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 Nabowa Dam

12 January 2022

Prepared by UNOPS for the Government of the Republic of Zambia

Names of Authors

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

Content

CONTENT III

LIST OF FIGURES VI

LIST OF TABLES VII

LIST OF PICTURES VIII

LIST OF ACRONYMS AND ABBREVIATIONS X

EXECUTIVE SUMMARY XII

1. INTRODUCTION 1

1.1 Project Background and Description 1

1.2 Objectives of the ESMP 3

1.3 Methodology 3

2. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK 5

2.1 National Policy and Legislative Framework 6

2.2 World Bank Operational Policies 14

2.3 World Bank Group Environment Health and Safety Guidelines 16

3.INSTITUTIONAL ARRANGEMENTS FOR E&S MANAGEMENT OF THE SUB-PROJECT 17

3.1 Ministries / IDSP-PIU 17

3.2 United Nations Office for Project Services (UNOPS) 18

3.3 The Contractor and Sub-Contractors 19

3.4 The Dam Community 19

4.ENVIRONMENT AND SOCIAL BASELINE CONDITIONS 21

4.1 Physical Conditions 21

4.1 Geology and Soils 21

4.1.2 Topography 22

4.1.3 Surface Hydrology 22

4.1.4 Surface Water Quality 25
4.1.5 Seismology 28
4.1.6 Climate and Climate Change 30
4.1.7 Land Use 33

4.2 Biological Conditions 37
4.2.1 Habitats 37
4.2.2 Protected Areas 38
4.2.3 Terrestrial Fauna 38
4.2.4 Birds 39
4.2.5 Mammals 40
4.2.6 Reptiles 41
4.2.7 Aquatic and Semi-Aquatic Fauna and Flora 41
4.2.8 Fishing Practices 41
4.2.9 Ecosystem Threats 41

4.3 Social Conditions 41
4.3.1 Social Conditions around the Dam 41
4.3.2 Administration of Water and Dam 42
4.3.3 Gender Equality and Gender-Based Violence 42
4.3.4 Cultural Environment 44

5. SUB-PROJECT CHARACTERISTICS 46

5.1 Dam Characteristics 46

5.2 Overall Legacy Issues at the Dam 54
5.2.1 Structural risks 54
5.2.2 Health and safety risks 63
5.2.3 Social risks 66

5.3 Potential Communities Affected by Works 66

5.4 Dam Safety 67

6. PROPOSED REMEDIAL WORKS 69

6.1 Embankment Remedial Design 69
6.1.1 Slope Stability 69
6.1.2 Rock Toe 70

6.2 Service Spillway, Channels, Drop Structures and Training Wall 72
6.2.1 Service Spillway 72
6.2.2 Inlet Return Channel 73
6.2.3 Return Channel Drop Structures 74

6.3 Return Channel Training Walls 75

6.4 Outlets 76

6.5 Construction Materials and Amenities 78

6.6 Construction Programme **80**

6.7 Drawings List Available to the Contractor **80**

7.RISK AND IMPACTS MITIGATION PLAN 81

7.1 New Remedial Works General Construction Works Management Plan **82**

7.2 Rehabilitation and Remediation Plan for the Previous Works' Sites **114**

8. CAPACITY BUILDING 121

9. STAKEHOLDER ENGAGEMENT 125

9.1 Grievance Redress Mechanism **125**

9.2 Stakeholder Participation **125**

9.3 Stakeholder Communication Plan **127**

9.4 Stakeholder Consultation Plan **130**

9.5 Proposed Strategy to incorporate the Views of Vulnerable Groups **132**

9.6 Reviews of Comments **132**

10. ESMP IMPLEMENTATION PROCESS 133

REFERENCES 137

APPENDIX A: COMPLETED CHECKLIST 138

APPENDIX B: CHANCE FIND PROCEDURES 144

APPENDIX C: SAMPLE CODE OF CONDUCT FOR WORKERS 145

APPENDIX D: MANAGING COVID-19 RISKS 149

APPENDIX E: TEMPLATE FOR CONDITIONS OF CONTRACT 155

APPENDIX F: ATTENDANCE SHEETS STAKEHOLDER CONSULTATIONS AND DMC LIST 156

APPENDIX G - NABOWA DMC 158

APPENDIX H: WORLD BANK INCIDENT CLASSIFICATION GUIDE AND INCIDENT REPORT FORM..159

APPENDIX I: SUMMARY OF CONSTRUCTION CONTRACTOR TRAINING REQUIREMENTS.....162

APPENDIX J: BIODIVERSITY ASSESSMENT AND BIODIVERSITY MANAGEMENT PLAN.....163

EXECUTIVE SUMMARY 163

Objectives of the BDA 166
Overall Objective 166

METHODOLOGY 167
Assessment methodology 167

Data collection methods 174
Data Analysis 181

RESULTS & DISCUSSION..... 183
Terrestrial Survey results..... 183
Aquatic Survey results 197
Evaluation of impacts 203

BIODIVERSITY MANAGEMENT PLAN (BMP) 219
Objectives..... 219
Scope 219
Follow-up and Monitoring..... 240
Implementation of the BMP..... 248

CONCLUSION..... 253

REFERENCES..... 254

Appendix 8. 1: Terrestrial data collection forms 256

Appendix 8. 2: Regeneration plot data collection sheet..... 257

Appendix 8. 3: Fauna data collection sheet 258

Appendix 8. 4: Aquatic data collection forms and water quality analysis results..... 259

Appendix 8. 5: Formulae used in calculating trees quantitative attributes..... 262

Appendix 8. 6: Habitat Management..... 264

Appendix 8. 7: Hydrology and Ecological flows 272

LIST OF FIGURES

Figure 1: Institutional arrangement for sub-project implementation 17
Figure 2: Map showing topography of the sub-project area 22

Figure 3: The Luena River Basin 23
Figure 4: Map showing catchment area as estimated for Nabowa Dam 24
`Figure 5: Nabowa Dam flood area 24
Figure 6: Reservoir water (Nabowa Dam), showing the sampling point 26
Figure 7: Portion of spillway completely dry. Surface unprotected from erosion 26
Figure 8: Seismic hazard, US Geological Survey 2013 30
Figure 9: Ecological Zones in Zambia 32
Figure 10 : Projected changes in monthly temperatures for Zambia 2020-2059 33
Figure 11: Google map showing Nabowa Dam and the vegetation around it 35
Figure 12: Location of Nabowa Dam and the surrounding infrastructure 36
Figure 13: Google map showing vegetation around the Nabowa dam 37
Figure 14: Map showing route to Kaoma/Nabowa Dam from Lusaka 42
Figure 15: Schematic consultation coverage 45
Figure 16: Google map showing location of Nabowa Dam, UNOPS 2020 46
Figure 17: Google map showing sites of concern 64
Figure 18: Raising Cross Section Showing Chimney Filter Location 70
Figure 19: Typical Section of Rock Toe and Filter in the Riverbed Section 71
Figure 20: Typical section of Toe Drain and Embankment Internal Filter 72
Figure 21: Plan View: Layout of New Gabion Drop Structures in Spillway Return Channel 75
Figure 22: Incident reporting process 135
Figure 23 Map showing the project area of influence 167
Figure 24 Mitigation hierarchy 174
Figure 25 Field team collecting floral attributes 176
Figure 26 Setting up camera trap to capture fauna 177
Figure 27 Stratification of Nabowa Dam into four sampling points: Filed team 178
Figure 28 Points of interest in the Nabowa Dam area; i = dam wall, ii = midpoint, iii = upstream and iv = downstream 179
Figure 29 Measuring turbidity with a secchi disc 180
Figure 30 Field and lab equipment used for plankton analysis 181
Figure 31 Two storied Miombo woodland dominated by Julbernardia spp 185
Figure 32 Bigger trees growing in sandy/loamy soils 185
Figure 33 Stand level size class distribution 188
Figure 34 Stand level size class distribution for the regenerates 189
Figure 35 Vegetation around settlements and cropland areas 190
Figure 36 Fungi colonised on dead wood and litter 191
Figure 37 Red ants and grasshoppers cited in the field. Source: Survey team 197
Figure 38 Average total fish catch (kg) per sampling point 201
Figure 39 Sampled fish at Nabowa dam. Source: field survey team 202

LIST OF TABLES

Table 1: Laws relevant to the sub-project 6
Table 2: Relevant World Bank Operational Policies 14
Table 3: Water quality analysis for Nabowa Dam compared with the other dams 27
Table 4: Water quality results for Nabowa Dam, sampled in March 2016 28
Table 5: Major earthquakes in Zambia (Zambian Seismic Network Country Report, 2017) 29
Table 6: Birds of conservation concern recorded in IBAT within a 50km radius of the dam site 40

Table 7: Mammals of conservation concern recorded in IBAT within a 50km radius of the dam site 40
Table 8: Fish species according to the IBAT - 5okm radius from Nobowa Dam..... 41
Table 9: Main characteristics of Nabowa Dam 47
Table 10: Results of Geotechnical Material Sampled 48
Table 11: Training plan 122
Table 12: Stakeholder communication plan 128
Table 13 Criteria for vegetation integrity (Latimer, 2009) 168
Table 14 Criteria for habitat integrity (Latimer, 2009)..... 168
Table 15 Criteria for aquatic habitat integrity (Kleynhans, 1996)..... 169
Table 16 Descriptive classes for the assessment of modifications to habitat integrity (Kleynhans, 1996) 170
Table 17 Criteria and weights used for the assessment of habitat integrity (Kleynhans, 1996)..... 170
Table 18 Intermediate habitat integrity assessment categories (Kleynhans, 1996) 171
Table 19 Terminology used to describe environmental and social impacts 172
Table 20 Parameters measured from the main plot Floral..... 176
Table 21 List of PSUs for the survey activity, where data was collected 178
Table 22 Description of habitat and vegetation condition 183
Table 23 Species importance values and IUCN status 187
Table 24 List of Mammals found and their status on the IUCN red list 191
Table 25 List of reptiles found and their status on the IUCN red list..... 193
Table 26 Avifauna species common around the dam area..... 193
Table 27 Invertebrate species found at the dam site 195
Table 28 The in-stream assessment for Nabowa Dam 197
Table 29 The riparian assessment for Nabowa Dam 198
Table 30 Water quality results..... 199
Table 31 Fish species composition during the hot wet season..... 200
Table 32 Average total fish catch (kg) per sampling point..... 201
Table 33 Fishing activity rate averages for the hot wet season..... 202
Table 34 List of Macro invertebrates..... 203
Table 35 Impact evaluation 204
Table 36 Biodiversity management plan 220
Table 37 Biodiversity Monitoring Plan..... 241
Table 38 Roles and Responsibilities of relevant stakeholders in in BMP implementation 248

LIST OF PICTURES

Plate 1: Downstream of Nabowa Dam 25
Plate 2: The downstream environment – No agriculture activities 34
Plate 4: Miombo woodlands in the project area 39
Plate 5: Rosewood in the project area..... 39
Plate 6: Existing Crest of Nabowa Dam..... 49
Plate 7: Embankment Upstream Slope 50
Plate 8: - Embankment Downstream Slope with Berm 50
Plate 9: Right Bank Erosion of Suspect Construction Material 51
Plate 10: Seepage at Downstream..... 52
Plate 11: Damaged Spillway Gabion Sills 52

Plate 12: Spillway Return Channel Showing Straight Flow Path 53
Plate 13: Pictures showing status of Upstream slope 56
Plate 14: Pictures showing status of downstream slopes 57
Plate 15: Pictures showing status of crest 58
Plate 16: Pictures showing status of downstream toe 60
Plate 17: Status of spillway at the dam. Service Spillway 61
Plate 18: Spillway at the dam; Emergency / Auxiliary Spillway 62
Plate 19: Cleared area previously used as a camp site needing revegetation 65
Plate 20: Spillway return channel needing rework to arrest erosion and sedimentation 65
Plate 21: Degraded areas and embankment needing revegetation. 66
Plate 22: Current status of Rock Toe 70
Plate 24: Typical Gabion Basket Erosion Protection in Channel 74
Plate 25: Gabion Basket Erosion Protection Structure 74
Plate 26: Spillway Channel Left Hand Training Wall Condition 76
Plate 27: Low Flow Pipe Outlet Valve Chamber 77
Plate 28: Inspection & Valve Chamber for Irrigation Pipe (COWI Report 2018) 77

LIST OF ACRONYMS AND ABBREVIATIONS

AF	Additional Financing
BDA	Biodiversity Assessment
BMP	Biodiversity Management Plan
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangerd Species of Wild Fauna and Flora
CoC	Code of Conduct
COD	Chemical Oxygen Demand
COVID-19	Corona Virus Disease 2019
CpUE	Catch per Unit Effort
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
EIA	Environmental Impact Assessment
EPB	Environmental Project Brief
EPP	Emergency Preparedness Plan
ESA	Environmental and Social Audit
ESMP	Environmental and Social Management Plan
ESSAT	Environmental and Social Standards Advisory Team
EPBs	Environmental Project Briefs
FAO	Food and Agriculture Organization of the United Nations
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
LC	Least Concern Status
KBA	Key Biodiversity Area
Kha	Thousand hectare
LMP	Labor Management Plan
MAR	mean annual runoff
MWDSEP	Ministry of Water Development Sanitation and Environmental Protection
msl	mean sea level
Mt	Million tonne
NGO	Non-governmental Organization
ODI	Overseas Development Institute
OP	Operational Policy (World Bank)
OPCS	Operational Policy and Country Services (World Bank)
PAD	Project Appraisal Document (World Bank)
PAP	Project Affected Person
PDO	Project Development Objective
PGA	Peak Ground Acceleration
PIU	Project Implementing Unit
RD	Relative Density
RBA	Relative Basal Area
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

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

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

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

The key structural legacy issues of the Nabowa Dam include the embankment slopes, which are too steep and the seepage and tension cracks on the embankment which present an erosion hazard and jeopardize embankment stability. Other structural legacy issues include the spillway capacity, which is not known or not built according to the design drawings. Additionally, the dam's spillway gabion basket drop is inadequately tied into the embankment and bypassed by flow.

UNOPS has developed detailed designs for the remedial works on Nabowa 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 activities, and b) remediation of the existing sites.

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

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

The ESMP addresses the environmental and social risks and impacts, which were identified through extensive field assessments. It includes a construction works management plan with mitigation measures and 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); labor and working conditions; decommissioning and rehabilitation measures; and maintenance and monitoring.

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

Health and safety and non-structural risks include the absence of safety hazard signs around the dam, which poses the risks of drowning or other accidents; the unrehabilitated borrow areas posing a variety of safety risks, though half of the affected area has been turned into a channel leading to the spillway; and the provision of a safe pedestrian access across the river.

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

Nabowa Dam was envisaged to supply water and a small scale irrigation system with the possibility of fish farming – following training of the local community. Neither the water supply nor the fish farming have been realized. Nabowa Dam's spillway has been operational since the inception, and there is no flow of water downstream even during or after heavy rains.

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

1. Introduction

Nabowa Dam is located in Kaoma District of the Western Province of Zambia. It is one of ten dams that have been selected for remedial works under the World Bank funded IDSP. According to OP 4.37, the dam is classified as a small dam because its height is less than 15m. The current structural integrity of Nabowa Dam has been compromised by the initial construction works, and therefore has become a safety threat to the local community. UNOPS has been tasked to prepare this Environmental and Social Management Plan (ESMP) on behalf of the Government of the Republic of Zambia. The ESMP guides the remedial works on the dam, mitigates imminent identified risks to the environment and the safety of communities and their associated livelihoods, and brings the dam into compliance with World Bank safeguards policies.

UNOPS has conducted desk reviews, interviewed and consulted key sub-project stakeholders, and gathered field data at the dam site. Initial field screening visits by the team have revealed that an in-depth biodiversity assessment of the dam site is required. This biodiversity assessment was undertaken, the data analysed and a BMP developed as a separate report, which is annexed to this ESMP.

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

1.1 Project Background and Description

The Nabowa Dam is a new dam, which was constructed in 2018 under the WRDP. It was built exclusively for irrigation and aquaculture purposes. No significant repair works have been undertaken since then. The proposed remedial works will help complete the dam. The proposed works will be undertaken under the World Bank-funded IDSP.

The Water Resources Development Project (WRDP)

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

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

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

Irrigation Development Support Project (IDSP)

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

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

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

Phase 1 covers preparatory activities that will facilitate the works to remediate dam safety and integrity and to 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 immediate, limited, structural and non-structural interventions to minimize immediate risks to communities caused by the dam.

IDSP Additional Financing (AF)

The AF extends the original deadline of the IDSP to 30 November 2022. It consists of three distinct sets of activities: Activity 1: Completion of ongoing works under the IDSP and cost replenishment; Activity 2: Remedial works for the 10 WRDP dams; Activity 3: Drought Emergency Response. The remediation of Nabowa 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 Nabowa Dam and provide support through training and capacity building, which is required to safely operate the dam and reduce the downstream environmental impacts. It is envisaged that the proposed widening of the spillway inlet channel upstream of the causeway to the full width of 41m and excavating down to a constant invert depth of 0.5m below

the causeway level may change the nature and scope of the existing scheme and may affect the dam's existing capacity. Nabowa Dam has structural challenges that may result in the remedial measures changing the quality or quantity of water flows downstream.

The scope of Phase 2 for Nabowa Dam consists of:

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

1.2 Objectives of the ESMP

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

1.3 Methodology

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

In summary the following activities were undertaken by UNOPS:

- Literature review, including data and documentation provided by the IDSP to UNOPS:
    - Remedial Environmental and Social Management Plans of Eight (8) Dams Under the Water Resource Development Programme (2018)
    - Approval Decision letters by Zambia Environmental Management Authority (2017)
    - Environmental Project Briefs (EPB) prepared under WRDP (2017)
    - Environmental and Social Audit (ESA) of 10 Dams (IDSP, 2020)
- Field studies by the UNOPS environmental and social (E&S) safeguards and engineering teams in July 2020, accompanied by IDSP team members:
    - Site environmental and social assessments.
    - Site and analytical geotechnical studies
    - Site surveying

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

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

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

2. Policy, Legal and Institutional Framework

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

2.1 National Policy and Legislative Framework

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

Table 1: Laws relevant to the sub-project

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Environmental and Natural Resource Management			
Environmental Management Act No.12, 2011	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's safety and integrity are likely to have environmental impacts. Provisions for mitigation measures for identified sub-project impacts are in place in order to eliminate or reduce the effects of these impacts. The measures are consistent with the requirements in the Environmental Management Act of 2011. As an example, some of the works to be undertaken may result in environmental discharges that will require ZEMA licenses for compliance and monitoring. Relevant pieces of regulations have been included in this ESMP and contractor's compliance with the regulations during the rehabilitation of the dam will be ensured.
Environmental Impact Assessment (EIA) Regulations, Statutory Instrument No. 28 of 1997	Under these regulations, a developer will not implement a project for which a project brief or an environmental impact statement is required, unless the project brief or an environmental impact assessment has been concluded in accordance with these Regulations and		At the national level, the Environmental Impact Assessment (EIA) regulation of 1997 gives guidance, schedules and categories for the various project types and the relevant EIA studies to be undertaken. It further gives provision on post- EIA approval management of projects and guidelines for developing ESMPs. This has been followed.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	the Council has issued a decision letter.		
Solid Waste Management Act of 2018	To ensure disposal of generated solid waste to designated sites	UNOPS to ensure the regulation is enforced through the ESMP. IDSP to monitor compliance throughout the sub-project lifespan; local municipal authority	The ESMP has taken into consideration solid waste management at work sites by introducing a parameter that will compel the contractor to take care of all the generated solid waste at its worksites and appropriately dispose of the same.
Natural Resources Conservation Act, Cap 315, 1970	To conserve and protect both natural and cultural heritage, e.g. waterfalls, in perpetuity and other resources within the boundaries of the site for the benefit of the present and future generations.	UNOPS to ensure enforcement during preparation and construction phase IDSP to monitor compliance throughout sub-project lifespan	The ESMP takes into consideration the BMP, which details specific conservation and mitigation measures to ensure sub-project activities promote the conservation and protection of both natural and cultural heritage in the sub-project affected areas, in compliance with the regulation.
Fisheries Resources Management			
Fisheries Act, Cap 200, 1974	Provides for development of commercial fishing and the registration of fishermen and their boats and the protection of endangered fish species.	IDSP Monitoring: Ministry of Agriculture and Livestock	The proposed dam will be used for fishing; commercial fishing may be eventually developed by communities. 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.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Lands Management			
The Lands Act, 1995 (CAP 292, CAP 289, CAP 288)	The Department of Lands administers the Land Act, 1995 (CAP 292, CAP 289, CAP 288) and the Lands Acquisition Act, 1995 for the allocation and alienation of land under statutory leaseholds. The Department is also responsible for the administration of lands and deeds registration and land surveys and mapping.	UNOPS to ensure enforcement during preparation and construction phase. Monitoring: Ministry of Lands, Natural Resources and Environment Protection.	No additional land is expected to be required for this sub-project. If any land acquisition be required, UNOPS/ IDSP will comply with this regulation which governs the acquisition of the land to be used for various developmental activities.
Urban and Regional Planning Act, No. 3 of 2015	Provides for the appointment of planning authorities, the preparation approval and revocation of development plans, and the control of development and subdivision of land.	UNOPS to ensure enforcement during preparation and construction phase. Monitoring: Ministry of Local Government and Housing; local authorities	The land around the dam falls within traditional tenure. UNOPS, on behalf of the GRZ, will comply with this regulation for the approvals of construction and development plans within a locality if required.
Local Government Act, 1990	Provides for the establishment of councils in districts, the functions of local authorities and the local government system.	Ministry of Local Government and Housing Local Authorities	The function of the municipalities is guided by the provision of the Local Government Act. UNOPS 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.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Agricultural Lands Act No 13 of 1994 (Cap. 187)	The Act establishes the Agricultural Land Board and provides for its functions which inter alia includes; keeping under review the use that is being made of state land, outside urban and peri-urban areas and to make recommendation to the Minister responsible for agriculture. The Act provides for tenant farming schemes.	UNOPS to ensure enforcement during preparation and construction phase Monitoring: Ministry of Agriculture	The sub-project construction work and dam operation activities may be carried out on agricultural lands and thus assessment of the impacts of these activities on the agricultural areas in the sub-project area was undertaken. UNOPS, the contractor and stakeholders will comply with this law in relation to rehabilitation and operation of the dam.
Forestry Resources Management			
The Forest Act No. 4 of 2015	Control, manage, conserve and administer national and local forests; Participation of local communities, traditional institutions, and NGOs; conservation and sustainable use of forests and trees.	UNOPS IDSP Monitoring: Zambia Forestry Commission (yet to be established) / currently by the Department of Forestry	The project area is close to a forest reserve, protection of the reserve will be provided with guidance of the Department of Forestry. In situations where forest resources are affected by the project, approvals and permits from Forestry Department will be obtained prior to disturbing the forest. Permits and approvals are the responsibility of the contractor.
Traffic Management			
The Road Traffic Act No. 11 of 2002	Establishment of the Road Transport and Safety Agency (RTSA). It also provides for a system of road safety and traffic management in Zambia.	Contractor Monitoring: UNOPS	The transportation of construction materials has the potential to cause accidents, hence traffic control measures must be employed and their development must comply with provisions of the Act. UNOPS and contractors will comply with all the regulations under this Act, traffic safety rules for communities, and traffic management. This ESMP includes a traffic management plan.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Tourism Management			
Zambia Wildlife Act No. 14 of 2015	Management and Protection of National Parks and Wildlife respectively	UNOPS to ensure enforcement during preparation and construction phase. Monitoring: Ministry of Tourism	The dam is located in a remote rural area, hence all activities by UNOPS, on behalf of the GRZ, will comply with the requirements of this regulation, if the protection of wildlife is required. The ESMP determines appropriate actions to ensure preservation of national parks and protected areas, wildlife, and protected and endangered species by including an ecologist on the team. A biodiversity assessment has been conducted and a BMP 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 comply with provisions of these regulations during the course of employment.
Occupational Health and Safety Act	Provides for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery.	Contractor, UNOPS Monitoring: Ministry of Labour	UNOPS will, on behalf of the GRZ, ensure that the contractor complies with the occupational health and safety requirements of the Act, promotes safety by putting in place all measures required to ensure the well-being of the workers.
Worker's Compensation Act No. 10 of 1999	Establishment and administration of a Fund for the compensation of workers disabled by accidents to, or diseases contracted by such workers in the course of their	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.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	employment, and for the payment of compensation to dependants of workers who die as a result of such accidents or diseases.		UNOPS and its contractors will comply with regulations under this Act by registering with the workers compensation Board and by providing safe working sites.
Community Health and Safety			
The Public Health Act of 1995	Prevention and suppression of diseases and regulation of all matters connected with public 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.). COVID-19 prevention and management measures are included in this ESMP.
The Gender Equity and Equality Act, 2015	Taking of measures and strategic decisions to ensure gender equity, equality and integration of both sexes in society; promotes gender equity and equality as a cross cutting issue in all spheres of life and stimulate productive resources and development opportunities for both sexes; prohibits	Contractor, UNOPS Monitoring: Ministry of Gender Ministry of Community Development and Social Services	Sub-project works and operation will require gender mainstreaming and prevention and mitigation measures for GBV UNOPS and its contractors will comply with all the regulations under this Act. This ESMP includes a gender equality and GBV action plan.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
	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		
The Anti-gender-based Violence Act, 2011	The Act provides for the protection of victims of gender-based violence; constitutes the Anti-Gender-Based Violence Committee.	Contractor, UNOPS Monitoring: Ministry of Gender Ministry of Community Development and Social services	Worker influx bears risks of GBV cases. UNOPS and its contractors will comply with all the regulations under this Act. Sensitisation, reporting and referral pathways will be put in place.
Disaster Management			
Disaster Management Act, 2010	Establishes and provides for the maintenance and operation of a system for the anticipation, preparedness, prevention, coordination, mitigation and management of disaster situations and establishes the Disaster Management and Mitigation Unit (DMMU).	UNOPS to ensure enforcement during preparation and construction phase. Monitoring: Office of the Vice President District Commissioner Office	Dam safety risk and emergency response measures need to be in concordance with the Act and should involve the necessary stakeholders. UNOPS engineering and safeguards teams will work together for remedial actions that promote safety. The UNOPS and IDSP will involve the DMMU in implementing safety and emergency measures.
Zambia Coronavirus	Construction and operational activities will	UNOPS to ensure enforcement during	COVID-19 prevention and management measures are included in this ESMP.

Legal Instrument	Relevance to the Sub-Project	Responsible Institutions	Action required for compliance
Disease (COVID-19) Statutory Instruments 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	involve workers and the community on site. Zambia is currently experiencing the COVID-19 pandemic according to the national notifiable infectious disease declaration notice of March 2020.	preparation and construction phase	

2.2 World Bank Operational Policies

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

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

Table 2: Relevant World Bank Operational Policies

OP	**Name**	**Actions to be followed by the IDSP AF / UNOPS**
OP 4.01	Environmental Assessment:	The project was classified EA Category B and an Environmental and Social Audit (ESA) was prepared to comply with OP 4.01. The policy is triggered because of the potential impacts the remediation works on Nabowa 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 Nabowa 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

[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.

		increasing human populations on both aquatic and terrestrial ecosystems were identified in the ESA as an area of weakness in the previous safeguards instruments that must be rectified. Cumulative changes brought about by the dam may negatively affect the downstream aquatic and wetland environment. As a result, a comprehensive biodiversity assessment was implemented and a BMP prepared. The opportunity to properly address these issues, as required by OP 4.01, has to some extent passed. The dam is already built. There are, however, some options for impact minimization. This ESMP provides measures to mitigate negative impacts on terrestrial and aquatic ecosystems in the area of influence of the dam, which include impacts that will be caused by the current construction teams in their day to day activities and those caused by the previous construction works (see remediation plan in this ESMP). In addition, UNOPS Ecological Experts conducted a biodiversity assessment and developed a BMP to promote conservation of flora and fauna during and after the remedial works
	Forests	This policy is triggered because potentially during future operation of the dam and expansion of the agricultural areas, tree loss and impacts on riparian forest could occur. In future, the Ministry of Agriculture will have to obtain relevant permits for expansion of agricultural activities around the dam, whenever need arises during the operational stage. Increasing populations supported by the irrigation schemes will create additional pressure on surrounding habitats, which may be important in the cases where the dam is in habitats with little transformation. The ESMP will include basic discussions of terrestrial habitats, flora and fauna to ensure identification and mitigation of potential biodiversity impacts. A Biodiversity Assessment and a Biodiversity Management Plan are prepared separately.
OP 4.37	Safety of the dam	This policy is triggered because the remediation works at the dam are necessary to ensure dam safety. The dam is considered a small dam because it has a height less than 15m. UNOPS and its contractors will follow Good International Industry Practice (GIIP) to determine and implement corrective actions that mitigate dam safety issues. For the sub-project a *Plan for construction supervision and quality assurance*, *Operation and Maintenance (O&M) Plan*, and an *Emergency Preparedness Plan (EPP)* have been prepared.

2.3 World Bank Group Environment Health and Safety Guidelines

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

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

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

The Nabowa 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 IDSP-PIU will manage and implement the broader AF activities, it has contracted UNOPS to oversee and implement the remediation works of the ten dams, including Nabowa Dam. The IDSP-PIU Environmental and Social (E&S) Team is responsible for all E&S aspects. It will supervise and monitor all E&S aspects of all activities implemented by the UNOPS Sub-PIU and UNOPS contractor at the Nabowa 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.

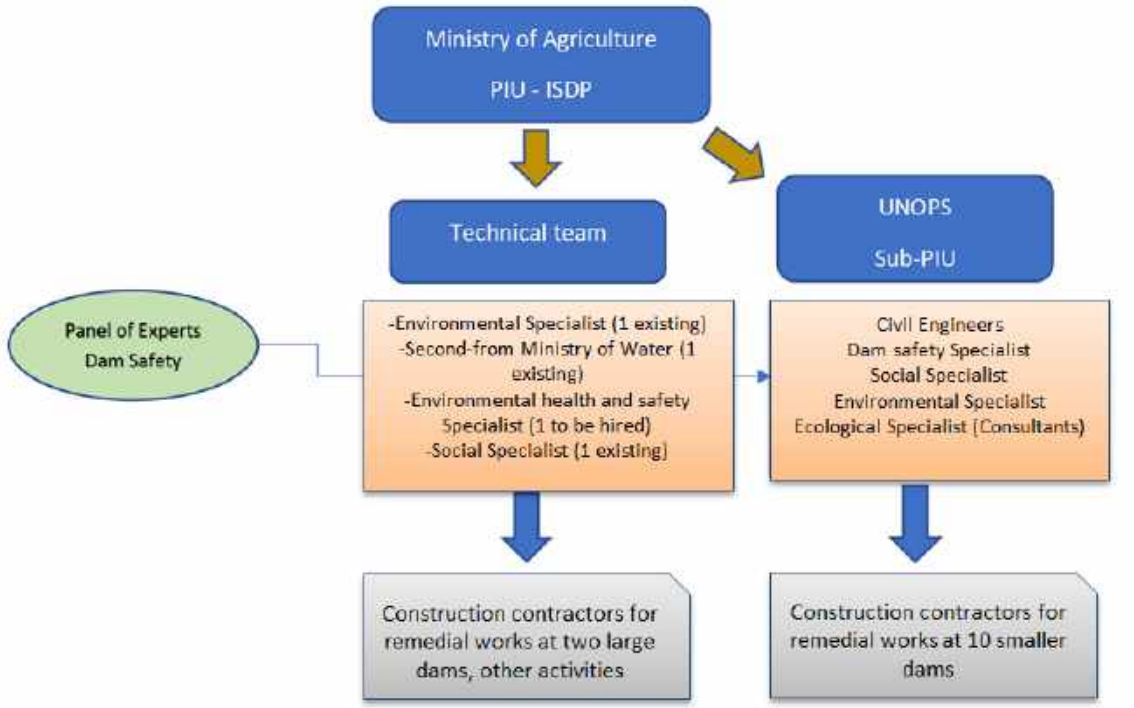


Figure 1: Institutional arrangement for sub-project implementation

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 Nabowa 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 Nabowa dam site. Environmental and social issues are the responsibility of all personnel, from the management to the operator. However, day-to-day supervision and monitoring for the planning and implementation of the whole sub-project lies specifically with the environmental specialist, the environmental health and safety specialist and the social specialist (Figure 1). Furthermore, at least one additional Ministry of Agriculture (MoA) field staff member with health, safety and environmental responsibilities will be located at Nabowa dam site for continuous onsite monitoring and reporting during the 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 Nabowa dam site. This E&S supervision includes the operationalization of the dam, during which the IDSP staff will be working with the respective local authorities, Dam Management Committee (DMC) and local communities, in preparation for a smooth handover when IDSP ceases to exist as a project.

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

3.2 United Nations Office for Project Services (UNOPS)

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

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

3.3 The Contractor and Sub-Contractors

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

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

The contractor is required to prepare method statements for the implementation of sub-project aspects, and to operationalize all action and management plans as defined in this ESMP (including non-hazardous waste, hazardous materials and waste, surface and groundwater pollution, protection measures for terrestrial and aquatic fauna and flora, air quality and noise, labour 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 DMC and community representatives, such as the headmen, will verify to ensure that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the Stakeholder Engagement Plan (SEP) below, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the environmental and social mitigation measures undertaken. Stakeholder engagement ensures that dam community members are consulted throughout the construction and operational phases.

The dam is operated by a DMC, which consists of community members. Only 4 out of 10 members are active (1 woman and 3 men). The Nabowa DMC composition is shown in Appendix G.

The dam management committee 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/will be involved during planning, construction and operation phases. Its role will include involvement in stakeholder engagement, auxiliary sites selection, employment, ESMP implementation, operation guidelines and monitoring, operation maintenance and dam safety. The level of involvement in the maintenance and management will depend on the type of technology, the range of maintenance activities and capacity building offered to the committee. Therefore, UNOPS and IDSP have and will further inform communities of their expected obligations and contributions during consultations and training.

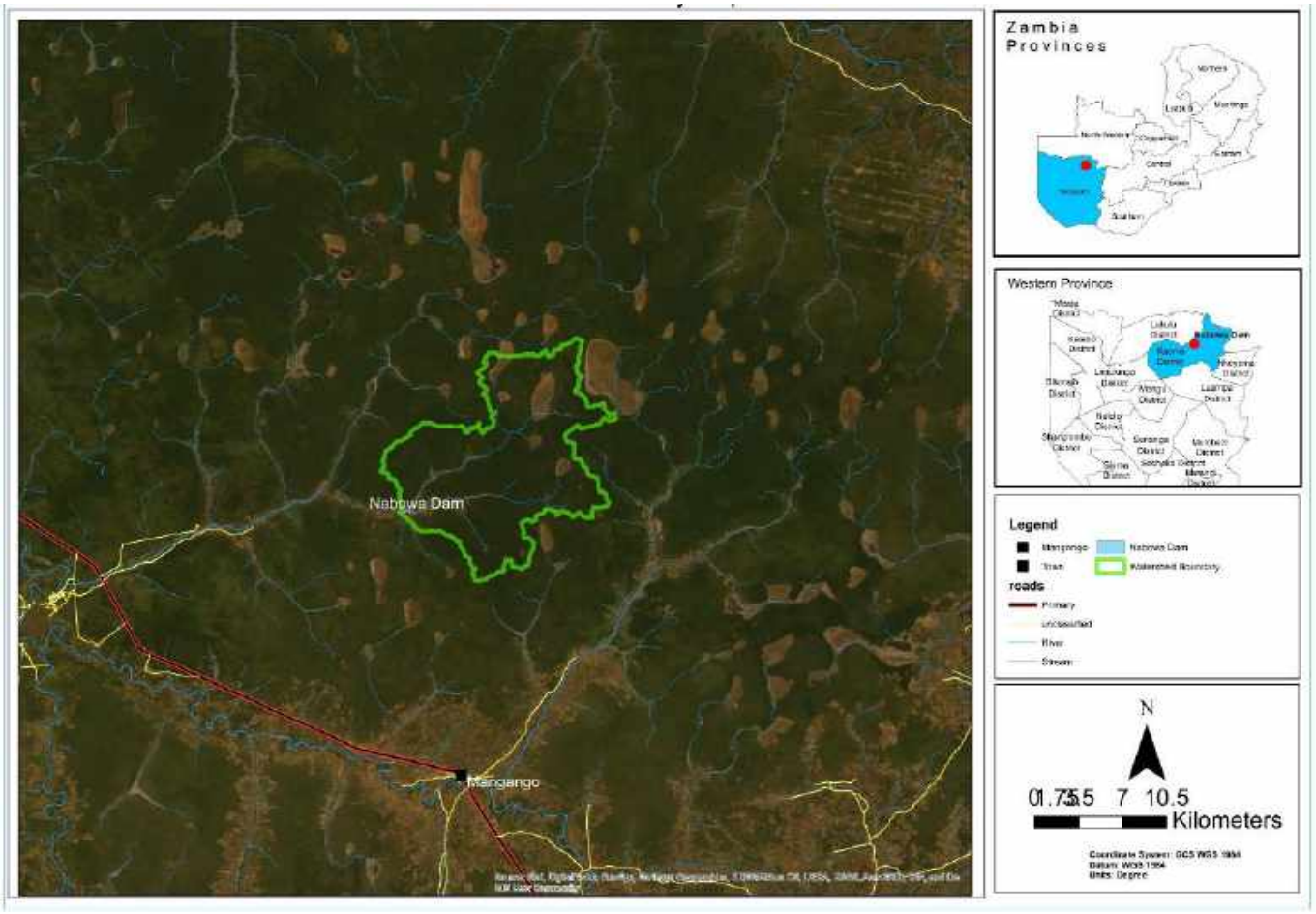
The 4 committee members of the DMC have been involved in meetings organized by the local office of the Ministry of Agriculture. The committee is yet to develop documents that will guide the management of the committee itself, such as a constitution, and further streamline leadership roles among the 10 members. This arrangement will then facilitate smooth management and execution of dam monitoring activities. The members will require some form of capacity building in dam management and various other facets, such as agriculture/irrigation systems and aquiculture. The committee will also require some form of training in the handling and management of Emergency Response Preparedness related to the operations of the Nabowa Dam. It will also be necessary to have the Forestry Department arrange meetings with the DMC on the management of the vegetation in the area, for purposes of preserving the environment and the surface water sources. Additionally, the promotion of agriculture activities in the area has the potential to promote tree cutting to pave way for agricultural activities. A balanced approach will have to be developed by Agriculture and Forestry Departments, and subsequently communicated to the community through the DMC Leadership.

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

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

4.Environment and Social Baseline Conditions

The Nabowa dam is located in the Western Province approximately 75 km north west of Kaoma Town and 21 km north of Mangango Town. It is located on the Nabowa Stream, which drains to the Luena River. The location reference is 228147.49 m E; 8398613.60 m S, UTM 35L°.



.

4.1 Physical Conditions

4.1 Geology and Soils

Zambia's Western Province consists of an extensive sand-covered Pliocene plain. Its recent geomorphological history has considerable bearing on the soil and vegetation of the area, and hence on land use. The whole of Western Province is presumably underlain by the PreCambrian basement complex. Upper Katanga schists, siltstones, and end-Kundelungu acid igneous rocks intrude into the siltstones, occurring North of Kaoma, and in the valleys of the Lalafuta and Dongwe rivers. The siltstones have been altered to schists in the vicinity of the granitic intrusions. The Karroo beds are mainly clastic sediments, sandstones, mudstones, grits, shales, etc... of continental origin and of very variable thickness. In some places they are overlain by basalt. A section at the junction of the Kafue and Zambezi rivers consists of over 1067 m of strata, 244 m of which are basalt. Karroo deposits are well exposed in the vicinity

of Livingstone; and the bed of the Zambezi above Victoria Falls as far as Senanga has been protected by Karroo basalt. Occurrences of basalt in the Kaoma area show outcrops in the Luena valley[3].

The geology around the proposed project site is characterized by rocks of the Kalahari Group with fossil sief dunes, which are tertiary to recent in age. The lithology comprises fine sands and sandstones with some clay.

Kaoma soils are predominantly a well-drained sandy loam (65%) with varying topsoil depth of 100– 150 mm in the relatively flat uplands. There are areas of sandy clay loam in the lower parts of the district. Solwezi District is covered by thick red brown to yellowbrown and light textured silt or sandy clay (loamy soil) including laterite at depth. The soil can generally be categories as ferrasols (high iron content) underlain by the rocks of the basement, i.e. metasilstone/phyllite with quartzite and foliated granite/gneiss.[4] Soil erosion and degradation is common in Kaoma which is a semi–desert and very sandy. The project area, however, is reasonably covered in vegetation and therefore has its soils held together.

4.1.2 Topography

The area around Nabowa is typically undulating plateau and the altitude at the dam is 1185 metres (m) above mean sea level (amsl), on average. The figure below provides a brief overview of the sub-project area and its topography.

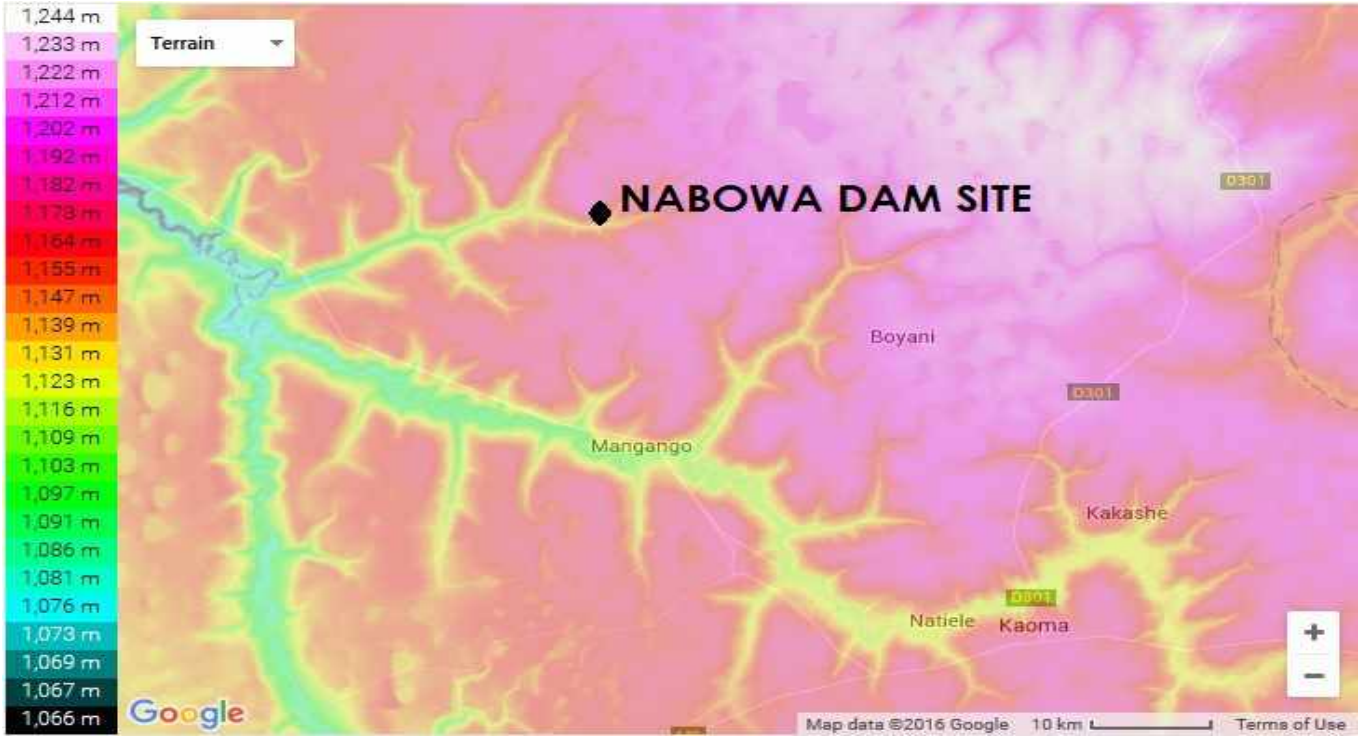


Figure 2: Map showing topography of the sub-project area

4.1.3 Surface Hydrology

The dam is located in Western Province, approximately 75 km north west of Kaoma Town and 21 km north of Mangango Town. It is located on the Nabowa stream, which drains into the Luena river.

[3] An Ecological Survey of Western Province, Zambia, Verboom W.C. and Brunt M.A., 1970

[4] TAZAMA EISA, 2014

Nabowa stream is a seasonal stream and wetland. The stream therefore becomes a seasonal tributary of the Luena river. The Luena river rises just west of the Kafue National Park and flows west through Kaoma to become a tributary of the Zambezi. In the dry season, just below its confluence with its seasonal tributary the Luampa river, the Luena river ends in swamps or marshes on the Luena Flats east of Lukulu, as shown in the map below. In the wet season the Luena Flats flood and overflow into the Ndandu channel or floodplain, which leads south-west to the Barotse Floodplain of Zambezi north of Limulunga and Mongu. It is the widest 'tributary' floodplain of the Barotse Floodplain, reaching 20 km wide at its mouth.[5]

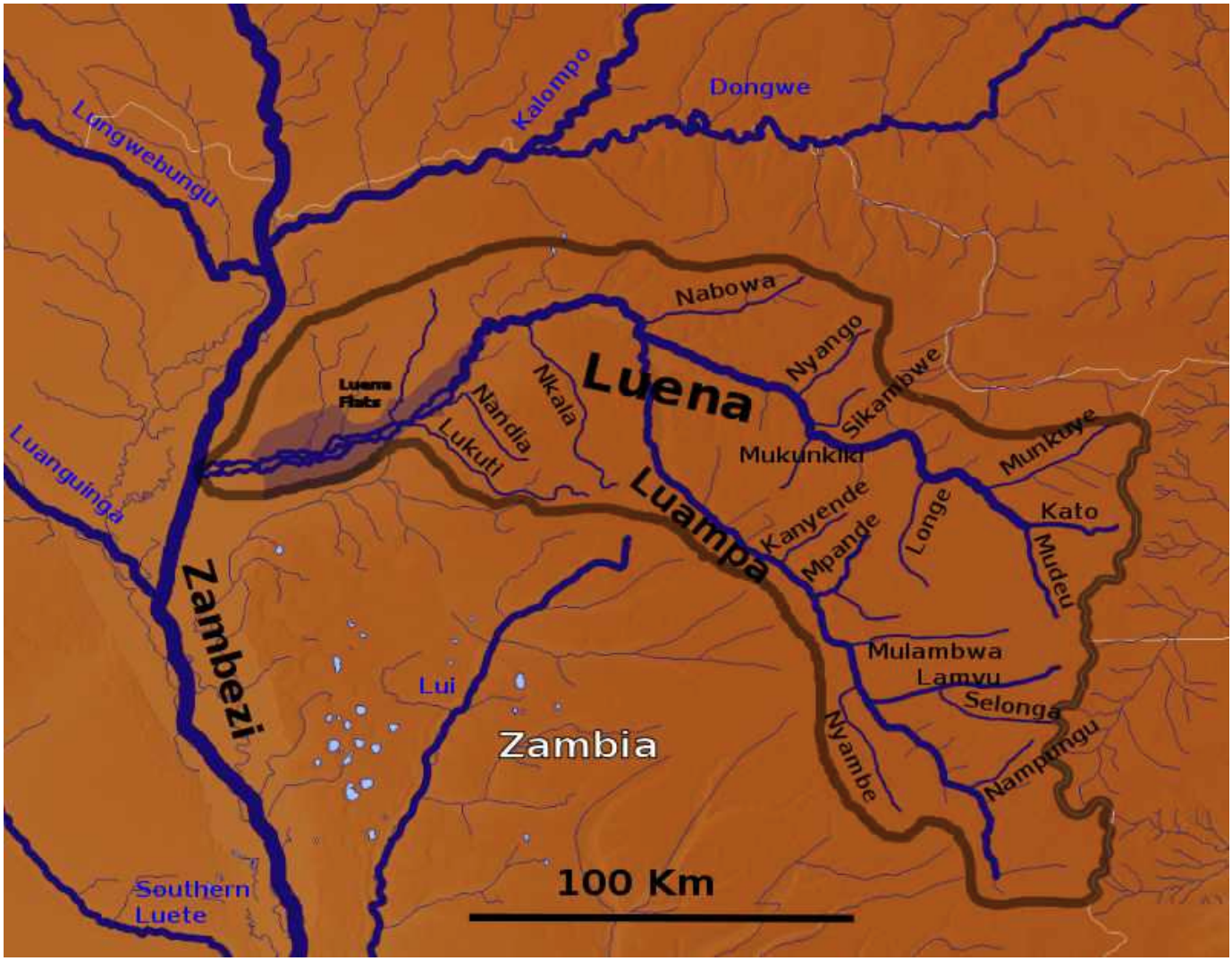


Figure 3: The Luena River Basin

The construction of the Nabowa Dam was based on the catchment size, which was then determined as being 176 km^2. This is represented in the map below.

[5] The Luena (Zambia) Basin OSM

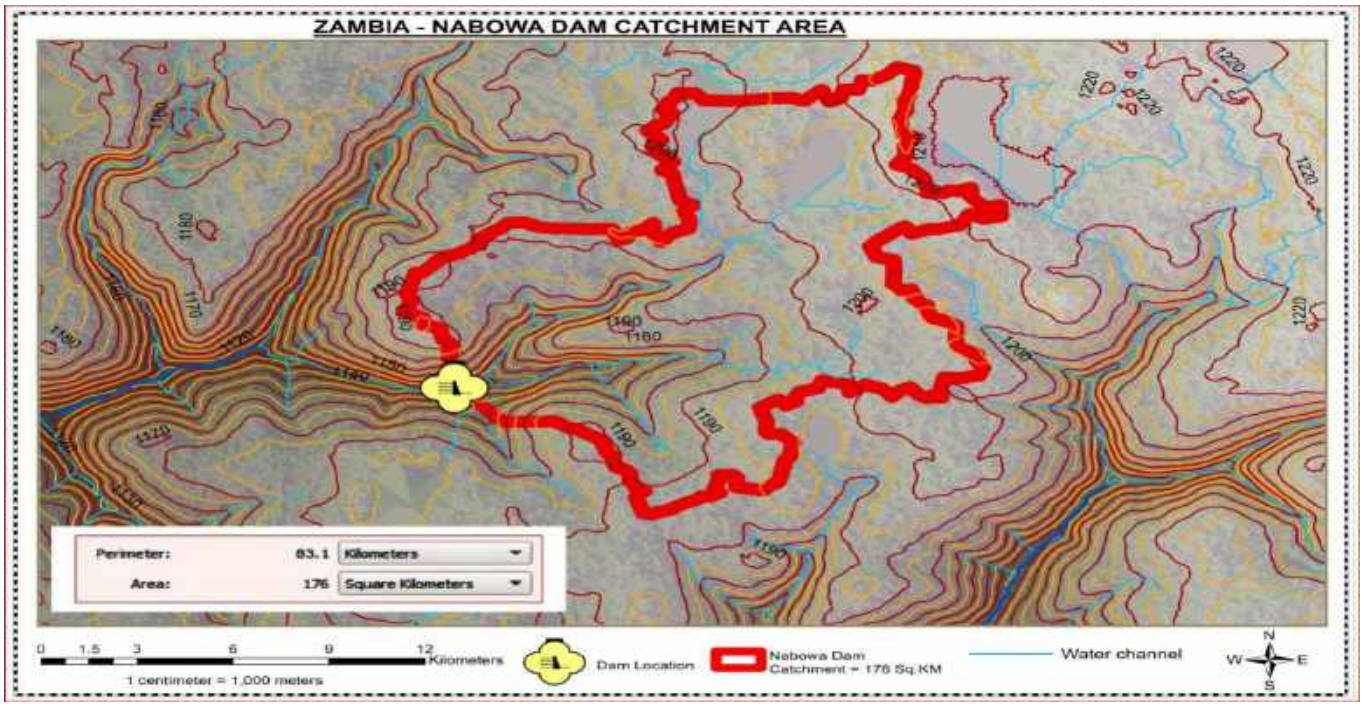


Figure 4: Map showing catchment area as estimated for Nabowa Dam

The maximum probable flood was determined at 1336m3/s in 2015, with a 100 years flood estimate of 601 m3/s. A Design Flood (PMF) of 364 m^3/s (1 in 10 000 years flood) was used in the remedial design by COWI in 2018 as well as a 1:100 year flood of 161.1 m^3/s. The map below shows the estimated extend of the probable flood at Nabowa Dam.

`Figure 5: Nabowa Dam flood area

The land slopes in the western direction from the dam. Nabowa stream seems to have terminated at the dam wall, because there is no water beyond the dam wall going downstream. During the rainy season, one or two families from the local community are able to grow some maize crops downstream on a small pieces of land for local consumption.

Plate 1: Downstream of Nabowa Dam

4.1.4 Surface Water Quality

Kaoma district is largely rural and serviced by pit latrines, boreholes, streams and shallow well water supply. The Western Water and Sewerage Company has had challenges with the provision of water and sanitation services due to limited infrastructure at their water works. Only the homesteads, lodges and institutions along the main road are provided with treated water from the company. Others are either receiving their water from boreholes or fetch it from the river and/or shallow wells. A number of village settlements are located away from the main Mwinilunga - Ikelenge road. These largely depend on water from shallow wells, streams and rivers, which are easily accessed by the community. This water is used for drinking and other domestic uses, such as cooking, washing, bathing and watering of gardens along the riverbanks. Accessibility to safe water remains a challenge. Wells are vulnerable to contamination and therefore have the potential to cause and spread water borne diseases. A number of houses have pit latrines and bathing shelters that are constructed of local materials with a thatch. Use of open bush is common in villages without pit latrines.

To note the quality of water in the dam, water samples were collected at the south western corner of the Nabowa reservoir; coordinates 14.472176"S; 24.477700"E; and analyzed at the University of Zambia.

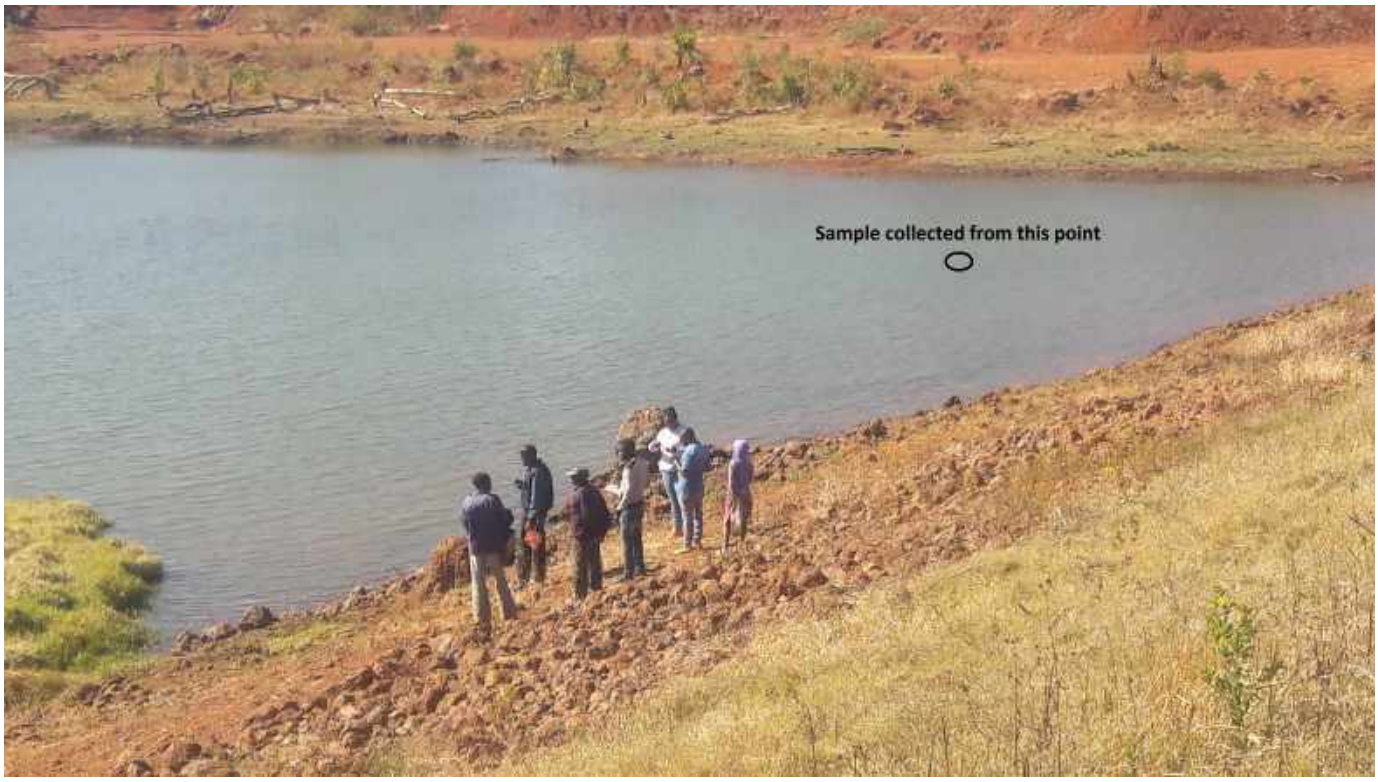


Figure 6: Reservoir water (Nabowa Dam), showing the sampling point

The quality of water in the dam is not impacted by the local community, because there are no agricultural activities in the vicinity of the dam. Potential pollution can only originate from the sedimentation from unstable grounds of the spillway channel, shown in the figure below.

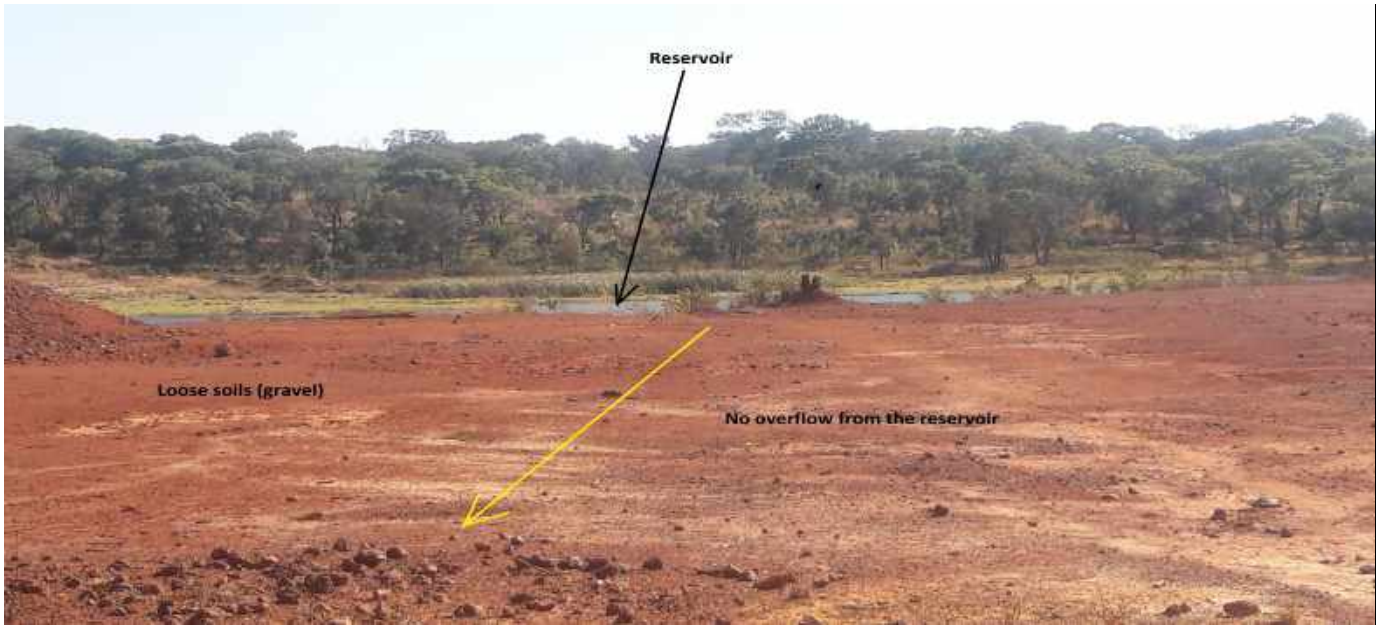
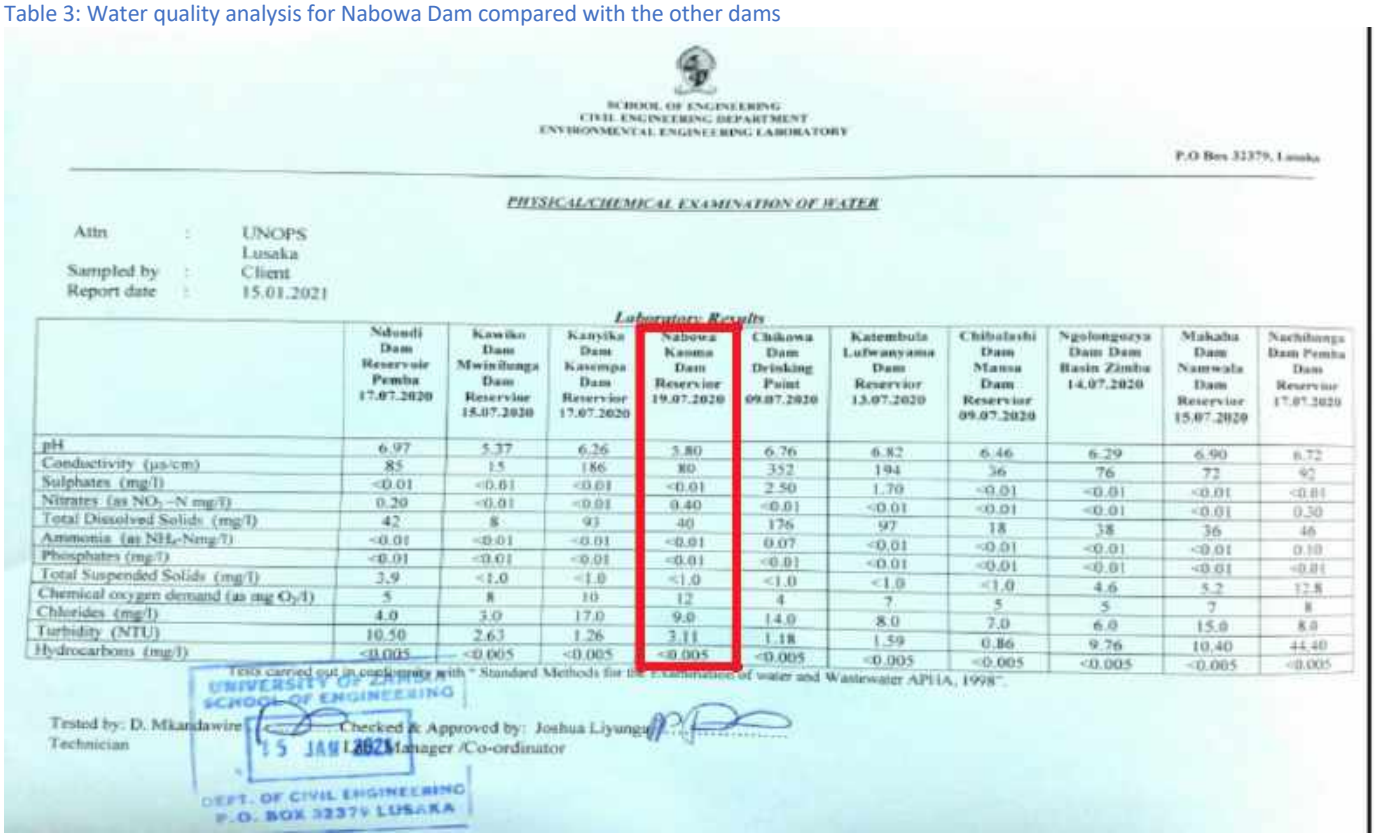


Figure 7: Portion of spillway completely dry. Surface unprotected from erosion

Table 3 shows the results of the 2020 water quality sample taken from Nabowa Dam, compared with other dams of the project. None of the water quality parameters exceeded the WHO guidelines' maximum permissible level for drinking water limit. A comparison to the water quality results obtained in 2016 (shown below) shows that the basin water's quality has been good for many years.

Table 3: Water quality analysis for Nabowa Dam compared with the other dams



SCHOOL OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
ENVIRONMENTAL ENGINEERING LABORATORY

P.O Box 32379, Lusaka

PHYSICALCHEMICAL 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 Reservoir 15.07.2020	Kanyika Dam Kasempa Dam Reservior 17.07.2020	Nabowa Kaoma Dam Reservior 19.07.2020	Chikowa Dam Drinking Point 09.07.2020	Katembula Lufwanyama Dam Reservior 13.07.2020	Chibolashi Dam Mansa Dam Reservior 09.07.2020	Ngolongozya Dam Dam Basin Zimba 14.07.2020	Makaba Dam Namwala Dam Reservior 15.07.2020	Nachibunga Dam Pemba Dam Reservior 17.07.2020
pH	6.97	5.37	6.26	5.80	6.76	6.82	6.46	6.29	6.90	6.72
Conductivity (µs/cm)	85	15	186	80	352	194	36	76	72	92
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01	2.50	1.70	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3 –N mg/l)	0.20	<0.01	<0.01	0.40	<0.01	<0.01	<0.01	<0.01	<0.01	0.30
Total Dissolved Solids (mg/l)	42	8	93	40	176	97	18	38	36	46
Ammonia (as NH_4-Nmg/l)	<0.01	<0.01	<0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	0.10
Phosphates (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total Suspended Solids (mg/l)	3.9	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	4.6	5.2	17.8
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".

Tested by: D. Mkandawire
Technician

Checked & Approved by: Joshua Liyungu
Manager /Co-ordinator

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

Table showing results extracted from the table above for Nabowa Dam

Element	Nabowa Dam	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard[67]
pH	5.80	6.5-8.5	6.00 – 9.00
Conductivity (µg/cm)	80	1500	
Sulphates (mg/l)	< 0.01	250	
Nitrates (as NO_3-N mg/l)	0.40	500	
Total Dissolved Solids (mg/l)	40	1000	
Ammonia (as NH4-Nmg/l)	< 0.01	1.5	10
Phosphates (mg/l)	< 0.01	-	
Total Suspended Solids (mg/l)	< 1.0	-	50
Chemical Oxygen Demand (as mg O2/l	12	-	250

[6] 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.

[7] 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.

Element	Nabowa Dam	WHO Guidelines maximum permissible levels for drinking water	WB Irrigation Water Quality Standard[67]
Chlorides (mg/l)	9	250	
Turbidity (NTU)	3.11	5	
Hydrocarbons (mg/l)	< 0.005	-	10

Table 4: Water quality results for Nabowa Dam, sampled in March 2016

NO.	WATER QUALITY PARAMETER	NABOWA DAM (MARCH 2016)	ZAMBIA BUREAU OF STANDARDS (DRINKING WATER)
1	pH	5.8	6.5 -8.5
2	Redox potential	46.5	-
3	Dissolved oxygen (mg/L)	0.5	5.0^
4	Water temperature	25.8	N/A
5	Conductivity (µS/cm)	140.3	1,500
6	Total Dissolved Solids (mg/L)	69.9	1,000
7	Total Suspended Solids (mg/L)	680	N/A
8	Total hardness (as mg $CaCO_3$/L)	40	500
9	Calcium hardness (as mg $CaCO_3$/L)	24	N/A
10	Magnesium hardness (as mg $CaCO_3$/L)	16	N/A
11	Bicarbonate (as mg $CaCO_3$/L)	48.7	400
12	Alkalinity (as mg $CaCO_3$/L)	39.9	N/A
13	Sulphates (mg/L)	<0.1	400
14	Chlorides (mg/L)	17	250
15	Magnesium (mg/L)	3.9	150
16	Calcium (mg/L)	9.6	200
17	Sodium (mg/L)	5.7	200
18	Potassium (mg/L)	6.8	N/A
19	Lead (mg/L)	0.12	0.01
20	Iron (mg/L)	32.1	0.3
21	Zinc (mg/L)	0.10	3.0

A detailed biodiversity study has been undertaken and a separate Biodiversity Management Plan (BMP) is currently under preparation.

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.

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

For Zambia, previously conducted studies on seismic hazard assessments estimate the PGA between 0.3 to 0.9g[8] (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).

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

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

According to the Seismic Hazard Map of Africa[9] there is a 10% probability of a PGA between 0.4 and 0.8 m/s2 being exceeded every 50 years.

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

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

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

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

Based on the findings interpreted in figure 11 below, the Western Province of Zambia's seismic event is of magnitude 4.9 on the Richter Scale[11]. With this probability, the sub- project area is in an area of low to medium seismic activity. It is recommended that seismic hazard is given due consideration in the design of structures in Zambia, especially in regions, which the study has identified as high earthquake risk regions, such as the Upper region of Luapula Province, which has rift valley influence. The study particularly recommends that all lifeline and critical installations and infrastructure, such as hospitals, bridges, dams and electrical power plants must be designed and built to withstand significant levels of seismic action.

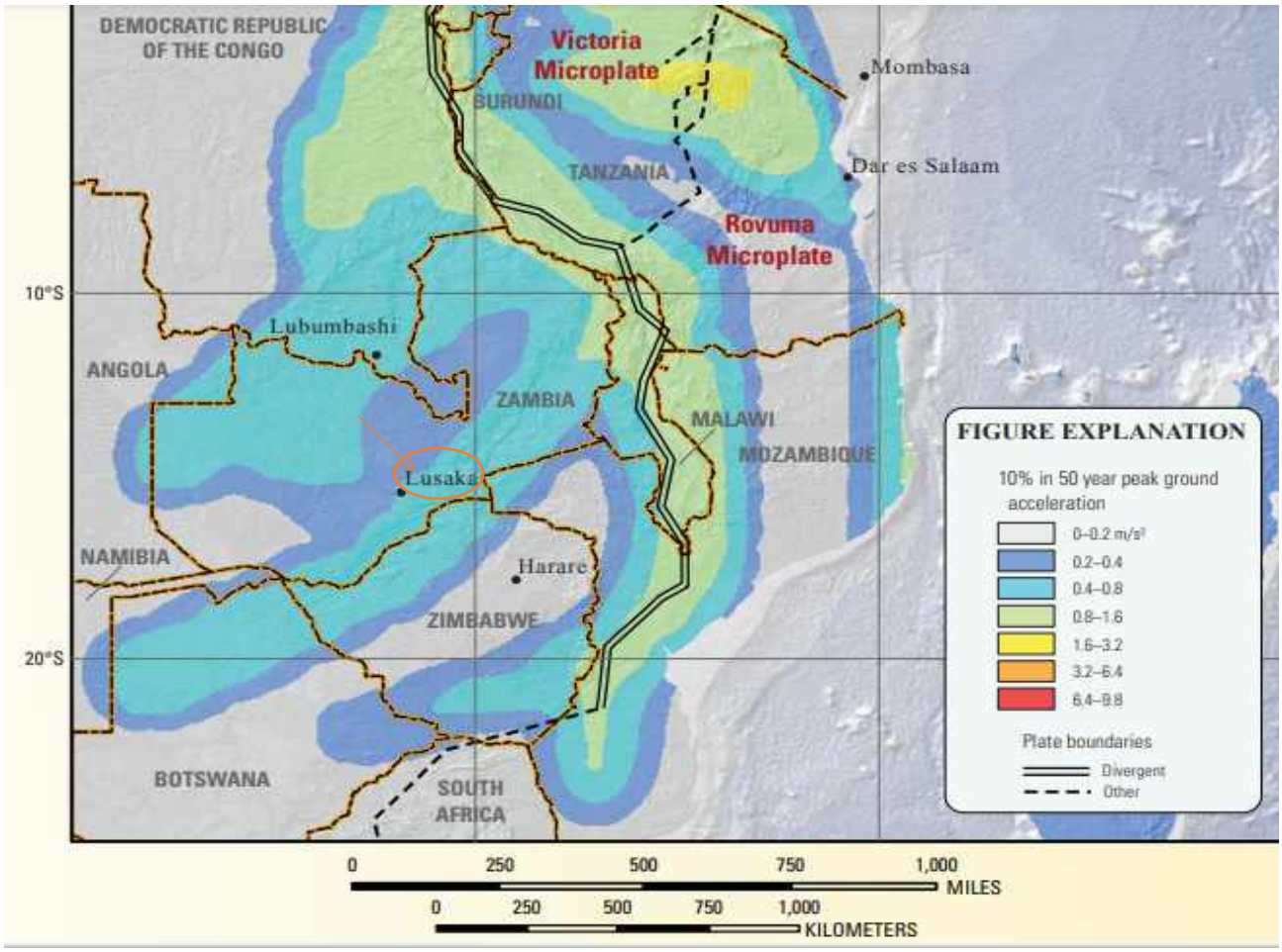


Figure 8: Seismic hazard, US Geological Survey 2013

4.1.6 Climate and Climate Change

Kaoma, like any other parts of the country, has a tropical climate with three distinct seasons: the warm-wet season, stretching from November to April with mean temperatures of 26°C; and the cool dry season from May to August with mean temperatures varying between 14 and 24°C. The hot dry season is experienced between September and October with mean temperatures of 32°C. The minimum temperatures are also at their lowest in June and July, averaging between 5 and 8°C, and they show a fairly rapid rise into October. They continue to rise until December and January, when they are maintained at about 17°C until the end of the rains.

The rains in the sub-project area are caused by the convergence of the North East and South East trade winds that form the Inter-tropical Convergence Zone (ITCZ). The area experiences early rains before most parts of Zambia and

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

the late rains, as the ITCZ moves northwards later than the southern part of the country, so that the rainy season is longer and the mean annual rainfall higher. The average length of the rainy season is just over five months with December, January and February experiencing the highest rainfall, while November and March have the lowest. The annual rainfall average is 1240mm.

Kaoma experiences very distinct seasons due to the 800–1,000 mm annual rainfall between November and April. Temperatures can be as high as 34°C in the driest period between October and November and during the cool period between June–July it can fall as low as 5°C. In terms of temperature, the winter months between May and July are generally cool and dry with maximum temperatures ranging from 18 to 25°C . The months of August to October are increasingly warmer and drier, with average daily temperatures of ranging from 30-34°C. However, as the rain begins around November, hot conditions become moderated by rainfall and can fall to about 23-26°C.

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

According to a UNDP study[13], 2008, climate change is set to increase food insecurity in agro-ecological zones I and II in Zambia. Agro-ecological zone I, which stretches along the southern border, has the least rainfall. Within these regions, since the late 1980s, there has been a tendency for the later onset and earlier withdrawal of rains, as well as more frequent droughts. Zambia has had droughts in the rainy seasons of 2000/01, 2001/02 and 2004/5. Floods are becoming more widespread too: over half of Zambia's districts were affected in the last few years – 2005/6, 2006/7 and 2007/8 – some for the first time. With very little infrastructure for water collection, Zambia is overwhelmingly dependent on rainfall. Water needs are met through boreholes and wells where available, or through rivers.

[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

Zone IIb has rainfall patterns between 800 and 1000mm, which implies that the area can be suitable for agriculture, especially for particular crops. The area is not in a heavy rainfall belt.

Figure 9: Ecological Zones in Zambia

Climate change projections point to an increase in temperature and a change in patterns of rainfall, leading to prolonged droughts and localized flooding. Climate change is super-imposed on unsustainable land-use practices, such as forest clearing for agriculture and charcoal production. Combined with poor livestock management systems, it has caused severe land degradation. The practices affect the dam sustainability.

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

Temperature

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

Precipitation

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

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

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

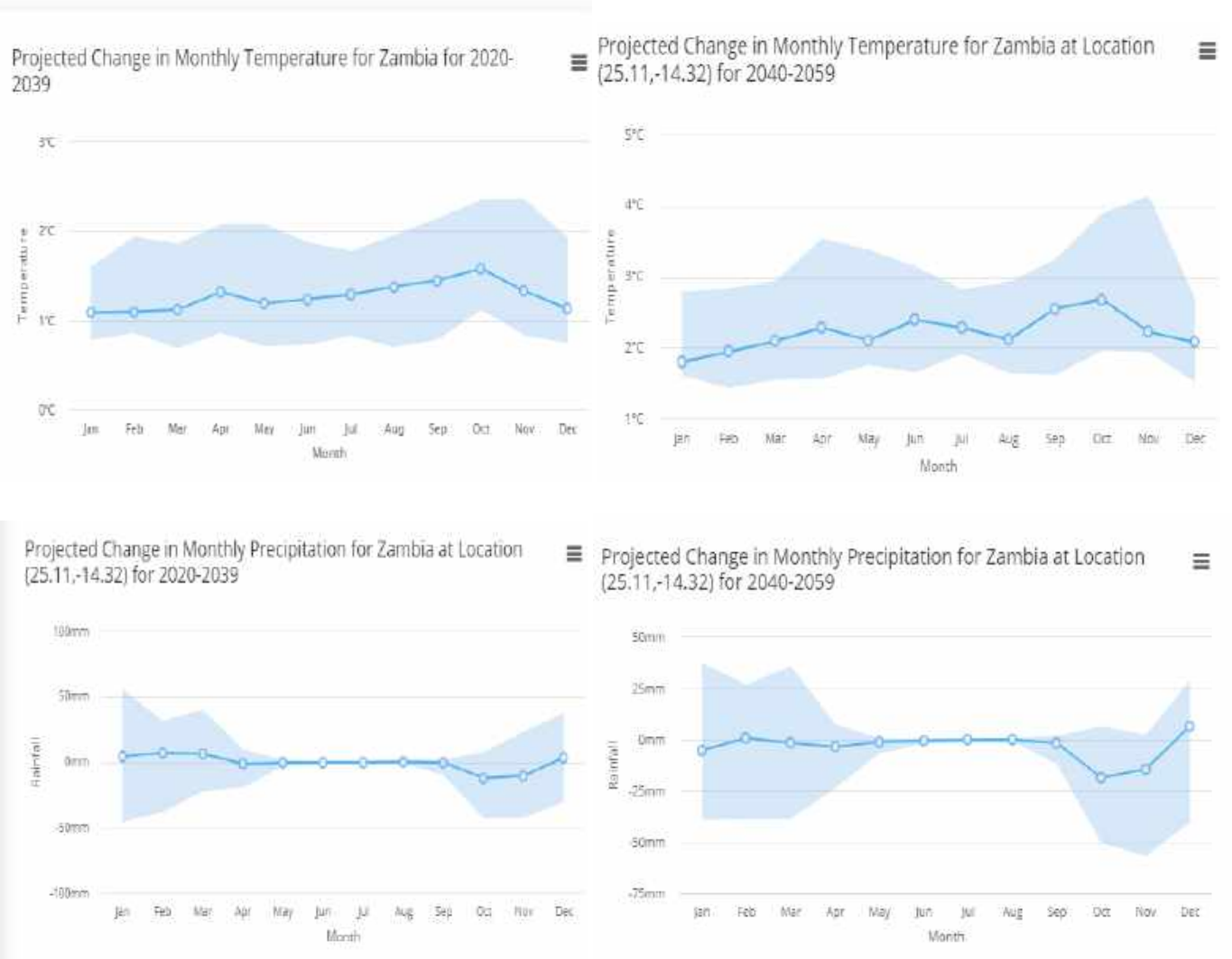


Figure 10 : Projected changes in monthly temperatures for Zambia 2020-2059

4.1.7 Land Use

The sub-project area is characterised by forest and grassland. The local communities base their main economy on timber trading. There are a few that practice subsistence farming, but at a very minor scale. Therefore, the sub-project area is not significantly disturbed by human activities. The Nabowa Dam does not allow water flow downstream. It probably serves as a reservoir or water storage for the small community in the sub-project area, which utilizes this water in the dry season. There are no homesteads downstream that cold feel the poor water flow impact.

Plate 2: The downstream environment – No agriculture activities

The sub-project area is in the the bush, a distance away from the next settlement area. The site is 71km north-west of the Kaoma town centre, and can be reached by gravel road, northwards into the bush, about 20km north from the Mangango-Lukulu gravel road junction. There is very limited infrastructure in the sub-project area, as shown in the map below.

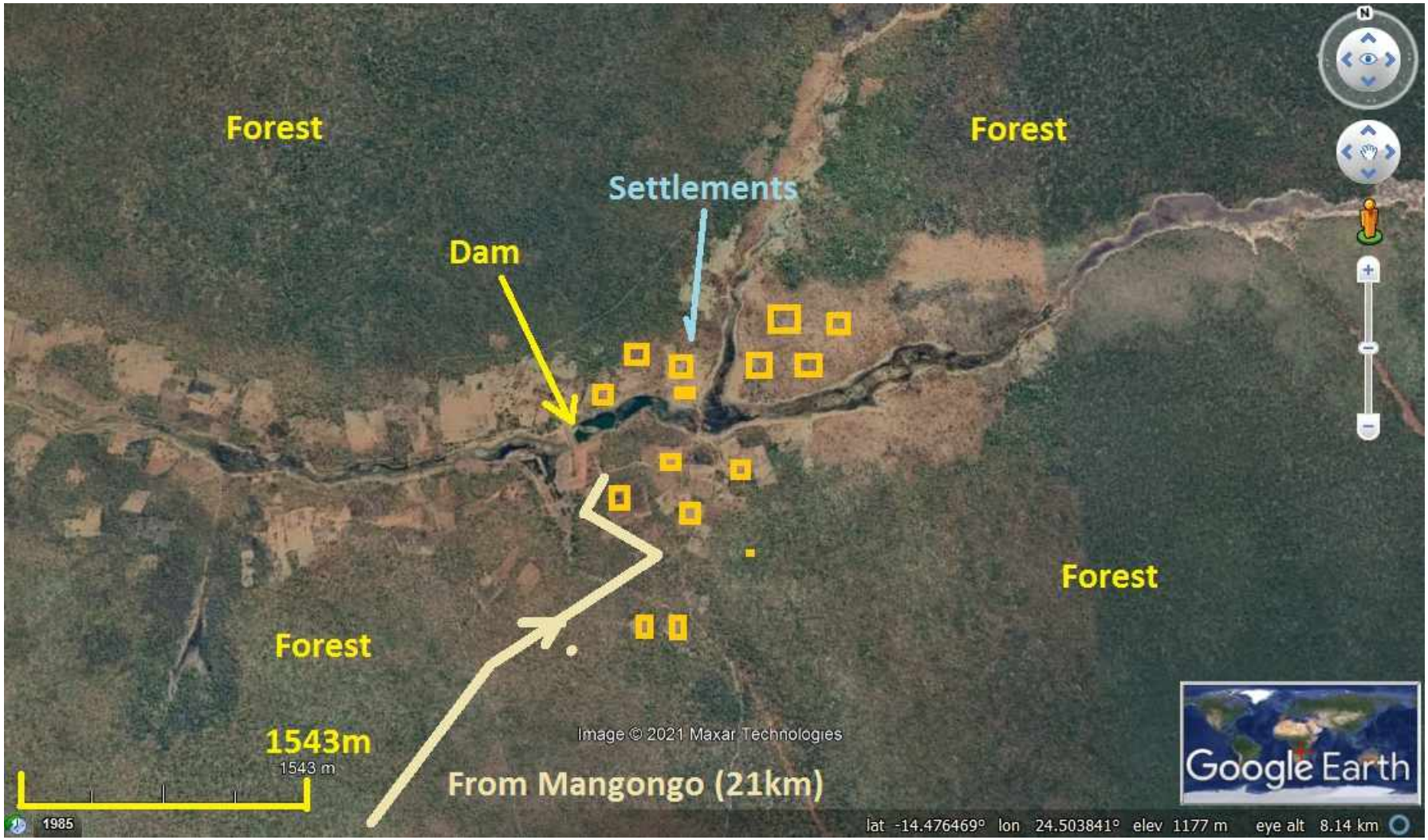


Figure 11: Google map showing Nabowa Dam and the vegetation around it

The map on the next page shows the type of infrastructure around the dam.

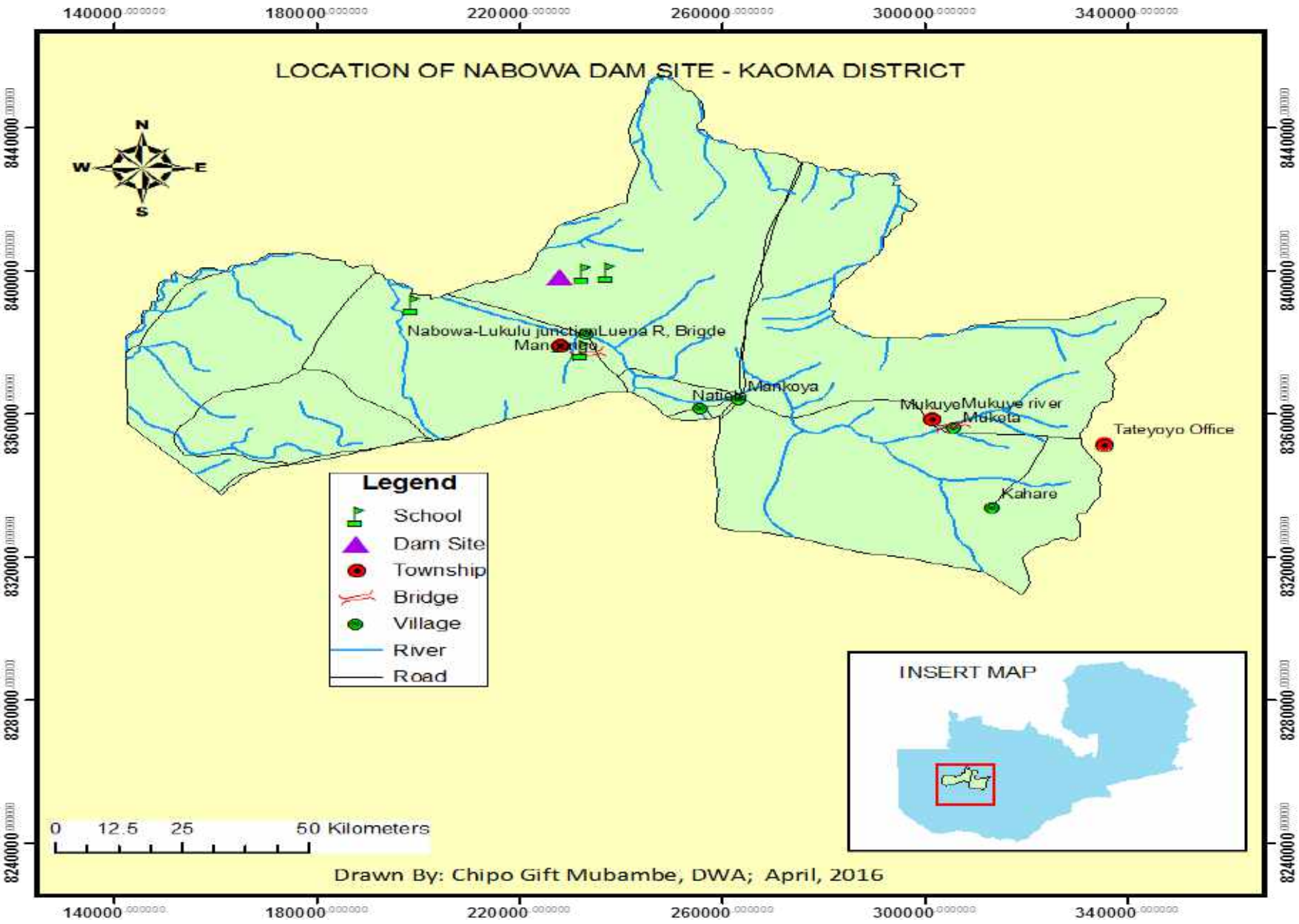


Figure 12: Location of Nabowa Dam and the surrounding infrastructure

4.2 Biological Conditions

Kaoma is part of the agro-ecological Zone II of Zambia, but it is differentiated by lower rainfall and sandier soils, poorer road and market infrastructure, and a high risk of droughts. Crops mainly include sorghum and millet as staple crops along with cassava, with some maize also being grown. This drought prone area is also suitable for extensive livestock production, cashew nuts, and timber. The dam is on Nabowa river, one of the tributaries of Luena river. The site is in Chief Mwene Mutondo's area in Kaoma district and 21km north of the Mangongo area.

The biodiversity assessment that was conducted by ecologists provides more details about the ecosystem of Nabowa Dam. Brief assessments and a literature review conducted are discussed in this section.

4.2.1 Habitats

Three quarters of Western Province is wooded (9.4 million ha) the remaining part is unsuitable for tree growth due to waterlogged soils and/or flooding. 7 per cent of the wooded area, about 5% of the total surface area of Western Province, belongs to the Demarcated Forest or Forest Estate. The Forest Estate consists of Local Forest and National Forest. The wooded areas near settlements are used for fuelwood, poles and shifting cultivation of mainly cassava and/or bulrush millet. Generally less than 2 per cent of the forest areas are used for crops. After a few crop harvests, the area has to be rested and forest regeneration has to take place. Up to 50 per cent of the forest area may be in the forest regeneration phase at a given time. Even outside the latter there is hardly virgin forest existing due to burning and logging[15].

The upstream and downstream of Nabowa Dam are normally water logged in the rainy season and covered in short grass, characteristic of a dambo area. The north-west and south-east of the dam are wooded areas covered in miombo woodlands.

Figure 13: Google map showing vegetation around the Nabowa dam

[15] Environmental Profile, Western Province, Zambia

Dividing the area into zones, the following is evident:

- Part 1-Upstream of the dam basin; habitats consist of some forest habitat, though disturbed to some extent by timber trading. Habitat integrity is medium to low and the area could be a potential source of sediment in the basin.

- Part 2-In the dam basin area; Grass cover seems to be typical for the disturbed habitats in the area, which were affected by the dam construction. There is floating weed, which may be detrimental to dissolution of oxygen into the water for fish and other aquatic species.

- Part 3-Downstream of the dam basin, short vegetation cover, almost like a dambo/wetland site. There are no trees in the area.

4.2.2 Protected Areas

There is a protected forest at least 20 km away from the Nabowa community. However, there are tree species in the area that are of value, such as the Mukula and Rose Wood.

4.2.3 Terrestrial Fauna

Miombo woodlands cover 70 per cent of Zambia and are typical of Africa south of the equatorial tropical evergreen forests and north of the savannas that start approximately at the Tropic of Capricorn. The major towns (Mongu, Kalabo, Senanga, Kaoma) of Western Province, as well as the tar road, are situated in the Miombo. This is the woodland type that most visitors to Western Province will observe. Miombo woodlands are characterized by a canopy of broad-leaf tree species of the subfamily Caesalpinoids: *Julbernardia* (Mutondo) and *Brachystegia* mainly and further*Erythrophleum africanum* (Mubako) and *Guibourtia coleosperma* (Muzauli); species of the genera *Combretum* and *Terminalia* also occur frequently. Most Miombo trees are deciduous, they drop their leaves for a short period during the dry and cold season. The trees have a canopy height of 15-25 m. Trees may be single stemmed, but many are two or three stemmed, thus reducing their timber value, this is between the single stemmed equatorial forest trees and the multi-stemmed Savanna trees further south. Another typical feature is the inclination of many Miombo trees. The Miombo on Kalahari sands is sometimes referred to as Kalahari Woodland.

In the sub-project area, the Kalahari Miombo may include the following marketed valuable hardwood timber trees: *Pterocarpus angolensis* (Mukwa), *Guibourtia coleosperma*, *Erythrophleum africanum, Brachystegia boehmil* (Mubombo) *and Afzelia quanzensis* (Mwande). Rosewood is one endangered species in Kaoma and the tree species is also found in the sub-project area. A detailed biodiversity study has been undertaken and a separate Biodiversity Management Plan (BMP) is currently under preparation.

Plate 3: Miombo woodlands in the project area

	
Rosewood preserved at the headman place in the project area	Timba trading: Truck ferrying rosewood timber for sale on the Copperbelt and Lusaka Provinces

Plate 4: Rosewood in the project area

4.2.4 Birds

Since the area covers both, the plateau and the valley, both waterfowl and woodland bird species are common. Woodland bird species common in the area include kites, sparrowhawks, doves, and vultures. Common waterfowl species include a wide variety of wild ducks, herons, egrets, and geese.

Table 6: Birds of conservation concern recorded in IBAT within a 50km radius of the dam site

Species (common name)	Scientific name	IUCN Status
Steppe eagle	*Aquila nipalensis*	EN
Grey crowned crane	*Balearica regulorum*	EN
Lappet-faced vulture	*Torgostracheliotos*	EN
Tawny eagle	*Aquila rapax*	VU
Southern ground-hornbill	*Bucorvus leadbeateri*	VU
Wattled crane	*Bugeranus carunculatus*	VU
Martial eagle	*Polemaetus bellicosus*	VU
Secretary bird	*Sagittarius serpentarius*	V
Steppe eagle	*Aquila nipalensis*	EN
Grey crowned crane	*Balearica regulorum*	EN
Lappet-faced vulture	*Torgostracheliotos*	EN
White-headed vulture	*Trigonoceps occipitalis*	CR

4.2.5 Mammals

The area near Kaoma is rich in wildlife. There are protected areas with a rich biodiversity found in the area. The sub-project area includes the Lunga –Luswishi, Kasonso - Busanga and the Matebo - Musele GMAs in Mumbwa, Kasempa and Solwezi Districts respectively. Only the Lunga – Luswishi and the Kasonso – Busanga GMA No. 32 are near Kaoma district. Lunga Luswishi has 19 species of large herbivores, which have been documented. These include elephant (*Loxodonta africana*), sable antelope (*Hippotragus niger*), buffalo (*Syncerus caffer*), hippopotamus (*Hippopotamus amphibius*), puku (*K.vardoni*), sitatunga (*Tragelaphus spekii*), roan antelope (*H. equinus*), hartebeest (*Alcelaphus buselaphus lichtensteini*), waterbuck (*K.ellipsiprymnus*), reedbuck (*Redunca arundinum*), impala, warthog. Several species of carnivores also exist. These include lion (*Panthera leo*), cheetah (*Acinonyx jubatus*), wild dog (*Lycaon pictus*), leopard (*P. pardus*), and spotted hyena (*Crocuta crocuta*). Species of omnivores and rodents include porcupine, squirrels, cane and mole rats are also found. Three groups of primates are found in the area including kinda baboons (*Papio cynocephalus kindae*), vervet monkeys (*Chlorocebus pygerythrus*) and bush baby.[16]

Table 7: Mammals of conservation concern recorded in IBAT within a 50km radius of the dam site

Species (common name)	Scientific name	IUCN Status
Mammals		
Black rhinoceros	*Diceros bicornis*	CR
White-backed vulture	*Gyps africanus*	CR
Hooded vulture	*Necrosyrtes monachus*	CR
African wild dog	*Lycaon pictus*	EN
Hippopotamus	*Hippopotamusamphibius*	VU
Leopard	*Panthera pardus*	VU
Temminck's pangolin	*Smutsiatemminckii*	VU
Black rhinoceros	*Diceros bicornis*	CR

[16] Mumbwa – Kalumbila Project, 2012

4.2.6 Reptiles

Reptile species found in the area include lizards (*Lacertilia*), chameleons (*Chamaeleo dilepis*), tortoise (*Testudinidae*) and various species of snakes, such as black mamba (*Dendroaspis polylepis*), black-necked spitting cobra (*Naja nigricollis*), boemslang (*Dispholidus typus*), and puff adder (*Bitis arietans*). The Nile crocodile (*Crocodylus niloticus*) and water monitor (*Varanus niloticus*) are also present in some rivers.

Overall, the occurrence of terrestrial fauna around the dam has been heavily impacted by habitat loss, and by intensive timber harvesting activities in the area. Use of the Integrated Biodiversity Assessment Tool (IBAT) shows 22 potentially occurring species of conservation concern - 7 mammals, 9 birds, 2 fish and 4 plant species within a 50 km radius of the dam site. Two vulnerable cichlids are recorded by IBAT. No Key Biodiversity areas (KBAs) fall within this buffer.

4.2.7 Aquatic and Semi-Aquatic Fauna and Flora

A field manual of Zambian fish and local key informant knowledge was used to identify the types of fish in the Nabowa stream. The types of fish reported[17] are presented in the table below. Some of these are only found in the waters during the rainy season and in the dispersed pools during the dry season. Generally, there has been a reduction in the quantity of fish due to fishing and poor management of the dam.

Table 8: Fish species according to the IBAT - 5okm radius from Nobowa Dam

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

4.2.8 Fishing Practices

The Nabowa reservoir has some fish stocks, which provides a source of food for the local community. The biodiversity assessment indicates the actual fish species present in the dam. Despite ongoing fishing activities by the community over the years, there are no accurate catch statistics available. Catching of fish using mosquito nets in the shallow ends of the dam may cause a depletion of fish species. Fish usually breeds in shallow waters and the use of a mosquito net implies catching all the fish in the shallow ends - including the juveniles. This practice is not sustainable if the dam has to be utilized as source of fish for the local community.

4.2.9 Ecosystem Threats

The biodiversity assessment and BMP contain relevant steps to take in an effort to conserve the ecosystem. Following the biodiversity assessment, the BMP was completed. Details on the threats to the river system and any possible threats to the fish species and other aquatic parameters have been discussed in the BMP, annexed to this document. .

4.3 Social Conditions

4.3.1 Social Conditions around the Dam

The dam is located in Mangango ward, which has an estimated population of 5,279 (consisting of 48% women and 52% men) with 1,006 households. The dam is surrounded by settlements of individual families constituting villages, the major villages around the dam include Iyuvwenu, Makanda, Lubinda, Katongo, Mutambwe. Notably, the dam beneficiaries are minimal as the area is remote. It is located about 21 kilometers from the main road, and has no reliable means of transportation and social services.

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

Figure 14: Map showing route to Kaoma/Nabowa Dam from Lusaka

The sub-project area is The sub-project area is served by only a few social services, all of which are located outside the direct area of influence of the dam. These include the Mushilo Community School, which is within the dam area, the Nyango and Mangango Secondary Schools and the Mangongo Health Centre (21 kilometers away along the Kaoma - Lukulu road). The community members are largely subsistence farmers engaged in farming and timber logging. The only disturbed land areas exist in the vicinity of the communities. They are disturbed due to subsistence agriculture. The biggest challenge around Nabowa Dam is the annual occurrence of bush fires, which tends to wipe out much of the first storey land cover.

The campsite location created by the previous works on the dam is within the project area about 50m south of the Nabowa dam reservoir. Trees had to be cut down to pave way for the camp. The affected area measures around 20m x 20m. The area is partially covered with some scanty vegetation.

The sub-project area is not significantly disturbed except for areas such as the spillway channel, which is all gravel (loose soils) that can easily cause sedimentation/siltation of the dam reservoir over time if not taken care of. The other notable degradation sites are the small access roads, which still remain unattended.

The local community at Nabowa Dam has access to clean water from the boreholes located around the area. There are about three boreholes in the sub-project area, one close to the area previously used as a campsite by the contractor. The community uses pit latrines for sanitation. The latrines close to the boreholes are at reasonable distance from the boreholes (at least 30m). There are no waste dumps around the site. The community residing close to the dam (about 1km radius) buries and burns its waste at its respective households.

4.3.2 Administration of Water and Dam

A DMC is in place, but only 4 members out of 10 are active. They consist of 3 men and 1 woman. However, the committee indicated that it requires further guidance and training in various issues. The committee has not yet prepared a constitution to guide its work, and it is not active in monitoring the site.

4.3.3 Gender Equality and Gender-Based Violence

Community members claimed during the field visits claimed that women are mostly engaged in small scale subsistence farming and washing of the cassava, while men are involved in small scale fishing and trading in timber.

Gender-Based Violence (GBV) exists among the dam communities, but it usually not reported, as reporting comes with significant social stigma. Generally, an estimate of 1 in 5 women in Zambia experience some form of sexual violence at some point in their lives.[18] In the Demographic and Health Survey of 2013-2014, 43% of women age 15-49 claimed to

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

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.[19] Alcohol and living in high-density areas have been identified as key issues contributing to higher rates of GBV.[20] 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.[21] 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.[22]

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.[23] 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, 24hrs toll free telephone counseling service).[24] 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.

The department of Community and Social Welfare and the Police in Kaoma handle some GBV cases in Kaoma. However, there is no well-qualified personnel to handle GBV cases and provide psycho-social counseling and legal services..

Asked about where they report GBV cases, community members stated that survivors would first inform the headman and if the survivor is injured, they then seek for transport to the Mangongo Health Post. Once the clinic personnel has attended the case, the Police Victim Support Unit will take up the case. The local community indicated that the upcoming

[19] USAID, UNICEF, UNFPA, CDC, Zambia: Demographic and Health Survey 2013-2014, p. 273.
[20] 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.
[21] ODI: Baseline Study, Stamping Out and Preventing Gender Based Violence (STOP GBV) in Zambia, March 2015, p. viii.
[22] Ditto, p. x.
[23] Ditto.
[24] Chidoori Rumbidzai, 2011, p. 32.

remedial works may present social challenges, such as the contractor luring little girls and married women and offering payment for their services.

4.3.4 Cultural Environment

At Kaoma, the Great West Road (M9), meets the Kaoma-Kasempa Road (D301). This juncture is located west of the Kafue National Park. Kaoma has previously been known by other names including: Nkoya, Mankoya, Mankoye, Nankoya, Nunkoya. The official name of the town was changed to Kaoma in 1964. The name Nkoya came from the first ethnic group to settle in the area. The Nkoya people can be found in Kaoma and the surrounding areas such as Mumbwa, Mulobezi, Kazungula, Mungulula (Mongu), Kalabo, Lukulu amongst other districts. The Nkoya people celebrate an annual traditional ceremony called the Kazanga Ceremony, which is held between April and August in Kaoma District, under Chief Mwene Mutondo and Chief Kahare.

Kaoma District has two constituencies called Kaoma Central and Mangango. The proposed sub-project area is situated in the Mangango constituency and is predominantly traditional land, administered by the headman and the chief. However, due to the valuable tree species in the area, most of the land is administered by the traditional leaders in consultations with the relevant ministries. Traditional village settlements dominate the sub-project area. Each village usually comprises of 10 housing units. Depending on the size, a few villages are then called sections and several sections form a ward. The reservoir site, however, has very few settlements in the vicinity.

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

This community too expressed concerns over the manner in which the contractor treated its workers, mostly from the local community. They cited examples such as late payments of workers. The community is therefore requesting that a good contractor be found and complete the remaining jobs amicably.

Stakeholders claimed that the previous public works on the dam have not impacted the communities' cultural practices or heritage, and that there are further no significant or historical features in the area. In case chance finds occur during construction activities, chance find procedures are attached to this ESMP.

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

The google map below shows the area extent of the persons consulted during the development of this ESMP.

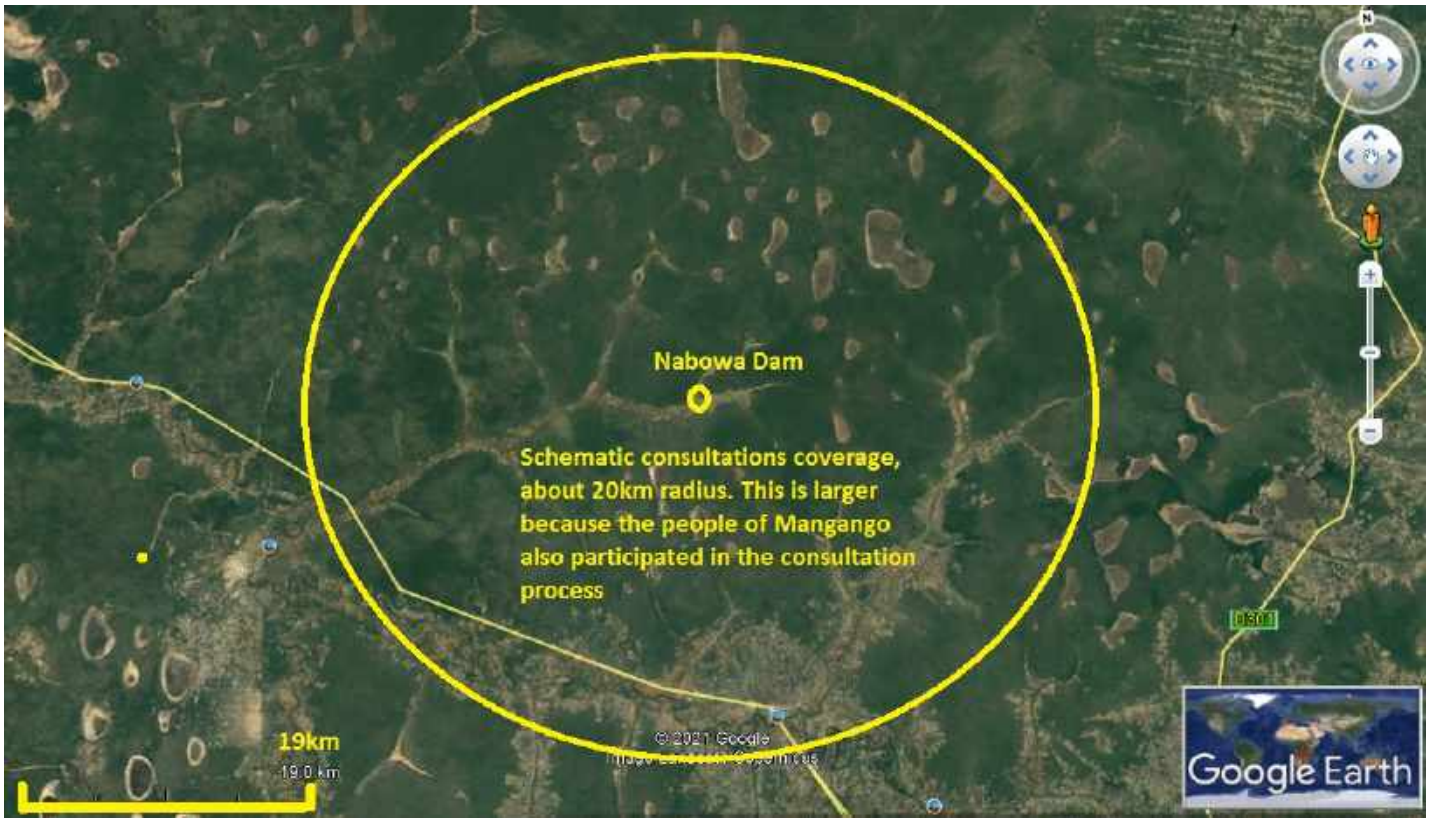


Figure 15: Schematic consultation coverage

5. Sub-Project Characteristics

5.1 Dam Characteristics

The dam is located in the Western Province, approximately 75 km north-west of Kaoma town and 21 km north of Mangango Town. It is located on the Nabowa stream, which drains to the Luena river. The Dam was first constructed in 2018 to provide water for irrigation and aquaculture. No further works have been undertaken at the dam since it was onstructed. The main dam characteristics are shown in Table 13.

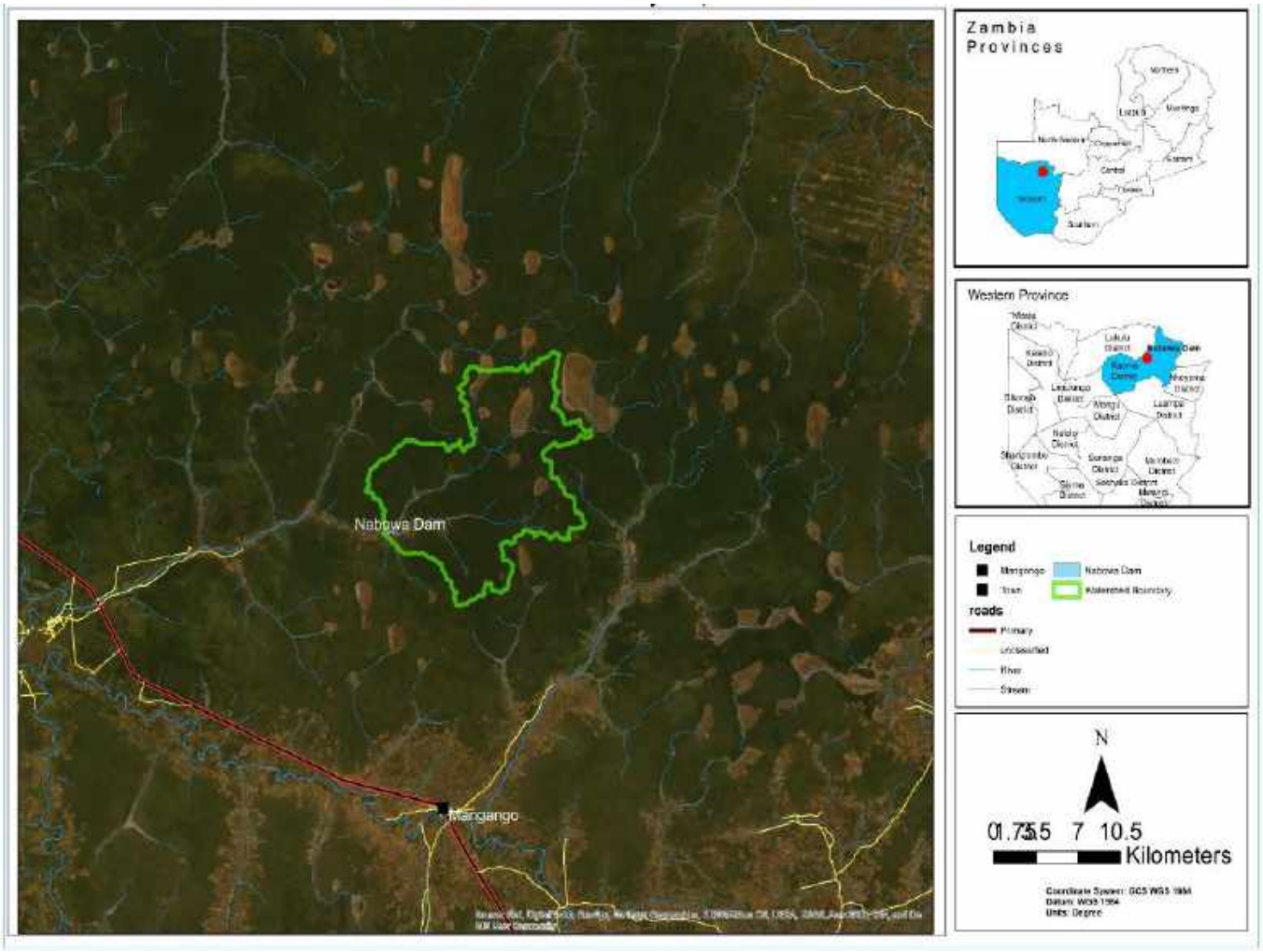


Figure 16: Google map showing location of Nabowa Dam, UNOPS 2020

Table 9: Main characteristics of Nabowa Dam

Dam Catchment Data

Catchment Area

Source Document	Year	km^2	Method of calculation
Ministry of M E & WD	2015	15	Not mentioned
COWI (initial report)	2018	96.4	Design from Survey in 2018
COWI - Aurecon	2018	234.25	Catchment Characteristics & Information
Ministry of Agriculture	2020	234.25	Taken from COWI - Aurecon submission
UNOPS	2020	176	STRM 3D DEM (NASA) and ArcGIS

For calculation purposes of the remedial design works, the UNOPS 2020 value of **176 km^2** for the ***catchment area*** has been adopted.[25]

MAP, MAR, and Inflow:

The Mean Annual Precipitation - MAP - for this area is **900 mm.**
The Mean Annual Runoff - MAR - for the area is **70 mm.**
The MAR used is in accordance with the Zambia National Water Resources Master Plan.

Based on the above data, the average annual inflow at the dam site is 176,000,000*0.070 = **12,320,000 m^3.**

Dam Capacity

Source Document	Year	m^3	Method of calculation
Ministry of M E & WD	2015	508,484	Desktop study for design report
COWI - Aurecon	2018	508,484	Taken from Design Report
COWI	2018	794,966	Full basin survey – topographic, UAV and bathymetric
Ministry of Agriculture	2020	508,484	Taken from COWI Aurecon 2018

For calculations, the 2018 value of **794,966 m^3** has been adopted.

.

Assuming a 70mm MAR the average annual inflow is	**12,320,000 m^3**
Current estimated capacity of the dam is	**794,966 m^3**

The site has been developed to only **6.45%** of its potential capacity. This is **15.5** times the current dam capacity.

Sedimentation

[25] This area was checked twice by UNOPS.

The catchment size is 176 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 34,200 m^3 per year. Thus within approximately 25 years the storage will be reduced to zero and to 35 per cent of the storage in 15 years.

Geotechnical Investigations: The SPT results indicate that the compaction was relatively consistent on this site, BH 4 the bearing capacity reduced from very stiff to stiff.

Regarding the Atterberg Limits Result all the materials sampled were CL, but were more gravely silts than silts. As a rapid guide in assessing the suitability of soils for shoulder material UNOPS refer to the Plasticity Product (PP). If the PP is above 600 it would consider this to be suitable as a core material. Shoulder material UNOPS would consider good between 400 and 200. Lower than 200 and either very coarse and still usable depending on the grading.

The results below indicate that these are predominantly silts, but they are acceptable as fill material.

Table 10: Results of Geotechnical Material Sampled

Sample	Plasticity Index (PI)	% passing the 75 µ	Soil Classification	Plasticity Product (PP)
1	16.1/14.0	47.1%/43.3%	CL	758/606
2	14.7/15.3	60.%/54.9%	CL	885/840
3	13.9/16.0	59.1%/59.1%	CL	821/945
4	13.3/5.9	49.9%/66.1%	CL	660/390

The PP results are high, which is an indication of a more plastic material.

Embankment Crest and Slopes

Embankment Crest: The crest at the time of the assessment visit was in good condition with no evidence of wash out. The wearing course of the gravel seemed not well graded and is highly susceptible to erosion even light rains or movement would result in gradual loss of material.

Minor shoulder erosion was present on both sides of the crest but with no visible signs of cracking. Repair works were not visible on the crest and the width was intact maintaining a horizontal crest.

Plate 5: Existing Crest of Nabowa Dam

Embankment Slopes: The embankment slopes - as per the original design drawings from 2015 - were given as 1V:2.5H (COWI report) and 1V:3H on the upstream and 1V:2H on the downstream, with a crest width of 4m in both the design report and drawing.

Checks carried out from the cross sections taken from the recently completed survey of the embankment show that the upstream slopes are closer to 1V:2.5H and downstream slopes vary but are closer to an average of 1V:2.2H.

Plate 6: Embankment Upstream Slope

The dam wall appears to have not been completed as per the original design, hence the berm shown in the picture below.

Plate 7: - Embankment Downstream Slope with Berm

The dam wall appears to have been constructed with good well graded material over most of the embankment, however, on the lower right bank the contractor placed what appears to be dispersive or at very least highly erodible material (see picture below).

Plate 8: Right Bank Erosion of Suspect Construction Material

This area will require the removal of as much of the poor material as possible with the construction of a chimney filter behind the replacement material in the embankment.

Internal Filters and External Drains

It is not clear if any filters were incorporated in the construction of this dam, although the original design did require a 50m wide x 0.5m thick blanket drain through the river bed section of the embankment, downstream of the core trench. There is also no effective rock toe or any toe drains. There is some seepage evident at the toe on the right bank of the embankment.

More seepage is evident downstream of the toe, but it appears to be more as a result of water passing beneath the embankment.

Plate 9: Seepage at Downstream

All seepage was observed to be clear at the time of the assessment visit with no evidence of any “boils”.

Spillway, Training Wall and Return Channel with Structures

The service spillway lays on an erodible bed with 3 gabion basket erosion protection structures/sills. The gabion sills have been damaged, as seen in the picture below, due to human and animal traffic.

Plate 10: Damaged Spillway Gabion Sills

For proper functionality, the damaged spillway gabion sills need to be replaced with properly designed and constructed

drop structures to lower the discharge water in a controlled manner on its return path to the main stream rather than the current straight flow line back to the stream (see picture below).

Plate 11: Spillway Return Channel Showing Straight Flow Path

The training walls – part excavated embankment and part constructed walls down the full length of the right and left banks of the return channel are both in good condition with fairly minor remedial works required. Generally, the return channel was fairly well defined and in good repair though the spillway channel has never been in use during the rainy season.

Flood Design

A Design Flood (PMF) of 364 m^3/s (1 in 10 000 years flood) was used in the remedial design by COWI in 2018 as well as a 1:100 year flood of 161.1 m^3/s.

The adopted design criteria for this project is based on the Mitchell Formulae used extensively in Zimbabwe for the PMF estimation. The return periods have been modified 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.	176.0 km2
Max Probable Flood	1336 m3/s
100 year Flood Estimate	601 m3/s
Fetch	0.80 km
Dry Freeboard	0.490 m
Service Spillway Width	41.00 m
Current Crest Level	1140.40 m

Spillway Level	1137.80 m
Current Freeboard	2.600 m
Coefficient of Discharge	1.8
Estimated Raising Required	2.10 m
Est. Freeboard Required	4.700 m
Revised Crest Level	1142.50 m
Riverbed Level	1130.40 m
Height of Wall	12.10 m
Water Depth	7.40 m

The design flood adopted will require an increase in the current freeboard of 2,1m. This will also assist in correction the downstream slopes to a uniform 1V:2.2H.

5.2 Overall Legacy Issues at the Dam

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

5.2.1 Structural risks

Spillway risks:

- Spillway capacity unknown
- Spillway built not according to the drawing
- Spillway gabion basket drops inadequately tied into the embankment
- Gabion baskets not well leveled which results in uneven distribution of flow
- The spillway inlet channel upstream of the causeway not adequate

Return channel drop structures and training wall risks:

- Erosion risks on the drop structures
- The right bank berm material may be dispersive
- Erosion in the return channel

Embankment risks:

- Slopes too steep – not built to the design standard of 1V:3H U/S and 1V/2H D/S.
- Seepage on the embankment
- Tension cracks on the embankment
- Damaged rip-rap

The following pictures illustrate the above conditions:

Upstream slopes

	
Crest and upstream slope of the dam	Upstream slope of the dam
	
Rip-Rap protection of the upstream slope	Damaged Rip-Rap due to animal movement. Needs to be reinstated
	
Scanty rip-rap	Damaged upstream protection

	
Damaged protection of the upstream berm	

Plate 12: Pictures showing status of Upstream slope

Scanty grass and vegetation were observed on the slope and damaged rip-rap; there is need to plan for planting of grass and reinstating the rip-rap. Pictorial evidence also shows that the slopes are not uniform. Signs of minor surface erosion may be attributed to animal movement. No evidence of cracking or settlement was seen.

Downstream slopes

	
Ant-hills on the downstream slope berm	Ant-hill on the downstream slope

	
Ant-hill on the downstream berm	Erosion on the downstream slope

Plate 13: Pictures showing status of downstream slopes

Irregularly spaced grass and wild vegetation are prevalent on this section of the dam. The stability of the downstream face of the dam needs slope stability tests as the current slopes do not appear structurally stable and this can be worsened in cases where the dam fills and is at FSL.

Remediation action could also involve assessing the extent of the anthills into the ground and systematic treatment of the ground to exterminate the ants.

	
Eroded berm on the downstream slope	Eroded berm on downstream slope

	
waterlogging due to seepage	downstream slope with berm

Soil erosion has been noted on a number of sections attributable to uncontrolled animal and human movements on some sections of the slopes. Wild grass has further been observed to grow on the slopes as well.

Crest

	
Crest of the dam	Crest and upstream slope of the dam

Plate 14: Pictures showing status of crest

No evidence of wash out has been observed on the crest. The wearing course of the gravel seems not well graded and is highly susceptible to erosion even by light rains or movement would result in gradual loss of material.

Minor shoulder erosion was present on both sides of the crest but with no visible signs of cracking. Repair works were not visible on crest and the width was intact maintaining a horizontal crest.

Downstream toe

Damaged gabion cill along the spillway return

Damaged cill along the spillway return

Damaged gabion cill along the spillway return due to human and animal tracking

Damaged Gabion Cill due to human and animal tracking

Spillway return: the spillway bed is of erodible earth	Spillway return

Plate 15: Pictures showing status of downstream toe

The dam does not have toe-drain. There is a soft toe condition near the right bank of the embankment with greening present further down.

	
Eroded berm on downstream slope	Waterlogging due to seepage
	
Waterlogging due to seepage	Downstream slope with berm

Discharge Structures

Spillway at dam (Service Spillway): It was observed that the service spillway laying on an erodible bed with 3 gabion basket drop structures/sill. For proper functionality, the damaged spillway gabion sills need to be repaired to working condition.

	
Damaged gabion cill along the spillway return	Damaged cill along the spillway return
	
Damaged gabion cill along the spillway return due to human and animal tracking	Damaged Gabion Cill due to human and animal tracking
	
Spillway return: the spillway bed is of erodible earth	Spillway return

Plate 16: Status of spillway at the dam. Service Spillway

Spillway at dam (Emergency / Auxiliary Spillway)

Spillway return and access drift

Access drift across the spillway channel

Spillway channel

Plate 17: Spillway at the dam; Emergency / Auxiliary Spillway

No auxiliary spillway is provided on this dam.

A low level pipe is provided but may not be functioning well. A pipe for irrigation was provided for but the level of the intake chamber, it appeared too high for the low water levels obtaining.

	
Non-functional Irrigation Intake chamber for the irrigation system. The dam has not filled and therefore the chamber seems suspended and not serving its purpose.	Irrigation intake chamber

Clearly the dam has not been filled with water in the most recent past and it is therefore recommended to relocate the position of the irrigation intake chamber in order for it to be useful and serve its design purpose.

5.2.2 Health and safety risks

Construction phase

Demobilization and Restoration Plan absence risks:

- Safety and health hazards for the community

Rehabilitation of disturbed works areas risks:

- Erosion and sedimentation

Rehabilitation of borrow site risks :

- Erosion and sedimentation
- Weed infestation
- Failure to rehabilitate causing increased soil erosion and sedimentation to nearby surface water body. Part of the section used to get gravel during construction is close to the reservoir.

Environmental flow releases risks:

- Inability to monitor and assess downstream ecological effects of dam operation due to poor flow over the spillway return channel. The spillway return channel has not operated from the time the dam was constructed.

Community health and safety risks:

- Stagnant water ponds within the spillway bed can be likely vector breeding areas
- General serious or fatal incidents/drowning

Access across the river risks.2.2

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

Operation phase

Community health and safety risks:

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

Photos illustrating some of the conditions above:

Figure 17: Google map showing sites of concern

Plate 18: Cleared area previously used as a camp site needing revegetation

Plate 19: Spillway return channel needing rework to arrest erosion and sedimentation

Plate 20: Degraded areas and embankment needing revegetation.

5.2.3 Social risks

Community development risks

- Food security – inadequate fish training for communities
- Erosion and sedimentation in the dam
- Lack of catchment management
- Destruction of ecosystem through timber trading

5.3 Potential Communities Affected by Works

The dam is surrounded by settlements of individual families constituting villages, the major villages around the dam include Iyuvwenu, Makanda, Lubinda, Katongo, Mutambwe and others.

The rehabilitation of the dam will benefit at least 5 villages, each village constituting individual families. The population to benefit from the dam is estimated at around 15 households upstream and around 10 households on the western end of the dam. There are 4 to 5 households on the northern side of the dam that are likely to benefit as well from the proposed rehabilitation works and the subsequent training in agriculture and fisheries. There could be more people that may be attracted to come and live close to the dam, for example from the Mangogo area.

The communities expressed their desire to engage in agriculture using the irrigation method in the dry season, as one way of improving their economic status. The challenge is that at the Nabowa Dam, there seems to be no water flow downstream for the local community to engage in agriculture at the moment. The dam has some fish stocks for the local communities, and therefore there are some fishing activities taking place. The challenge is that there is no control on when to fish and when to allow fish to breed.

Furthermore, the rehabilitation activities will create temporary local employment activities for the duration of the construction and will therefore benefit both, women and men. Contractors will be required to recruit local workers. The total workforce is not known yet but may be around 30 people. 12 out of this amount are likely to be externally recruited, including an engineer, a foreman, sitemen, a storekeeper, and those handling heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the communities. Around 18 workers will be recruited from the Nabowa/Mangongo communities. Their tasks will comprise of 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. There will be some impacts on local resources and services for the fact that the semi-skilled workers are likely to camp within the Nabowa community. Similarly, risk of exacerbation of local existing conflicts may exist. However, the potential that a workforce meets local communities from different political or factional backgrounds is small.

For the 12 external workers, the contractor may require a site office, for meetings and for the storage of materials. However, out of the 12 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, 5-7 external workers may be at the site permanently. Workers will be transported to the construction site and likely remain there for the construction period. Staff, like the engineer, will visit the project site, but will not be there the entire time.

It is likely that the contractor will build a campsite for the 12 or so workers, who are not transported to the site on a daily basis and who are not locally recruited. There will be construction of areas for storage of construction materials, including provision of convenience facilities for the whole workforce. The community respondents and local authorities, during field visits, indicated that the previous contractor camped at the site close to the dam in the south-eastern direction. To avoid clearing of vegetation in other places, the contractor will potentially camp at the same site. Access to portable water (borehole) is less than 50m from the potential camp site location.

5.4 Dam Safety

The dam safety reports for Nabowa Dam include the prepared 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 mitigate any consequences for human life, health, property, infrastructure and the environment.

It is incumbent on the dam owner to have an EPP in place and to ensure that the dam is safety evaluated, as prescribed, and that site monitoring and documentation are kept up to date by the operator. It is important that there is adequate training of the operator(s) to identify early signs of failure and the correct

notification procedures. The emergency preparedness and responses should be established in advance. The plan should be regularly exercised, to make all parties aware of their roles and responsibilities as well as to identify possible flaws in the plans. A notification flowchart is essential for any EPP and the contacts in particular should be updated regularly.

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

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

The operation and maintenance planning includes the following:

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

6. Proposed Remedial Works[26]

6.1 Embankment Remedial Design

6.1.1 Slope Stability

Slope stability analysis for the downstream embankment slope would require considerably more tests than are warranted for this size of dam. Apart from the SPT and grading results we are awaiting some triaxial results which will provide limited information as to the c and Ø value of the sample.

SPT and grading results have received shear box results and are awaiting some triaxial results.

Current Upstream slope approximately 1V:2.5H
Current Downstream slope approximately 1V:2.2H

On the basis of the shear box results, a stability analysis has been undertaken and with a downstream raising of the wall with a 1V:2.2H slope, the analysis indicates that all conditions are satisfied.

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

As it has been assessed that there is a requirement for raising of the Nabowa embankment, the results of the stability analysis carried out confirm that the embankment is safe in its proposed remedial configuration.

There is no indication of a phreatic surface daylighting on the downstream slope of the current embankment but given the uncertainty as to quality control of the placing, we are incorporating a 500mm wide chimney drain for the entire length of the embankment.

This chimney will start at the current toe line and follow up the existing downstream slope (once it has been properly trimmed) - to the height of the full supply level (FSL) in the deepest section of the embankment and right across both embankment shoulders - effectively along the interface of the new placement against the existing embankment (see figure 19).
When looked at 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 approximately 7.4m of water above riverbed level at the Full Supply Level.

[26] Nabowa Dam Remedial Design, January 2021

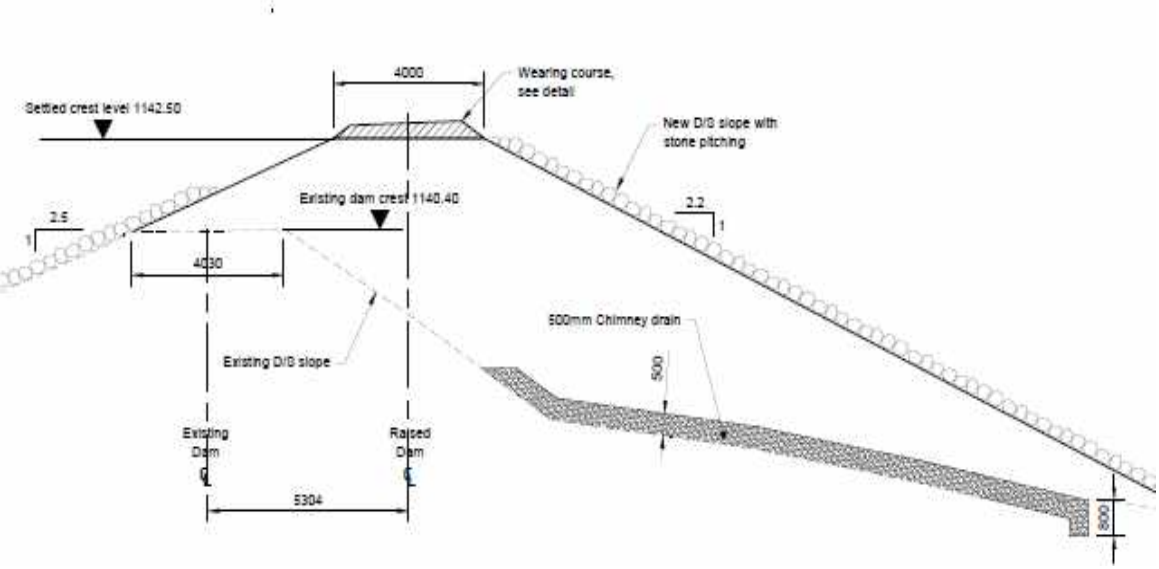


Figure 18: Raising Cross Section Showing Chimney Filter Location

Above the rock toe level 1.5m x 0.5m finger drain offtakes at 20m centres on either side will lead off the base of the chimney to reverse filters into a toe drain constructed at the new toe. The raising will have the effect of moving the center line of the current embankment downstream.

The current slope of 1V:2.2H will be maintained in the downstream raising.

The upstream slope will be repaired above the water line and stone pitching will be placed to cover the complete surface - mainly to prevent future livestock damage.

6.1.2 Rock Toe

The original downstream rock toe in the deepest section of the embankment currently consists of only a few scattered rocks and is completely ineffective (see picture below).

Plate 21: Current status of Rock Toe

A more extensive rock toe will have to be placed in this area, extending at least 2.0m vertically up the embankment face and 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. This will be linked in with the new internal filter system (chimney drain) that will be constructed during the raising.

In addition to controlling seepages the rock toe will provide additional weight against the embankment thereby increasing the overall stability.

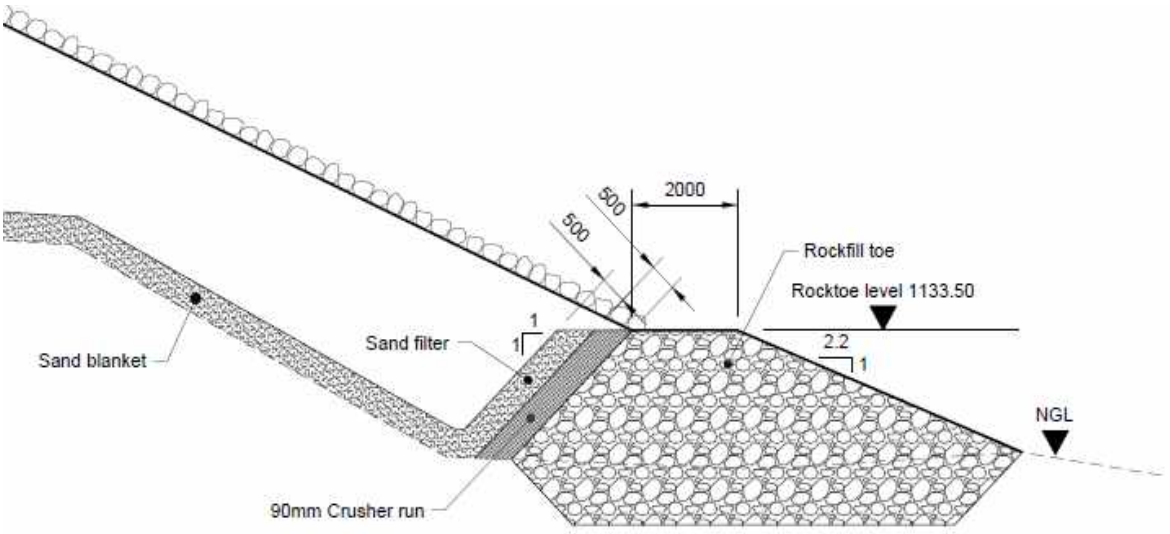


Figure 19: Typical Section of Rock Toe and Filter in the Riverbed Section

Concrete/stone pitched open toe drain: The embankment does not have a downstream toe-drain and it is recommended that this be introduced.

This will collect the outflow from any 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 2.2:1 - and the downstream slope can be cut at 1:1 (see figure 21).

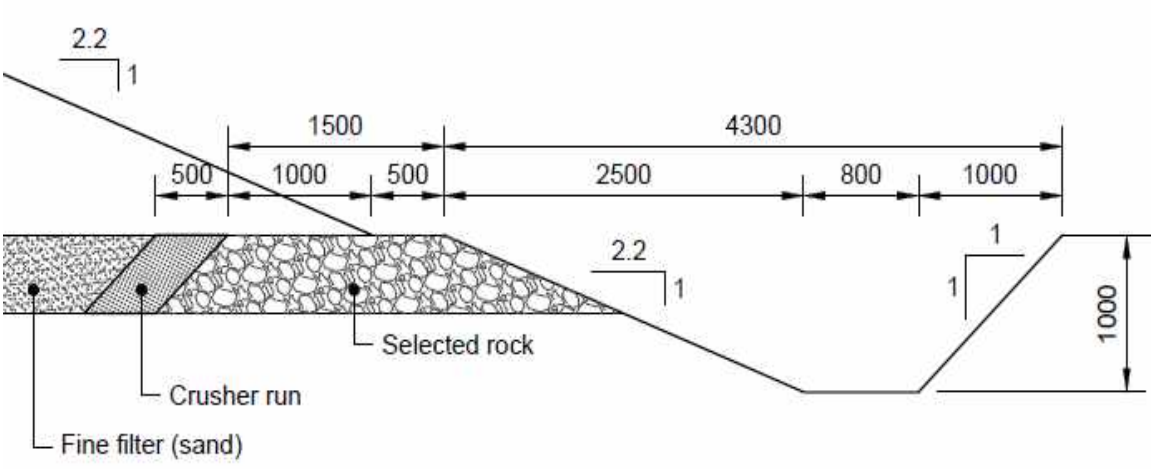


Figure 20: Typical section of Toe Drain and Embankment Internal Filter

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, Channels, Drop Structures and Training Wall

6.2.1 Service Spillway

The spillway is defined by a competent concrete causeway which requires no further work on the spill section but does need the addition of suitable erosion protection works.

While this causeway crosses the spillway channel (inlet into discharge – picture below) at an angle, it does not align with the embankment crest center line. There will be no need to realign the causeway to cater for the downstream shift of the embankment centerline (approximately 2.5m) due to the raising as the approach to the causeway can be adjusted at the end section of the embankment.

There is need to construct suitable causeway abutments to protect either end of the causeway and prevent erosion of the right hand end of the embankment and the spillway channel right bank where the road exits the causeway. This can be done adequately with gabion baskets and stone pitching which is detailed below.

The road approaches off the dam crest and on the left bank of the spillway / drift will be a grade of 1:8. This will require a double head wall on the dam embankment and similar protection to the left bank.

These abutments will also be constructed of gabion baskets which will be keyed in 2m at either end of the spillway. The abutment walls and cut off walls will extend up to at least the height of the High Flood Level - effectively the wet freeboard.

The upstream approaches to the abutments and downstream outflow sections away from them will be protected by a 2m gabion mattress and stone pitching as detailed in the drawings.

6.2.2 Inlet Return Channel

The inlet channel to the spillway causeway section starts approximately 50m upstream of the causeway and is effectively the control section for the spillway width. While the channel width at the causeway itself is 41m, the channel width some 40m upstream is only 30m effectively drastically reducing the spillway design capacity.

The inlet channel will need to be cut back from the concrete spillway section to the mouth of the channel along the left bank to ensure a channel width of at least 40m along its length. The floor of the approach channel will also be cut down and levelled to a uniform depth of 500mm below the causeway to improve the flow characteristics in this section of channel and entering the spillway section. Material from these excavations can be used in the raising of the embankment.

The spillway discharge channel has adequate width along its entire length and the floor currently has very little erosion damage.

6.2.3 Return Channel Drop Structures

The 40m wide spillway return channel is on an erodible bed with 3 gabion basket structures/sills which as previously reported are in various stages of disrepair (see figure 16a and 16b).

Plate 22: Typical Gabion Basket Erosion Protection in Channel

Plate 23: Gabion Basket Erosion Protection Structure

These damaged gabion structures will have to be replaced with properly constructed gabion basket drop structures to reduce the elevation of discharge channel floor in successive drops of 1m from the spillway level to discharge back into the stream.

It is proposed to construct a series of four (4) stepped gabion basket structures back down to the riverbed level. Each 1m drop on the downstream side of the gabion structure is protected with a 2m wide Reno Mattress as well as on the upstream side, to reduce the shallow undercut of the structure. The crest of the next drop structure is at the same level as the upstream drop.

The typical gabion drop structure section that will be used is shown below (figure 22).

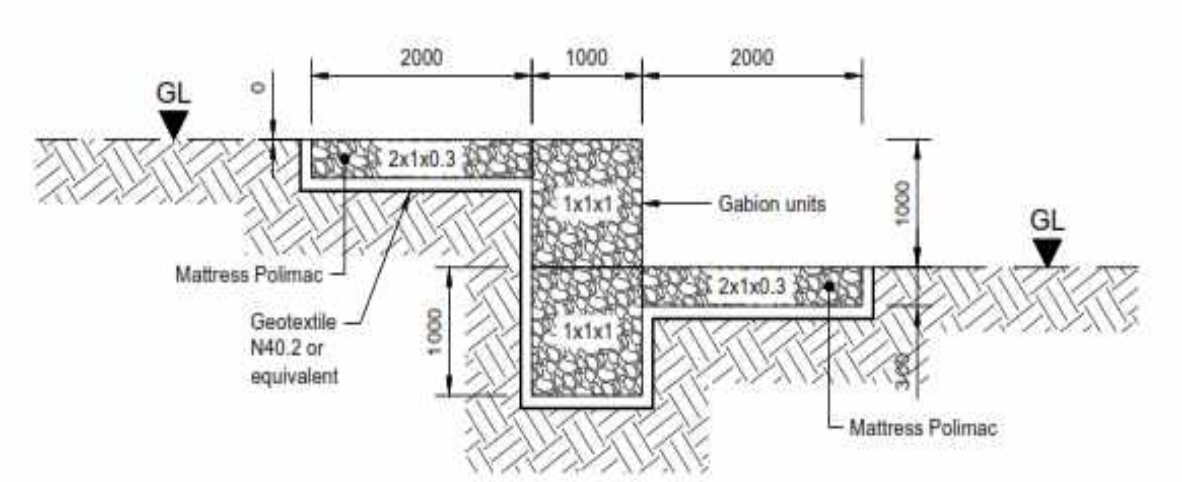


Figure 21: Plan View: Layout of New Gabion Drop Structures in Spillway Return Channel

The channel floor will be stepped and levelled across its width between each drop and the suitable material will be used for the embankment raising or any training wall remedial works.

The critical point of each such structure will be its connection with the training wall, this is where the gullying may occur. A 2m gabion mattress will run up the entire embankment both upstream and downstream of the head walls and will be tied into the head wall and link into the mattresses.

6.3 Return Channel Training Walls

The training walls on both the left and right banks of the spillway return channel only start some distance downstream of the spillway (approximately 80m on the right bank and 120m on the left bank) as up to these points the channel had to be excavated. The training walls are still in good condition with only minor repair works required. Material for these remedial works will be obtained from the excavations in the channel floor itself.

Plate 24: Spillway Channel Left Hand Training Wall Condition

Additional Remedies

- 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 and treatment of each colony
- 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.

6.4 Outlets

There are two separate pipes through the Nabowa embankment, a low flow pipe of 150mm NB diameter steel which according to the design report has an inlet chamber with a steel trash grid at the upstream end and an outlet chamber with a 150 mm diameter gate valve to control outflow.

Plate 25: Low Flow Pipe Outlet Valve Chamber

Once the new toe drains and seepage remediation works have been implemented, it is not anticipated that any further work is required to the pipe other than great care in placing material over and around the pipe.

The second pipe is a 300mm NB steel pipe for supplying water downstream for irrigation purposes, with a concrete intake chamber with steel trash screen which is non-functional as it is above the dam water level.

Downstream is a concrete valve chamber with a 30mm NB gate valve to control the releases. The valve and chamber appear to be in good operating condition although the backfilling around the chamber when constructed appears to have not been completed. *Refer Figure 20.*

Plate 26: Inspection & Valve Chamber for Irrigation Pipe (COWI Report 2018)

Care must be taken during the embankment raising and in particular the excavation of the toe drains that these pipes are not damaged in any way.

6.5 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 - 5km within the dam locality
- Stone for gabion basket filling - 5km within the dam locality
- Rock for riprap and downstream rock toe from 5km within the dam locality
- Sand and Stone for reverse filter at rock toe -5km within the dam locality
- Common fill material for embankment maintenance and spillway training wall repairs.

Preferred locations are within 5km of the dam. However, possible and suitable sources of rockfill, aggregates, earthfill and sand, will be identified by the contractor and approved by the engineer. Before finalizing on the use of the site, it will be the responsibility of the contractor to engage the DMC and the local community in order to get consent from the local leadership on the use of the site as source of raw materials and avoid land and other conflicts. Should the sources selected for construction materials prove inadequate or unsuitable in any way, the contractor will be required to identify suitable alternative sources including additional borrow areas, and will be expected to go through the same channel of communication with the local persons/authority and consultations with the local community before use of the identified source

The designation of certain areas as borrow areas does not imply that all the materials within that area are suitable for use in the dam embankment. The engineer's representative will indicate which materials from within the general borrow areas are to be used in the embankment and which are to be left unused.

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 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 ZEMA approved quarry sites or from an approved commercial supplier identified within Kaoma District or nearby, provided it is economical. In some cases the Contractor would set up their own crushing and screening plant. However, the later process may take longer to approve 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 sourced 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. New quarry sites and new borrow pits will require permits from Zambia Environmental Management Agency (ZEMA).

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

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 will be responsible for locating suitable deposits prior to tendering thereof for approval by the engineer's representative.

Overhaul of Materials

There is no provision for the payment of overhaul of earthfill, gabion rock infill, rockfill or of concrete coarse aggregates and crushed filter material, and tenderers will include 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 and gravel over a long distance and passing through a settlement, the transporter will be required to cover the material with a tarpaulin and will use a defined route from the source to the construction site.

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

Water supply

The contractor will provide temporary potable water storage facilities and connection to the existing local borehole that is within 200m radius of the dam location and specifically in the south-eastern direction of the dam, without compromising community access to the water. Water from this borehole will be tested to note compliance against drinking water standards, before the water can be used by the contractor and his/her staff.

Campsite

A campsite for 12-15 external workers- to be structurally constructed within the sub-project area, in the south-eastern direction of the Nabowa Dam reservoir.

The contractor will provide the following for the site:

- Washing and sanitation facilities- incl. VIP latrines to be constructed within the site for ca. 40 workers

(at least 2 latrines, 2m x 3m per toilet with opposite/alternate access and a privacy screen, one for men and one for women). Each toilet will have a hand wash basin.

- Cooking facility at the campsite- all the cooking activities will only be conducted at the designed facility. Waste management (non-hazardous waste)- collection from waste receptors within the site, and disposal at council designated site located in Kaoma District as will be guided by the local authority.
- Waste management (hazardous waste)- collection within the site under stipulated conditions in the ESMP table. Remediate where necessary or dispose of as per regulations.
- Any hydrocarbon storage facility will require banded walls according to the stipulated ESMP table requirements. Any recyclers and re-users of waste must be licensed and monitored according to ZEMA guidelines.
- Temporary accommodation facilities for his staff. The temporary facility will be made up of local building materials or tents and with a minimum spacing requirement of 4.5sqm living space per staff.
- 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.

Access roads

Access to Nabowa Dam is by gravel road, 75 km north west of Kaoma Town and 21 km north of Mangango town, as shown in the location map of this dam.

Labor force

The total workforce may be around 30 people. 12 are likely to be externally recruited, including an engineer, a foreman, sitemen, a storekeeper, and those handling heavy machinery and equipment as it is not expected that specialized or skilled workers will be available in the local communities. Approximately 25 workers will be recruited from the Nabowa/Mangongo communities.

6.6 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 6 to 7 months.

6.7 Drawings List Available to the Contractor

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

7.Risk and Impacts Mitigation Plan

This section provides the following.

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

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

7.1 New Remedial Works General Construction Works Management Plan

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

Construction Phase Risk Mitigation Measures						
Sanitary facilities	hydrocarbons and sewer Public health and safety hazards	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. The fuel dispensing pumps must also stand in a concreted area, with drains to an oil interceptor. • The contractor will not wash vehicles in		wastes concrete-lined and bunded • Treated contaminated sites, 100 % • Training/ sensitization records, 100% of workers • Waste disposal records and logs available • 100 % of sites are cleaned up • 100% of sites specific waste management plans exist		

Construction Phase Risk Mitigation Measures						
		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 destabilization leading to erosion and land subsidence Road surface instabilities	• Following acquisition of relevant permits from local council and ZEMA, the contractor will prepare borrow pit method statements and management plans for each site to detail the operation of the site and compliance with the ESMP. • The contractor will limit excavations and clearing to necessary worksites. • The contractor will ensure that site installation, excavations and any other soil movement activity will not be done during the rainy season to avoid erosion of material and gully formation. • The contractor will methodically conduct site assessments, selection, and operation of the sites as indicated below: A depth of utmost 2.5m will be excavated from borrow areas for safety reasons. The excavated slopes will be reduced to a stable slope, and indicated in the method statements. • The contractor will create and maintain topsoil stockpiles. Topsoil depth ranges will be between 150 mm and 500 mm. The exact depth will be determined from the geotechnical site assessment. Topsoil will be stripped and stockpiled away from other materials. Topsoil will be only used for reclamation purposes when pit	Construction Phase Daily	• Minimized land and soil disturbances at the work sites • Suppressed dust levels and soil movement / erosion • All sites are soil stabilized sites • Separate soil stockpiles to specification • Drainage and run off control • Site restoration, 90% for regeneration • Site Method Statements and management plans prepared	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 3000/month

Construction Phase Risk Mitigation Measures						
		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. • For a new borrow site area, which is approved by the engineer, the contractor will seek approval for use of the site as source of construction material. The caution here is that obtaining a permit may take not less than 2 months and hence the need to identify already existing sites and develop plan for managing the site.				
Land Use and Aesthetics Management						
Infrastructure rehabilitation works, Disturbance of sites, campsite construction	Changes in aesthetics, scenic view, visual character and land use	• The contractor will maintain consistency with existing land-use features and designs.	Construction Phase Monthly	• Minimised aesthetic impacts • Rehabilitated and restored sites, 100% • Blending land-use	Contractor Engineer and HSSE Officer UNOPS/IDSP	HSSE Officer Cost 2000/month
Surface and Groundwater Pollution Management						

Construction Phase Risk Mitigation Measures						
Activities and Works around and on water bodies	Poor water quality Public health and safety risks	• The contractor will control siltation, minimise unchanneled runoff and soil erosion by constructing drainage channels. • The contractor will provide sanitary facilities in the form of 2 VIP toilets for the workers at the campsite (1 for females and 1 for males). These will be monitored and properly decommissioned by adding lime. • The contractor will inspect machinery and vehicles for spillages and leakages on a daily basis, before use. • The contractor will dispose of construction debris and any wooded debris in legally designated site at the council dumpsite. Disposal in the reservoir or water bodies will be prohibited. • The contractor will monitor water quality in the upstream basin and downstream by conducting initial water quality monitoring at commencement with monthly monitoring during construction.	Construction Phase Monthly Or as required in case of an emergency/ incident	• Refer to water quality results in the ESMP and biodiversity studies • 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 hydrocarbon contamination is	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

Construction Phase Risk Mitigation Measures						
				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 minimise haul distances and avoid worksites close to sensitive receptors such as households, clinics, schools etc... • Working hours to be limited to between 06:00 and 18:00. • The community will be sensitised on working sites and routes. Equipment noises below acceptable limits. • The contractor will continually water sites and limit soil movements during works by stone pitching sites or vegetation. However, care must be taken to ensure that water used for this activity does not deprive local communities or affect the dam water quantities	Construction Phase Daily	• Complaints records • Inspection sheets • Receptor sites protection	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 2000/month

Construction Phase Risk Mitigation Measures						
Construction materials (sand, stone, rock, gravel)						
Extraction and transportation activities	Land degradation, falls, waterborne diseases due to collecting water, health and safety injuries during mining, non ZEMA regulated activities, soil erosion, biodiversity loss, traffic accidents, noise and air quality, child labour from unregulated sources	• The contractor will source materials from reliable, regulated sources with ZEMA approved operations • The contractor will refer to the relevant management plans in the table; traffic, labour, air, noise, water, biodiversity, soil, land, health and safety. The Contractor is also expected without fail to make reference to the management plan discussed under aapendix J	Construction phase Daily	• Refer to the remedial design report • Use of approved regulated miners • Constant material supply • Environmentally mitigated operations and keep a copy of their environmental assessment • Refer to the relevant plans' performance indicators	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 3000/month
Campsite Management						
Construction, operation and decommissioning activities	Non-hazardous Waste management, Hazardous waste management, noise, wood fuel	• 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.	Construction phase Daily	• Refer to the relevant plans' performance indicators • Limited vegetation clearance • Campsite operations inspection reports	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 4000/month

Construction Phase Risk Mitigation Measures						
	forest depletion, energy conservation, air pollution due to dust, water conservation, surface and ground water pollution, soil conservation, land pollution/ degradation, health and safety risks	• The contractor will 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.		• Well kempt campsite • Decommissioned site after operations as indicated in the decommissioning plan		
Traffic Management						
Transportation of materials, vehicle and equipment movements, pedestrian movements	Poor road surfaces, conflict of use with the community, safety hazards	• Contractor will assess available access, rehabilitate if needed and provide appropriate signage where relevant to inform the local community. If any road infrastructure is closed due to the works, alternative routes must be assessed and constructed with minimal impacts on the community social and environment aspects. • Contractor will prepare the traffic management method statement which will be reviewed and approved by UNOPS in collaboration with IDSP. The method statement will firm procedures and include cost. The management plan will cover parameters such as covering the transported raw materials with tarpaulin	Construction Phase Daily	• Safety inclusion • Existing community access infrastructure • Training records for communities and workers • Inspection reports • Complaints records • Site Specific Traffic Management Plan in place	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ DMC	HSSE Officer Cost 2000/month

Construction Phase Risk Mitigation Measures						
		and avoid pollution of the environment or disturbance to the local community. Additionally, once source of material is known, the contractor working in consultation with the engineer and the local authority will define a route to use throughout the construction period. • Contractor will include hazard identification, risk assessment, safety measures such as signage, routes, parking areas, loading, unloading, reversing, crossings, sensitisations, fencing, competent drivers, working hours, operating low speed (about 10 to 20km/h). • In summary the contractor traffic management plan will include: the desired flow of pedestrian and vehicle movements, the expected frequency of interaction of vehicles and pedestrians, illustrations of the layout of barriers, walkways, signs and general arrangements to warn and guide traffic around, past, or through a work site or temporary hazard, and how short term, mobile work and traffic situations will be managed. • Responsibilities of people managing traffic in the workplace, responsibilities of people expected to interact with traffic in the workplace, and instructions or procedures for controlling traffic including in an emergency will also be included by the contractor.				
Biodiversity Management and Flow Management (to be clarified through a Biodiversity Assessment)						

Construction Phase Risk Mitigation Measures						
Aquatic biodiversity **Works within habitats**	Biodiversity loss and ecological flow limitations	• The contractor will ensure the parameters contained in the BMP, annexed to this ESMP, are implemented during the construction period. Consistent with the content in the BMP, the contractor will ensure the communities is sensitised/trained and will avoid exploitation of biological resources. Contractor will review the content of the BMP regularly and update its workforce accordingly to ensure compliance. Specific method statement for works will include: ○ Location of the specific works; ○ Any details obtained in the pre-works services; ○ Explicit details of mitigation measures which should be applied in the area; ○ Details of any specific construction practices which should be applied in the area to protect biodiversity; ○ Details of any timing restrictions which apply to works in the area; ○ Restoration details for the habitats within the area where the method statement applies. • As guided in the BMP, the contractor is required to ensure that all employees receive appropriate training in relation to biodiversity issues, so that the activities do not generate impacts on biodiversity. • Making reference to the BMP, the	Construction Phase Daily	• Number and extent of undisturbed areas • Species register • Flow measurement inclusion • Water quality results • Training registers and species protection regulations	Contractor Engineer and HSSE Officer UNOPS/ IDSP/ Fisheries Forestry	HSSE Officer Cost 2000/month UNOPS ecologist consultant costs

Construction Phase Risk Mitigation Measures						
		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 ensure they implement the proposed measures as guided in the BMP annexed to this document The contractor is required to ensure that all its employees receive appropriate training consistent with the contents of the BMP annexed to this ESMP so that the activities do not generate impacts on biodiversity • Consistent with the BMP, the contractor will avoid clearing unnecessary areas for works and disturbances to the habitat and ecology. Wherever possible the felling of significant/mature trees will be avoided and connectivity between areas of forest habitats will be maintained. • In the event that trees are cut to provide access to some infrastructure at the dam or when setting up a campsite, the Contractor will record the number of trees cut for purposes of making a replacement at the right time, in consultation with the forestry department. • Consistent with the directive in the BMP, the contractor will take measures to avoid wildfires, and any use of firewood from the cutting of trees around the dam. The	Construction Phase Daily	• Rehabilitation records and extents • Extents and number of disturbed sites and species • Maintain a fauna sighting and fatality register. Conduct regular monitoring of works to ensure compliance • Training records and fauna register • Vegetation cleared only in worksites	Contractor Engineer and HSSE Officer UNOPS/IDSP/ Fisheries Forestry	HSSE Officer Cost 10000 UNOPS ecologist consultant costs

Construction Phase Risk Mitigation Measures						
		contractor must organise alternative energy sources. • The contractor's works, rehabilitation of roads, operation of material sites and campsites should minimise on destruction of terrestrial biodiversity. • Contractor will prepare site specific measures to enhance conservation of biodiversity/ habitat sites. Specific method statement 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		Number of trees cut and their details recorded for replacement (biomass equivalent) at rehabilitation phase		
Community Health and Safety						
Lack of health and safety measures	Community health risks which include accidents, injuries and	• The contractor will install safety signage around the dam reservoir, embankment, crossings, material sources, roads, depressions, pits and other sensitive sites. • The contractor will monitor traffic and	Construction Phase	• Adequacy of safety signage • Training records • Refer to the technical	Contractor Engineer and HSSE Officer UNOPS/ IDSP	HSSE Officer Cost 15000

Construction Phase Risk Mitigation Measures						
	drowning in open sites such as borrow pit	road safety throughout the operations in order to maintain a safe working environment, including that workplaces, machinery, equipment and making sure processes under their control are safe and without risk to health. • The contractor will sensitise communities on safety and response, including sensitise communities on vector and waterborne diseases prevention and management. • The contractor will decommission stagnant water points, provide good quality drinking water, and practice hazardous waste management to promote health. • 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/ 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.		safety reports	Ministry of Health	
	Contamination of water in the reservoir as a result of poor farming practises and open	• The community living close to the dam, including those upstream shall be sensitised on the importance of having own latrine and avoid open defecation.		• Water quality free of coliforms. All parameters within the WHO limits	Ministry of Health & Ministry of Agriculture	

Construction Phase Risk Mitigation Measures						
	defaecation upstream					
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, contractor is expected to have the technical capability to manage the occupational health and safety issues of their employees, extending the application of the hazard management activities through formal procurement agreements. Preventive and protective measures should be introduced according to the following order of priority: ● Eliminating the hazard by removing the activity from the work process. Examples include using an alternative that is less harmful, etc. ● Controlling the hazard at its source through use of engineering controls. Examples include machine guarding, acoustic insulating, etc; ● Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc. ·	Construction phase	● Training of workers, record in place ● All workers in rightful PPE ● Good house keeping	Contractor Engineer and HSSE Officer	HSE Officer Costs

Construction Phase Risk Mitigation Measures						
		• Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE. • The application of prevention and control measures to occupational hazards should be based on comprehensive job General EHS Guidelines. • COVID-19 spread at the construction site to be mitigated through attached plan (see appendix D)		• Emergency preparedness and response plan for occupational emergency situations • Report on COVID-19 mitigation plan implementation		
Gender Equality and GBV/SEA						
Gender Mainstreaming	Work force does not have gender parity	• The contractor will endeavour to recruit 50% women among their locally recruited workforce.	Construction Phase	• Contractor recruitment plan includes 50% women	Contractor UNOPS	
GBV/SEA	Sexual Abuse, Exploitation (SEA) and Harassment of work force vis-à-vis the local communities	• The IDSP and UNOPS will conduct stakeholder consultations held with a focus on GBV/SEA and child protection risk. • The contractor will ensure that all workers understand and sign a Code of Conduct (CoC) that reference zero tolerance in regards to GBV/SEA/SH. This also includes consultants and suppliers. • All CoCs will be disclosed through appropriate means (see SEP) – including in the local languages. • The contractor will ensure community and stakeholder awareness on GBV/SEA and child protection response mechanisms. • UNOPS to train senior GRM staff in GBV/SEA appropriate responses and	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	Contractor UNOPS / IDSP	Gender Consultant UNOPS, 16.000/year

Construction Phase Risk Mitigation Measures						
		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 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		risks and obligations • Community awareness 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						

Construction Phase Risk Mitigation Measures						
Labour and Working Conditions	General Risks and Impacts	• Contractors to recruit local workers where possible • IDSP will establish and implement effective GRM (including address of GBV cases). • Adequate Occupational Health and Safety requirements. This will be in compliance with the local Factories Act and OSHA Act. This includes complying with the safe working conditions and safe acts on site. • The contractor will incorporate strict COVID-19 prevention and management measures (See Appendix D and F)	Construction Phase	• At least 60% of workforce at dam site is locally recruited • Contracts contain labour influx provisions • All workers have signed a Code of Conduct	Contractor UNOPS / IDSP	Included in GRM costs (not specific for labor influx UNOPS staff costs Contractor budget (awareness sessions in communities and for workers): 5.000 USD / 6 months
Labour Influx	Conflicts between local community members and workers based on cultural differences	• UNOPS/IDSP will conduct local community consultations during the sub-project design and implementation stage, as per SEP • The contractor will disseminate rigorous information dissemination about sub-project details and GRM, as per SEP (see below) • This will include awareness raising among local communities and workers • The contractor will provide information on CoC (in local languages) • Contractor to conducts cultural sensitization of workers	Construction Phase	• Monthly reports received on consultations and key issues identified • Information on CoC has been translated in local language • 100% of workers from outside have received training	Contractor UNOPS	UNOPS staff costs / travel budget of Safeguards staff 20.000 USD / year Contractor budget (costs for awareness sessions / training 5.000 USD / 6 months
Conflicts	Conflicts between workers, based on cultural or other differences	• The contractor will design and implement a workers' GRM	Construction Phase	• Monthly reports on Workers' GRM received • Reports received on Workers' GRM	Contractor UNOPS	Contractor budget Staff costs and travel budget

Construction Phase Risk Mitigation Measures						
	Risks of disagreements between local workers and employers	• The contractor will operate workers' GRM				
Labour Influx	Increased risks of communicable disease, e.g. HIV/AIDS, STDs	• The contractor will implement awareness raising on HIV/AIDS and STD for the workforce	Construction Phase	• Every workers has received training	Contractor UNOPS	Contractors' budget (training costs, awareness raising in community costs, translation costs for COC) 5.000 USD / 6 months
Decommissioning and Rehabilitation Measures (Structured management to minimise environmental risk of dam construction impacts)						
Erected infrastructure **Demobilization of the contractor's services and equipment used in performing the work required under the contract**	Residue impacts Aesthetic impacts Safety hazards	• The contractor will review of the types of activities carried out on the site, including material extraction, machinery, buildings erected, waste handling and recovery operations. • The contractor will conduct identification of potential hazards, including an evaluation of the raw materials and waste products typically stored on-site, site hydrogeology, ecological effects, control measures for dam safety to prevent incidents, all items of plant and other materials, including buildings that may be decommissioned, rendered safe or removed from site for disposal or recovery in the event of 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 40,000

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

Construction Phase Risk Mitigation Measures						
		acceptable material (approved by the supervisor's E&S 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	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
		at three trees per one removed tree. Local/ native species are indicated in this ESMP. • The contractor will ensure alternative and safe crossing is installed at the dam during construction period. • 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 that the rehabilitation plan will be in the contractor's site method statement and management plan • The contractor will implement rehabilitation and monitor effectiveness over three years.				
Campsite	Land use and aesthetics	• The contractor will remove all campsite facilities retaining those that need to be handed over to the community /DMC (if there will be any), for use. After accomplishing the dam construction works and before handing over, the campsite should be rehabilitated in an environmentally sound and acceptable manner to satisfy ZEMA regulations.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Contaminated materials and hazardous waste	Soil and water Pollution safety hazards	• The contractor will conduct detailed site inspections and prepare a snag list. Prepare snag list defining each area where remedial action is necessary, including location of waste oil drums and/or other hazardous chemicals, location of oil-	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer Supervisor/ PIU	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
		contaminated soils and the required actions • The contractor will where possible return some materials to the suppliers, e.g. diesel and disinfectants for resale or reuse. The remaining materials be disposed of as waste, some of which may be deemed hazardous waste due to their composition e.g. oils. Such materials will be disposed of off-site in accordance with appropriate waste management regulatory requirements and facility waste management procedures. Soil contaminated with hydrocarbons will be excavated up to clean material beneath the base of the to the contamination plume and bio-remediated in a land farm. Where the contamination plume is shallow, 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	Construction Phase	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
		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.	After conclusion of works		UNOPS/ PIU	
Stock piling	Land use and aesthetics safety hazards	• The contractor will ensure that all heaps of overburden material should be used to back-fill the borrow pits and the sections properly levelled to suit the natural landscape. • Stock-pilling/preservation of the felled trees - The recommended practice is that the contractor is required to stockpile all the felled trees. There will be no burning of burying any felled trees.	Construction Phase After conclusion of works	• Rehabilitated and restored site	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Reservoir Water Quality	Ecological services and aesthetic impacts	• The contractor will set up a designated livestock area on the upstream that will be stone pitched for controlled livestock movement and watering to prevent soil movements. • The ground will be prepared and then pitching will be done before vegetation is planted.	Construction Phase	• Livestock watering area at the basin	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Embankment fencing **Embankment structural works**	Forest cover loss threats Embankment failure	• The contractor will install metallic poles in a liner fashion for the animal barricade at the ends of the embankment wall to replace the temporary log fencing. • The contractor will completely dig out ant habitants and their tunnels exposed and	Construction Phase	• Permanent fencing to keep animals away from the embankment	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost

Construction Phase Risk Mitigation Measures						
		broken down then backfill and compact with suitable fill material				
Environmental Flow	Ecological flows	• It is likely that during the construction period, the dam will not have any downstream flows from the reservoir as construction will likely be done during the dry season. However, should rehabilitation works cause environmental flows downstream, this will need to be monitored. In this case, the contractor will install the user friendly durable flow gauge for regular flow measurements. • UNOPS will conduct training for the DMC on flow reading and management. • A rock toe will be incorporated into the design of the downstream embankment drainage. A suitably sized rock toe should be considered to be incorporated into the remedial design. This should have a double filter layer along its intersection with the current downstream face at the toe to allow for safe drainage.	Construction Phase	• Training and flow monitoring	Contractor Engineer and HSSE Officer UNOPS/ PIU	In rehabilitation cost
Covid 19 Pandemic	Spread of Covid-19 pandemic among the workforce and the local community	• The contractor will provide and implement relevant COVID-19 guidelines for all the workers to follow in the quest to avoid/prevent the spread of Covid-19 among the workforce and the local community. This will be consistent with the provisions in the WHO and Zambia's Public Health Regulations on COVID-19 management.	Preparation and construction phases	• Sensitization and actual provision of sanitizers and face masks.	Contractor Engineer and HSSE Officer	In rehabilitation cost

Operation Phase Risk Mitigation Measures						
Aspect	**Impact**	**Mitigation measure (prevent, reduce, mitigate, and compensate)**	**Time frame/ frequency of monitoring**	**Monitoring Performance indicator**	**Supervision and Operation Responsibility**	**Cost USD**
Non Hazardous Waste Management						
Construction and Operation activities	Waste releases from local communities Public health and safety hazards Potential waste types include domestic solid waste due to activities around the dam- plastics, containers, boxes, papers	• The DMC will be trained on household waste management. There will be no disposal or storage of waste at the Nabowa dam site.	Operation Phase	• Properly designated waste collection and disposal points • Training/ sensitization records • Waste disposal records and logs • 100% of sites are cleaned up	DMC/ Water User Committee Ministry of Agriculture DWRD	500/month
Hazardous Waste Management						
Operation activities- pest management, fertilisers	Hazardous waste generation and releases into the environment- Chemicals	• IDSP, Ministry of Agriculture, Department of fisheries will train the communities on operation activities that minimise pollution of water. These are outlined in the capacity and training program.	Operation Phase Monthly	• Non-polluting farming, animal watering and fishing methods (e.g. farmers not to push nitrate-based fertilizers into the surface water/dam) are applied • Training/ sensitization	DMC/ Water User Committee Ministry of Agriculture DWRD IDSP	100/month

Operation Phase Risk Mitigation Measures						
				records, 100% • Water quality monitoring records		
Surface and Groundwater Pollution Management						
Livestock watering and activities in the water	Siltation Poor water quality	• The IDSP will conduct and promote community farming methods that will not pollute the water- chemicals or runoff and soil erosion. • The Department of Forestry, Community Development, Water Resources and IDSP will conduct catchment management sensitisations during community trainings to promote raw water quality in all catchment sources, review land use practices/ social needs, biodiversity conservation and minimise run off on a catchment scale. This will focus on creating a catchment management scheme. • Communities will continue sensitizing the farmers on catchment management practices, stock watering control and soil conservation.	Operation Phase Quarterly	• Water quality results from the dam and main tributaries in the catchment • Pollution control structures • Training and sensitisation records	DMC Ministry of Agriculture Forestry IDSP	Once off- 20,000 700/month
Sanitation Management						
Community sanitation	Environmental pollution, public health risks	• The community will be trained in the impacts of open defecation.	Operation Phase	• Existing adequate sanitary facilities	DMCs Ministry of Health	500/month
	Breakout of water borne disease as a result of poor	• Sensitisation of the local community both those living upstream of the dam and those living around the dam, using a programme	Construction and Operation Phase	• Records of sensitization programme stating	During Construction	**7000**

Operation Phase Risk Mitigation Measures						
	sanitation practices by communities living upstream of the dam	called Community Led Total Sanitation Programme (CLTS). This programme compels the members of the community to have atleast a toilet per household. This in turn reduces and completely stops open defecation by the same community members.		where sensitisaion took place, how many of these programmes, name and number of villages attended.	IDSP working with Ministry of Health During Operations Ministry of Agroculture 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 sensitise the community on appropriate use of the infrastructure to avoid and minimise failure. It will carry out regular inspection and maintenance of the infrastructure, and maintain the infrastructure and safety measures. • IDSP will train DMC on use, maintenance and monitoring requirements.	Operation Phase Quarterly	• Training records • Inspection records • Maintenance records	DMC IDSP	3000/year
Biodiversity Management and Flow Management						
Aquatic biodiversity Operational activities	Biodiversity loss and ecological flow limitations,	• The BMP will be implemented accordingly to ensure appropriate measures are put in place for biodiversity conservation purposes to the extent possible	Operation Phase	• Ecological flows monitor • Relevant quantity, quality and timing of	DMC Fisheries	10000/year

Operation Phase Risk Mitigation Measures						
	population increases	• Maintain ecological flows all year round and integrity of the ecological function • UNOPS to increase basin water holding capacity by rehabilitating the structure in order to enable constant downstream flows and basin water levels. Otherwise the basin may run dry. This would also relocate the aquatic species from the dam. A system for equitable allocation of water is based on available supply. • Include gauge levels monitoring facilities. DMC to strictly monitor inflows, retention water and outflows in order to have a balanced system. • UNOPS to include outlet infrastructure for downstream flows. • DMC to monitor the erosive capacity of the streams downstream for sediment barrier occurrence upstream. • DMC to monitor flow level changes downstream. Natural flows and dam controlled flows. • Communities to protect vulnerable and endangered species. • Avoid exploiting biological use of resources and invasive methods. • Secondary developments to take aquatic biodiversity into consideration.		water flows required to sustain ecosystems and the human livelihoods and well-being that depend on these ecosystems in the downstream region.	Forestry UNOPS IDSP	
Loss of fish in the dam, which is of	Food insecurity	• Ministry of Agriculture working with Department of Fisheries to train the community and DMC that benefit from the ecological value of the dam so they can	Operations Phase	• Training records showing number of persons trained and when	Ministry of Agriculture;	**6000**

Operation Phase Risk Mitigation Measures						
conservation concern		learn sustainable fishing skills and preserve the fish juveniles in the shallow waters			Department of fisheries	
Terrestrial biodiversity, operational activities	Biodiversity and habitat loss	• The BMP will be implemented • Active control of invasive and alien species after trainings by government departments. • The community will incorporate catchment management measures habitats around the dam. Avoid displacements and over exploitation of species	Operation Phase	• Biodiversity conservation measures in place	Fisheries Forestry Ministry of Agriculture	1500/year
Communication and Community Engagement						
Communication to Stakeholders	During operational phase, dam is not managed well by local communities	• IDSP to train DMC in E&S issues indicated in the UNOPS and contractor training plans.	Operations Phase	• DMC exists • DMC has been trained	IDSP local authorities	5.000
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,	Operation Phase	• Inspection reports • Training records • EPP revisions and reviews • Safety signage Plan and records • Refer to the technical safety reports	DMC Ministry of Agriculture DWRD IDSP	2000/year

Operation Phase Risk Mitigation Measures						
		prevention and response, reporting faults and security measures at the dam.				
Dam Catchment Management						
Catchment Management	Excessive rates of erosion and sedimentation	• The IDSP will ensure the DMC and the Officers from Government departments such as Water andn Agriculture are appropriately oriented to appreciate the contents of the O&M Manual, use and benefits, for sustainable management of the dam catchment area.	Operation phase	• The following personnel trained in the implementation of the O&M; - DMC, - Waters Affairs - Agriculture • Camp site officer	IDSP DWRD DMC	Included in training costs above
Gender Equality and GBV Action						
Gender Mainstreaming	DMCs do not have female members	• UNOPS will define gender parity in constitution of the DMC and include gender equality training in the training of DMCs.	Operation Phase	• DMCs have 50% female members	UNOPS	Included in training costs above
Maintenance and Monitoring Management						
Dam maintenance	Structural deterioration Dam Management	• The IDSP will conduct further DMC trainings on dam maintenance and dam safety. • The DMC will ensure incidents are reported to the resident IDSP staff and 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	Operation Phase Bi annual	• DMC Quarterly meetings and resolutions • Flow measurements and action plans • Training records • Dam maintenance records and monitoring records • Refer to technical safety reports	UNOPS IDSP DWRD DMC	3000/ year

Operation Phase Risk Mitigation Measures						
		Dam maintenance works done by the department and by the community.				
Catchment management	Excessive rates of erosion and sedimentation	• The IDSP will ensure the DMC and the Officers from Government departments such as Water and Agriculture are appropriately oriented to appreciate the contents of the O&M Manual, use and benefits, for sustainable management of the dam catchment area.	Operation phase	• The following personnel trained in the implementation of the O&M; - DMC, - Waters Affairs - Agriculture • Camp site officer	IDSP DWRD DMC	Included in training costs above
Monitoring measures	Lack of monitoring	• IDSP will conduct water quality measurements for parameters indicated in this ESMP. • IDSP will conduct and follow up on flow measurements. • The Ministry of Fisheries and Forestry will conduct biodiversity monitoring as indicated in the BMP.	Monthly	• Refer to the biodiversity assessment • Monitoring records • Pictures • Training records • Flow measurements • Water quality results, monthly The monitoring parameters will include biological, physical and chemical drinking water quality parameters. These will include parameters analysed in this ESMP: pH, conductivity (µg/cm), sulphates (mg/l), nitrates (as no3-n mg/l), total dissolved solids (mg/l),	UNOPS IDSP DWRD DMC	4000/ year

Operation Phase Risk Mitigation Measures						
				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.		
Waterborne diseases and fishing practices	Poor community health and extinction of fish species	• Government to provide deliberate programmes aimed to educate the communities affected, with the best practises in regards to ensuring there are no pads around their community and also to ensure good fishing practises are well inculcated in their minds.	Monthly	• Number of engagement programmes held on the topic	Ministry of Health and Ministry of fisheries	USD 10,000

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 large extent covered in the actual remedial design works, and hence the discussion in this section is limited to aspects which are non-structural. This Rehabilitation Plan is prepared in reference to the ESA Table 9-2 'Requirements for rehabilitation plan', which provides guidance for rehabilitation specifications for embankments, borrow pits, access roads / tracks created during past construction/ and any areas of downstream erosion/embankment destabilization that has been caused by the previous construction works and the initial operation of the dam.

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

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

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
Structural risks						
Spillway	Location: Images: Section 5 'Dam characteristics' Open unstable and/ or eroding slopes Risks: structure failure, soil loss	Refer to the dam design reports	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Rock quantities 300m^3	Contractor liability period Site inspections Pictures Continuous maintenance	Trimmed, extended and stabilized slopes Gullying and erosion protection	In BoQ

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
			Equipment: Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator *Workmanship* Up to 5 machine operators and 15 laborers as per above and up to 4 months for the equipment			
Return channel drop structures and training wall risks	Open soils and unstable Risks: Gullies and erosion in the return channels Erosion risks on drop structures	Refer to the dam design reports.	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earth works: Sand, quantities 100m^3 Rock, quantities 200m^3 Crusher runner from a commercial quarry , quantities 100m^3 Equipment: Backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship* Up to 5 machine operators and 15 laborers as per above and up to 4 months for the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated walls and adequate gabion presence	In BoQ

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
Embankment crest and slope stability risks	Exposed soils and unstable slope Risks: Erosion hazard and embankment stability Embankment weakening.	Refer to the dam design reports.	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Sand, quantities 150m^3 Rock, quantities 300m^3 Crusher runner from a commercial quarry , 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 6 machine operators and 12 laborers as per above and up to 4 months for the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated walls and adequate gabion presence	In BoQ
Rock toe risks	No rock toe present for seepage control Risks: Weakening of side slope	Refer to the dam design reports.	*Timing:* Commencement of contraction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Rock, quantities 200m^3	Contractor liability period Site inspections Pictures Continuous maintenance	Rehabilitated walls and adequate gabion presence	In BoQ

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
			Equipment backactor; tractor dumpers; and haul truck for materials as well as a concrete mixer and poker vibrator. *Workmanship and timeline:* Up to 6 machine operators and 15 laborers as per above and up to 4 months for the equipment			
Non-structural risks						
Waste and rubble snag list	Not present on site					
Hazardous waste snag list	Not present on site					
Borrow site	Location: Southern front of the Dam reservoir is the area where gravel material was sourced from including the sites along the spillway return channel. The site needing revegetation may measure around 40mx60m Coordinates: Immediate south of the dam reservoir	Include earthworks, rehabilitation of the sites to promote drainage, aesthetic uniformity, and revegetation by seeding and natural succession vegetation, slopes and safety. Plant native seeds in addition to the replacement of top soil to ensure coverage. Construct appropriate surface slopes with drainage channels to prevent water from collecting at the site. Final slopes within the site will be a maximum horizontal to vertical slope (H:V) of 3:1 or 33% grade. Ensure drainage to avoid accidents and public health risks. Stabilize areas of disturbance and steep slopes.	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Construction Contractor Supervisor: UNOPS Remedial works will include earth ripping to enable regrowth of natural vegetation. Assisted vegetation (seeding and soil fertilization with watering) will be included on all sites to supplement possible natural vegetation. The unnecessary roads should be closed by scarifying the roadway, ripping and recontouring.	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Contouring Drainage Stabilized slopes Desired landform	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
	-14.4724" Lat, 24.4782" Lon; Images: Section 4.1 Risks: community health and safety , biodiversity loss	Implement reinstatement by natural succession together with full cover assisted vegetation seeding interventions, which will require intense monitoring and maintenance within the 3 years maintenance period. This will include sub-base preparation, top-soiling, fertilizing and seeding for each area which requires rehabilitation.	Re-establish natural drainage patterns on the closed roads. *Materials and equipment* Earthworks Spoil Soils for top soiling within the borrow area stockpiles Grass seeds- approved noncompetitive native species Watering equipment Fertilisers/ soil fertility promoters Equipment Backactor; tractor dumpers; and haul truck *Workmanship and timeline:* up to 6 machine operators and 5 local workers for less than 4 months.			
Access routes	Location and Condition of the sites: 1 existing gravel road (about 2.5m wide) leading to the dam. This is about 400m. Risks: biodiversity loss	Rehabilitate and close the road, which will not be used by the current contractor. Include earth ripping to enable possible regrowth of natural vegetation, even as assisted vegetation will be implemented on full coverage of the areas. Close unnecessary roads by scarifying the roadway, ripping and recontouring. Create an environment supporting over ground with natural regeneration	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Limited gravel utilizing existing surface to form with a grader and tractor dumpers Grass seeds- approved noncompetitive local/ native species	Contractor liability period Site inspections Pictures Continuous maintenance during the 3 year maintenance period	Ripped roads for revegetation Revegetation	In provisional sum Day works

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
		to support the assisted vegetation. Assisted vegetation will included seeding, watering and maintenance of locally adapted vegetation. Re-establish natural drainage patterns on the closed roads.	Watering equipment Fertilizers/ soil fertility promoters *Workmanship and timeline:* 4 Operators and 8 laborers as per above equipment 4 days per equipment			
Eroded and disturbed areas	Open areas around the basin, the spillway drop structures area and the area used as a site camp. Risk: dam basin siltation, poor water quality contribution, limiting water use, soil movements and loosening possibly resulting in sedimentation	Implement reinstatement by natural succession with assisted vegetation seeding interventions, which will require intense monitoring and maintenance within the 3 years maintenance period. This will include sub-base preparation, top-soiling, fertilizing and seeding for each area which requires rehabilitation. Develop a costed method statement for disturbed sites. Designate livestock watering points and promote soil 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.	*Timing:* day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Earthworks Compacting, stone pitching material and native vegetation seeds for soil stabilization method Concrete trough, pump, tank Tractor dumpers; and haul truck for materials *Workmanship and timeline:* 10 laborers and 1 month use of the equipment	Contractor liability period Site inspections Pictures Continuous maintenance	Soil stabilization and livestock watering points	In provisional sum Day works
Community health and Safety	Lack of safety signage around the dam	Include a method statement for the design of signage and location mapping. This will be approved by the supervisor. Apply design-	*Timing:* Day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period	Contractor liability period Site inspections Pictures	Training records in all stipulated topics	In provisional sum

Aspect	Condition/ risks	Remedial measures	Schedule for Implementation	Monitoring	Performance indicators	Estimated Cost
	Lack of safety and health sensitization over the dam Risk: accidents and waterborne diseases due to lack of knowledge and signage warning	approved standard dam safety signage around the dam and contractor sites for construction and operational phases. Finalize and administer the community sensitizations and training planned in the ESMP. These include drinking water health, water borne diseases, avoidance of dangerous spillway crossings, swimming risks, emergency preparedness in floods or dam failure, EPP, safety signage, etc...	Implementation Role: Contractor Supervisor: UNOPS *Materials and equipment* Training plans Signage design and subcontractor Signage installation *Workmanship and timeline:* One trainer persons Signage installation 3 laborers	Continuous maintenance DMC regulation	Existing correct signage Signage method statement	Day works
Flow gauges	Downstream flows	Flow monitoring	*Timing:* day works-Commencement of construction activities so that recovery is demonstrable by the end of the contractor's liability period Implementation Role: Contractor, DMC Supervisor: UNOPS *Workmanship and timeline:* 1 operator and 4 laborers Equipment: concrete mixer and poker vibrator equipment	Contractor liability period Site inspections Pictures Continuous maintenance and biodiversity monitoring	Installed monitoring gauges Training records	In provisional sum Day works

Implementation Role: contractor, DMC
Supervisor: UNOPS

8. Capacity Building

Community / Stakeholder Health and Safety training plan

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

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

Monitoring of training will be conducted by the IDSP and UNOPS by reviewing the training materials, filing training records and noting feedback and following up on recommendations/ action 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 14[27]:

Table 11: 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*	5 after ESMP disclosure prior to construction works Repeated after 3 months and at completion	5 after ESMP disclosure prior to construction works Repeated after 3 months and at completion	100 community members 15 District DMMU members DMC

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

Training Content	Number of Days, Time, Frequency	Trainers / Supervision	Participants
maintenance and ESMP monitoring *First aid: First aid basics and response*			
Estimated Costs: 2,000 USD per session			
Grievance Redress Mechanism and ESMP monitoring requirements			
KeytTraining concepts: sharing of the ESMc by IDSP/ Contractor to the stakeholders	2	UNOPS: Environmental Specialist Environmental Health and Safety Specialist Dam Safety Specialist IDSP: Dam Safety Specialist Environmental Specialist	18 district officers 2 officers from each of the following Departments: • Town Council • Ministry of Chiefs and Traditional Affaires • DWRD • Ministry of Health • Forestry Department • Ministry of Gender • Community Development • Ministry of Fisheries and Livestock • Ministry of Agriculture
Estimated Costs: 1,500 USD			
Dam operation activities			
Key training concepts: fishing regulations, species, fisheries conservation, catchment management, environmental protection, forestry regulations and	3 at works commencement and repeated annually	UNOPS: Environmental Specialist Environmental Health and Safety Specialist Government: Agriculture Fisheries Forestry	100 community members

Training Content	Number of Days, Time, Frequency	Trainers / Supervision	Participants
biodiversity conservation measures, dam sustainability, nurseries, farming methods and dams, sustainable irrigation, pest management, water pollution, crop selection, soil conservation methods		Community Development IDSP: Dam Safety Specialist Environmental Specialist	
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 recognise the diverse and varied interests and expectations of stakeholders and seek to develop an approach for reaching each of the stakeholders in the different capacities at which they interface with the sub-project. The aim is to create an atmosphere of understanding that actively involves project-affected people (PAPs) and other stakeholders leading to improved decision making.

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

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

9.1 Grievance Redress Mechanism

Stakeholder engagement includes access to a Grievance Redress Mechanism (GRM) implemented by IDSP. The GRM is designed ensure that feedback can be received in relation to the remedial works for the Nabowa Dam. It is set up to respond to concerns and grievances from 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.

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

9.2 Stakeholder Participation

The preparation of the ESMP has relied significantly on local level stakeholder engagement 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 Nabowa dam communities are stated below:

Department /Organisation	**Concerns /Input**	**Response**
General		
Community members	Reported that water from the dam does not get to overflow from the spillway to downstream areas. They expressed concern that the people living downstream of the dam may be cut off from accessing water from the overflows.	The community was told that once the rehabilitation works are completed, the issue at hand will be resolved.
Community members	As regards compensation, the community indicated that they have been partially compensated. One of the community members stated that Cash Compensation was done and that only the aspect of land for land compensation remained incomplete.	IDPS informed the community that compensation was completed.
The Area Councillor	The Councilor expressed concerns over the manner in which the contractor treated its workers, mostly those from the local community. They cited examples such as late payments of workers. The community is therefore requesting that a good contractor be found and complete the remaining jobs amicably.	The community was assured that the new contractor will be monitored to ensure the law is adhered to and this includes the labour laws both local and international.

Department /Organisation	Concerns /Input	Response
DMC members	***The need for the dam***: There was an indication that the dam water will mostly be used for irrigation purposes to grow the following crops; ▪ Growing vegetables such as cabbage, rape etc ▪ Cultivating maize, sweet potatoes, groundnuts, velvet beans, etc	The project team noted this contribution.
Community members	As regards access to drinking water, the community indicated they draw their water from one of the two springs upstream. This is where the community does its house chores such as washing. The biggest worry with this practice, the site being upstream of the dam, is the washing down of soap which has a negative effect on ecological processes.	The community was informed about the pending assignment through the council to drill boreholes in the area.
Community members	The community is looking forward to the commencement of the planned rehabilitation works. They also look forward to work in harmony with whichever contractor will be engaged to complete the works.	The project team assured the community that they will work in harmony with the contractor that will be appointed to deliver this work.

9.3 Stakeholder Communication Plan

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

Table 12: Stakeholder communication plan

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

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

9.4 Stakeholder Consultation Plan

In addition to information dissemination, the sub-project will ensure consultations of 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, DMCs and district authorities Venue: community meeting venue at the dam Time: June 2020 and April 2021	local headmen, DMCs 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	Community meetings (all interested community members)	Community level stakeholders	UNOPS
		Suggestion box at district office, school, church	Community members, including vulnerable groups	IDSP Social Specialist
		Stakeholder meetings – with social distancing	DMC and district level stakeholders	UNOPS
		email	National level stakeholders	UNOPS

	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	DMC, local headmen, and District Disaster Committee to receive feedback in person	Community level stakeholders, including vulnerable groups	IDSP Social Specialist
		email	National level stakeholders	UNOPS

9.5 Proposed Strategy to incorporate the Views of Vulnerable Groups

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

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

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

9.6 Reviews of Comments

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

10. ESMP Implementation Process

Step 1: Procurement and Bidding Process

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

Step 2: Contractor Management

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

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

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

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

of their workers;

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

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

Step 3: Monitoring and Reporting Structures

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

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

The contractor must report on all HSSE matters related to this ESMP to UNOPS on a monthly basis. UNOPS will administer the monthly reports from the contractor, and will prepare its own quarterly reports, based

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

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

Step 4: Incident Reporting

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

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

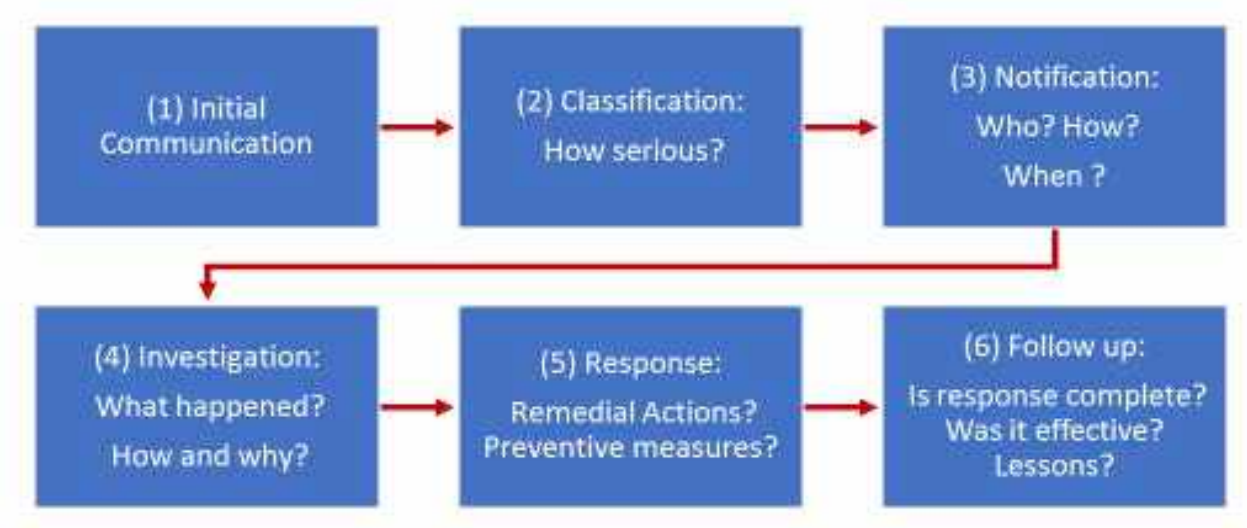


Figure 22: Incident reporting process

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

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

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

Step 5: Handover for Operation

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

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

References

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

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

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

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

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

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

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

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

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

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

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

World Bank, Climate Portal: Zambia; accessed at: https://climateknowledgeportal.worldbank.org/country/zambia

Appendix A: Completed Checklist

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

1-Date of the visit: 16th and 17th July 2020			
Name of the Environmental Specialist filling this checklist: Titus Chilongo			
Job Position: HSSE Analyst			
Have completed training in the Environmental and Social Safeguards of the World Bank: Yes / No…Yes			
Have read the Environmental and Social Audit report and the ISDS prepared for the Additional Financing of the project: Yes / No…a Yes			
Have you read the information available of this dam: Yes / No…Yes			
Note: if you marked No in any of these questions, you are not ready to fill this checklist. Please coordinate with the PIU team to provide you with these reports.			
2-Information about the Dam			
Name of the Dam: Nabowa Dam			
Location Kaoma	**Region** Western Province	**District** Kaoma	
Villages /communities	Nabowa		
Geographical location	**Coordinate South** 14°28'18.97''	**Coordinate East** 24°28'37.79''	
3-Remediation works- please indicate the main proposed works that could cause environmental and social impacts			
Slope works	Material sourcing	Access routes	
Outlets	Erosion/ soil loosening		
Infiltration	Site preparations/ clearing		
Other	Waste management		
4.MATERIALS NEEDED			
Does the project need aggregate or a new borrow pit	Yes		

Indicate potential sources to buy or extract the construction materials:	Within Kaoma	
Aggregates	Within Kaoma	
Sand/ clay	Within the Community	
Wood	Not Applicable	
Diesel for transportation	Kaoma Town	
Water source for the construction	Within the Community	
Water source for drinking for workers	Within the Community	

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

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

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

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

7-LEGACY ISSUES /REMEDIATION	
PLEASE INDICATE. Any of these legacy issues that are environmental legacies that need to be resolved by the project, costed and included in the contract of contractors. Recommend measures so the engineering team can include them in the remediation plans.	
Legacies	**Measures to be included in the ESMP**
o **Solid waste (Wood, plastic, etc)**	
o **Hazardous wastes (diesel containers, old machinery, batteries, paints, metals, contaminated waters or soil,**	
o **Borrow pits**	Decommissioning and rehabilitation of a borrow site
o **Unsafe paths**	Rehabilitation of former contractor roads and road access used during construction of the dam
o **Rehabilitation of degraded sites**	Revegetation of the degraded area used as a camp site by former contractor
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 (you need to coordinate) **Yes** **No** 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 yet to be concluded early January.
Are people using the water below the dam? What for?	Not at all. Water does not flow beyond the spillway.
Based on these findings, please indicate if it is possible to install a structural solution to improve the ecological flow **No** **Explain:**	**Yes Explain:** If the spillway return channel is leveled and its elevation lowered. **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 (BEMP)**	
10-Final recommendation	
Name: Titus Chilongo	**Date: 6 June 2021**
Signature: 	
Comments for the preparation of the ESMP and BAP incl. Ecological flow measures. Detailed environmental and social studies and inclusion of such matters in the designs. Further Ecological surveys	
Field visits registration	
Photo: Spillway elevation higher for overflow to take place. Spillway has not been in use since the dam was construction.	Photo: Basin vulnerable to sedimentation. Surrounding wall prone to erosion.

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[28]

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

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

General

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

Travel to sites

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

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

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

Site Access Points

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

Communication and awareness

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

Canteens and Eating Arrangements

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

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

Changing Facilities, Showers and Drying Rooms

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

Avoiding Close Working

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

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

Site Meetings

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

Cleaning

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

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

Procedure in case of contagion

Any worker with symptoms of the COVID-19 should:

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

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

UNOPS Construction Site Supervision

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

Field Offices < 6 People and Field Monitoring

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

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

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

Short monitoring/handover missions (for multiple sites)

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

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

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

IRRIGATION DEVELOPMENT SUPPORT PROJECT (IDSP)

COVID-19 Response Planning and Monitoring

August 21, 2020

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

Appendix E: Template for Conditions of Contract

DIRECTION TO IMPLEMENT HEALTH AND SAFETY MEASURES - COVID 19 EPIDEMIC

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

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

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

Yours faithfully

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

Appendix F: Attendance Sheets Stakeholder Consultations and DMC List

IRRIGATION DEVELOPMENT SUPPORT PROJECT

ATTENDANTS LIST

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

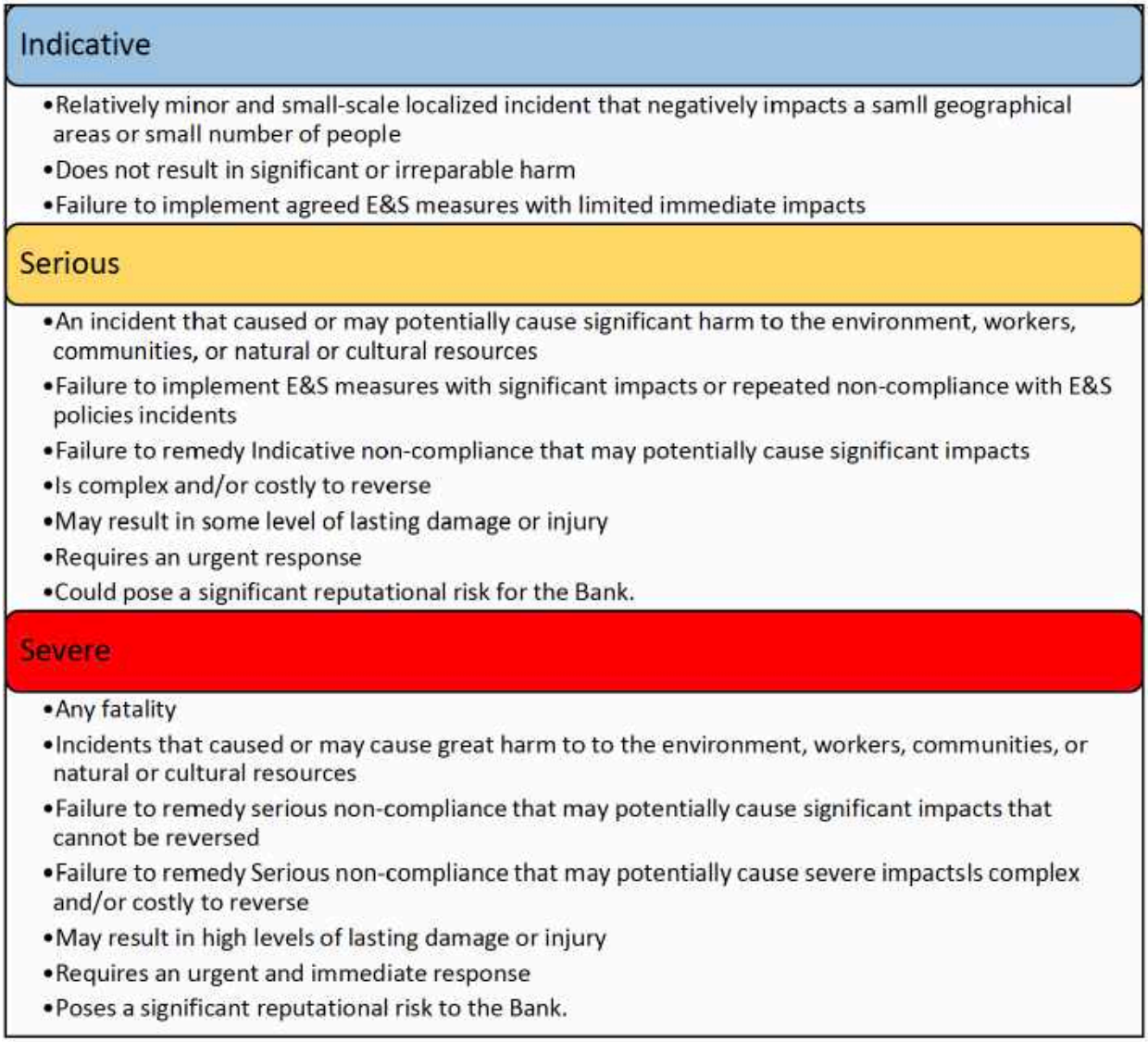
S/N	NAME	GENDER	DESIGNATION	VILLAGE / ORGANISATION	CONTACT DETAILS	SIGNATURE
1	NGUNI EZEKIEL	M		THOMAS	0900 75??x	Thomas
2	EVARISTO KANGWA	M		KANGWA	0960548??	
3	LEVY MUKOFWA	M		THOMAS	0969432706	
4	ROBGES MANGOWANI	M		MANGWANI	0953505923	
5	GOSPEL TIKI	M		TIKI	0953465252	
6	MOFFAT NGUNI	M				
7	FANWILL MUTANDA	M				
8	NGUNI SEPETILYA	M		THOMAS		
9	EZEKIEL NGUNI THOMAS	M		NGUNI	0955453032	
10	THOMAS NGUNI	M		NGUNI	0956942349	
11	ROSA BWELUPE	F		BWELUPE		J. Kapepa
12	TEDDY JACOB	M		MWELUMUKA		J. Kabwata
13	TEDDY KAJOKA	M		KAJOKA	0960757364	
14	[illegible]RAN MAKOLINO	M		MAKOLINO	0957572893	
15	BERNARD MWELUMUKA	M		MWELUMUKA	0956080063	
16	TIKI GEORGE	M		TIKI	0962042332	
17	MICKSON NOALIA	M		NOALIA	0954481745	
18	KABAKATENGO MARTIN	M		KABAKATENGO	0955730416	
19	KENNY MUKUMWA	M		MUKUMWA	0963992521	
20	WISDOM MULONGA	M		MULONGA	0969886598	
21	EDITH MUKUMWA	F		MUKUMWA	0760 89 12 63	




Appendix G - Nabowa DMC

SN	NAME	POSITION	Sex	PHONE
1	MwitunwaKumoto	Chairman	Male	0966 981303
2	Noah Yuvwenu	Vice chairman	Male	0971 826285
3	Maybin Kashando	Member	Male	
4	Priscar Shakwamba	Member	Female	
5				
6				
7				
8				
9				
10				

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



An incident report should contain the following information:

Incident Report Form

Please report any incident within 24 hours to UNOPS:

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

i. Details of Incident

Incident Date	
Incident Time	
Incident Place	

ii. Identification of Type of Incident and Immediate Cause

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

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

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

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

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

Provide a description of the immediate cause of the incident:

iii. Description of the Incident

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

iv. Root Cause Analysis

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

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

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

Appendix I: Summary of Construction Contractor Training Requirements

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

Appendix J: Biodiversity Assessment and Biodiversity Management Plan

EXECUTIVE SUMMARY

Biodiversity Assessment Results

The terrestrial species diversity/richness was moderately high in the sub-project area of influence, as indicated by the calculated SI index of 1.89 from field data. *Julbernardia paniculata (LC)* was found to be the dominant tree species in the sub-project area of influence having an importance value index (IVI) of 66.24. The sub-project area of influence exhibited typical existence of a normal forest formation indicated by a *reverse – j* shaped graph obtained through analysis of stand level size class distribution. Regeneration showed normal distribution indicating massive regeneration potential. No terrestrial plant *spp* were found to be endangered and/or threatened. There was very low diversity of wildlife animals in the sub-project area of influence, which could be partly explained by the fact that majority of people settled there for hunting purposes. Among the fauna found in the area, only the wild dog *Lycaon pictus* is endangered. The terrestrial habitat was found to be wet miombo containing few big trees and a lot of juvenile trees in a health condition. The habitat is characterized by a secondary forest with massive ability to regenerate despite anthropogenic disturbances. The habitat is of high ecological significance in the project area of influence because it plays a critical role in maintaining biological diversity. Nabowa seasonal stream and wetland, on which the dam was built, is part of the Luena River a tributary of the Zambezi River system. The dam has relatively rich fish fauna (12 species) although species richness is below that of most dams in southern Africa. The *O.niloticus* invasive aquatic species was not present in the waters. . The present species are not species of conservation concern. Nabowa Dam is a small dam built on a non-perennial Stream. Ecological flows are therefore expected to be seasonal over the spillway. The dam also has non functional outlets for irrigation.

The water quality parameters (pH, Dissolved Oxygen, Temperature and Transparency) assessed did not show any significant difference among the sampling points and were all within the acceptable range for fish survival.

The damming of the Nabowa wetland has both positive and negative ecological outcomes, such as the creation of favourable grounds for an adaptive radiation, multiplying the diversity of founder species in Nabowa Dam, while blocking migratory pathways for some species such as catfish.

The current activity rate by the local community has limited effect on the ecological status of Nabowa Dam. However, use of wrong fishing gear was observed and the maintenance of the stocks will depend on the correct management of these activities.

The rehabilitation of Nabowa Dam may have significant potential impacts on the biodiversity of the sub-project area of influence through loss of vegetation and associated fauna.

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 slightly impacted over many years by anthropogenic activities given that it is far (50Km) from Kaoma town. It has moderate to high value terrestrial ecological significance. The habitat is mainly dominated by *Julbernardia paniculata* (LC) species for both regeneration and big trees. The condition of the vegetation was found to be healthy and most plants were found to be either young stems or in the regeneration stage which is evidence of past human disturbances. Additionally, the presence of Zambezi teak (*Baikiaea plurijuga* (NT)) within the vicinity of the dam makes the area of high conservation value. The main disturbances going on in the area are logging, charcoal manufacturing and firewood collection, farming and fire occurrences. The habitat was found to be very resilient to forest disturbances as plants easily regenerate typical of the nature of miombo woodland. This is unlikely to change because of the remedial works on the dam. Nabowa dam has a number of large mammals. All fauna except for two (wild dog (*Lycaon pictus)* (EN) and the African clawless otters *(Aonyx capensis)* (NT) encountered and reported have an LC status on the IUCN red list (IUCN, 2021). The crowned crane (*Balearica regulorum)* (EN) and wattled crane (*Grus carunculatusis*) (VU) are also present at around the dam's project area of influence. Although, the vegetation and habitat assessment of Nabowa dam area was found to be of moderate quality, the continued presence of the wild dog is threatened due to habitat fragmentation as a result of increasing human population and small population extinction due to diseases. The crowned crane and wattled crane are also affected by habitat fragmentation and human population pressure. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The habitat for Nabowa dam was found to be in a generally good state except for a few attributes like encroachment of a dense floating macrophyte. This macrophyte poses the danger of covering the dam and limiting the uses to which the dam can be put. Other aquatic species found in the dam include *Cyperus papyrus* and *Ceratophylum demersum.* Using the habitat assessment index, the in-stream assessment shows that it is moderately modified and the riparian zone is also moderately modified. The dam does not pose a barrier effect to the fish population. The fish species listed on the IUCN Red List were not found during the study. The major threat to fish species, the Nile tilapia, introduced into the Kafue River system, 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. Invasive weed control should be implemented.

Proposed Mitigation Measures

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

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

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

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

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

Objectives of the BDA

Overall Objective

The overall objective of this BMP is to guide the remedial works on Nabowa 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 presents the methods and instruments that were used in the collection of relevant data including the criteria for determining habitat and vegetation condition of the study area. The IUCN Red List was used to determine the conservation status of the flora and fauna in the project area of influence.

Assessment methodology

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

Terrestrial

This dam is considered as category B project, the direct area of influence for the terrestrial assessment is commensurate with other category B projects. The preliminary scoping also indicated that there was no need to have a larger direct area of influence. After a reconnaissance survey, the field team established a 500 meters buffer surrounding the Nabowa dam reservoir extent as study area for detailed ecological assessments. The operation was conducted in ArcGIS version 10.4 and resulted into a total area of 141.74 hectares. The study also reviewed additional ecological aspects within a distance of 50 kilometres for a wider understanding of terrestrial ecology surrounding the project area of influence.

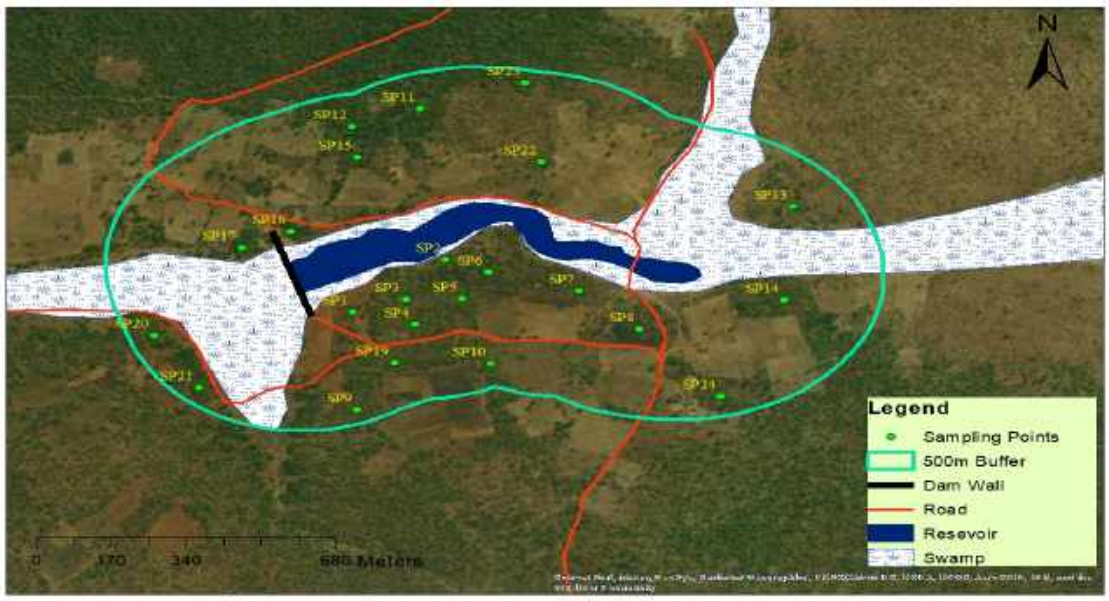


Figure 23 Map showing the project area of influence

Aquatic

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

Value of ecological resources and vulnerability of receptors

For terrestrial resources the valuation was based on the criteria given in table 1 and 2 after (Latimer, 2009) while the valuation for aquatic and riparian ecosystems was based on the criteria developed by Kleynhans[29] (1996). IUCN Red list of endangered species was used to assess the vulnerability of receptors.

Terrestrial

Table 13 Criteria for vegetation integrity (Latimer, 2009)

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

Table 14 Criteria for habitat integrity (Latimer, 2009)

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

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

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 high 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.

Aquatic

Table 15 Criteria for aquatic habitat integrity (Kleynhans, 1996)

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

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

Table 16 Descriptive classes for the assessment of modifications to habitat integrity (Kleynhans, 1996)

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

Table 17 Criteria and weights used for the assessment of habitat integrity (Kleynhans, 1996)

In-stream Criteria	Weight	Riparian Zone Criteria	Weight
Flow modification	13	Indigenous vegetation removal	13
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 18.

Table 18 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.	- 19

Evaluation of significance

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

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

Table 19 Terminology used to describe environmental and social impacts

Category	Terminology	Definition
Scope of Impact		
Frequency	Frequent Infrequent Rare	Uninterrupted or on a daily basis Once or more per day Less than once per day Single event/less than once per year
Likelihood	Certain Likely Unlikely No impact	Impact possibility estimated to be 100% Impact possibility estimated as between 50% and 99% Impact possibility estimated as < 50% Zero estimated possibility of impact
Extent	Local Provincial Regional National International	Within 2 km of the Project site Outside the Project site but <20 km away Outside the Project site but < 200 km away Within Zambia Outside Zambia
Duration	Short Medium Long	Less than the life of Project The life of project Greater than the life of 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 Project Impact which does not result directly from by activities within the scope of Project, but which has a connection with the Project's presence.
Potential Significance		
Significance	Low Medium High	Any low magnitude impact, or medium magnitude impact that is unlikely to occur or is of short duration. Any medium magnitude impact that is certain or likely to occur and of medium or long duration. Also, any high magnitude impact that is unlikely to occur, of short duration, or local in extent. Any high magnitude impact that is certain or likely to occur, of medium or long duration, and regional in extent.
(1) (2)	All terms are characteristics of the impact(s). For example, duration refers to duration of impact, not the activity causing it. As indicated, the impact magnitude for some environmental aspects can be defined in relation to the limit criterion specified by ZEMA or international regulations, or best practices when national standards are not available. However, in the absence of definitive quantitative criteria, a qualitative assessment of the magnitude is used relating to the impact type.	

Approach to mitigation of impacts

The conservation objectives and 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.

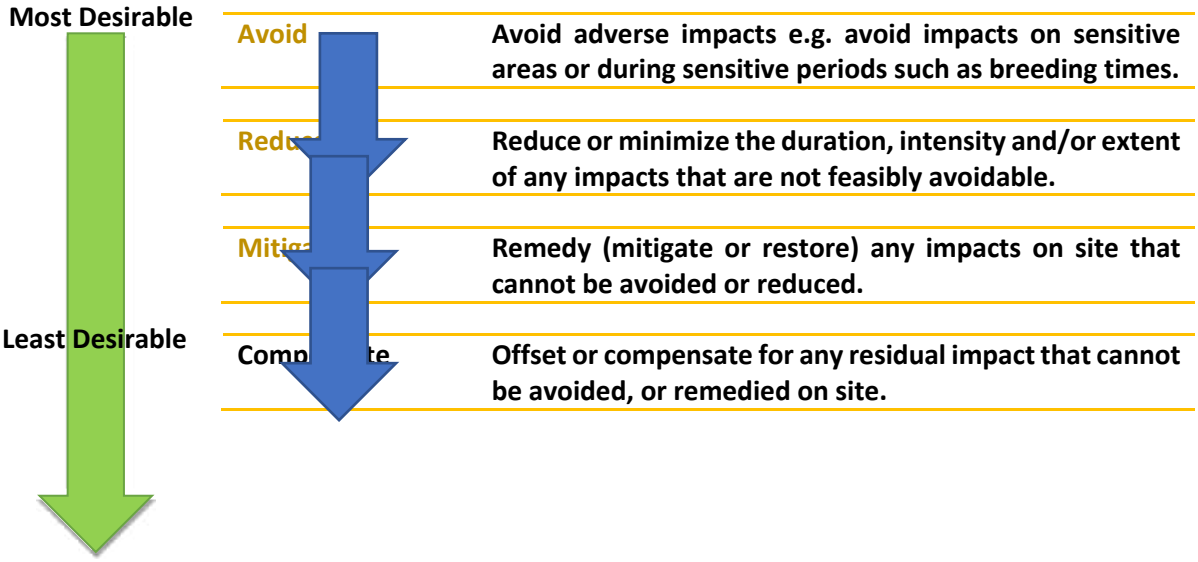


Figure 24 Mitigation hierarchy

Data collection methods

Desk review

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

Documents reviewed included but not limited to:

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

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

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

Completion of field surveys

Biodiversity Assessments were conducted by three professionals (Lead ecologist, and two assistants) over a period of 4 days from 30th March to 2nd April, 2021.

Reconnaissance survey

A team of three (lead ecologist, assistant aquatic, assistant terrestrial) conducted a reconnaissance survey of Nabowa dam on 29th March, 2021 in the company of officers' from various government departments. This was useful for offering an overview of the study site in terms of its land use and physical features e.g. soils, vegetation, topography etc. which were then surveyed at a more detailed level. The reconnaissance survey also helped the assessment team to decide the area to be sampled and the sampling intensity.

Terrestrial ecosystems

- **Sampling design**

Stratified simple random sampling method was used. This method was ideal in order to avoid sampling points falling on bare, or cropland with an advantage of spreading sample plots all over the areas of interest with no bias. Circular plots of 20 meter radius were used because they are known to capture sufficient data in the miombo forest formation and are easy to layout in the field (Densanker, Frost, Justice, & Scholes, 1997). The sampling points were pre-randomly determined using data management tools in ArcGIS version 10.4 and coordinates recorded. The points were then located in the field using a GPS.

- **Sampling intensity**

Intensity of sampling is a ratio of the area sampled to the total area of study. For Nabowa dam area of influence, a sampling intensity of 0.02 percent of 3.12 ha gave 24 circular plots of 20 meter radius. This sampling intensity was considered adequate due to the homogeneity of the area's vegetation cover as was discovered during the reconnaissance survey.

- **Floral survey**

Flora assessment was done by field walks guided by GPS used to track the sampling points earlier determined. For each sampling point, species identification was done based on expert knowledge and available field guides [Storrs, (1995); Smith & Allen, (2004); Phiri, (2005); and Fanshawe, (1971)]. Additionally, consultation with local community members was done which provided important ethno-botanical information. For species that could not be identified, specimens and pictures were collected for cross referencing with different databases until the species were identified. Floral attributes collected from each sampling plot are given in Table 20.

Figure 25 Field team collecting floral attributes

Table 20 Parameters measured from the main plot Floral

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

- **Faunal Survey**

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

- **Setting up of Traps**

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

Figure 26 Setting up camera trap to capture fauna

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

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

Aquatic Ecosystems

- **Sampling design**

The dam was stratified into four sampling points; downstream, at the dam wall, midpoint of the dam and upstream as shown in Figure 27.

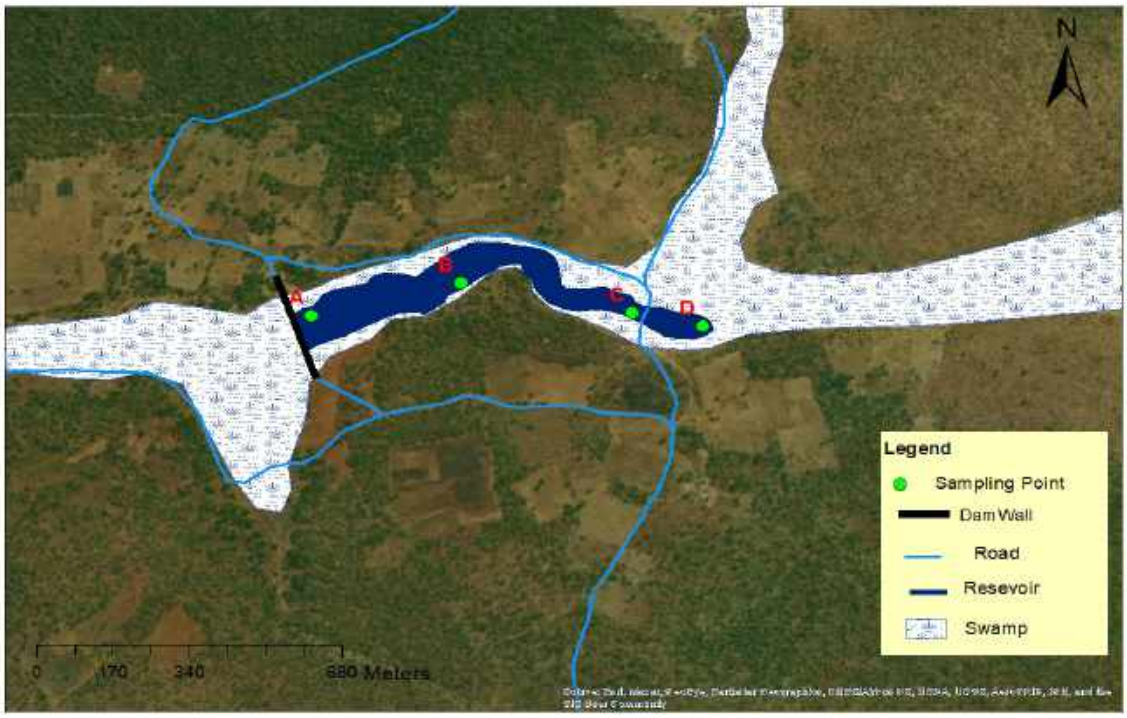


Figure 27 Stratification of Nabowa Dam into four sampling points: Filed team

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

Table 21 List of PSUs for the survey activity, where data was collected

Sample Code	PSU Description	Location
A	Dam wall	S0228040° E8398645°
B	Mid point	S0228540° E8398667°
C	Dam tail	S0228783° E8398567°
D	Upstream	S0229451° E8398665°

Figure 28 Points of interest in the Nabowa Dam area; i = dam wall, ii = midpoint, iii = upstream and iv = downstream

- **Water Quality**

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

Figure 29 Measuring turbidity with a secchi disc

- **Fish**

A variety of techniques were applied to sample fish species. The sampling methods depended on site characteristics and included cast netting, gill netting, angling and seine netting. A quantitative and qualitative fish assessment was completed. Fish community structures and diversity were determined for each sampling site; this information was used to investigate basic community characteristics. The information and specific characteristics of dominant fish species, and the species occurring, allows for the analysis of the present ecological state of the aquatic ecosystem.

- **Plankton**

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

Figure 30 Field and lab equipment used for plankton analysis

- **Macroinvertebrates**

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

Data Analysis

Terrestrial

Data was analyzed using Microsoft Excel 2007 package. In each plot, the botanical name, diameter at breast height (Dbh, 1.37m) and stem height for tree species with Dbh < 5cm were collected as primary data. The collected information was used to determine: species list/diversity, ecological density, abundance, frequency, relative dominance, relative density, relative frequency, size class distribution for trees, and relative importance value indices (IVI) of every tree species (see formula in Appendix 8.5)**.** Additionally, tables and graphs showing size class profiles were developed from diameter data collected in the study. Species richness refers to the total number of species recorded within the study area. Also to have a clear understanding of species diversity, the Shannon Diversity Index (SI) and the Simpson Index (1-D) (Abiot and Gonfa, 2015) were used as stated in equation 1 and 2 respectively

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

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

In the Shannon Diversity Index (SI), Pi is the number of individuals of species in a given plot divided by the total number of individuals in the plot, Ln is the natural logarithm, and is the sum of the calculations. The index incorporates the species richness and the proportion of each species in all sampled plots (evenness)

(Cordell, 2005). Furthermore, production of maps and analysis of spatial attributes was done using ArcGIS software version 10.4.

Aquatic

For aquatic biodiversity, Microsoft excel 2007 package was used to analyze for fishing activity rates and fish species composition, diversity and abundance. All captured aquatic fauna and flora were checked against the IUCN red list of threatened species to ascertain their conservation status. For water quality parameters, (pH, dissolved oxygen and water transparency) known reference values were used as benchmarks for which the project site's aquatic environment was assessed.

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

RESULTS & DISCUSSION

Terrestrial Survey results

Habitats

The main habitat found within a 2 km radius of Nabowa dam was the wet Miombo woodland containing secondary forest characterised by health but small trees and a lot of regeneration. The habitat is mainly dominated by *Julbernardia paniculata* (LC) species for both regeneration and big trees. The condition of the vegetation was found to be healthy and most plants were found to be either young stems or in the regeneration stage which is evidence of past human disturbances. The main disturbances going on in the area are logging, charcoal manufacturing and firewood collection, farming and fire occurrences. The habitat was found to be very resilient to forest disturbances as plants easily regenerate typical of the nature of miombo woodland. Nested within the miombo woodlands was the temitaria vegetation (small mounds) which was floristically intact. Going beyond the 2 km radius, the habitat changes to Kalahari type of vegetation but having some characteristics of dry miombo woodland. This Kalahari type of vegetation was dominated by species *Baikiaea plurijuga* (NT), *Pterocarpus angolensis* (LC)*, Pericopsis angolensis* (LC)*,* and *Julbernardia paniculata* (LC)*.* The forest floor was rich with humus, debris and decaying logs colonized by fungus.

The vegetation of the area is characterised by moderate density, basal area, and volume, and despite the scarcity of large diameter trees this indicates that the forest is in a good condition. Ecological significance of the study area was determined based on the geospatial data (Michal et al, 2013) and the survey findings especially during the vegetation assessment. Based on these approaches the study area was analysed for naturalness, size, diversity, rarity, fragmentation, abundance, age results which helped in determining the ecological significance.

Table 22 Description of habitat and vegetation condition

Type of Habitat		Classification value (importance)	Reasons for classification
1.	Wet miombo Woodlands	Moderately high	The area exhibit moderate level of intactness (2 storeys) although dominated by small diameter trees. Moderate degree of regeneration. Presence of insects, birds, reptiles and small mammals. Forest floor littered with decaying and decayed leaves, logs and vegetation. Evidence of disturbance by local people through hunting for small fauna, pole and fibre, fuelwood, honey and mushrooms.

Type of Habitat		Classification value (importance)	Reasons for classification
	Termitaria	High	This habitat type was intact and well vegetated. *Markhamia obtusifolia* dominated this habitat with lots of holes in the mounds.
2.	Riparian	Low	Riparian habitat is fragmented on the downstream by farming activities. Dam wall blocked water from flowing down stream. No riparian trees due to cutting during construction and subsequent inundation.
3.	Kalahari woodland	Moderate	Being exploited for rosewood but largely intact with rich species diversity.

Overall, the Nabowa dam area and its catchment have a moderate to high value ecological significance. The reported presence of endangered fauna makes the place of significant conservation value.

Flora

The project site is comprised of the Miombo woodland growing on loamy and a bit of sandy soils, with *Julbernardia paniculata* (LC) as the most dominant tree species. Structurally the woodland showed formation of a two-storied physiognomic unit and a canopy cover of about 50 percent. This canopy cover has enough spaces through which light penetrates to support regeneration. The structure and floristic composition of the Miombo have been well documented by several ecologists (Astle 1969; Fanshawe 1971; Lawton 1964, 1978; Werger & Coetzee 1978; White 1962, 1983). Generally, Miombo can be found in most countries of Southern and Central Africa and is the dominant forest formation of Angola, Zambia, Tanzania, Malawi, Mozambique and Zimbabwe.

Figure 31 Two storied Miombo woodland dominated by Julbernardia spp

Further away from the study area, the vegetation slowly translates into the Kalahari type with bigger trees commonly found in Western Province. The **Zambezi Teak** (*Baikiaea plurijuga)* which has a **vulnerable status** (IUCN, 2021) is found within this forest type and is heavily exploited for its valuable timber.

Figure 32 Bigger trees growing in sandy/loamy soils

The area near and around the project site showed a moderate composition of vegetation. The area has settlements nearby rendering it susceptible to forest degradation. Out of the total sampled area of 3.12

ha, the average Dbh was found to be 17.79cm and vegetation density is indicated by a total number of 363 stems/ha that were enumerated averaging of 169 stems/ha for stems with Dbh ≥ 5cm while those with Dbh < 5cm had an average of 195 stems/ha.

Table 23 Species importance values and IUCN status

Botanical name	Relative Frequency (%)	Relative Density (%)	Relative Dominance (%)	Importance Value Index	IUCN Status
Julbernardia paniculata	95.83	49.41	53.46	66.24	LC
Bobgunnia Madagascariensis	70.83	7.81	2.65	27.1	LC
Vitex doniana	54.17	4.1	4.33	20.9	LC
Ochna pulchra	50	3.91	5.07	19.66	LC
Syzygium guineense	50	3.71	2.65	56.37	LC
Dalbergia nitidula	41.67	4.69	3.19	18.79	LC
Combretum molle	37.5	2.93	1.76	14.06	LC
Pterocarpus angolensis	33.33	3.52	4.96	13.94	LC
Pericopsis angolensis	29.17	4.1	4.53	12.6	LC
Monotes africanus	33.33	2.15	2.15	12.5	LC
Parinari curatellifolia	33.33	2.54	1.49	12.46	LC
Acacia polyacantha	33.3	1.77	1.45	12.18	DD
Albizya adianthifolia	20.83	3.125	5.25	9.74	LC
Acacia sieberrana	25	1.76	1.31	9.35	LC
Pseudolachnostylis maprouneifolia	25	1.37	1.24	9.2	LC
Anonna senegalensis	20.83	1.56	2.67	8.36	LC
Markhamia obtusifolia	16.67	0.78	1.78	6.41	LC
Erythrina abyssinica	8.33	0.78	0.05	3.05	LC

The total number of woody species identified was 18. The order in which different species have dominated the vegetation in the study area is shown in Table 23 and the most dominant species in the study area is *Julbernardia paniculata* (LC) as shown by its importance value index (IVI). This species was found to dominate both for stems with Dbh ≥ 5cm and those with Dbh < 5cm. The rest of the species have got importance value indices below 60 (see table 4-2). Table 4-2 also indicates the relative frequency, relative dominance, and relative density. These parameters show the distribution of individuals of a species in the area (relative frequency); the numerical strength of each species in relation to a definite unit area (relative density); and the cover of each species based on basal area (relative dominance). The overall species diversity as measured by the Shannon Index (SI) was moderately high as indicated by the calculated SI index of 1.89 (Appendix 8.5). Despite this moderate species diversity in the area, the species composition is highly dominated by one species (*Julbernardia paniculata*) for both class categories (top storey and regeneration) as noted during field surveys.

Size-class distribution includes results on Dbh both at stand level and species level hence showing vegetation structure in the project site. Size-class distribution was determined in two ways i.e. using diameter at breast height for those trees with dbh > 5cm and height for those with dbh < 5 cm (regeneration). Distribution of tree diameters provides a means of understanding a forest composition and structure. The analysis of Dbh distribution at stand level for size classes of stems above 5cm Dbh indicated that the forest (study area vegetation) has a *reverse – J* distribution of tree diameters in which the number of trees declines rapidly with increasing size class typical of a normal forest (Figure 33).

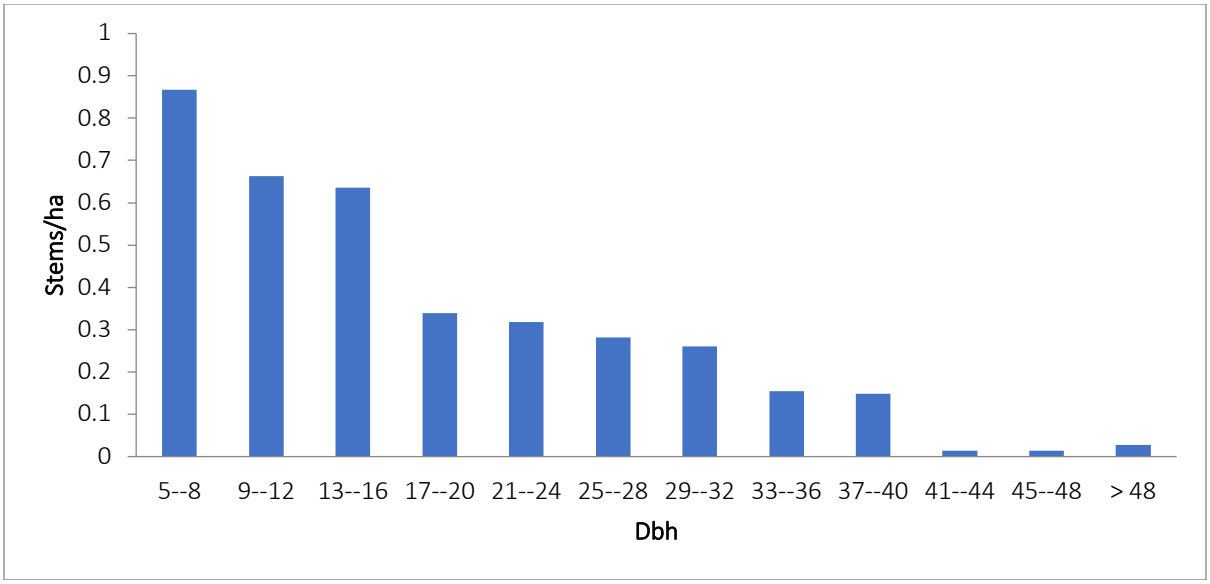


Figure 33 Stand level size class distribution

Figure 33 give the size-class distribution of plants whose Dbh was < 5cm. For this category height was used as a measure of size and most stems fell within height classes of 1 – 1.9 and 2 – 3.9 m respectively. The surrounding area of Nabowa dam has much potential for regeneration. This is characteristic of miombo vegetation type (Syampungani, 2008).

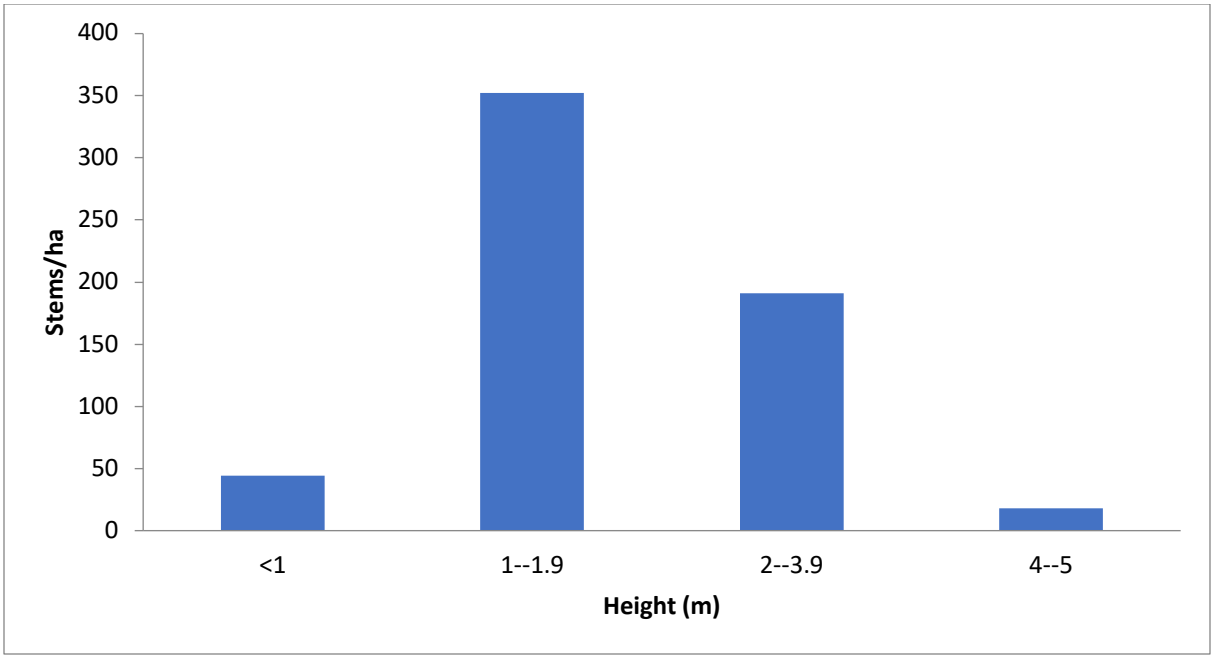


Figure 34 Stand level size class distribution for the regenerates

Diameter distribution analysis of the project site clearly shows that most of the trees are in their regenerative stages with very few trees in older classes. This suggests that trees are regenerating but due to anthropogenic activities many do not survive to reach maturity as they are cut out for various purposes by the local community. Furthermore, stems with Dbh < 5 cm representing regeneration have a normal distribution (Figure 34). This clearly shows that plant species growing in and around the study area are generally performing well despite the existing disturbances. Given the opportunity, the vegetation can re-establish and colonize the area successfully. The amount and spatial distribution of regeneration of woody species is important to maintaining historical structure and is an indication of integrity of disturbance regimes (Franklin et al. 2008). Lack of regeneration is indicative of altered ecological processes and has adverse impacts on the biotic integrity of the ecosystem of an area.

Influencing the vegetation pattern around the settlements is mainly composed of agriculture related activities. The animal grazing and shifting cultivation agriculture system practiced in the area has made much of the settlements void of vegetation cover. Furthermore, uncontrolled fires around settlements have affected the flora regeneration potential for much of the area. The vegetation around the settlement was characterized by the remnants of miombo species.

Figure 35 Vegetation around settlements and cropland areas

As observed in the field, forest tree crown cover is approximately in the range of 50 percent to 75 percent. This leaves out spaces within which light can pass and be accessed by the undergrowth. As a result, the project site has a lot of plant regeneration and a healthy secondary forest. Canopy structure is an important reflection of ecosystem dynamics and the distribution of total cover, and crown diversity reflects natural disturbance regimes across the landscape and affects the maintenance of biological diversity, particularly of species dependent upon specific stages (Norman and Campbell, 2000).

The project area of influence has moderately good litter accumulation composed of deadwood and plant leaves etc. Litter accumulation of organic material and an intact litter layer are integral to a variety of ecosystem functions, e.g. surface water storage, percolation and recharge, nutrient cycling, and support of certain plants and fungi (Collins et al. 2006). Due to the relatively good forest floor condition of the Nabowa dam site, a number of both edible and non-edible fungal species were found growing (figure 4-6). Some of these are *Termitomyces sp*, *Russula spp., Luctarius spp.* and *Amanita* species. The available litter layer provides areas for primary production and decomposition necessary for maintaining functioning food chains. They nurture fungi essential to the growth of rooted plant organisms.

Figure 36 Fungi colonised on dead wood and litter

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

Fauna

Nabowa area is devoid of large mammals; only some birds and one snake were cited by the survey team. Miombo woodlands are associated with low faunal richness. This may be attributed to the consequence of the extreme harshness of the dry season, with a virtual seven-month drought, often accompanied by intense bushfires (Rodgers et al. 1996).

Coupled with anthropogenic disturbances such as human settlement and agricultural activities very few animals were found especially the large mammals, which may have completely been depleted due to over hunting. Tables 23 and 24 give lists of animals found during the survey. Out of the 12 threatened species found in Zambia, only the wild dog *Lycaon pictus* (EN) and the African clawless otter *Aonyx capensis* (NT) are believed to be present at the project site. Interviews with key informants indicated that the African clawless otter was spotted in areas surrounding the dam.

Table 24 List of Mammals found and their status on the IUCN red list

Common name	Scientific Name	IUCN STATUS
Rat	*Rattus norvegicus*	LC
Giant mole rat	*Cryptomys mechowi*	LC
Hare	*Lepus victoriae*	LC
African ground squirel	*Xerus inauris*	LC
Bush pig	*Potamochoerus larvatus*	LC
South African bush baby	*Galago moholi*	LC
Thick-tailed bush baby	*Otolemur crassicaudatus*	LC

Vervet monkeys	***Chlorocebus*** *aethiops*	LC
Chucma baboons	*Papio ursinus*	LC
Wild dog	*Lycaon pictus*	EN
Common duiker	*Sylvicapra grimmia*	LC
Greater cane rat	*Thryonomys swinderianus*	LC
Sun squirrel	*Heliosciurus mutabilis*	LC
Tree squirrel	*Paraxerus cepapi*	LC
Woodland mouce	*Grammomys dolichurus*	LC
Tiny musk shrew	*Crocidura fuscomurina*	LC
Lesser red musk shrew	*Crocidura hirta*	LC
Four-toed elephant-shrew	*Petrodromus tradactylus*	DD
Short-snouted elephant-shrew	*Elephantulus brachyrhynchus*	LC
Bushy-tailed mongoose	*Bdeogale crassicauda*	LC
Large grey mongoose	*Herpestes ichneumon*	LC
Slender mongoose	*Galerella sanguinea*	DD
Miller's mongoose	*Rhynchogale melleri*	LC
Water mongoose	*Atilax paludinosus*	LC
Tree rat	*Thallomys paedulcus*	LC
Namaqua rock mouce	*Aethomys namaquensis*	LC
Red veld rat	*Aethomys chrysophilus*	LC
House rat	*Rattus rattus*	LC
African civet	*Civettictis civetta*	LC
African clawless otter	*Aonyx capensis*	NT
Honey badger	*Mellivora capensis*	LC
Common slit-faced bat	*Nycteris thebaica*	LC

Ecology of the vulnerable mammals

The wild dog *Lycaon pictus* (EN) are generalist predators, occupying a range of habitats including short-grass plains, semi-desert, bushy savannas and upland forest. It appears that their current distribution is limited primarily by human activities and the availability of prey, rather than by the loss of a specific habitat type. African wild dogs mostly hunt medium-sized antelope. Their main prey are Impala (*Aepyceros melampus*), Greater kudu (*Tragelaphus strepsiceros*), Thomson's gazelle (*Eudorcas thomsonii*) and Common wildebeest (*Connochaetes taurinus*). African wild dogs also take very small prey such as hares, lizards and even eggs, but these make a very small contribution to their diet (IUCN, 2021). The population of wild dogs in Nabowa is threatened by the imminent in-migration as a result of the Nabowa dam.

The African Clawless Otters *Aonyx capensis* (NT) are predominantly aquatic and are found near water. Freshwater is an essential habitat requirement, and they only occur in marine habitats where there is access to fresh water. In marine habitats, rocky shores are preferred (Van Niekerk et al. 1998). African Clawless Otters have been found in towns and cities, and can occupy rivers with high pollution and eutrophication levels (Somers and Nel 2013). The African clawless otters prefer hunting at depths of 0.5–1.5 m. This is despite having a higher hunting success, catching larger, more energy-rich prey (fish), and shortest time foraging per catch, at depths of 1.5–2.5 m (IUCN, 2021). Increased fishing effort by the Nabowa community members provides competition for the African clawless otter due to subsequent reduction in fish abundance and quality in the dam.

Table 25 List of reptiles found and their status on the IUCN red list

Common name	Scientific name	IUCN STATUS
Python	*Phyton sebae*	DD
Brown house snake	*Lamprophis capensis*	DD
Black mamba	*Dendroaspis polylepis*	LC
Rock lizard	*Agama atra*	LC
Sand Lizard	*Pedioplanis lineoocellata*	LC
Spitting cobra	*Naja nigricollis*	LC
Puffadder	*Bitis arietans*	DD
Common lizard	*Agama agama*	LC
Brown house snake	*Lamprophis capensis*	DD

A few birds were seen by the survey team but there was evidence of the presence of many birds through continuous bird calls and information from key informants. Table 4-4 gives a list of birds that were seen and those reported to be present.

Table 26 Avifauna species common around the dam area

Common name	Scientific name	IUCN status

Bronze mannikin	*Spermestes cucullata*	
Laura's warbler	*Phylloscopus laetus*	
Square-tailed drongo	*Dicrurus ludwigii*	
Southern puffback	*Dryocopus cubla*	
Grey-backed camaroptera	*Camaroptera brevicaudata*	
African golden oriole	*Oriolus auratus*	
Trumpeter hornbill	*Bycanistes bucinator*	
Burchell's coucal	*Centropus superciliosus*	
African fish eagle	*Haliaeetus vocifer*	
Honey buzzard	*Pernis apivorus*	
Osprey	*Pandion haliaetus*	
Common quail	*Coturnix coturnix*	
Cape wagtail	*Motacila capensis*	
Fiery-necked nightjar	*Caprimulgus pectoralis*	
Natal nightjar	*Caprimulgus natalensis*	
Lilac-breasted roller	*Coracias caudatus*	
Red-billed quelea	*Quelea quelea*	
Common bulbul	*Pycnonotus barbatus*	
Crested guineafowl	*Guttera pucherani*	
Helmeted guineafowl	*Numinda meleagris*	
Red-eyed dove	*Streptopelia semitorquata*	
Pelican white	*Pelecanus onocrotalus*	
Pelican pink-backed	*Pelecanus rufescens*	

Cattle egret	*Bubulcus ibis*	
African mourning dove	Streptopelia decipiens	
Cormorant reed	*Phalacrocorax africanus*	
Wattled crane	*Grus carunculatus*	
Crowned crane	*Balearica regulorum*	
African green pigeon	*Treron calva*	
Greater striped swallow	*Cercropis cucullata*	

The crowned crane *Balearica regulorum* (EN) inhabits wetlands such as marshes, pans and dams with tall emergent vegetation (Hockey et al. 2005), riverbanks (Meine and Archibald 1996), open riverine woodland, shallowly flooded plains (Urban et al. 1986) and temporary pools (del Hoyo et al. 1996) with adjacent grasslands, open savannas, croplands (del Hoyo et al. 1996) (del Hoyo et al. 1996, Meine and Archibald 1996), pastures, fallow fields and irrigated areas (del Hoyo et al. 1996). It shows a preference for short to medium height open grasslands adjacent to wetlands for foraging (Meine and Archibald 1996), and breeds within or at the edges of wetlands (Meine and Archibald 1996) especially in marshes with water 1 m deep and with emergent vegetation 1 m above the water (Urban et al. 1986). It roosts in water along rivers or in marshes, or perches on nearby trees (Urban et al. 1986, Meine and Archibald 1996).

Similarly, according to IUCN, (2021) the wattled crane *Grus carunculatus* (VU) occupies large home ranges which consist largely (75%) of grassland with a small core of essential wetland breeding habitat (McCann and Benn 2006). It nests in shallow sedge-dominated wetlands, often above 2,000 m altitude (del Hoyo et al. 1996). During the non-breeding season the species continues to rely on wetland habitats surrounded by grassland (McCann and Benn 2006). It congregates at large wetlands on riparian floodplains, but also requires pristine or semi-pristine, high-altitude wetlands and grasslands in some places (Archibald and Meine 1996; Barnes 2000; Mitchell et al. 1998). Dams and pans are used as roosting sites during the non-breeding season (Hockey et al. 2005). The wattled crane feeds on rhizomes, roots and bulbs of sedges (*Cyperus* and *Eleocharis* spp. [Bento 2002]), and grass sward and seed (Hockey et al. 2005). It will also take animals including small aquatic snails, fish and frogs (Hockey et al. 2005).

However, although reported to be observed in the area, neither the wattled crane nor the crowned crane were seen during field work by this ecologist. This could be attributed to the fact that the Nabowa dam site does not provide the exact preferred habitat for these birds.

Invertebrates

Several colonies of red ants, black ants and grasshoppers (e.g. *Gymnobothrus lineaalba, Gymnobothrus temporalis, Acrida acuminate),* common house flies and assorted butterflies were seen in the project site (Table 27).

Table 27 Invertebrate species found at the dam site

Common Name	Scientific Name	IUCN Status

Grasshopper	*Gymnobothrus temporalis*	DD
Wasps	*Belonogastar junceus*	DD
Grasshopper	*Caelifera spp*	DD
House Fly	*Musca domestica*	DD
Spider	*Trichonephilia clavipes*	LC
Butterfly	*Acraea eponina*	LC
Dung beetle	*Madateuchus viettei*	DD
Butterflies	*Eurema brigitta,*	LC
Beetles	*Carabidea*	DD
Ants	*Dorylus helveolus*	DD
Termites	*Microtermes goliath*	DD
Dragon Fly	*Trithemis kirbyi*	LC
Stink Bug	*Halyomorpha halys*	DD
Green Stink Bug	*Chinavia hilaris*	DD
Giant Cricket	Acanthoplus discoidalis	LC

Figure 37 Red ants and grasshoppers cited in the field. Source: Survey team

Aquatic Survey results

The information contained in this section was collected through site inventories which involved the direct measurement of some parameters on the site. Reviews of relevant documents as well as interviews with relevant stakeholders were done.

Habitats

The habitat for Nabowa dam was found to be in a generally good state except for a few attributes like encroachment of a dense floating macrophyte. This macrophyte poses the danger of covering the dam and limiting the uses to which the dam can be put. Other aquatic species found in the dam include *Cyperus papyrus* and *Ceratophylum demersum.* Using the habitat assessment index, the in-stream assessment shows that it is moderately modified and the riparian zone is also moderately modified.

Table 28 The in-stream assessment for Nabowa Dam

Instream	Average score	Score

Water abstraction	0	0
Flow modification	12	6.24
Bed modification	12	6.24
Channel modification	3	1.56
Water quality	6	3.36
Inundation	1	0.4
Exotic macrophytes	11	3.98
Exotic fauna	0	0
Solid waste disposal	0	0
Total Instream	**78.2**	
Category	**CLASS C (moderately modified)**	

Table 29 The riparian assessment for Nabowa Dam

Riparian Zone	**Average score**	**Score**
Indeginous vegetation removal	6	3.12
Exotic vegetation encroachment	0	0
Bank erosion	5	2.8
Channel modification	16	7.68
Water abstraction	0	0
Inundation	12	5.28
Flow modification	12	5.76
Water quality	6	3.12
Total Instream	**72.2 (moderately modified)**	
Category	**CLASS C**	

Both the in-stream and riparian habitats of Nabowa seasonal stream fall in category C because of the modifications that were observed. The riffle sections of the downstream have been turned into pools/ dambos thereby forming habitat for biodiversity of the stream during dry seasons.

Water quality

The results of four water quality parameters taken in-situ and those analyzed ex-situ are presented in Table 4.9. Laboratory results for pH are included in Table 4.8 in brackets. The ex-situ water quality results are also shown in Appendix 8.4.

Table 30 Water quality results

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

#	Parameter	Sampling Point					
		Ref. values	Borehole	A Dam wall	B Mid point	C Dam tail	D Upstream
1	pH	6.5-8.5	(6.44)	7.5 (6.56)	8.3 (6.53)	7.6	7.0 (6.18)
2	Dissolved Oxygen (mg/L)	5-7.5		6.1	2.9	5.9	3.0
3	Temperature (°C)	25-30		30.9	28.2	28.2	25.3
4	Transparency (Secchi disc) (m)	0.25-0.6		0.7	0.7	0.23	0.6
5	Nitrates (as NO_3 –N mg/l)	10	<0.01	<0.01	<0.01	<0.01	<0.01
6	Conductivity (µs/cm)	150-500	148	75	84		8
8	Total Suspended Solids (mg/l)		<0.01	3.9	5.8		<0.01
	Phosphates (mg/l)	0.1	0.10	0.10	<0.01		0.30
	Chemical oxygen demand (as mg O_2/l)		3	9	9		2
	Alkalinity (as $CaCO_3$ mg/l)		100	50	50		12
	Total Dissolved Solids (mg/l)		74	38	42		4
	Ammonia (as NH_4-Nmg/l)	<0.06	<0.01	<0.01	<0.01		<0.01

A comparison of the monitoring values with reference values (Table 4-8), indicates the following:

- The pH of Nabowa dam water falls within and the acceptable range for the habitation of aquatic biota. This is important because the dam is meant for animal watering among other uses. For irrigation water to small scale vegetable growers, the ex-situ pH results of dam water are not a hindrance to high crop yields. Vegetable crops grow well in pH range of 5.5 – 7. The pH for the dam water will not render some plant nutrients toxic or unavailable for plant uptake. However, if the insitu results are the correct ones, then this hinders agriculture. pH shall be further investigated in the site baseline quality analysis (refer to the BMP table).
- Dissolved oxygen ranged between 2.9 mg/L to 6.1 mg/L during the hot wet season.
- Temperature was consistent across the sampling points with a slight low at point D.
- Turbidity was found to be high at point C with the rest of the points having relatively clear water. Nabowa dam exhibited favourable water clarity during the sampling which supports aquatic life. Measuring of light transmission is useful in assessing the level of primary productivity in the river as well as the presence of dissolved organic matter. However, secchi disk reading can vary seasonally due to changes in primary productivity and amount of sediment entering the water during flooding. Light is dissipated by three factors: absorption by the water itself, absorption by dissolved or suspended particles in the water and scattering by particles in the water.

Similarly, the other parameters measured during the surveys such as water temperature, pH and DO were found to be within the tolerable ranges for aquatic organisms. Water temperature is an important factor because if affects the growth rate, development, metabolic rate, and distributions of aquatic species while DO is critical for the survival of most aquatic life forms. Most animals and plants grow well when DO levels are higher than 5mg/L. They become stressed below 4 mg/L. as the water becomes hypoxic with mobile species moving elsewhere while immobile ones may die.

Water quality affects the composition, productivity, abundance and physiological conditions of the aquatic species. Reservoirs are essentially affected by the environmental pollutants as they are constant receiving environments.

Fish Survey

Only seven (7) out of the thirteen (13) fish species reported in the Nabowa dam were sampled during the hot wet season survey; results of these are presented in Table 4-8. For a seasonal stream, Environmental flows are designed to be seasonal over the spillway enabling upstream and downstream flows.

Table 31 Fish species composition during the hot wet season

Common name	Scientific name	IUCN status	Migratory (Yes/No)
Red barb	*Barbus fasciolutus*	D D	No
Longbeard barb	*Barbus unitaeniatus*	LC	No
Straightfin barb	*Barbus Paludinosus*	LC	No
Stripped robber	*Brycinus lateralis*	LC	No
Redfin robber	*Brycinus imberi*	LC	No

African catfish	*Clarias gariepinusp*	LC	Yes
African catfish	*Clarias theodorae*	LC	Yes
Redbreasted bream	*Coptodon rendalli*	LC	No
Dwarf bream	*Tilapia sparrmanii*	LC	No
Largemouth bream	*Serranochromis angusticeps*	LC	No
Purplemouth bream	*Serranochromis macrocephalus*	LC	No
Pink Happy	*Sargochromis giardi*	DD	No
Dwarf bream	*Pseudocrenilabrus philander*	LC	No

Of the captured fish species *Pseudocrenilabrus philander* had the highest abundance. However, the captured fish were mostly small in size. Figure 4-8 gives the abundances of the sampled fish species while Table 32give total weight of fish at each sampling point.

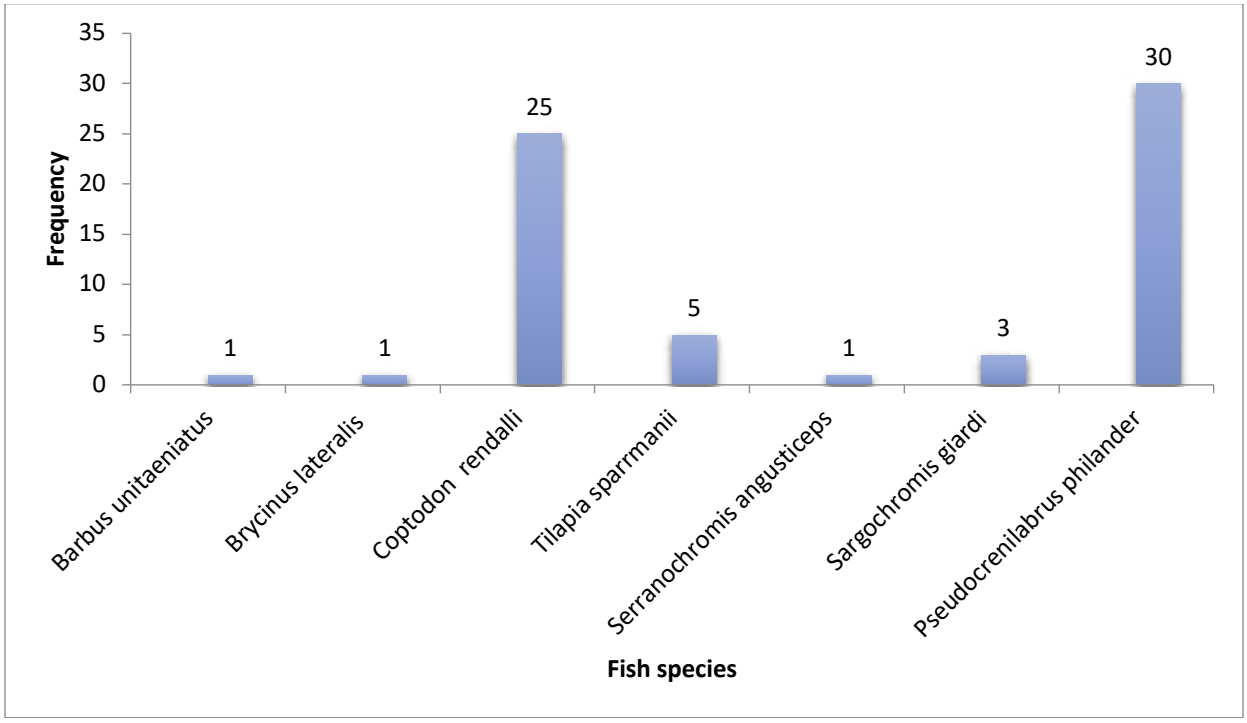


Figure 38 Average total fish catch (kg) per sampling point

Table 32 Average total fish catch (kg) per sampling point

Description	Point A	Point B	Point C	Point D
Catch in KGs	1.9kg	0.7kgs	1.1kgs	**0.0kgs**

Although it has been reported that there are four hundred and ninety (490) species of fish belonging to 24 families in Zambia, Nabowa Dam has approximately 13 different species of fish which include 6 species of bream, 3 barbs, 2 catfish and 2 robbers. Of these, seven (7) were captured during the survey while 6 were recorded from secondary information. Most of these are indigenous to the upper and middle Zambezi basin. The waters did not show the presence of invasive species such as *O.niloticus*. in addition, there are no species of conservation concern.

Figure 39 Sampled fish at Nabowa dam. Source: field survey team

The fishing activity rate (AR) (expressed either as a ratio or fraction between 0 and 1 or percentage) shows how often fishers go out fishing in a given period while fishing effort (FE) is the amount of fishing gear of a specific type used on the fishing grounds over a given unit of time. The AR and FE of Nabowa dam is given in Table 33.

Table 33 Fishing activity rate averages for the hot wet season

Description (AR/RE)	Point A	Point B	Point C	Point D	River Average
AR for Nabowa	0.2	0.1	0.23	0.1	0.15
No. of fishers	6	7	5	0	
Canoes	00	00	00	00	
Plank Boats	00	00	00	00	
Fiber Boat	00	0	00	00	
Dingi	0	0	0	00	
Aluminum	0	0	0	0	
Gillnets	6	6	6	6	
Baskets	0	0	0	0	
Seine Nets	1	1	1	1	
hooks	7	7	7	7	
No. of villages	1	1	1	1	

The community surrounding the dam comprises of very low income group peasants. Most of these people are believed to have moved to this area to hunt for wildlife. With the depletion of wildlife many depend

on the dam as a source of animal protein. This has put pressure on the few fish stocks in the dam. There are not many alternative livelihood strategies for the community hence their dependence on the dam. Alternative livelihoods have a direct bearing on the fishing activity rate of fishers within a given fishing area. Further, the rate at which fishers go out fishing varies with seasonal changes. Observations by this team indicated that Nabowa community's other livelihood strategy is in the timber industry where they are used as labourers for cutting and loading timber on to trucks. This is mainly performed by able-bodied energetic young men leaving the weaklings, women and children without any other alternative livelihood strategy.

Invertebrates, plankton and macrophytes

A number of macro-invertebrate species were observed (Table 34). These include bottom – dwelling animals such as crustaceans, worms and aquatic insects. Beetles, caddis flies, stoneflies, mayflies, hellgrammites, dragonflies, true flies, and some moths are among the groups of insects represented in streams. Macro-invertebrates are an important link in the food web between the producers (leaves, algae) and higher consumers such as fish.

Table 34 List of Macro invertebrates

Common Name	Scientific Name	Frequency
Earthworm	*Lumbricina spp*	7
Whirligig beetle	*Gyrinidae spp*	3
Crab spider	*Thomisidae spp*	6
Mosquito pupa	*Aedes spp*	2
Round worm	*Nematoda spp*	1
Fishing spider	*Dolomedes spp*	2
Freshwater slater	*Asellus spp*	1
Water strider	*Gerridae spp*	6
Crawling water beetle	*Haliplidae spp*	various
Pygmy back swimmer	*Pleidae spp*	2

Evaluation of impacts

Using the criteria explained in this report, the potential impacts that the proposed sub-project may have on the biodiversity in the area were evaluated and reported in Table 35. The unmitigated values are shown below. Some impacts have high unmitigated significance levels due to possible effects on the species of conservation concern identified at the dam's project area of influence. It is anticipated that the impact significance will be lower once the proposed mitigation measures in the BMP are applied.

Nabowa Dam is located 50 Km from the nearest built up town, Kaoma. There are few settlements close to the site, as it is mainly surrounded by vegetation. It is not in a legally protected and internationally recognized area of biodiversity value**.** The Nabowa Dam might be classified as a critical habitat according to WB standards and the ESA[30] because i) it is not significantly modified; the level of existing disturbance is low[31] and ii) the habitat can be classified as a critical habitat with 5 species of conservation concern (including endangered species) that might be impacted[32] (refer to section above). However, this is an existing dam and the short term sub-project aims to remediate the dam. In addition, it is not in a legally protected site. Therefore, the recommended biodiversity mitigation measures in the BMP table and the ecological management and monitoring requirements suggested in the monitoring section and Appendix 8.

Table 35 Impact evaluation

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

[31] ESA Table 9.3 page 219 of the ESA-Preparation of a Biodiversity Action Plan (BAP) and ecological flow remediation actions

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

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
1.0. TERRESTRIAL											
Site Preparation and Construction Phase											
Impacts on Terrestrial Biodiversity											
Flora clearing for site preparation and access roads	Loss of Indigenous flora species/reduction in population i.e. stocks per area Loss of the species of conservation concern (Zambezi teak)	Paving way or creation of space for access roads, setting up of construction camp as well as excavation of laterite (borrow pits) for construction works will certainly demand for clearing of vegetation in certain locations of the site The project area of influence inhabits the tree species of conservation concern- Zambezi teak	Infrequent	Likely	Local	Long	Medium	Negative	Direct	High	Medium
	Habitat fragmentation	Creation and/or rehabilitation of access roads, construction camp and setting up of working or operational areas will further fragment the already fragmented habitats on site Loss impacts of the species of conservation concern[33], the two identified crane birds, Zambezi teak, the wild dog and the otter.	Infrequent	Likely	Regional	Long	Medium	Negative	Indirect	High	High

[33] Presence of a number of species of conservation concern has led to a higher impact significance

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
	Loss of habitats and associated fauna	Vegetation clearing will result in loss of habitats for the fauna observed on site - birds, insects (invertebrates), mammals (mainly hares and mice) as while as reptiles (snakes and lizards) on site. Birds may also lose nesting trees. If not checked, this may consequently result in loss of fauna Loss impacts of the species of conservation concern, the two identified crane birds, the wild dog and the otter.	Infrequent	Likely	Regional	Long	Medium	Negative	Direct	High	High
Heightened noise levels	Disruption of fauna activities	Noise from heavy construction machinery (vehicles), increased number of people on site and general workings on site will likely unsettle or disturb the fauna. Sleeping schedules, feeding movements and resting time may be affected in this regard	Rare	Likely	Local	Short	Medium	Negative	Direct	Medium	Medium
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. Loss impacts of the species of conservation concern, the two identified crane birds, the wild dog and the otter.	Rare	Likely	Local	Short	Low	Negative	Direct	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
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 Loss impacts of the species of conservation concern, the two identified crane birds, the wild dog and the otter.	Rare	Likely	Local	Short	Low	Negative	Direct	Medium	Medium
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. Loss impacts of the species of conservation concern, the Zambezi teak	Rare	Likely	Local	Short	Low	Negative	Indirect	Medium	Medium
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) Loss impacts of the species of conservation concern, the Zambezi teak	Rare	Likely	Local	Short	Low	Negative	Indirect	Medium	Medium
Impacts on Terrestrial Habitats											

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
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. Loss impacts of the species of conservation concern, the two identified crane birds, the wild dog and the otter.	Infrequent	Likely	Regional	Long	Medium	Negative	Direct	High	High
	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	Infrequent	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											

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
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. Loss impacts of the species of conservation concern, the two identified crane birds, the teak, the wild dog and the otter.	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 Loss impacts of the species of conservation concern, the two identified crane birds, the wild dog and the otter.	Rare	Likely	Local	Short	Low	Negative	Indirect	Medium	Low
	Injury or mortality of fauna		Rare	Likely	Local	Long	Low	Negative	Indirect	Medium	Medium
Operations Phase											
Water Availability											

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
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 Nabowa dam, this may happen. In case of occurrence this may kill or injure flora and fauna downstream.	Rare	Unlikely	Regional	Long	High	Negative	Direct	High	High
2.0. Aquatic											

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Site Preparation and Construction											
Compromised aquatic habitats for fauna and loss of breeding areas Increase in invasive weed coverage	Clearing vegetation Unprotected water bodies such as the dambos Choking of water bodies by the aquatic weeds	Creation of access roads, setting up of construction camp, clearing dam area of vegetation during rehabilitation, could contribute to an increase of siltation within aquatic habitats The project area of influence has dambos. Activities around the sensitive water bodies can negatively impact their ecological functions Loss impacts of the species of conservation concern, the two identified crane birds, teak, the wild dog and the otter. The dam has a presence of aquatic weeds altering flows and affecting fauna	Infrequent	Certain	Regional	Long	Medium	Negative	Indirect	Medium	Medium
Increase in water and noise pollution	Stresses flora, fauna and habitats	Some materials used during site preparation and construction could pollute the water in the dam During construction, there will be an assortment of machinery operating, and an increased number of people. Ultimately, this could increase noise levels (pollution) in the area. This could stress some lifeforms •	Rare	Certain	Local	Long	Medium	Negative	Direct	Medium	Medium

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
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. Loss impacts of the species of conservation concern, the otter.	Infrequent	Likely	Regional	Long	Medium	Negative	Direct	High	High
Increased demand for water	Compromised aquatic habitat	Construction is a task demanding water. Further, the construction workers will need water for personal use. Loss impacts of the species of conservation concern, the otter.	Infrequent	Likely	Regional	Long	Medium	Negative	Direct	High	High
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 Loss impacts of the species of conservation concern, the otter.	Rare	Unlikely	local	Medium	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Operations Phase											
Increase in populations of flora and fauna	Populations of flora & fauna to increase, and habitats enhanced	When the dam is fixed, it will operate efficiently. Consequently, habitat integrity is enhanced. This could ultimately impact positively on the populations of flora and fauna The dam provides enough water all year round and an environment for species to thrive. The water body has more life forms than the 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 More settlements by humans	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 More settlements around the dam leading to vegetation clearing and habitat disturbances Loss impacts of the species of conservation concern, teak, wild dog, the otter.	Infrequent	Likely	Regional	Long	Medium	Negative	Direct	High	High

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Maintained environmental flows downstream and protected dam habitats	The downstream flows shall continue in relation to the design	The flows will be maintained as per the design and storage ratios. The habitats protection is part of the training programme for DMC. Once these are protected the biodiversity in the dam will be sustained. Species shall be protected and will have conducive habitats to live in.	Rare	Certain	Regional	Longterm	Medium	Positive	Direct	Medium	Medium
Decommissioning											
Increased ecological integrity	Increase in the life forms populations in the dam	The maintenance of the dam shall ensure increased habitat integrity and populations of aquatic biodiversity	Frequent	Certain	Local	Medium	High	Positive	Direct	Medium	Medium
Settlements /Infrastructure downstream may be inundated and damaged	Loss of flora and fauna, infrastructure. And unfortunately, there could loss of human lives	Decommissioning could happen if there is a desire to reconstitute the environment. It involves well thought out plans to reinstate the initial river course by removing the weir.	Rare	Unlikely	Local	Medium	Low	Negative	Indirect	Medium	Low

Impact	Sub Impact/Potential Source	Impact Description	Impact Evaluation (Assessment) (Unmitigated negative impacts)								
			Frequency	Likelihood	Extent	Duration	Magnitude	Effect	Action	Sensitivity	Significance
Increase in water pollution	Chemicals used for agriculture and loose soils from fields may run into the waters	Increased chemical pollution from agriculture practices which can lead to algae growth and eutrophication. Sedimentation due to soil erosion resulting from farmlands and agriculture land tilling methods around the dam, upstream and downstream	Frequent	Likely	Local	Medium	Medium	Negative	Indirect	Medium	Medium

Impacts Summary

Terrestrial Biodiversity Environment

Negative Impacts during rehabilitation works include:

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

Positive Impacts during operation and maintenance include:

- Increased water availability for fauna growth

Negative Impacts during operation and maintenance include:

- Vegetation clearing due to anthropogenic activities
- Loss of fauna due to vegetation clearing
- Fragmentation of habitats
- Reduced integrity of habitats
- Introduction of Invasive species and pathogens
- Loss of species of conservation concern

Aquatic Biodiversity Environment

Positive Impacts during rehabilitation works include:

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

Negative Impacts during rehabilitation works

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

Positive impacts during operation and maintenance include:

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

Negative impacts during operation and maintenance include:

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

Concluding Impact Statement

The dam is built on the Nabowa seasonal stream and wetland, which is part of the Luena River a tributary of the Zambezi River system. There are also some dambos that form in the river bed during the dry season. 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 slightly impacted over many years by anthropogenic activities given that it is far (50Km) from Kaoma town. It has moderate to high value terrestrial ecological significance. The habitat is mainly dominated by *Julbernardia paniculata* (LC) species for both regeneration and big trees. The condition of the vegetation was found to be healthy and most plants were found to be either young stems or in the regeneration stage which is evidence of past human disturbances. Additionally, the presence of Zambezi teak (*Baikiaea plurijuga* (NT)) within the vicinity of the dam makes the area of high conservation value. The main disturbances going on in the area are logging, charcoal manufacturing and firewood collection, farming and fire occurrences. The habitat was found to be very resilient to forest disturbances as plants easily regenerate typical of the nature of miombo woodland. This is unlikely to change because of the remedial works on the dam. Nabowa Dam has a number of large mammals. All fauna except for two (wild dog (*Lycaon pictus)* (EN) and the African clawless otters *(Aonyx capensis)* (NT) encountered and reported have an LC status on the IUCN red list (IUCN, 2021). The crowned crane (*Balearica regulorum)* (EN) and wattled crane (*Grus carunculatusis*) (VU) are also present at around the dam's project area of influence. The site might be classified as a Critical Habitat, but this is an existing dam requiring a few remedial works for safety for which mitigation measures shall be employed. It is not in a legally protected area but requires biodiversity conservation. The old sites shall be prioritised as contractor sites to avoid habitat disturbances. Although, the vegetation and habitat assessment of Nabowa dam area was found to be of moderate quality, the continued presence of the wild dog is threatened due to habitat fragmentation as a result of increasing human population and small population extinction due to diseases. The crowned crane and wattled crane are also affected by habitat fragmentation and human population pressure. Since the stream is seasonal and at the upper end of the catchment, there are no migratory fish movements of significance. The habitat for Nabowa Dam was found to be in a generally good state except for a few attributes like encroachment of a dense floating macrophyte. This macrophyte poses the danger of covering the dam and limiting the uses to which the dam can be put. Other aquatic species found in the dam include *Cyperus papyrus* and *Ceratophylum demersum.* Using the habitat assessment index, the in-stream assessment shows that it is moderately modified and the riparian zone is also moderately modified. The dam does not pose a barrier effect to the fish population. The fish species listed on the IUCN Red List were not found during the study. The major threat to fish species, the Nile tilapia, introduced into the Kafue River system, 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. There are few settlements close the dam but once the dam is fully operational, the population in the project area of influence might increase.

Since the dam was first only 3 years ago it is still likely that the remedial works may encourage additional cultivation through increased irrigation activities and will change the current patterns of stock use or fishing that have existed since and before construction. Key management requirements are to continue efforts to improve catchment conditions, particularly around the perimeter of the dam, by discouraging

cultivation in the riverine areas. This will be the responsibility of the nominated DMC, with assistance and support from the Ministry of Agriculture, Forestry and Fisheries and DMC. Irrigation farming methods that protect the land and water resources shall taught to the DMC and farmers. Invasive weed control should be implemented. The dam is an area of high conservation value due to the identified number of species of conservation concern and low level of modifications. Therefore, these species should be protected during construction and post construction and the relevant government departments must be involved according to the national and international biodiversity standards, agreements and regulations. Mitigation strategy for construction and operation phase includes the following: to remove or reduce adverse impacts on natural habitats/ species or their functions, keeping such impacts within socially defined limits of acceptable environmental change; restricted conversion or modification by using old sites and limiting site clearing or aquatic invasive works; reintroduction of species; mitigation measures to minimize the ecological damage; and post development restoration works; restoration of degraded and legacy habitats.

BIODIVERSITY MANAGEMENT PLAN (BMP)

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

Objectives

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

Scope

The BMP's focus is to manage the potential impacts outlined in sections 4.3 and implement mitigation measures for those impacts. It is limited to Nabowa dam area of influence.

Table 36 Biodiversity management plan

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
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 Loss of species of conservation concern (as shown under section 4)	To avoid and where not feasible minimize the loss of indigenous vegetation	The contractor shall ensure that vegetation clearing is subject to approval by the Project management team or Manager on site to avoid unnecessary flora loss. Riverine buffer zone shall not be disturbed (Appendix 8.6- dam and dambo management). Flora management shall be included in the sites' method statements (refer to ESMP). Protection of species of conservation concern: The contractor with Forestry guidance, shall protect the teak species and shall not cut these down. The identified species shall be mapped and reported by the contractor. The guidelines for conservation of these species shall be followed. Any disturbed or cut down species shall be reported and an incident report shall be prepared (Section 2- biodiversity agreements and legislation)[34]. Further measures	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS Forestry

[34] This applies to all species of conservation management measures below and in this BMP

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			are shown in Appendix 8.6 under Ecological management and monitoring)			
			The contractor shall use old site access roads as they are still open. Only in instances where existing access roads need widening will the necessary clearing be done. This measure will ensure avoidance of unnecessary vegetation clearing. Roads shall not be close to riparian buffer zones/ water bodies (Appendix 8.6- dam and dambo management).	Mobilization	End of construction works	Contractor Supervision- UNOPS
			Whenever possible e.g. at camp sites, the contractor shall ensure that trees will be cut at knee height to promote coppicing at the end of the sub-project	Mobilization	End of construction works	Contractor Supervision- UNOPS
		Avoid use of indigenous wood/timber	The contractor shall not use indigenous and protected 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 and Forestry shall sensitize and discourage its employees from using Charcoal and firewood on site. Instead alternatives such as gas stoves will be promoted	Beginning of construction works	End of construction works	Contractor Supervision- UNOPS
1.1.2	Habitat loss by the introduction	Avoid and/or prevent the introduction of	The contractor shall not allow the planting or seeding of alien or foreign	Beginning of construction	Project closure	Supervision- UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
	of Invasive flora species	invasive species	flora species on site. To this effect, all employees on site will be sensitized.	works		
			The contractor shall implement an alien invasive species prevention protocol to prevent the introduction and transfer of invasive plant species. This will include the avoidance of affected areas by staff and vehicles where possible and wash down procedures for Project vehicles that are suspected to have been in areas infested with invasive species.	Beginning of construction works	Project closure	Contractor and UNOPS Supervision- UNOPS
			The contractor shall ensure that only non-invasive local plant species are used for revegetation efforts under the project	Beginning of construction works	Project closure	Contractor Supervision- UNOPS
Fauna						
1.1.3	Injury and/or loss of fauna Loss of species of conservation concern- birds, wildlife (as shown under section 4)	To preserve fauna in and around the project site	The contractor shall not allow or permit hunting or killing of any wildlife on site. Hunting will constitute a serious breach of contract and will be reported to relevant authorities. Fauna management shall be included in the sites' method statements (refer to ESMP). The species of conservation concern shall be protected by the contractor and any siting of this shall be reported in the defined reports. These species and their breeding areas shall not be killed or disturbed.	Beginning of construction works	Project Closure	Contractor, ZAWA, Traditional Authorities and DMC Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			Where these species are encountered they shall be reported to the Engineer before any works can commence. The contractor shall involve the relevant government departments in the management of these species of conservation concern. The guidelines for conservation of these species shall be followed. Any injured or killed species shall be reported and an incident report shall be prepared (Section 2- biodiversity agreements and legislation)[35]. Further measures are shown in Appendix 8.6 under Ecological management and monitoring)			
			The contractor shall avoid clearing/cutting down of trees in riparian habitats and on the edges of wetlands for any purpose. This is because trees in the riparian habitats are mainly used for nesting by indigenous birds.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor shall ensure that active bird nests are not damaged during site preparation and construction activities. As far as possible tree and scrub clearance will not be undertaken during the breeding season (March to August inclusive).	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS

[35] This applies to all species of conservation management measures below and in this BMP

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			Should clearance during this time be necessary a preclearance nesting bird check of the vegetation to be cleared will be undertaken by the Biodiversity Specialists and a decision on whether to move the nest or defer the clearance will be made by the Biodiversity Specialists.			
1.1.4	Injury or mortality of fauna and species of conservation concern due to accidents	Avoid collisions of vehicles with fauna on site	The contractor shall • Provide driver awareness and training; • Enforce speed limits; • Restrict vehicle and machinery operation to daylight hours to avoid collisions with nocturnal and crepuscular fauna • Report any collision, document species affected and area of occurrence for record keeping and development of better abatement strategies.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.5	Disturbance or disruption of fauna due to construction works	To avoid disturbance of nocturnal fauna on site	The contractor shall restrict construction and related works to day time (6AM – 6PM). Night working and the use of excessive artificial lighting will not be permitted to avoid adverse impacts on nocturnal and crepuscular fauna observed on site. Strong lightning sources may also disturb migration or night movement of certain species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			When there is need to use lighting at	Beginning of	Project	Contractor

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			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.	construction works	Closure	Supervision - UNOPS
		To avoid disturbance of fauna on site during day time	To reduce noise on site, the contractor shall: • Service all equipment and vehicles in line with manufacturers specifications; • Not allow idling of vehicles on site and unnecessary honking; • Sensitize employees on the need to minimize noise on site	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
1.1.6	Introduction of invasive fauna species into the project area of influence	To avoid the introduction alien fauna species	The contractor shall: • Develop Project staff conduct guidelines that would include the interdiction of transporting live or dead animals, plants or seeds in Project related vehicles; • Inspect company vehicles for illegal fauna and flora products before access to site is granted; • Provide Project staff with a hygiene and vaccination campaign; • Train staff to recognize key invasive species.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
Habitats						

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
1.1.7	Destruction of existing habitats on site and loss of species of conservation concern	Avoid further fragmentation of habitats	The contractor will not create new access roads on site. Instead old ones will be rehabilitated for continued use	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
		To maintain the natural extent of the dambos in sub-project To protect endangered species habitat	The contractor will not carry out any construction and related sub-project activities within dambos, critical habitats and the forests. The contractor shall ensure that there is no significant conversion or degradation of critical habitats for species of conservation concern. Where these species are encountered or frequent they shall be reported to the Engineer before any works can commence.	Beginning of construction works	Project Closure	Contractor Supervision - UNOPS
			The contractor will set the construction camp site at least 100m from the nearest spring and the riverine. It is strongly recommended that the old camp site areas	Beginning of construction works	Project Closure	UNOPS and DMC
			The DMC and UNOPS shall ensure that there are no agricultural activities within identified water bodies, forests and along the riverine	Project mobilization	On-going	Traditional Authority and DMC
1.1.8	Loss of integrity of the terrestrial habitats and loss of species of conservation concern	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 minimize risk of pollution, the	Beginning of	End of	Contractor

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			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	construction works	construction works	Supervision - UNOPS
1.1.9	Increase in fire outbreaks and loss of species of conservation concern	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	UNOPS will offer biodiversity management training to contractor employees and the locals. This training will include sensitization on:	Project mobilization	Project closure	UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
		management	• flora and fauna present in the area • Importance of flora and fauna present within in the sub-project site • Contents of this BMP, its implementation and roles of community and employees • Sustainable management of the water dam on site • Identification and Handling of key invasive species • Roles of community members on biodiversity management			
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 and loss of species of conservation concern	To ensure that pollution, soil loosening and siltation is controlled To protect the dambos	The contractor will carefully handle materials that have a potential to cause pollution. Work sites will control soil erosion and prevent soil loosening activities. Solid waste shall be disposed of in a matter prescribed by ZEMA and the local town council. The contractor shall protect the dambos. Activities are to be avoided around these site.	Beginning of construction works	End of construction works	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			The contractor will maintain buffer zones (Appendix 8.6- dam/ dambo management).			
1.2.3	Increased fishing pressure that could lead to a reduction in fish population Loss of species of conservation concern-Otter	To avoid depletion of fish population on account of heightened fishing pressure To avoid loss of the otter	The DMC collaborating with other stakeholders (Department of Fisheries, Ministry of Livestock and fisheries, Traditional authorities, fishers) shall issue fishing passes to fishers on rotational basis. This should be informed by research as regards the standing biomass of fish at any particular time. Further, fishers should be encouraged to harvest fish by way of employing passive gears such as hooks and lines, and gillnets. Gillnets of mesh size less than 63 mm should not be allowed to avoid capturing immature fish. The DMC will protect the otter and fishing practices should not affect the populations and breeding areas of this animal	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 and disturbance of the species of conservation	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 shall be kept in bunded facilities. The final handlers shall be licensed waste management handler. Hydrocarbons shall not be allowed in	Project mobilization	End of construction works	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
	concern		water. Any spill will be handled using spill kits and isolation methods. These shall be disposed of in a matter prescribed by ZEMA. The contractor will maintain water quality monitoring including establishing baslines water quality. This shall include the pH investigations which were inconclusive during the study (section 4.2.2).			
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) shall ensure prudent usage of this resource. Suffice to mention that the sub-project area of influence is prone to droughts.	Project Mobilization	On-going	• Contractor • Supervision UNOPS • DMC • Traditional leaders • Department of Water resources development
2.0. OPERATIONS PHASE						

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
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 8.6)	DMC and IDSP shall initiate the revegetation exercise to restore flora in cleared areas on the peripheral of the dam within 500m. Exposed areas will be tilled to a depth of 20cm and top soiled were possible. The area will be seeded with indigenous trees and grass species. This will be done between November and February during the rainy season (Appendix 8.6- dam and dambo management) The Ministry of Agriculture, Department of Forestry and Fisheries shall implement catchment management with DMC and traditional leaders for upstream protection and dam conservation needs. Catchment management is detailed in Appendix 8.6.	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS Forestry, WARMA, Agriculture, Fisheries etc.
Fauna						
2.1.2	Increase in conservation/management of fauna on site- including species of conservation concern	To conserve/manage fauna within the dam's area of influence	DMC in collaboration of the Local authorities shall continue implementing fauna management actions during the operation phase of the dam. These measures will include: Prohibition of hunting Prohibition of tree cutting within the vicinity of the dam Prohibition of agricultural activities	Operations Phase of the project	On-going	DMC and UNOPS Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			within sensitive habitats within the sub-project area of influence Continued sensitization on the benefits of flora and fauna conservation			
Rehabilitation of Legacy and New Borrow Pits						
2.1.3	Promotion of habitats by the rehabilitation of legacy and present borrow sites	To rehabilitate both New and Old Borrow Pits on site	At the end of construction works (during operation phase of the dam), the contractor shall rehabilitate both new and old borrow pits. This will be done by: Re-sloping the edges of the pits to a gradient equal to or less than 450; Creating a drainage system so has to avoid stagnation of water at the borrow pit sites; and Tilling the area to a depth of 30cm and revegetating with indigenous tree species and grass seeds	Operations Phase of the project	Completion of rehabilitation works	Contractor and UNOPS Supervision - UNOPS
Training (Capacity Building)						
2.1.4	Increase in capacity building activities among DMC and local community members	To train or sensitize DMC and local communities	Before handing over of the dam, UNOPS shall sensitize and train the DMC and key members of the local communities such as traditional authorities, and selected influential individuals on: Dam management and safety; Emergency Preparedness in an event	Project Operation Phase	Completion of training	UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			of dam failure Continued biodiversity conservation; Continued implementation of this BMP; and their roles in all this.			
Invasive Species						
2.1.5	Increase in invasive fauna and flora species management	To Prevent colonization of project area of influence by invasive species	UNOPS and forestry shall train the DMC and selected local community members on the implementation of invasive species management Communities shall not introduce invasive species. Any spotted invasive species shall be controlled by the DMC from the start.	Project Operation Phase	Completion of training	UNOPS DMC
Demobilization						
2.1.6	Increase in site disturbances and aesthetics effects	To leave the site in the initial or better state relative to the baseline	At the end of construction works, the contractor shall remove all equipment and structures from construction camp site; turn over the soil on site to a depth of 20cm; Re-slope to mimic the natural terrain; and Re-vegetate with indigenous flora species	End of construction works	Demobilization	Contractor Supervision - UNOPS
			At the end of remedial construction works, the contractor shall rehabilitate all borrow pits on site as described under section 2.1.3 of this BMP	End of construction works	Demobilization	Contractor Supervision - UNOPS

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
2.2. AQUATIC (OPERATIONS PHASE)						
2.2.1	Increase in populations of flora, fauna; when habitat integrity is enhanced	Providing a conducive habitat for aquatic biodiversity	The contractor shall rehabilitate the dam which is a habitat for aquatic biodiversity and will protect habitats during works. DMC shall be trained in proper sustainable fishing methods and dam protection. Protection of the dambos by the DMC and community by using allowed fishing methods and protecting their integrity.	End of construction works	Demobilization	DMC IDSP
2.2.2	Maintained environmental flows	To enable and promote ecological flows of the dam and protection of dambos	The UNOPS design will ensure ecological flows over the spillway according to the dam's storage ratio and the stream's non perennial flow regime. The IDSP and UNOPS shall train the DMC on flow monitoring and its importance. The DMC and IDSP shall monitor flows. DMC shall ensure protection and maintenance of. The dambos and dam shall be protected by conserving the features, avoiding gardens around them and siltation, using proper fishing methods, preventing invasive species, and prevention of soil erosion. Protecting these habitats shall ensure continuous protection of life forms and their flow during runoff seasons	End of construction works	Demobilization	DMC IDSP

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
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 Loss of species of conservation concern	To reduce pressure on the area around the dam	DMC to ensure vegetation is maintained around the dam and animal feeding is away from the dam. Catchment management training programmes included in the training plan. The DMC shall not allow grazing close to the dam and vegetation shall be maintained. Preventing cattle and human activity to intervene in riparian/wetland areas would be important to avoid further degradation (Appendix 8.6- Dam and dambo management). The DMC shall protect the Otter and shal not allow killing or disturbance of its habitat and breeding area.	End of construction works	Demobilization	DMC Traditional leaders Forestry Fisheries IDSP
2.2.4	Pollution and sedimentation of water which stresses flora, fauna and habitats	To minimize contamination of water and loss of biodiversity	The DMC shall take part in catchment management and protection of buffer zones (Appendix 8.6) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC shall allocate specific livestock watering points that have some erosion control vegetation and rock features to minimize soil loosening.	End of construction works	Demobilization	DMC Traditional leaders IDSP Forestry

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
2.2.5	Potential growth of algae in the dam due to irrigation (use of chemicals) and from livestock droppings Increase in aquatic weeds	To ensure preservation of the environment and quality of water upstream, in the dam and downstream during agriculture and irrigation activities To maintain flows	The IDSP/ MoA shall ensure that the local community are trained the best way to practice crop and animal agriculture to ensure preservation of the environment and quality of water The DMC shall uproot any identified weeds and avoid introduction of such	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 minimize contamination of water and loss of biodiversity	The DMC will take part in catchment management and protection of buffer zones (Appendix 8.6) processes and avoid tree cutting, implement re vegetation around the dam and prevent soil erosion and loosening due to livestock watering practices. The DMC shall allocate specific livestock watering points that have some erosion control vegetation and rock features to minimize soil loosening.	End of construction works	Demobilization	DMC Traditional leaders IDSP Forestry
2.2.7	Overexploitation of fish resources which reduce fish population	To ensure that fish resources are sustainably utilized	The DMC and other key stakeholders (Min. of Fisheries, traditional leaders,) should exert some form of control with respect to who can fish, where, when and how. The dam should not be open access with respect to fishing. The DMC and traditional leaders, Min. of Fisheries and Livestock, shall ensure that awareness and education executed as regards sustainable	End of construction works	On-going	DMC Ministry of fisheries & Livestock Traditional leaders

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			harvesting of the 2 threated tilapia species. DMC and fisheries shall ensure controlled catching and breeding season breaks will be enforced. Fishing methods shall be regulated by DMC with sustainable methods to prevent catching and destruction of eggs, invertebrates, plankton, and small fishes. Biodiversity shall be protected by sedimentation control and pollution prevention by the communities; and catchment management. The DMC and Fisheries shall not introduce invasive species on the water			
2.2.8	Increased education and awareness on threatened species Capacity building- Increased knowledge and ability among	To create awareness and educate the communities concerning the threatened species to ensure sustainability	The DMC collaborating with the DMCand 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,	Project mobilization	On-going	Supervision DMC Ministry of Agriculture Ministry of Fisheries and Livestock Traditional leaders

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

REF NO.	IMPACT	OBJECTIVE	MANAGEMENT ACTION	TIMING		RESPONSIBILITY
				START	END	
			the ground			
2.2.12	Increased infrastructure failure and sedimentation due to lack of maintenance activities In case of maintenance failure and dam failure, settlements/infrastructure downstream may be inundated and damaged with loss of flora and fauna. And unfortunately, there could loss of human lives	To ensure that sedimentation is controlled To ensure dam functionality To promote maintenance activities post rehabilitation works	The contractor shall execute designed works with expected skill supervised by UNOPS. Afterwards, there should be regular monitoring of the dam's integrity by key stakeholders to forestall decommissioning. There will be adherence to the operations and maintenance manual by the relevant stakeholders as indicated in the manual. The stakeholders (DMC, Ministry of fisheries and Livestock, Ministry of Agriculture, Water resources development, Ministry of water, sanitation and environmental protection, Traditional leaders) should collectively invest efforts to ensure that the dam wall and other accompanying structures are always in a good condition. They shall also implement catchment management activities over a period of time (Appendix 8.6).	Project mobilization	On-going	DMC Ministry of Agriculture Ministry of Fisheries and Livestock Traditional leaders Water resources development department

* = Non-wood forest products.

Follow-up and Monitoring

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

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

Table 37 Biodiversity Monitoring Plan

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

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
		matter and soil micro-organisms lost due to trampling and compaction by equipment and machinery during remedial measures.	affected areas with miombo vegetation to allow for re-colonization of the associated biodiversity.	remedial works.	Forestry Department Dam management committee.	restocked with miombo vegetation.
4.	Loss of soil properties needed to support terrestrial	To avoid polluting the soil with spent oil (oil from the engine) and/or fuel.	The contractor shall ensure that the equipment and machinery used is in good working conditions. No fuel and oil leakages. Vehicles and other equipment should be parked and stored in designated places when not in use.	During remedial works	Contractor UNOPS	Affected sites restored by use of oil adsorbents, with report indicating how much was used.
5.	Rehabilitation of legacy and current sites	To ensure that all impacted sites are brought back to their near original state.	The contractor shall rehabilitate all impacted sites or opened up areas by providing for regeneration of vegetation in the affected areas	At the end of remedial works	Contractor UNOPS	Re-vegetation / Tree planting done.
6.	Training / Capacity building	To ensure compliance to various environmental parameters and knowledge of dam operations and maintenance	UNOPS shall develop a dam operation manual and selected relevant sections to capacity build in the DMC. The contractor with stakeholders shall provide trainings to the DMC and community. Guided by the supervising engineer, selected	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

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			topics will be covered to sensitize the local community			
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 shall conduct reforestation of the impacted areas. They shall: Promote biological diversity conservation programmes that have positive impacts on the natural ecosystems. These include bee keeping, and conservation agriculture. Additionally, promotion of NWFP (such as caterpillar, mushrooms, wild fruits etc.) through provision of ready market opportunities. This can encourage and motivate local communities to focus more on activities that are friendly to the natural ecosystem. Conduct community awareness programmes on various issues dealing with biological diversity and ecosystem management and conservation.	During and after rehabilitation works. Monthly visits in the initial stages then quarterly after the reforested areas establish and when community structures become fully functional.	DMC Local traditional leadership Ministry of Agriculture Forestry Wildlife Catchment committee	Reforestation of cleared areas done at the onset of the rain season following completion of rehabilitation works. Fliers for community sensitization produced not more than 3 months after completion of works. One community sensitization meeting report per quarter.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			Implement community based natural resource management Catchment management (Appendix 8) DMC shall control and monitor any invasive weed infestation			
	Loss of species of conservation concern (flora and fauna)[36]	To determine the species types, numbers, variations in quantities To protect habitats and enhance conservation To promote skills and knowledge of species of conservation concern	Species of conservation concern shall be recorded and monitored by the DMC. Any deaths or injuries shall be on record. Wildlife and Forestry department shall be involved in training, sensitizations and monitoring. The habitats shall be mapped and protected Avoid disturbing or clearing species of conservation concern	After completion of rehabilitation works. Annually 3-5 years	DMC Local traditional leadership Ministry of Agriculture Forestry Wildlife Catchment committee	Reporting on species of conservation concern and their habitats Photos etc. Habitat changes Numbers and types of species Uses of the resources Training records Incident reports

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

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
		To understand the uses of the resources To determine threats on the species	The DMC shall work with the relevant stakeholders to protect habitats Avoid activities in critical and sensitive habitats Protect the breeding grounds Introduce additional numbers of the same species			No. Of threats
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 shall protect the Nkakula stream catchment area through proper management of the forest ecosystem around the area (No cutting of trees).	During and after completion of rehabilitation works.	Contractor Forestry Department committee. Local traditional leadership. DMC	Catchment area protection sensitization programme.
2.0 Aquatic						
Construction phase						
1.	Loss of feeding and breeding grounds Loss of species of conservation concern	To avoid loss of feeding and breeding grounds To avoid loss of fauna	The contractor shall maintain any feeding and breeding grounds for aquatic life during works. The Otter shall be protected	During rehabilitation works.	Contractor UNOPS DMC Fisheries	Protected breeding grounds
2.	Loss of natural dambos	Loss of habitats	The DMC and contractor shall avoid activities around these sites	During rehabilitation works	Contractor UNOPS DMC	Protected natural water sites

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
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 shall regulate fishing activities to protect the stock from overfishing.	After rehabilitations works	Fisheries department DMC Local traditional leadership	Dam management by-laws drafted by completion of rehabilitation works
5.	Increased impacts on the species of conservation concern	To avoid any mortalities of these species	The contractor shall conduct robust visual observations before undertaking any works The DMC and fisheries shall implement a monitoring survey of this species post-construction.	During and after rehabilitation works	Contractor Fisheries department DMC	No mortalities recorded for every 6 monthly reporting period
Operation phase						
1.	Increased feeding and breeding grounds for fish once the dams are restocked with fish	To main the feeding and breeding grounds for fish and ensure sustenance of fish production.	DMC and Fisheries shall protect the breeding grounds for fish by ensuring no fishing activities take place in shallow waters. DMC and Fisheries shall protect fish species by monitoring the quantities and using safe fishing methods	During and after rehabilitation works.	Department of Fisheries Local Traditional Leadership DMC	Dam management by-laws drafted by completion of rehabilitation works.

REF NO.	POTENTIAL IMPACT/ISSUE	OBJECTIVE	MITIGATION MEASURE	TIMING AND/OR FREQUENCY	RESPONSIBILITY	INDICATORS OF REFERENCE
			DMC shall monitor and control invasive weeds			
2.	Bed modification: Low deposition of silt	To maintain reduced siltation in the dam so as to maintain diverse habitats.	DMC shall maintain riparian vegetation around the dam by prohibiting cutting and farming close to the dam. DMC, Forestry and Fisheries and other stakeholders shall 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 shall protect the dam from solid waste disposal by completely arresting indiscriminate disposal of waste.	During and after rehabilitation works.	DMC Local traditional leadership	Reports from DMCs 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 38 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 Nabowa 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 Nabowa dam site. The IDSP-PIU shall retain the primary responsibility for ensuring that environmental and social commitments for the Nabowa 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 Nabowa Dam site. The IDSP shall have an environmental specialist who shall oversee the UNOPS staff with regards to the BMP tasks. At least one additional MoA field staff member with HSSE responsibilities will be located at Nabowa dam site for continuous onsite monitoring and reporting during remediation of the dam and its operation – for the lifespan of the IDSP. The safeguards supervision includes the operationalization of the dam, during which period the IDSP personnel will be working with the respective local authorities, DMC and local communities, in preparation for smooth handover when IDSP ceases to exist as a project. The PIU will implement capacity building and training of local stakeholders to ensure their informed cooperation in E&S matters during the remedial works and during the operational phase of the dam as well as advising the DMC. IDSP will implement its own monitoring and supervision activities as they apply for all activities, including the remediation of Nabowa Dam. IDSP has the overall responsibility for monitoring

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

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

	Excavation works and stock piling Sanitation and water management Traffic management and access routes management Biodiversity management Training, engagement and sensitization Contractor shall work within the requirements of legislative requirements and standards Contractor shall carry out any corrective actions instructed by UNOPS and IDSP. In case of non-compliances/discrepancies, the contractor shall carry out investigation and submit proposals on mitigation measures and implement remedial measures to reduce environmental impact. Non-compliance by the contractor may cause for suspension of works and other penalties until the non-compliance has been resolved to the satisfaction of UNOPS. The contractor must report on all HSSE matters related to this BMP to UNOPS on a monthly basis. UNOPS shall administer the monthly reports from the contractor, and will prepare its own quarterly reports, based on its supervision and monitoring activities, as well as designated UNOPS activities in this BMP to IDSP. Quarterly progress reports will include the status of the implementation of risk mitigation measures, trainings, workers' GRM, as well as lessons learnt, any adjustments made to improve E&S management and performance and corrective actions undertaken, if applicable. Quarterly reports will also be made available to the local DMC and local authorities.
Local community and DMC	As owners of the dams, the dam community will be encouraged to be active partners during the construction. It will be regularly consulted on a variety of issues. It will further be asked to report any misconduct by the contractor or contractor's personnel to the IDSP-PIU, through the Grievance Redress Mechanism (GRM), which has been designed for the AF activities. Community members will be appointed by the DMC to verify that the works do not cause harm to people and nature. Furthermore, stakeholder engagement, as laid out in the Stakeholder Engagement Plan (SEP) in the ESMP, will be conducted by UNOPS, IDSP and the contractor, to ensure that community engagement informs the sub-project, that dam communities are well informed about the remedial works and the biodiversity mitigation measures undertaken. The dam is operated by a DMC, which consists of community members. The Nabowa 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 Nabowa DMC. In order to successfully operate the dam, and limit impacts on people and environment, the DMC members require further capacity building and training. Training will include issues such as dam safety management/ structural deterioration; habitat management; dam usage and best practice, biodiversity protection, erosion control and conservation (see training plan is included in the ESMP).

	Quarterly reports will also be made available to the local DMC and local authorities. MoA has representatives at the dam site who will periodically report to IDSP.

Step 2: Incident Reporting

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

Incident reporting will follow the management and reporting process below:

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

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

Step 3: Handover for Operation

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

CONCLUSION

The Biodiversity assessment was conducted in compliance with local and international guidelines in determining the baseline terrestrial and aquatic conditions in the project area of influence. The mitigation measures for the reconstruction/rehabilitation of project impacts on the terrestrial and aquatic ecosystem (flora and fauna) have been devised as documented in chapter four (4) and five (5) of this report for application by the contractor and beyond the construction phase.

Further ecological findings revealed that the dam was constructed in a dambo area and on a seasonal stream and for that reason, the dam has never gortten full for the past 4 years since time of completion. Additionally, the dam has already disturbed terrestrial and aquatic ecosystem of the area. The nature of rehabilitation/reconstruction will only amplify the negative impacts

REFERENCES

1. African wildlife Foundation (2021): African Wild dog. (https://www.awf.org/wildlife-conservation/african-wild-dog).
2. Amon, G., 1992: Clearing of deep – rooted perennial vegetation has altered freshwater
3. Amy Blaylock, 2002: Aquatic Macroinvertebrate identification key
4. Camporeale, C., and Ridolfi, L., 2006, Riparian vegetation distribution induced by river flow variability: A stochastic approach, Water Resour. Res., 42, W10415.
5. Carruthers, V. (ed) (2017): Wildlife of Southern Africa: A field guide to anilas and plants of the region. Struik Nature, South Africa.
6. Department of Environment and Heritage Protection. 2017. *Guide to determining terrestrial habitat quality: A toolkit for assessing land-based offsets under the Queensland Environmental Offsets Policy Version 1.2.* State of Quensland
7. Department Water Resources Development, 2016. Environmental project brief (epb)/Environmental & social management plan (esmp). The construction of Nabowa dam (Chief Mwene Mutondo, Kaoma district), Lusaka, Zambia.
8. Desanker, P. V., Frost, P. G. H., Justice, C. O. and Scholes, R. J. (eds). 1997. *The Miombo Network: Framework for a Terrestrial Transect Study of Land-Use and Land-Cover in the Miombo Ecosystems of Central Africa*. IGBP Report 41 Stockholm, 109pp.
9. Eyre, T.J., Kelly, A.L, Neldner, V.J., Wilson, B.A., Ferguson, D.J., Laidlaw, M.J. and Franks, A.J. 2015. *BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual*. Version 2.2. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.
10. Fanshawe, D. B. 1971. The vegetation of Zambia. Government Printer, Lusaka.
11. FAO, *State of the World's Forests 2007*, Food and Agriculture Organization of the United Nations, Rome, Italy, 2007.
12. FAO, "Global forest resources assessment: options and recommendation for a global remote sensing survey of forests," *Forest Resources Assessment Programme Working Paper* 141, Food and Agriculture Organization of the United Nations, Rome, Italy, 2007.
13. Kleynhans, C.J., 1996 A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. Journal of Aquatic Ecosystem Health 5: 41–54
14. Kolding. J, Musando. B and Songore. N., 2004. *Inshore fisheries and fish population changes in Lake Kariba*
15. Latimer, W., (2009) Assessment of Biodiversity at the Local Scale for Environmental Impact Assessment and Land-use Planning, Planning Practice & Research, 24:3, 389-408,
16. Ministry of Agriculture, 2020. Environmental and Social Audit Report and Remedial Action Plan for Ten Dams in Zambia Additional Financing Irrigation Support Development Project (P102459 & AF-P172140), Lusaka, Zambia.
17. IUCN (2021). IUCN Red List of Threatened Species. Version 2021.2. <www.iucnredlist.org>. Downloaded on 30 April, 2021.
18. Muma A.K, (2000). In: Starkey P and Simalenga T (eds), 2000. Animal power for weed control. A resource book of the Animal Traction Network for Eastern and Southern Africa (ATNESA). Technical Centre for Agricultural and Rural Cooperation (CTA), Wageningen, The Netherlands. ISBN 92-9081-136-6.
19. Norman, J.M., Campbell, G.S., 2000. Canopy structure. In: Pearcy R.W., Ehleringer J.R., Mooney H.A., Rundel P.W. (eds) Plant Physiological Ecology. Springer, Dordrecht. https://doi.org/10.1007/978-94-010-9013-1_14.
20. Phiri, P.S.M. 2005. *A checklist of Zambian vascular plants*. Southern African Botanical Diversity Network Report No. 32. SABONET, Pretoria.

21. Skeleton. P., 2006. Field Guide to Fish species of Southern Africa.
22. Storrs A.E.G. 1995. *Know your trees; Some of the common trees found in Zambia*. Regional Soil Conservation Unit.
23. Syampungani, S. (2008). *Vegetation change analysis and ecological recovery of the Copperbelt miombo woodland of Zambia*. PHD Thesis, Stellenbosch University.
24. Utsungi, K. and Malingaliwa, K., 2002. *Field Guide to Zambia Fishes*, *Plankton and Aquaculture*.

Appendix 8. 1: Terrestrial data collection forms

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

Appendix 8. 2: Regeneration plot data collection sheet

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

Appendix 8. 3: Fauna data collection sheet

Mammals			
Species	**No. seen**	**Signs- write details**	**Other faunal species**
			Reptiles
Birds			
Species	**No. seen**	**Signs- write details**	
			Amphibians
			Invertebrates
Notes:			

Appendix 8. 4: Aquatic data collection forms and water quality analysis results

SAMPLING FORM 1
FISH SPECIES

A. Length-Weight Data

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

Coordinates:…… Date:……/……/…….

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

Sampling Form 2
WATER QUALITY

B. Physicochemical Parameters

Sampling Point …… Sampling Day:……

Coordinates:…… Date:……/……/…….

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

Sampling Form 2

C. Aquatic plants

Sampling point …… Sampling day:……

Coordinates:…… Date:……/……/…….

S/#	Species	Monocots	Dicots
Emergent			

Submerged			
Free floating			

D. Macroinvertebrates survey

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

Water analysis results:

SCHOOL OF ENGINEERING
CIVIL ENGINEERING DEPARTMENT
ENVIRONMENTAL ENGINEERING LABORATORY

P.O Box 32379, Lusaka

PHYSICAL/CHEMICAL EXAMINATION OF WATER

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

Laboratory Results

Sample ID	Nabowa Downstream	Nabowa Borehole	Nabowa Middle	Nabowa Upstream
Sampling date	**30.03.2021**	**30.03.2021**	**30.03.2021**	**30.03.2021**
Parameter				
pH	6.56	6.44	6.53	6.18
Conductivity (µs/cm)	75	148	84	8
Sulphates (mg/l)	<0.01	<0.01	<0.01	<0.01
Nitrates (as NO_3 –N mg/l)	<0.01	<0.01	<0.01	<0.01
Alkalinity (as $CaCO_3$ mg/l)	50	100	50	12
Total Dissolved Solids (mg/l)	38	74	42	4
Ammonia (as NH_3-Nmg/l)	<0.01	<0.01	<0.01	<0.01
Phosphates (mg/l)	0.10	0.10	<0.01	0.30
Total Suspended Solids (mg/l)	3.9	<1.0	5.8	<1.0
Chemical oxygen demand (as mg O_2/l)	9	3	9	2
Chlorides (mg/l)	10.0	15.0	10.0	<1.0
Turbidity (NTU)	17.20	4.33	36.80	2.00
Hydrocarbons (mg/l)	<0.005	<0.005	<0.005	<0.005

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

Appendix 8. 5: Formulae used in calculating trees quantitative attributes

Important Values Indices (IVI) shows the dominance of a species in relation to other species in a stand or community (Curtis & Mcintosh, 1959). The IVI was obtained by the below formula

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

Where:

- RF = Relative Frequency;

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

- RD = Relative Density; and

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

- RBA = Relative Basal Area

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

Species diversity by Shannon and Simpson index

Tree Species	Freq (n)	pi	pi2	ln (pi)	pi ln pi
Acacia polyacantha	9	0.01758	0.00030899	-1.71	-0.030058594
Acacia sieberrana	9	0.01758	0.00030899	-1.71	-0.030058594
Albizya abiscala	16	0.03125	0.00097656	-1.17	-0.0365625
Anona senegalensis	8	0.01563	0.00024414	-4.1	-0.0640625
Combretum mole	15	0.0293	0.00085831	-3.5	-0.102539063
Dalbergia boehmii	24	0.04688	0.00219727	-3	-0.140625
Erythrina abyssinica	4	0.00781	6.1035E-05	-4.61	-0.036015625
Flacourtia indica	20	0.03906	0.00152588	-3.2	-0.125
Jubanadia paniculata	253	0.49414	0.24417496	-0.71	-0.350839844
Monotes africanus	11	0.02148	0.00046158	-3.9	-0.083789063
Ochna pulchra	4	0.00781	6.1035E-05	-4.96	-0.03875
Parinari curatellifolia	13	0.02539	0.00064468	-3.69	-0.093691406
Pericopsis angolensis	21	0.04102	0.00168228	-3.19	-0.130839844
Pseudolachnostylis maprouneifolia	7	0.01367	0.00018692	-3.5	-0.047851563
Pterocapus angolensis	18	0.03516	0.00123596	-3.5	-0.123046875
Swazia Madagascariensis	40	0.07813	0.00610352	-2.7	-0.2109375
Syzygium guineense	19	0.03711	0.00137711	-3.3	-0.122460938
Vitex doniana	21	0.04102	0.00168228	-3.21	-0.131660156
				s	18
				N	512
				sum (pi ln pi)	-1.898789063
				sum (pi2)	0.264091492
				Shanon index	1.898789063

	Simpson index	3.786566517

Appendix 8. 6: Habitat Management

Catchment Management and Dam Management Guidelines

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[37]. During the ESMP and BMP assessments for the rehabilitation sub-project, concerns were expressed about the management of the upper catchment of the River, which should be handled by stakeholders in the operation phase for sustainability even though the area seems to not be modified. The study has shown that the habitats seem very resilient to disturbances as plants easily regenerate when the pressure eases. However, there may be threats of future modification if the catchment is not protected and managed.

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

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

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

According to WARMA, The Water Resources Management Act of 2011 provides for a decentralized management system in line with the principles of Integrated Water Resources Management (IWRM) that manages water resources at catchment and sub-catchment levels and promotes local participation through formation of Water User Associations (WUAs)/ DMAs. Functions of catchments and sub-catchments (enshrined in Part III section 18 & 20 of WRM Act No 21 of 2011):

- Coordinating, supervising, monitoring and evaluating Water Resources Management activities in the water catchments

[37] 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 Nabowa Dam catchment can be derived from the key issues raised in the consultation process, which is to ensure sustainable land use practices to protect the water resources of the catchment while enhancing biodiversity, dam uses and the livelihoods of the communities in the catchment.

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

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

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

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

6) Time lines:

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

7) Funding:

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

Dam/ River Management

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

- Vegetation retention of existing undisturbed local provenance native plants should be standard practiced by the contractor and locals
- Restoration of native vegetated sites and buffers which have been degraded or removed, re-vegetation of slopes, should (where practical be restored) with native vegetation equivalent in type, form, density, and diversity to that occupying the adjacent area or more as approved by the engineer. Planted buffers should consist of a mix of native trees, shrubs and groundcover using natural and assisted vegetation as indicated in the ESMP.
- These buffers and revegetated sites should be sustainable, with the least practical need for human intervention. Management activities may periodically be necessary to remove invasive species, for hazard reduction to prevent wild-fires and ensure community safety.

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

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

Ecological Management and Monitoring

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

i. Management Guidelines:

Critical Habitats

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

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

Nabowa dam may qualify as an important biodiversity conservation area because of having a number of species of conservation concern as listed in the IUCN Red list and being in undisturbed habitats. But, it is not in a legally protected site.

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

OP4.04 Appendix A Issue	**Management measures to be taken**

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

ii. Monitoring and Evaluation Measures:

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

A robust and appropriately designed, long-term operation phase biodiversity monitoring and evaluation program aimed at assessing the status of critical habitat and species is important for sites that have species of conservation concern. Long term monitoring requires funding and is therefore beyond the present project's budget similar to catchment management above.

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

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

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

Community-the traditional leaders and DMC

- The community will need to understand the value of the species of conservation concern. This can be done by annual training and sensitisation programs with incentives.
- The community should have a register of such species and location of their habitats.
- The DMC should have regulations relating to protection of such species as guided by the district stakeholders below.
- Incidents involving these habitats and species shall be reported to the relevant stakeholders and records shall be kept by the DMC

- The DMC shall assist the stakeholders in carrying out conservation measures
- Control of settlement patterns and cultivation land allocations. These should not be in or disturb sensitive habitats and species.
- They shall assist with flow monitoring after training by IDSP

Parks and wildlife

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

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

Forestry

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

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

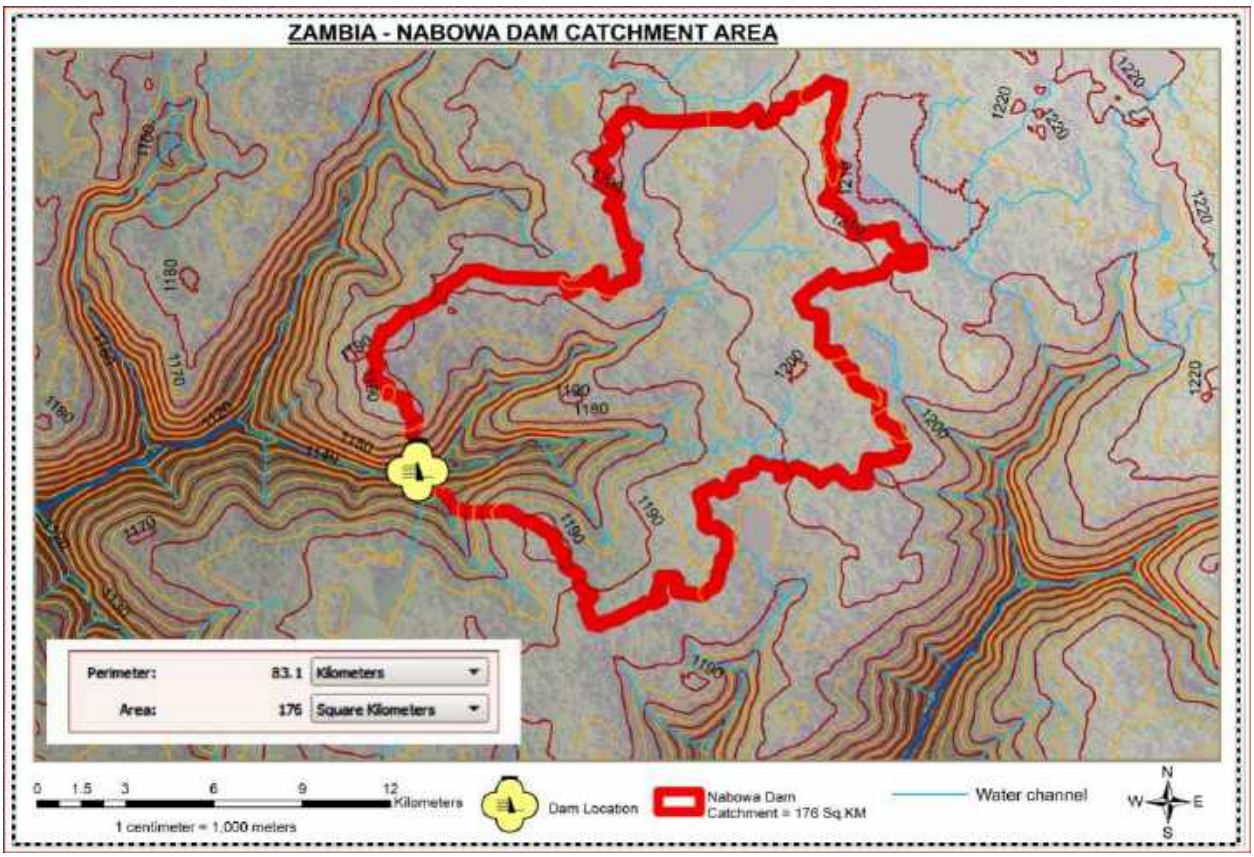
Agriculture

- They shall set objectives for the monitoring and evaluation program
- They shall annually train and sensitise the community in conservation and proper agriculture practices that will protect habitats and species
- They shall sensitise the community on invasive species and species of conservation concern
- They shall review the DMC's regulations and offer sector guidance
- They shall conduct annual site inspections and monitoring reporting submitting to the district and IDSP
- They shall conduct flow monitoring

- They shall take part in conducting detailed biodiversity assessments and reporting every 3-5 years for the project area of influence

Appendix 8. 7: Hydrology and Ecological flows

Dam catchment area



Flows in the reservoir close to the dam embankment, runoff season April 2021

Limited flows upstream of the dam, runoff season April 2021