

a) **General Integrated Catchment Management Guidelines**

A Catchment means a geographical area which naturally drains into a water resource and from which the water resource receives surface or ground flow that originates from rainfall[28]. During the ESMP and BMP assessments for the rehabilitation sub-project, concerns were expressed about the management of the upper catchment of the stream, which should be handled by stakeholders in the operation phase for sustainability.

These concerns related mainly to existing land use practices and resulting erosion and siltation problems including water quality problems. The present land-use practices at the Ndondi 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 dambos which will affect the biodiversity habitats.

To address these, and other concerns 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

[28] WARMA Act

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

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

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

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

5) Catchment-wide projects will be proposed to protect the dam, or may already be in place or planned for implementation. These can include:
   - Communication and awareness
   - The establishment and functioning of the Council
   - Formulation and training of the DMC and users association
   - Community capacity building and training;
   - Provision of sanitation facilities
   - A sustainable livelihoods programme
   - A sediment management programme
   - A reservoir/ dam management plan
   - A dam sediment study
   - The establishment of new monitoring points and revision of monitoring frequency
   - Implementation of water quality monitoring variables
   - Accreditation of a water laboratory

- Zoning plan for use of upper catchment
- Mapping of key wetlands
- Development of policy on management of invasive plants
- Creation of indigenous plants nursery
- Energy sources assessments
- Provision of off-channel livestock watering points
- Zoning of buffer zone around dam
- Dam and Dambo Management

6) Time lines:

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

7) Funding:

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

Dam/ Dambo Management

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

- Vegetation retention of existing undisturbed local provenance native plants should be standard practiced by the contractor and locals
- Restoration of native vegetated sites and buffers which have been degraded or removed, re-vegetation of slopes, should (where practical be restored) with native vegetation equivalent in type, form, density, and diversity to that occupying the adjacent area or more as approved by the engineer. Planted buffers should consist of a mix of native trees, shrubs and groundcover using natural and assisted vegetation as indicated in the ESMP.
- These buffers and revegetated sites should be sustainable, with the least practical need for human intervention. Management activities may periodically be necessary to remove invasive species, for hazard reduction to prevent wild-fires and ensure community safety.
- Riparian vegetation provides a natural boundary. Buffers should be measured outward from any recognized damp land vegetation fringing the water resource or where the margins of missing riparian vegetation are uncertain, and the rain season banks of the water body.

- Buffer composition should comprise under-storey vegetation (grasses), over-storey (tall shrubs, trees) and carbon-rich tree parts on the ground matching the density and diversity of undisturbed local native vegetation.
- 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 dambos. There will be a buffer between the busy roads and the water bodies.
- Maintaining some grass at the water inlets to beneficial for sediment and contaminant filtration purposes.
- Contamination prevention is important with land use activities set up and operated to have minimal impact on buffers and associated water resources. Precautionary strategies to protect buffers from harm, erosion may include:

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