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ENVIRONMENTAL IMPACT STATEMENT

NAZILONGO DAM – MULDERS FARM

KALOMO DISTRICT – SOUTHERN PROVINCE, ZAMBIA

BY: DONALD C. CHIKUMBI

ENVIRONMENTALIST

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EXECUTIVE SUMMARY

Introduction

This preliminary Environmental and Social Impact Statement (ESIS) Report, prepared by Chikumbi Consulting Company for Muilders Farm in the Nazilongo area of Kalomo District, Southern Province, outlines the anticipated environmental and social impacts of the proposed Nazilongo dam project. The report incorporates input from Interested and Affected Parties (IAPs) and stakeholders gathered during field visits and public meetings. It details the project scope, activities during construction and operation, and current environmental and socio-economic conditions. Potential positive and negative impacts are identified, along with measures to mitigate them in compliance with Zambia Environmental Management Agency (ZEMA) regulations. The report's commissioning adheres to ZEMA's guidelines, including approval of Scoping exercises and ESIA Terms of Reference (TOR). The draft ESIS is open for public comment, with revisions planned based on stakeholder feedback before final regulatory approval.

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PART 1 – ENVIRONMENTAL IMPACT ASSESSMENT

1.0 INTRODUCTION

1.1 Background

The location of the proposed dam project is in Mukwela area in Kalomo district Southern Province of Zambia. Kalomo district is about 350 km away from the capital city Lusaka and 120 km from Livingstone. The dam site is on the Nazilongo River a tributary of the Mweemba River which is als the tributary of Kalomo River.

1.2 Project

Recurrent droughts have become a norm in the Southern Province of Zambia. In order to mitigate against these droughts, Mulders Farm plans to construct the proposed Dam Project on the Nazilongo River. The project will involve construction of an earth dam of capacity 1,614,901m^3 at full scale. The water stored in the dam will be used for irrigation of crops that include Tobacco, Avocado, Oranges and Maize. Once completed, Mulders Farm will manage and maintain the dam. With the construction of the dam, it is expected that there will be reliable water supply throughout the year leading to increased agricultural production thus contributing effectively to food security and national economic growth.

1.3 The developers' details

Mr. GW Mulders

1.4 Particulars of Shareholders

1.5 Experience of the Corporation

The Mulders have been farming in the Nazilongo area of Kalomo district for over 60 years. They grow tobacco and citrus fruits. They are also cattle ranchers.

1.6 Project Investment

The estimated total cost of constructing the dam is US$120,000 as per the design Engineer's estimate

1.7 Project Life

The life of the dam is expected to be over 50 years

2. DESCRIPTION OF THE PROJECT LOCATION

2.1 Project Rationale

The rationale behind construction of this dam is that runoff resulting from the rain during the rainy season which is currently lost will be captured.

2.2 Project Location

Mulders farm proposes to construct an earth dam on Nazilongo River within Mukwela area of Kalomo District. The stored water in the earth dam amounting to 1.6 million cubic meters at full capacity will be used mainly for irrigation and animal watering. Nazilongo River is a tributary of the Mweemba River.

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2.3 Methodology

The study used an integrated approach involving various methods. These ranged from literature review to field work. Further information was also collected through verbal communication with key informants and resource persons within the project area.

2.3.1 Public Awareness

The public hearing was held at the District Commissioners Office – Kalomo in the presence of the district Commissioner, Mr. Joshua Sikaduli.

At this meeting Mr. G.W Mulders explained the purpose of the meeting which was to undertake a process to construct a dam of 1,500,000 cubic meters on the Nazilongo River that passes through his farm. He went on to mention that the dam would cover 20 hectares full supply area, with a full supply level of 1267m

Specific concerns and issues raised at the meetings that the EIA will address include the following:

i. Reinforcement of laws prohibiting cultivation along river banks.
ii. Expedited approval process for dam construction by ZEMA, as directed by the President.
iii. Support for the proposed dam due to its potential to employ the existing 220 employees.
iv. Assurance that the dam will have no impact on local communities as it will be located on a private farm, far from the nearest villages.

2.3.2 Literature Review

The literature review on the study area, proposed activities and possible impacts and mitigations was mainly undertaken using topographical maps covering the project area and available secondary information on climate, geology, geomorphology, ecology, archaeology, socio-economy and other documents with relevant information to the study area.

2.3.3. Field Work

In early April 2024, consultants conducted field research for the proposed dam project. This involved walking along the dam site, both upstream and downstream, to study soil and rock formations, vegetation, and local wildlife. They collected soil and water samples for lab analysis. The team also visited local communities along the Mweemba River to evaluate potential risks and impacts. They interviewed community members and leaders to understand their concerns about the proposed dam on the Nazilongo River, a tributary of the Mweemba. The study also considered the socioeconomic effects of the dam on these communities.

2.3.4 Oral Interviews

Information on features of ecological and geomorphologic significance in the project area around its vicinity the study was also collected by way of oral interviews mainly with the local people located within the project area.

3. LEGAL AND POLICY FRAMEWORK

3.1 Zambian Environmental Policy:

1. **Description:** The Zambian Environmental Policy promotes sustainable development through the conservation and sustainable use of natural resources, pollution prevention, and environmental management.
2. **Relevance:** It helps government agencies, industries, and communities integrate environmental considerations into their policies, programs, and projects, including dam construction.
3. **Compliance:** Ensuring compliance means aligning dam construction with the policy's principles, such as minimizing environmental impacts, conserving biodiversity, and encouraging community participation and stakeholder engagement.

3.2 Irrigation Policy 2004:

1. **Description**: The Irrigation Policy aims to promote sustainable irrigation development to enhance agricultural productivity, food security, and rural livelihoods while ensuring efficient water use and environmental conservation.
2. **Relevance**: It guides the planning, implementation, and management of irrigation projects associated with dam construction, emphasizing water resource management and environmental sustainability.
3. **Compliance**: Compliance involves incorporating irrigation components into dam projects in accordance with the policy's principles and guidelines, including water allocation, irrigation efficiency, and environmental impact assessment requirements.

3.3 National Environmental Legislation:

1. **Description**: National environmental legislation comprises laws and regulations governing environmental protection, conservation, and management in Zambia, including the Environmental Management Act and associated regulations.
2. **Relevance**: It provides the legal framework for environmental governance and regulation, addressing issues such as pollution control, natural resource management, and environmental impact assessment, which are relevant to dam construction.
3. **Compliance**: Compliance involves adhering to relevant environmental laws and regulations throughout the planning, construction, and operation phases of dam projects, obtaining permits, conducting impact assessments, and implementing mitigation measures as required.

3.4 The Environmental Management Act (Amendment) Act No.8 of 2023:

1. **Description**: This amendment to the Environmental Management Act introduces updates and enhancements to the existing environmental management framework, addressing emerging environmental challenges and strengthening regulatory mechanisms.
2. **Relevance**: It ensures that environmental management practices and regulations remain current, effective, and responsive to evolving environmental issues, including those related to dam construction.
3. **Compliance**: Compliance involves incorporating new provisions and requirements introduced by the amendment into dam construction projects, updating environmental management plans, and ensuring adherence to revised standards and procedures.

3.5 The Hazardous Waste Management Part IV (Regulations 18-30) of SI 112 (2013):

1. **Description**: These regulations provide guidelines for the management, handling, storage, transportation, and disposal of hazardous wastes, ensuring their safe and environmentally sound management.
2. **Relevance**: They are relevant for dam construction projects as they address the proper handling and disposal of hazardous materials and wastes generated during construction activities.
3. **Compliance**: Compliance involves identifying and categorizing hazardous wastes generated by dam construction, implementing measures to minimize their generation, and ensuring proper storage, transportation, and disposal in accordance with regulatory requirements.

3.6 EMA Statutory Instruments:

1. **Description**: EMA Statutory Instruments are subsidiary regulations issued under the Environmental Management Act, providing detailed specifications and procedures for implementing specific provisions of the act.

2. **Relevance**: They provide guidance and clarification on various aspects of environmental management, including environmental impact assessment, licensing, and pollution control, which are relevant to dam construction.

3. **Compliance**: Compliance involves following the requirements and procedures outlined in relevant statutory instruments when obtaining permits, conducting assessments, and implementing environmental management measures for dam projects.

3.7 Statutory Instrument No. 28 of 1997 Environmental Impact Assessment (EIA) Regulations:

1. **Description**: These regulations set out the requirements and procedures for conducting environmental impact assessments (EIAs) for proposed projects, including dam construction, to evaluate potential environmental impacts and identify mitigation measures.

2. **Relevance**: They ensure that dam construction projects undergo thorough environmental assessments to minimize adverse environmental effects and promote sustainable development.

3. **Compliance**: Compliance involves conducting EIAs in accordance with the regulations, including scoping, baseline studies, impact assessment, public consultation, and submission of EIA reports for approval before commencing dam construction activities.

3.8 Environmental Licensing Regulations (SI No.112 of 2013):

1. **Description**: These regulations establish the requirements and procedures for obtaining environmental permits or licenses for activities with potential environmental impacts, including dam construction.

2. **Relevance**: They ensure that dam construction projects meet specified environmental standards and requirements before they can proceed, promoting environmental protection and compliance with regulatory standards.

3. **Compliance**: Compliance involves applying for and obtaining environmental licenses or permits as required by the regulations, demonstrating adherence to environmental standards, mitigation measures, and monitoring requirements throughout the project lifecycle.

3.9 Air Pollution Control:

1. **Description**: Air pollution control measures aim to prevent, reduce, or mitigate air pollution from various sources, including industrial processes, vehicle emissions, and construction activities.

2. **Relevance**: They are relevant for dam construction projects to minimize emissions from construction machinery, vehicles, and other sources, ensuring compliance with air quality standards and protecting public health and the environment.

3. **Compliance**: Compliance involves implementing measures to control dust emissions, exhaust fumes, and other air pollutants generated by dam construction activities, including using clean technologies, dust suppression measures, and emission controls as required by regulatory standards.

3.10 Noise Regulations:

1. **Description**: Noise regulations establish limits and standards for noise levels from various sources, including industrial activities, construction sites, and transportation.

2. **Relevance**: They are relevant for dam construction projects to minimize noise disturbances to surrounding communities, ensuring compliance with noise level limits and protecting public health and well-being.

3. **Compliance**: Compliance involves implementing measures to reduce noise emissions from construction activities, such as scheduling noisy activities during off-peak hours, using noise barriers or mufflers, and implementing sound insulation measures to mitigate noise impacts on nearby residents.

3.11 Water Resources Management Act 21 of 2011

Description: This act governs the management, conservation, and allocation of water resources in Zambia, including the regulation of water use, water rights, and water infrastructure development.

Relevance: It is highly relevant for dam construction as it provides the legal framework for managing water resources, obtaining water permits, and ensuring sustainable use of water for irrigation, hydropower generation, and other purposes.

Compliance: Compliance involves obtaining water permits, conducting environmental impact assessments for water-related projects such as the proposed Nazilongo dam, and adhering to regulations for water quality protection and water conservation.

3.12 Noxious Weeds Act (Cap. 231):

Description: This act addresses the control and management of invasive plant species that pose a threat to agriculture, ecosystems, and biodiversity.

Relevance: It is relevant for dam construction projects as it may require measures to control and prevent the spread of invasive weeds in dam reservoirs, surrounding lands, and irrigation areas.

Compliance: Compliance involves implementing weed control measures as required by the act to prevent the introduction and spread of noxious weeds in dam construction sites and adjacent areas.

3.13 Zambia Wildlife Act No.14 of 2015:

Description: This act provides regulations for the conservation, protection, and management of wildlife and their habitats in Zambia.

Relevance: It is relevant for dam construction as it may involve impacts on wildlife habitats and species, requiring compliance with regulations to minimize disturbance and mitigate adverse effects on wildlife.

Compliance: Compliance involves conducting wildlife surveys, implementing habitat conservation measures, and obtaining necessary permits or approvals to ensure compliance with wildlife protection regulations.

3.14 Forest Act No. 4 of 2015:

Description: This act governs the sustainable management, conservation, and utilization of forest resources in Zambia, including regulations for timber harvesting, forest protection, and reforestation.

Relevance: It is relevant for dam construction as it may involve deforestation or land clearing activities, requiring compliance with regulations for forest conservation and sustainable land use.

Compliance: Compliance involves obtaining forest permits, implementing reforestation plans, and adhering to regulations for sustainable forest management to mitigate deforestation and habitat loss associated with dam construction.

3.15 Land Act No. 20 of 1996:

Description: This act addresses land tenure, land administration, and land use planning in Zambia, providing regulations for land acquisition, land rights, and land development.

Relevance: It is relevant for dam construction as it may involve land acquisition, land use planning, and resettlement of communities, requiring compliance with regulations to ensure equitable land allocation and compensation for affected landowners.

Compliance: Compliance involves obtaining land permits or leases, conducting land surveys, and adhering to regulations for land use planning and community consultation to minimize social impacts and conflicts associated with dam construction.

3.16 National Council for Construction (NCC) Act, No. 10 of 2020:

Description: This act establishes the National Council for Construction (NCC) and provides regulations for construction industry standards, licensing, and quality control.

Relevance: It is relevant for dam construction as it sets standards and regulations for construction practices, materials, and safety requirements.

Compliance: Compliance involves obtaining construction permits or licenses, adhering to construction standards and codes, and ensuring compliance with safety regulations to maintain quality and integrity in dam construction projects.

3.17 The Lands Acquisition Act No. 13 of 1994 (SI 110 of 1992):

Description: This act governs the process of land acquisition by the government for public purposes, including infrastructure development projects.

Relevance: It is relevant for dam construction as it may involve compulsory acquisition of land for dam reservoirs, access roads, and associated infrastructure.

Compliance: Compliance involves following the legal procedures and requirements specified in the act for land acquisition, including conducting land surveys, notifying affected landowners, and providing fair compensation for acquired land.

3.18 National Heritage and Conservation Commission Act of 1989:

Description: This act establishes the National Heritage and Conservation Commission and provides regulations for the conservation and protection of national heritage sites, cultural heritage, and historical monuments.

Relevance: It is relevant for dam construction as it may involve impacts on cultural heritage sites, archaeological sites, or areas of cultural significance.

Compliance: Compliance involves conducting cultural heritage assessments, implementing mitigation measures to protect heritage sites, and obtaining necessary approvals or permits to ensure compliance with heritage conservation regulations.

3.19 Roads and Traffic Control Act No.11 of 2002:

Description: This act provides regulations for the construction, maintenance, and management of roads and transportation infrastructure in Zambia.

Relevance: It is relevant for dam construction as it may involve the construction of access roads, transportation of construction materials, and management of traffic during construction.

Compliance: Compliance involves obtaining permits for road construction, adhering to road construction standards and safety regulations, and implementing traffic management measures to minimize disruptions and ensure safety during dam construction activities.

3.20 Urban and Regional Planning Act, No. 3 of 2015:

Description: This act provides regulations for urban and regional planning, land use zoning, and development control in Zambia.

Relevance: It is relevant for dam construction as it may involve land use planning, environmental impact assessment, and infrastructure development in urban or peri-urban areas.

Compliance: Compliance involves obtaining planning permits or approvals, conducting environmental impact assessments, and adhering to regulations for land use zoning and development standards to ensure sustainable development and minimize environmental impacts associated with dam construction.

3.21 The Public Health Act CAP 535 of 2006:

Description: This act addresses public health issues and provides regulations for disease prevention, sanitation, and environmental health.

Relevance: It is relevant for dam construction as it may involve impacts on public health, such as waterborne diseases, vector-borne diseases, or exposure to hazardous substances.

Compliance: Compliance involves implementing measures to protect public health, ensuring safe drinking water supply, controlling disease vectors, and mitigating environmental health risks associated with dam construction activities.

3.22 The Solid Waste Regulation and Management Act No. 22 of 2018:

Description: This act provides regulations for the management, disposal, and recycling of solid waste in Zambia.

Relevance: It is relevant for dam construction as it may involve the generation of construction waste, such as debris, excavated soil, or packaging materials.

Compliance: Compliance involves proper handling, storage, transportation, and disposal of solid waste generated during dam construction activities, adhering to waste management regulations to minimize environmental pollution and health hazards.

3.23 The Employment Code Act N0. 3 of 2019:

Description: This act addresses labor rights, employment conditions, and workplace safety standards in Zambia.

Relevance: It is relevant for dam construction as it

3.2 INTERNATIONAL POLICIES

3.1.1 WORLD BANK

The World Bank's Environmental and Social Standards (ESS) apply to dam construction projects to manage environmental and social risks, protect labor rights, and promote resource efficiency and pollution prevention. Compliance with these standards is crucial for sustainable development and minimizing negative impacts on communities, workers, and the environment. The following provides a description of each ESS policies and its applicability to dam construction:

3.1.1.1ESS1: Assessment and Management of Environmental and Social Risks and Impacts:

1. **Description**: ESS1 requires borrowers to identify, assess, and manage environmental and social risks and impacts associated with their projects throughout the project lifecycle. It includes requirements for environmental and social assessments, stakeholder engagement, and management plans to address potential adverse effects on communities, ecosystems, and cultural heritage.

2. **Applicability to Dam Construction**: ESS1 is highly relevant to dam construction projects as they often have significant environmental and social impacts on surrounding communities, ecosystems, and cultural resources. Compliance involves conducting comprehensive environmental and social assessments, engaging stakeholders, and developing management plans to mitigate risks and impacts associated with dam construction activities

3.2.1.2 ESS2: Labour and Working Conditions:

1. **Description**: ESS2 aims to ensure that projects provide safe and healthy working conditions, fair labor practices, and opportunities for workers' well-being and development. It includes requirements for occupational health and safety, fair wages, working hours, non-discrimination, and grievance mechanisms.

2. **Applicability to Dam Construction**: ESS2 is applicable to dam construction projects to ensure the safety and well-being of workers involved in construction activities. Compliance involves implementing measures to protect workers from occupational hazards, providing training and capacity building, ensuring fair wages and working conditions, and establishing grievance mechanisms for addressing labor-related concerns.

3.2.1.3 ESS3: Resource Efficiency and Pollution Prevention and Management:

1. **Description**: ESS3 focuses on promoting resource efficiency, pollution prevention, and sustainable management of natural resources to minimize adverse environmental impacts. It includes requirements for reducing resource consumption, minimizing pollution emissions, managing hazardous materials, and promoting sustainable practices.

2. **Applicability to Dam Construction**: ESS3 is relevant to dam construction projects to minimize resource consumption, pollution, and environmental degradation associated with construction activities. Compliance involves adopting measures to optimize resource use, reduce energy consumption, manage construction waste, control pollution emissions, and implement best practices for sustainable construction and operation of dams.

3.2.1.4 ESS4: Community Health and Safety:

1. **Description:** ESS4 focuses on safeguarding the health and safety of communities affected by World Bank-funded projects. It includes measures to identify, assess, and manage potential health and safety risks arising from project activities. This standard emphasizes the importance of proactive measures to prevent and mitigate adverse health and safety impacts on project-affected communities.

2. **Applicability to Dam Construction:** ESS4 is highly relevant to dam construction projects as they can have significant impacts on the health and safety of nearby communities. Construction activities such as excavation, blasting, and heavy machinery operation pose potential risks to community health and safety. Compliance involves conducting health and safety assessments, implementing measures to minimize risks, providing community awareness and training programs, and establishing emergency response mechanisms to address health and safety incidents.

3.2.1.5 ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement:

1. **Description:** ESS5 addresses the acquisition of land, restrictions on land use, and involuntary resettlement that may result from World Bank-funded projects. It sets out principles and requirements to avoid, minimize, and mitigate adverse impacts on people and communities affected by land acquisition or resettlement, ensuring that affected individuals and communities are fairly compensated and provided with assistance to restore or improve their livelihoods.

2. **Applicability to Dam Construction:** ESS5 is particularly relevant to dam construction projects as they often involve the acquisition of land for reservoirs, infrastructure, and resettlement of affected communities. Compliance involves conducting comprehensive land acquisition and resettlement planning, consulting with affected communities, providing compensation and assistance packages, and implementing resettlement plans to minimize adverse impacts and promote the well-being of affected individuals and communities. It also entails ensuring that resettlement activities adhere to internationally recognized principles of involuntary resettlement, such as those outlined in the World Bank's Operational Policy on Involuntary Resettlement.

3.2.1.6 ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources:

1. **Description**: ESS6 focuses on the conservation and sustainable management of biodiversity and living natural resources affected by World Bank-funded projects. It aims to avoid, minimize, and mitigate adverse impacts on biodiversity, ecosystems, and ecosystem services, and promote their conservation and sustainable use.

2. **Applicability to Dam Construction**: ESS6 is relevant to dam construction projects as they can have significant impacts on biodiversity, including habitat loss, fragmentation, and alteration of river ecosystems. Compliance involves conducting biodiversity assessments, implementing measures to avoid or minimize impacts on sensitive habitats and species, and implementing biodiversity conservation and restoration measures as necessary to maintain ecosystem health and resilience.

3.2.1.7 ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities:

1. **Description**: ESS7 addresses the rights and interests of indigenous peoples and historically underserved traditional local communities affected by World Bank-funded projects. It requires meaningful consultation, participation, and consent of these communities in project planning, implementation, and benefit-sharing.

2. **Applicability to Dam Construction**: ESS7 is relevant to dam construction projects that may impact indigenous peoples or historically underserved communities through land acquisition, displacement, or changes in natural resource access. Compliance involves conducting free, prior, and informed consent (FPIC) processes, respecting traditional knowledge and cultural practices, and ensuring that affected communities participate in decision-making processes and benefit from project outcomes.

3.2.1.8 ESS8: Cultural Heritage:

1. **Description**: ESS8 focuses on the protection and preservation of cultural heritage sites, monuments, and resources affected by World Bank-funded projects. It aims to avoid, minimize, and mitigate adverse impacts on cultural heritage and promote its conservation, documentation, and sustainable management.

2. **Applicability to Dam Construction**: ESS8 is relevant to dam construction projects that may impact cultural heritage sites, archaeological sites, or cultural landscapes. Compliance involves conducting cultural heritage assessments, identifying and protecting cultural heritage resources, implementing measures to avoid or minimize impacts, and documenting and monitoring cultural heritage sites throughout the project lifecycle.

3.2.1.9 ESS9: Financial Intermediaries (FIs):

1. **Description**: ESS9 applies to projects financed through financial intermediaries (FIs), such as banks or financial institutions, where the World Bank's funds are provided indirectly through loans or investments. It sets out requirements for assessing and managing environmental and social risks associated with FI-funded projects.

2. **Applicability to Dam Construction**: ESS9 may be relevant to dam construction projects that receive financing through financial intermediaries. Compliance involves ensuring that FIs conduct due diligence, risk assessments, and environmental and social management consistent with the World Bank's environmental and social standards.

3.2.1.10 ESS10: Stakeholder Engagement and Information Disclosure:

3. **Description**: ESS10 emphasizes the importance of meaningful stakeholder engagement, transparency, and information disclosure throughout the project lifecycle. It requires proactive and inclusive engagement with project-affected communities, stakeholders, and the public, and timely disclosure of project-related information.

4. **Applicability to Dam Construction**: ESS10 is relevant to dam construction projects for building trust, fostering dialogue, and addressing concerns of project-affected communities and stakeholders. Compliance involves developing and implementing stakeholder engagement plans, providing access to project information, soliciting feedback and grievances, and incorporating stakeholder input into decision-making processes.

3.3 INTERNATIONAL FINANCE COOPERATION (IFC)

The following are the descriptions and applicability of the mentioned International Finance Corporation (IFC) Performance Standards (PS) as they relate to dam construction projects:

3.3.1 IFC PS 1: Assessment and Management of Environmental and Social Risks and Impacts:

1. **Description**: PS1 requires clients to identify and assess potential environmental and social risks and impacts of their projects. It also mandates the implementation of management plans to mitigate adverse impacts and enhance project benefits. PS1 emphasizes stakeholder engagement and the integration of environmental and social considerations into project decision-making processes.

2. **Applicability to Dam Construction**: PS1 is highly applicable to dam construction projects, which often have significant environmental and social impacts. Compliance involves conducting comprehensive environmental and social assessments, engaging stakeholders, developing and implementing management plans to mitigate risks, and monitoring performance throughout the project lifecycle.

3.3.2 IFC PS 2: Labor and Working Conditions:

1. **Description**: PS2 aims to ensure that workers involved in project activities are provided with safe and healthy working conditions, fair wages, and adequate labor protections. It covers areas such as occupational health and safety, working hours, wages, and grievance mechanisms.

2. **Applicability to Dam Construction**: PS2 is directly applicable to dam construction projects, which involve labor-intensive activities. Compliance involves ensuring compliance with national labor laws and regulations, providing a safe working environment, conducting regular health and safety assessments, and establishing mechanisms for addressing worker grievances.

3.3.3 IFC PS 3: Resource Efficiency and Pollution Prevention:

3. **Description**: PS3 focuses on promoting resource efficiency and pollution prevention in project activities. It encourages the efficient use of resources, reduction of pollution emissions, and adoption of cleaner production practices.

4. **Applicability to Dam Construction**: PS3 is relevant to dam construction projects, which can have significant resource consumption and pollution generation. Compliance involves implementing measures to optimize resource use, minimize pollution emissions, and adopt environmentally friendly construction practices, such as sediment control measures and erosion prevention techniques.

3.3.4 IFC PS 4: Community Health, Safety, and Security:

5. **Description**: PS4 aims to ensure the health, safety, and security of project-affected communities. It requires clients to identify and assess potential risks to community health and safety and implement measures to prevent or mitigate adverse impacts.

6. **Applicability to Dam Construction**: PS4 is directly relevant to dam construction projects, which can pose risks to the health, safety, and security of nearby communities. Compliance involves conducting risk assessments, implementing safety measures at construction sites, providing emergency response plans, and engaging with communities to address concerns and grievances related to health, safety, and security.

3.3.5 IFC PS 5: Land Acquisition and Involuntary Resettlement:

7. **Description**: PS5 addresses the acquisition of land and involuntary resettlement that may result from project activities. It requires clients to avoid or minimize displacement, provide fair compensation and assistance to affected persons, and promote their livelihood restoration.

8. **Applicability to Dam Construction**: PS5 is highly applicable to dam construction projects, which often involve land acquisition and resettlement of communities. Compliance involves conducting comprehensive social impact assessments, consulting with affected communities, providing compensation and assistance packages, and implementing resettlement plans in accordance with international standards and best practices.

3.3.6 IFC PS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources:

9. **Description**: PS6 focuses on the conservation and sustainable management of biodiversity and living natural resources affected by project activities. It aims to avoid, minimize, and mitigate adverse impacts on biodiversity and promote its conservation and sustainable use.

10. **Applicability to Dam Construction**: PS6 is relevant to dam construction projects, which can have significant impacts on biodiversity and ecosystems. Compliance involves conducting biodiversity assessments, identifying and protecting sensitive habitats and species, implementing measures to avoid or minimize impacts, and implementing biodiversity conservation and restoration measures as necessary.

3.3.7 IFC PS 7: Indigenous Peoples:

11. **Description**: PS7 addresses the rights and interests of indigenous peoples affected by project activities. It requires clients to identify and assess potential impacts on indigenous peoples, engage with them in a culturally appropriate manner, and obtain their free, prior, and informed consent for projects that may affect their lands, resources, or cultural heritage.

12. **Applicability to Dam Construction**: PS7 is applicable to dam construction projects that may impact indigenous peoples' lands, resources, or cultural heritage. Compliance involves conducting consultations with indigenous peoples, respecting their traditional knowledge and cultural practices, and obtaining their consent for project activities that may affect them.

3.3.8 IFC PS 8: Cultural Heritage:

13. **Description**: PS8 focuses on the protection and preservation of cultural heritage sites, monuments, and resources affected by project activities. It requires clients to identify and assess potential impacts on cultural heritage, develop measures to avoid or minimize adverse impacts, and implement plans for the conservation and management of cultural heritage resources.

14. **Applicability to Dam Construction**: PS8 is relevant to dam construction projects that may impact cultural heritage sites, archaeological sites, or cultural landscapes. Compliance involves conducting cultural heritage assessments,

3.4 THE UNITED NATIONS POLICIES

Here are the descriptions and applicability of the mentioned international environmental conventions as they relate to dam construction:

3.4.1UNFCCC (United Nations Framework Convention on Climate Change Ratified 1997):

1. **Description**: The UNFCCC is an international treaty aimed at addressing climate change by stabilizing greenhouse gas concentrations in the atmosphere. It sets out general principles and commitments for mitigating climate change and adapting to its impacts through international cooperation.

2. **Applicability to Dam Construction**: The UNFCCC is relevant to dam construction due to its focus on mitigating greenhouse gas emissions, which can be generated during the construction and operation of dams. Dam construction may also have implications for climate change adaptation, particularly in managing water resources in the context of changing climatic conditions.

3.4.2 UN Convention on Biological Diversity (1992):

3. **Description**: The Convention on Biological Diversity (CBD) is an international treaty aimed at conserving biodiversity, promoting sustainable use of biological resources, and ensuring fair and equitable sharing of benefits arising from genetic resources. It addresses issues related to conservation, sustainable use, and equitable benefit-sharing of biological diversity.

4. **Applicability to Dam Construction**: The CBD is relevant to dam construction projects due to their potential impacts on biodiversity, including habitat destruction, alteration of river ecosystems, and disruption of wildlife populations. Compliance involves conducting biodiversity assessments, implementing measures to minimize impacts on biodiversity, and incorporating biodiversity conservation and restoration measures into dam construction and operation.

3.4.3 UN Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal (1992):

5. **Description**: The Basel Convention is an international treaty aimed at controlling Trans boundary movements of hazardous wastes and ensuring their environmentally sound management. It regulates the generation, transport, and disposal of hazardous wastes to minimize risks to human health and the environment.

6. **Applicability to Dam Construction**: The Basel Convention is relevant to dam construction projects as they may generate hazardous wastes such as contaminated soil, construction debris, or waste chemicals. Compliance involves implementing measures to minimize the generation of hazardous wastes, properly handling, transporting, and disposing of hazardous wastes in accordance with the provisions of the convention and relevant national regulations.

INSTITUTIONAL FRAMEWORK

3.5.1 Ministry of Environment and Green Economy

This Ministry is responsible for the development of policies on environment. It also coordinates and monitors other Ministries that contribute to effective conservation and management of the environment.

3.5.2 Zambia Environmental Management Agency (ZEMA)

This is a statutory body created by an Act of Parliament under the Ministry of Environment and Green Economy. It is tasked with enforcement of the provisions of Environmental Management Act (EMA) on the protection of the environment and control of pollution in particular so as to provide for health and welfare of persons, animals, plants and the environment in general.

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4. DESCRIPTION OF THE PROJECT

4.1 Project Background

Mulders farm proposes to construct an earth dam on Nazilongo River within Mukwela area of Kalomo District. The stored water in the earth dam amounting to 1.6 million cubic meters at full capacity will be used mainly for irrigation and animal watering. Nazilongo River is a tributary of the Mweemba River. The rationale behind construction of this dam is that runoff resulting from the rain during the rainy season which is currently lost will be captured.

The catchment area of the proposed dam will be around 3,963 Ha. The average yield of this earth dam once constructed is expected to be 1,614,901 m^3 at Full Supply Level (FSL) while the height of crest above river bed will be 8.75m. A throwback of about 1Km is expected and mainly grazing land will be submerged. All the land that is expected to be inundated is within the developer's farm. The dam wall length will be 310m. This size of the dam is classified as a small dam. No households (HHs) are expected to be relocated or affected. The dam rock consists of Karoo basalt, granite gneiss, shale and sandstone. The estimated total cost of constructing the dam is US$120,000 as per the design Engineer's estimate

4.2 PROJECT LIFE CYCLE ACTIVITIES

The project will have three stages namely Site Preparation, Construction and Operation Phases. The estimated implementation time frame for the proposed project is estimated to be two hydrological years depending on rainfall pattern. The project is expected to begin in 2024, however actual commencement date of the project will depend on when the approvals from ZEMA, WARMA and other relevant authorities will be obtained. During Site Preparation phase the project area was investigated for dam construction suitability through a number of tests. The concept was to determine the nature of the soil and geology critical in dam construction. In addition, hydrological investigations were conducted.

In addition, a number of alternative sites were investigated. However, all the sites except for the site where the earth dam is proposed to be located were found to be lacking in one way or another. Reasons for not choosing the other sites included unsuitable topography, soils and underlying geology for constructing the earth dam wall, spillway and foundation. The construction phase will mainly involve excavations, earth movements and development of embankment. The Operation phase will involve filing the dam and abstraction of water for irrigation.

4.3 INPUT RAW MATERIALS

To implement the proposed dam project, it will require various raw materials as input. For outlet works, rubber lined pipes and fittings of various diameters will be used. The embankment and spillway will be cleared of vegetation and top soil. The core will be excavated to bedrock, spread and compacted with suitable impervious material. The rest of the embankment will be constructed using suitably conditioned material.

The material to be used for the embankment will mainly be excavated from the spillway area, outlet works and borrow pits to be sited during construction.

The borrow areas will be cleared of vegetation and top soil (spillway excavation also regarded as borrow pit). All vegetation will be disposed of if not required by making compost manure for soil conditioning, surplus soil will be retained either for embankment cladding or borrow area rehabilitation. The borrow area will be in close proximity to the main embankment thereby reducing hauling distances. In addition, removing of the soil from the outflow area down to rock will limit siltation for the downstream portion of the stream. Detailed management plan for borrow pits are given in the annexes.

4.4 EMBANKMENT

The embankment will be a zoned type. The hearting shall overlie the cut off trench and extend up to full supply level. with the crests of about 4m wide. The downstream and upstream slopes will be 1:2.5 and 1:2.5 respectively. Sand clay loams laid in layers will be used to construct the hearting and upstream zone. However, for upstream zones, sand clay loam containing gravel within it will be placed on the water face to aid in resisting wave action erosion. The downstream zones will be made of gravel, coarse grained sand and medium grained sand layered at optimum moisture and compacted. Dry stone toe and foundations will be incorporated in these zones. The selection of materials will take into account the hydraulic stability of the materials in the dam.

4.5 PROJECT RATIONALE AND OBJECTIVE

Recurrent droughts have become a norm in the Southern Province of Zambia. In order to mitigate against these droughts, Mulders plans to construct the proposed Dam Project on the Nazilongo River. The project will involve construction of an earth dam of capacity 1,614,901m^3 at full scale. The water stored in the dam will be used for irrigation of crops that include Tobacco, Avocado, Oranges and maize. Once completed, Mulders Farm will manage and maintain the dam.

With the construction of the dam, it is expected that there will be reliable water supply throughout the year leading to increased agricultural production thus contributing effectively to food security and national economic growth.

4.6 PROJECT JUSTIFICATION

Field surveys indicated that Nazilongo River is not a perennial river but has excess runoff during rainy season if the hydrological year is normal. Therefore, it is imperative that the excess runoff water is harnessed by constructing water retaining infrastructure such as an earth dam. This is runoff that is currently not harvested as there is no storage facility. The river was dry during the survey in the first week of April. This would greatly mitigate the effects of unreliable rain pattern.

On the other hand, Zambia ranks quite low in the region regarding overall water storage capacity and number of dams in existence. Kalomo has about 301 small to medium sized and large earth Dams. It is Zambia's most drought prone where most of the streams and rivers are ephemeral and non perennial. They dry up after the rain season hence there is no water available during the dry season for productive use. Most streams and rivers have good sites for Dam construction. Mulders farm intends to construct an earth dam to be able to store enough water for irrigation during the dry season to enhance agricultural productivity. This would in turn contribute to increasing the country's national water storage capacity as well as the area under irrigation. The increase in crop production would contribute to reduction in poverty and enhance the overall national economic growth

Besides, commercial farming requires heavy capital investment. To realize meaningful returns on such an investment, it would be unwise to entirely depend on rain fed farming. Rain fed farming has its own short comings that include unreliable rain patterns as witnessed in recent years. Many times, rains are adequate but the period may be too short or scantly prolonged leading to crop stress, resulting into poor crop yield.

4.7 PROJECT ALTERNATIVES

Project alternatives may comprise alternative sites, alternative processes or alternative implementation schedules. The EIA process contributes to generation of anumber of project alternatives.

A variety of project alternatives presented themselves from the design and management of dam project. Due consideration was given to topographical characteristics;

1. Narrowest section of the valley is preferred,
2. Catchment area of the dam- the wider the Catchment area of the dam the higher discharge available,
3. Distance to fields or areas to be irrigated the shorter the conveyance the more economical,
4. Accessibility of the site- the easy accessibility of the site the cheaper it is to construct.
5. The geology and soil type are the other critical factors that were taken into account.

With regard to the overall project development, three options were considered namely;

1. Avoid construction of the earth dam at the proposed site and continue to depend on rains with the view of increasing agricultural productivity without irrigation
2. Construct a single large dam on another site on Nazilongo River or Mweemba River within the project area

4.7.3 Construct a number of smaller earth dams at a number of identified sites.

The first option which is a do nothing option is retrogressive for an existing enterprise such as Mulders farm who want to grow farming operations across the agricultural value chain. Choosing this option would entail perpetual losses on the part of Mulders resulting in low productivity as witnessed in recent years.

This would further undermine the championing of agriculture as an engine for economic growth in the country. Further no additional employment opportunities are envisaged under this option.

The second option appears to be the most attractive and a onetime investment whose returns can be huge. This option would certainly be a solution to the projected water demand for the current and future undertakings. However, considering the fact that large dams have far reaching environmental effects most of which are irreversible, choosing this option would be invariance with the company's policy on environment. The company embraces the principle of sustainable development that ensures that any development meets the needs of the present generation without compromising those of future generations. Therefore, this option was found to be inappropriate and environmentally challenging.

The third option not only provides a technical solution but also in many ways it's environmentally sound. Settling for this option cumulatively guarantees availability of adequate water throughout to meet current and future water demand for meaningful irrigation. A number of small earth dams with minimum flooded areas will be constructed on Nazilongo and Mweemba Rivers. In which case, the environmental effects will be minimized to small portions of land hence reducing the extent of impacts within the project area. Besides, the environmental effects resulting from small dams can easily be minimized and managed. However, cumulatively the benefits will be huge. Employment for the local people would be guaranteed due to increased agricultural productivity. As such, settled for the third option as the best option under the circumstance. During this phase the first small earth dam will be constructed and thereafter others will follow on the downstream.

4.8 WATER RIGHT

Information obtained from the WARMA indicated that there are no existing water right holders on both upstream and downstream of the dam site on Nazilongo River. The river is ungauged and reliable consistent hydrological data is unavailable. Nonetheless the developer takes full recognition of existing water rights and is convinced that priority of use will be applied in granting the water right to ensure water availability to downstream users as prescribed in the Water Resources Management Act. In this regard, the developer has made a preliminary application for a Water Right permit subject to the EIA report for the proposed dam being approved by ZEMA.

5.0 DESCRIPTION OF BASELINE ENVIRONMENT

5.1 Climate Change

The impacts of climate change have resulted in diminished surface water availability, affecting both domestic water usage and agriculture. Moombe et al. (2020) highlighted the profound effects of these climate-related shifts on livelihoods and food production. Nonetheless, maize production in the region has remained unaffected, largely due to the support provided by governmental and non-governmental organizations (NGOs) in supplying agricultural inputs

5.2 Agroecological Setting

Nazilongo is situated within Zambia's Kalomo district, falling under Agroecological Zone IIb. This zone typically receives an annual rainfall ranging from 800 to 1200 mm, albeit with highly variable distribution, averaging around 50 rainy days annually (with a range from 27 to 69 days). Over the years, there has been a general decline in rainfall amounts, as depicted in Figure 2. Temperatures in Zone IIb range from 2°C to 40°C, with an average around 20°C.

The climate of the area exhibits three distinct seasons: a warm rainy season from November to March, a cool dry season from April to July, and a hot dry season from September to October. Recent years have seen an increase in temperatures exceeding 30°C, resulting in elevated evapotranspiration rates and crop damage. The 2023/2024 season was particularly severe, marked by one of the worst droughts on record.

5.3 Rainfall Patterns
Kalomo, Zambia, experiences approximately 127 days of rainfall annually, accumulating around 574 mm (22.6 inches) of precipitation throughout the year. The rainy season spans from January through July, and again from October through December, with December recording the highest precipitation, averaging 156 mm (6.14 inches) over 24.1 rainy days. August and September typically see little to no rainfall.

5.4 UV Index
The months with the lowest UV index are January, May through July, and December, with an average maximum of 5. Conversely, the highest UV index occurs in September and October, reaching an average maximum of 7.

5.5 Humidity
February registers as the most humid month, with an average relative humidity of 84%, while September is the least humid, averaging around 30% relative humidity.

5.6 Temperature
July stands out as the coldest month, with average high temperatures reaching 22.6°C (72.7°F) and lows of 10.5°C (50.9°F). On the other hand, October is the warmest month, with average highs of 32.6°C (90.7°F) and lows of 19.6°C (67.3°F).

5.7 Daylight and Sunshine
June experiences the shortest days, averaging 11 hours and 6 minutes of daylight, with a corresponding average of 7.5 hours of sunshine. Conversely, October enjoys the longest daylight hours, with an average of 12.2 hours of sunshine.

Overall, Kalomo's climate exhibits diverse conditions, characterized by variations in temperature, humidity, and rainfall throughout the year, significantly influencing agricultural practices and other outdoor activities.

5.8 Wind

Field surveys indicate that prevailing winds predominantly blow towards the southwest in the area. The average annual wind speed in Kalomo hovers around 3 km/h, peaking at 8 – 10 km/h during August to October.

5.9 Topography
Kalomo District, located on the elevated Tonga plateau, features diverse topography including the plateau, eastern escarpment, southern Zambezi Basin, and western plains, all draining towards the Zambezi River. The main river, the Kalomo River, has a 6,636 km² catchment area and is fed by several tributaries, including the Nazilongo River, which is the site for a proposed dam. The Nazilongo flows into the Mweemba River, which then joins the Kalomo River before reaching the Zambezi. Other significant tributaries include Sichikwenkwe, Maunga, Ngolongozya, Nekaya, Kasibuku, Maziba, and Luezi.

Additional rivers such as Ngwezi, Nayemu, Munyeke, and Nanzhila, which flow into the Kafue Basin, originate within the district. The Nanzhila Catchment is the largest sub-catchment in the Lower Kafue, covering 7,134 km². Other notable sub-catchments are Bwengwa, Magoye, and Munyeke. Most rivers in the district are seasonal, making the proposed dam on the Nazilongo River crucial for water storage.

A key challenge is the encroachment of riparian vegetation for agriculture and fuel, causing siltation downstream, particularly near Mulders Farm. Effective land use management along riverbanks is essential to protect the district's water resources.

5.10 Air Quality

Assessing baseline air quality in the project area is essential, particularly for projects that may release pollutants. In the Nazilongo Catchment, dry season grassland and forest fires generate smoke and dust, causing air pollution and a noticeable haze, especially during cooler months due to temperature inversions. Visual assessments found the air quality to be generally satisfactory, largely due to the area's predominant agricultural activities.

5.11 Geology

Southern Province's geological composition includes diverse igneous, sedimentary, and metamorphic rocks. In Kalomo, the landscape features high-grade metasedimentary gneisses and schists, with Mesoproterozoic granite and granitic gneisses from the Choma-Kalomo batholith. The region is characterized by granite gneiss, heavily metamorphosed schists, and quartzites, along with other undated granites. These basement rocks are overlain by sequences of quartzites, pelites, and schists.

5.12 Soils

Nazilongo is located on the Tonga Plateau, featuring loamy sand soils known as the Kalomo soil series. Recent tests at the proposed dam site confirmed these well-drained, deep to moderately deep loamy sands, classified as Ferralic Cambisols (FAO-UNESCO) and Oxic Ustochrepts (USDA). These soils, derived from igneous gneiss of the Choma-Kalomo Batholith, contain significant iron oxide and are prone to weathering and erosion. Despite this, they are suitable for agriculture, especially for crops needing well-drained soils with moderate fertility. Enhancing soil fertility and pH balance with organic matter and lime is recommended. The area’s native vegetation includes miombo trees and hyperrhenia grass, with soil pH typically ranging from 4.7 to 5.0.

5.13 Soil moisture and temperature regimes

The soil moisture regime associated with the Nazilongo area is described as ustic, indicating dryness for 90 or more cumulative days annually but with moisture retention in some parts for over 180 cumulative days. Soil temperature in Southern, Southern Western, and Lusaka Provinces is typically hyperthermic, with a mean annual temperature exceeding 22°C and a significant difference between summer and winter temperatures. These conditions suggest the potential benefits of constructing dams on rivers like Nazilongo to manage variable moisture levels and support agriculture and communities during dry periods.

5.14 Vegetation

The natural vegetation of Kalomo is miombo woodland with Bracchystegia sp, Julbernadia Globiflora, Isoberlinia and other typical miombo trees, and hyparrhenia spp grass (Soil survey report No. 20, 1974; Moombe K.B. et al 2020). This is similar to the vegetation that is also present at Maulders farm.

5.15 Land Use

Kalomo District in Zambia has a rich historical and agricultural heritage, once serving as the administrative capital of North-Western Rhodesia. Known as the "land of maize and cattle," agriculture is vital to the local economy, supporting 70% of the population. However, the district grapples with challenges such as water scarcity, urbanization, land degradation, and climate change. Agriculture, both rain-fed and irrigated, covers 46% of the land, with over 67,000 farmers recorded in 2020. Livestock farming,

particularly cattle, is significant, alongside efforts in aquaculture to meet local fish demand. Despite its agricultural significance, Kalomo faces threats to its two forest reserves due to population growth and agricultural expansion.

5.16 Hydrology and Water Resources Potential

The Nazilongo River, stretching 15 kilometers and draining 224 square kilometers, has a gentle slope of 1.3 meters per kilometer. While its flow data is unrecorded as a non-perennial tributary to the Mweemba River, the Nazilongo catchment contributes around 1.6 million cubic meters of water annually across 3,963 hectares. The proposed Nazilongo dam on the Mulders property will feature a 310-meter embankment and a capacity of 1.6 million cubic meters, mainly for crop irrigation and animal watering.

5.17 Water Potential and Catchment Yield of Nazilongo Catchment

The Nazilongo River, a non-perennial tributary of the Mweemba River within the Kalomo River catchment, has an estimated catchment yield of 3,963 Mm3. Both rivers share similar geomorphology, climate, and land use patterns. The Nazilongo River has a mean monthly discharge of approximately 0.12 m3/s, peaking at around 0.35 m3/s in February. With a catchment area of 224 km2, it significantly contributes to the overall catchment yield. See Figure 4.3 for a visual of the Nazilongo Sub-catchment and proposed dam site.

5.18 Existing and Proposed Dam Sites

One existing dam upstream of the proposed Nazilongo dam sites has a total storage capacity of around 0.75 Mm3 when full. The proposed Nazilongo dam sites, with a combined storage of 1.6 Mm3, are expected to receive 2.4 Mm3 of the entire catchment yield. There are no dams downstream, so the construction is forecasted to utilize less than ten percent of the catchment yield, leaving over ninety percent available for downstream users. Given the prevailing rainfall pattern, minimal impact on existing downstream users is anticipated from the proposed dam construction.

5.19 Groundwater Potential

Kalomo district, situated atop the Choma-Kalomo Batholith, has limited groundwater aquifers reliant on water flow through fissures, channels, or discontinuities. Fissured aquifers yield locally between 0.1 to 10 L/s, while others show very limited availability, ranging from 0 to 2 L/s due to formations like Karoo basalts, mine series shale, and basement gneiss. Groundwater exploitation faces challenges, with a borehole success rate of 19% to 23%, resulting in one in every five boreholes drilled being dry. The district's poor rainfall pattern, spanning only about two and a half months, and inadequate vegetation cover exacerbate runoff, limiting groundwater replenishment. According to the Water Resources Master Plan, the annual groundwater potential in Southern Province is estimated at 9.4% of annual rainfall, approximately 69.27 mm per annum, translating to an estimated potential of 5.7 x 10^9 m3/annum in Kalomo District. Additionally, the annual change in groundwater level is approximated at 1.93 m. Overall, the Nazilongo Sub-catchment shows low potential for groundwater resources.

5.20 River Flow Characteristics at Proposed Dam Site

Hydrological data for the Nazilongo River is unavailable due to the absence of a gauging station on the river. Neither the Nazilongo nor the Mweemba Rivers have gauging stations, according to information from WARMA. Discharge measurements were impossible due to the river being dry during the study period, with no flow recorded. However, community input estimated peak flow at approximately 0.1m3/s.

5.21 Water Resources Quality

Reliable and consistent water quality data for the Nazilongo River is lacking. Field surveys suggest that agricultural activities, particularly the use of chemical fertilizers, herbicides, and pesticides, may impact water resources in the Mukwela Farming area. However, no significant pollutant sources are identified in the region. The river was dry during the survey, preventing water sampling for baseline surface water quality assessment. Establishing baseline water quality data before project development is essential for comparing water quality post-dam construction.

5.22 Heritage, Cultural and Social Landscape

Kalomo District holds historical and cultural significance spanning pre-colonial, colonial, and post-independence eras, serving as an administrative center in North-Western Rhodesia. While facing challenges from anthropogenic activities, including degradation of protected areas and compromised water access, the proposed Nazilongo Dam poses minimal risk to cultural sites and may enhance biodiversity. Expected to coexist harmoniously with human settlements and grazing areas, the dam has the potential to improve water flow in the Mweemba River, benefiting downstream communities.

6.0 ENVIRONMENTAL IMPACTS AND MITIGATIONS

The proposed Nazilongo Earth Dam Project is anticipated to have more positive than negative impacts, largely localized due to its limited throwback of barely 1km and an inundated area of 55 Ha at full supply level. Negative impacts mainly relate to dam construction and irrigable area development, with primary impacts possibly leading to secondary and tertiary effects such as sedimentation and eutrophication of reservoir water, potentially causing oxygen depletion downstream, spread of aquatic weeds, disease vectors, and fish mortality. Impact zones include areas influenced by hydrological changes in the river system and those affected by dam construction activities. Mapping of ecological zones was conducted using handheld GPS receivers and field surveys aided by topographical maps, with predictions made through analytical techniques and expert judgement. Key considerations include the oxygen budget of the reservoir during filling and early operation, potential for excessive algae bloom due to nutrient supply from inundated vegetation decay, and health risks like malaria and hookworm in irrigated areas and reservoirs. Vegetation, wildlife, and aquatic ecosystems may also be affected by the project, highlighting the need for careful environmental assessment and management.

6.1 IMPACT CLASSIFICATION AND CRITERION

Based on general considerations, impact predictions, and expert judgment, a range of impacts, both positive and negative, were identified for the proposed Nazilongo Earth Dam Project. These impacts were classified based on the dam design, project details, environmental and socio-economic baseline study. The water course was divided into four sections, with associated impacts identified for each section. Please refer to Table 5.1 for a detailed breakdown of these impacts.

Table 6.1: General Impacts Associated with Dam Construction

Category	General	Above dam	Below dam	Barrier effect
General Impacts	Loss of terrestrial habitats/farmland/settlements	Loss of river section	Reduced flows	Blocking of Migration of fish
	Local rise in water table	Changes in flow regime	Reduced oxygen levels	Blocking of Migration of invertebrates
	Visual impacts of retaining walls	Siltation	floodplain siltation	
	Water borne pathogens			
	failure risks			

6.2 POSSIBLE ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS

For purposes of this report, possible impacts have been categorized based on classification criterion outlined in table 6 below;

Table 6.2: Criterion and Classification of Impacts

Item	Impact Criterion	ct Consideration on Environment	Classification of Effect	
			Expression	Effect Description
I	Positive or Negative	Will impact be positive ornegative	Positive	A positive impact
			Negative	A Negative impact
Ii	Likelihood of occurring	What certainty of occurrence is associated with impact	Certain	Will occur
			Unlikely	May not occur
			Possible	May occur
Iii	Duration	What timeframe or periodis effect to be felt or last	Permanent	Will last a lifetime
			Short term	Will last up to end of construction activities
			Medium Term	Will last as long as operation Activities
			Long Term	Will last beyond project operation life
Iv	Timing	At what stage will impactoccur or felt	Immediately	Will occur upon starting project activities
			Near Future	Will occur during project operation activities
			Distance future	Will occur beyond project operation activities
V	Significance	How severe will the impact be	Low	Little impact
			Medium	Moderate impact
			High	High impact

Item	Impact Criterion	ct Consideration on Environment	Classification of Effect	
			Expression	Effect Description
Vi	Extent	Areal extent or coverage of impact	Project Area	Effect confined to project Area
			Surrounding Environs	Effect to be felt by surrounding areas
			nd Surrounding Environs	Effect to be felt within, surroundings and beyond Environs
Vii	Overall Rating	How important is Impact in project design	Insignificant	Impact not substantial needs no mitigation/ enhancement
			Low	Impact of little importance needs limited mitigation / enhancement
			Moderate	Impact has influence and requires mitigating / Enhancing
			High	Impact of great importance mitigation/ enhancement a must

The proposed dam development is categorized into eight development components, each associated with potential impacts due to construction:

1. Dam wall and spillway construction
2. Equipment mobilization, storage, and operation
3. Borrow pit operation, materials handling, and rehabilitation
4. Inundation of productive land
5. Changes in stream flow regime, morphological features, and water quality

6. Changes in groundwater level and quality

7. Waste management

8. Socio-economic and cultural factors

Please refer to the detailed discussion for each component for a comprehensive understanding of the potential impacts.

6.1.1 Dam wall and spillway construction

The proposed activities include site clearing, stripping of subsoil, and preparation of the riverbed foundation, including excavation of core trenches and treatment of rock joint fissures. The embankment cross-section will have a height of up to 8.75 meters, a crest width of 4 meters, and upstream and downstream slopes of 1:2.5. A spillway training wall with a length of 50 meters will also be constructed. Additionally, the crest will be raised to allow for a 10% settlement.

6.1.2 Construction Stage

Impact: Displacement of people:

There were few people actually living in the Catchment area of the proposed reservoir as observed from the field surveys. It was established during field surveys that the project area particularly impoundment areas are part of commercial fields meant for agricultural activities. Therefore, no households are expected to be relocated due to inundation.

6.1.2 Impact: loss of productive land, historical and cultural sites:

No historical and cultural sites are located within the impoundment area. However, loss of agricultural land due to impoundment will be there though relatively small compared to the available arable land.

6.1.3 Impact: Loss of wildlife habitat, indigenous flora and fauna:

The project site will not interfere directly with any existing wildlife reserves ornational parks. Wildlife is in fact expected to resurface in the area due to improved water supply. However, limited loss of some wildlife habitat and flora is expected while aquatic life will be enhanced.

6.1.4 Impact: Erosion of the top soil and reservoir sedimentation:

The project necessitates the use of heavy machinery, primarily for earth movement and leveling during construction. This can potentially destabilize the soil, leading to soil erosion, particularly of topsoil. Consequently, if not controlled, this erosion may result in siltation and sedimentation of rivers and reservoirs in the catchment area.

6.1.5 Impact: Skills transfer to locals:

When the local people are employed during dam wall construction, they will acquire skills in construction which they can use later in future. By employing as many local people as possible there will be skills transfer thus building human capacity in the area.

6.2 Operation Stage

Impact: Pollution due to increased usage of pesticides and fertilizers:

The increased availability of water supply for irrigation year-round may result in higher usage of agrochemicals. The contamination levels of drainage water and the toxicity of residue will vary based on the dosage, frequency of use, and types of agrochemicals employed. Unregulated use of agrochemicals poses threats to human health, as well as to fish and wildlife populations.

6.2.1 Impact: Deterioration in water quality in downstream reaches of the stream:

Water quantity measures can significantly impact water quality dynamics. Impoundment, or the creation of reservoirs, can alter pollutant concentrations in receiving waters, either by increasing or decreasing pollutant loads through processes like dilution. Conversely, withdrawals from water sources may indirectly raise pollutant levels, as water returned to the source after use can carry contaminants. Therefore, the construction of reservoirs introduces new environmental conditions, potentially leading to distinct water quality issues that can affect downstream areas to varying degrees.

6.2.2 Impact: Change in water quantity in downstream reaches of the stream:

Nazilongo River will be completely impounded but will allow environmental flows through the outlet valve on the dam wall for both the ecosystem and any other activity that may be undertaken downstream at any given time. Besides, excess flow during summer season is targeted for filling of the dams. It is also worth noting that filling of a dam is normally gradual and may take a number of rain seasons.

6.2.3 Impact: Encroachment of aquatic weeds and water quality of the reservoirs:

The aquatic ecosystem in newly constructed reservoirs is very unstable and water is often eutrophic as a result of the inundation of fertile land. Explosive growth of certain plant species may seriously threaten the effective use of such reservoirs. In eutrophic circumstances, reservoirs can suffer a fast growth of unicellular algae, mostly of a blue green nature. Since these algae do not enter common food chains, these blooms are unfavorable to fish production.

6.2.4 Impact: Threat to public health:

Development of reservoirs in tropic countries usually leads to change in incidence of water-borne diseases. In Zambia, this may imply the spread of mosquitoes and vectors of malaria. This may threaten public health if no special attention and mitigation measures are put in place.

6.2.5 Impact: Dust pollution:

The project will take place in the dry season which is well known for dust circulation. Dust pollution is expected to pose a negative impact that can affect human health.

6.3 EQUIPMENT MOBILISATION AND OPERATION

The nature of the project requires use of heavy trucks and earth moving machinery. Taking these to site would require making access roads as well as a camp site with storage facilities for materials and lubricants. This will result in the disturbance of soil and vegetation and the likelihood of oil spillages. During operation, the dust will be generated and noise may disturb wildlife.

6.3 1Construction Stage

6.3.1.1 Impact: Loss of wildlife habitat, indigenous flora and fauna

The activities at the project site will not interfere directly with any existing wildlife reserves or national parks. Infact Wildlife may resurface in the area due to improved water supply. However, the exercise of mobilization of equipment and machinery will lead to limited loss of some wildlife habitat and flora.

6.3.1.2 Impact: Erosion of the top soil and reservoir sedimentation

Mobilization of heavy machinery to site for earth movement and levelling will cause instability of the soil in the area and as a result cause soil erosion mainly of top soil. Consequently, this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled.

6.3.2 Operation Stage

6.3.2.1 Impact: Erosion of the top soil and reservoir sedimentation

During operation of heavy machinery for earth movement and levelling, soil in the area will be disturbed and as a result cause soil erosion mainly of top soil. Consequently, this may lead to siltation and sedimentation of rivers/ reservoirs in theCatchment if not controlled.

6.3.2.2 Impact: Soil and water pollution due to oil spills

Use of machinery which is not well maintained or serviced may lead to leakages thuspolluting soils and consequently water resources.

6.2.2.3 Impact: Skills transfer to locals

When the local people are employed for operation of heavy machinery and equipment, they will acquire skills in operation and maintenance of the equipment and machinery which they can use later in future. By employing as many local people as possible skill transfer will be enhanced thus building human capacity in thearea.

6.3.2.4 Impact: Dust pollution

The mobilization of machinery and equipment will be done during dry season which is well known for dust circulation. Dust pollution is the expected negative impactthat will pose a danger to human health.

6.4 BORROW PIT OPERATION, MATERIALS HANDLING AND REHABILITATION

Since the dam to be constructed will be an earth dam, gravel for the embankment would be obtained within the project area. As a result, loss of vegetation due to land clearance, land degradation due to excavation works and dust are expected.

6.4.1Construction Stage

6.4.1.1 Impact: loss of productive land, historical and cultural sites:

No historical and cultural sites are located within the impoundment area. However, loss of agricultural land due to creation of borrow pit will be there though relatively small compared to the available arable land.

6.4.1.2 Impact: Loss of wildlife habitat, indigenous flora and fauna

The project site will not interfere directly with any existing wildlife reserves ornational parks. Wildlife is in fact may resurface in the area due to with improved water supply. However, formation of borrow pit will lead to limited loss of some wildlife habitat and flora.

6.4.1.3 Impact: Erosion of the top soil and reservoir sedimentation

Heavy machinery will be required during construction of the borrow pit. This would lead to instability of the soil in the area and as a result cause soil erosion mainly of top soil. Consequently, this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled.

6.4.1.4 Impact: Dust pollution

Dust pollution is the most expected negative impact that will pose a health hazard. The project construction works will take place in the dry season known for dust circulation thus posing a danger to human health.

6.4.1.5 Impact: Loss of Cultural Sites

No cultural site is reported at the proposed site and as such none is likely to be affected. Should any site be discovered during operation the matter will be brought to the attention of the relevant authorities

6.4.2 Operation Stage

6.4.2.1 Impact: Erosion of the top soil and reservoir sedimentation

Owing to the nature of the operation of a borrow pit, heavy machinery will be required for earth movement and excavation. This would lead to instability of the soil in the area and as a result cause soil erosion mainly of top soil. Consequently, this may lead to siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled.

6.4.2.2 Impact: Dust Pollution

Dust pollution is expected during excavation and earth movement posing a health hazard especially that the project will take place in the dry season which is well known for dust circulation thus posing a danger to human health.

6.5 INUNDATION OF PRODUCTIVE LAND

The proposed dam will result into loss of agricultural land belonging to Mulders. However, this will be minimal compared to the available total land.

6.5.1 Construction Stage

6.5.1.1 Impact: Displacement of people:

There few people living in the catchment areas of the proposed reservoirs as observed during the field surveys. It was established during field surveys that the project area particularly impoundment areas are part of fields meant for agricultural activities. As such no households are expected to be affected due to inundation.

6.5.1.2 Impact: loss of productive land, historical and cultural sites:

No historical and cultural sites are located within the impoundment area. However, loss of agricultural land due to impoundment will be there though relatively small compared to the available arable land.

6.5.1.3 Impact: Loss of wildlife habitat, indigenous flora and fauna

The project site will not interfere directly with any existing wildlife reserves ornational parks. Instead, wildlife may resurface in the area due to improved water supply. However, impoundment of the reservoir will lead to limited loss of some wildlife habitat and flora.

6.6 CHANGE IN STREAM FLOW REGIME, MORPHOLOGICAL FEATURES AND WATER QUALITY

Construction of a dam affects variations in discharges and water levels. The discharge regime becomes more regular compared to the conditions without dam and both low and high discharges occur less frequently. Hydrological changes in the river system may lead to greater area of influenced both upstream and downstream.The stream morphological features may also change with time.

6.6.1 Construction Stage

6.6.1.1 Impact: Deterioration in water quality in downstream reaches of the stream:

During construction, waste in form of rubble and other forms may cause pollution towater quality that can affect downstream users

6.6.2 Operation Stage

6.6.2.1 Impact: Deterioration in water quality in downstream reaches of the stream

Impoundment may increase or decrease (dilution) the pollutant load of receiving waters while withdraws may indirectly lead to an increase of pollutant loads. Therefore, construction of a dam (reservoir) implies creation of a new environment, developing its own typical water quality problems that may affect the downstream section to some extent

6.7 CHANGE IN GROUNDWATER LEVEL AND QUALITY

Groundwater levels are liable to be impacted by the creation of an impoundment. Raised water levels upstream may result in a localized change to the water table. These changes to water levels may impact on groundwater upstream anddownstream, resulting in water logging of soils or wells, and changes to catchments Infiltration.

6.7.1 Operation Stage

6.7.1.1 Impact: Increase in groundwater level

Impoundment of a stream may lead to increased percolation of water to deeper levels resulting in localized increase in groundwater level and consequently overall quantity. If this is not checked this may lead to water logging of soils. However, this is mainly the case where the water table is too near to the surface which is not the case in Nazilongo Catchment. Instead recharge to groundwater will be enhanced and is desired since the area has generally poor groundwater yields.

6.7.1.2 Impact: Deterioration in groundwater quality

Since impoundment of a stream may lead to increased percolation of water to deeper levels, the percolating water if contaminated may lead to groundwater quality deterioration depending on soil type and condition.

6.8 WASTE MANAGEMENT

During the construction and operation stage solid waste is expected resulting from land clearance and levelling, excavation and rock blasting. However much of the earth and rubble will still be used in the erection of the dam wall. In addition, human activity involving workers will also result into waste being generated.

6.8.1 Construction Stage

6.8.1.1 Impact: Pollution due to solid waste

Due to construction works solid waste in form rubble and litter is expected. If not properly disposed this may pollute soil and water resources.

6.8.1.2 Impact: Deterioration in Water quality due liquid waste

Water quality can be affected by receiving untreated human waste. Absence of proper sanitation facilities for construction workers may result in human waste finding itself in stream water thus polluting it and posing a health risk to people who depend on river water for domestic use.

6.8.2 Operation Stage

6.8.2.1 mpact: Threat to human health

Water pollution due to indiscriminate disposal of waste may lead to water borne diseases especially that the majority of the local community depend on Nazilongo River.

6.9 SOCIO-ECONOMIC AND CULTURAL

The construction of the proposed dam will result into inundation of a portion of productive land. However, there are no settlements that will be affected since the land in question is part of the agricultural land for commercial farming. From the situational analysis of the existing baseline socio-economic conditions, issues of concern will include Loss of productive agricultural land and Loss of livelihood (from wild fruit trees) among others.

6.9.1 Construction Stage

6.9.1.1 Impact: Displacement of people:

There are few people actually living in the Catchment areas of the proposed reservoirs as observed during the field surveys. It was established during field surveys that the project area particularly impoundment areas are part of fields meant for agricultural activities. As such no households are expected to be relocated due to inundation.

6.9.1.2 Impact: Loss of productive land, historical and cultural sites:

No historical and cultural sites are located within the impoundment area. However, loss of agricultural land due to impoundment will be there though relatively small compared to the available arable land.

6.9.1.3 Impact: Increased employment opportunities

Construction and operation of a dam will create opportunities for jobs mainly for the local communities. At preparatory and construction stage, local people will be engaged and consequently livelihood for family members will be guaranteed.

6.9.1.4 Impact: Increase in Local Population

The construction of the dam will have an influence on the population size of the area. During the construction, skilled personnel will add on to the local population. After the construction of the dam is over, more skilled manpower may come to the area to seek jobs thus putting pressure on the available natural resources.

6.9.1.5 Impact: Increase in local economic activities

Dam construction will provide trading opportunities to the local people. Farm produce and food stuffs will be sold to construction workers. It is also expected that the dam once operational will result in more fish production thereby providing a long term positive addition to the livelihood of the community due to increase in income.

6.9.1.6 Impact: Loss of social and cultural infrastructure

No social or cultural infrastructure is likely to be flooded. In particular there are no grave yards expected to be submerged.

6.9.2 Operation Stage

6.9.2.1 Impact: Increase in employment opportunities

Construction and operation of dams create opportunities for jobs mainly for thelocal communities. At operation stage, local people will be engaged andconsequently livelihood for family members will be guaranteed. In a long term, increased productivity in the area as a result of irrigation will equally further create job opportunities.

6.9.1.2 Impact: Boost to economic growth

Reliable water supply throughout the year will effectively enable Mulders to increase its production levels. This entails enough production to satisfy local demand while at the same time export. As a result, earn the country the much needed foreign exchange thus contribute to overall economic growth.

6.9.2.3 Impact: Increase in local population

The operation of the dam will have an influence on the population size of the area. The dam is anticipated to temporary attract additional people who are interested in working for Chobe thus putting pressure on the available natural resources.

6.9.2.4 Impact: Increase in local economic activities

The irrigation scheme will provide both permanent and temporal employment to thelocal people. This means more income for the community in the area resulting into increased economic activities. Further, increase in fishing and other supporting trading activities will all contribute to increase in economic activity.

6.9.2.5 Impact: Skills transfer to locals

Operation of the dam and the irrigation scheme will result into skills being transferred to the local people which they can use later in future. Thus human capacity will be built in the area.

6.9.2.6 Impact: Threat to human health

The operation of the dam and irrigation scheme will result in increased economic activity in the area consequently more people will be attracted to the area. This will expose the community to the foreign people who may lead to the spread of HIV/AIDS and other STIs.

6.9.2.6 Impact: Weakening of social cohesion

Since no displacement of households is expected no weakening of the social cohesion will take place for surrounding farm communities that may lead to loss of livelihood.

6.9.2.7 Impact: Loss of immovable assets

No immovable assets of different value which include houses, pit latrines, gardens, wells and shops will be lost since no relocation of people is expected.

6.9.2.8 Impact: Enhanced Livelihood

There will be more fish that could make more people to adopt fishing as an additional source of livelihood. Employment and new trading activities will equally support livelihood for the locals.

For a summary and evaluation of potential impacts see Table 5.3 during Construction Stage and Table 5.3 during Operation Stage.

Table 6.3: Evaluation Matrix for potential environmental Impacts - Construction stage

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						ERALL IMPACT RATING
		POSITIVE(+VE) OR NEGATIVE (-EV) IMPACT	IKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: DAM WALL AND SPILLWAY CONSTRUCTION								
1	Displacement of people:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
2	loss of productive land	-VE	CERTAIN/	PERMANENT	IMMEDIATE	Medium	PROJECT AREA	MODERATE/
3	historical and cultural sites:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
4	Loss of wildlife habitat, flora and fauna:	-VE	CERTAIN	SHORT TERM	IMMEDIATE	LOW	PROJECT AREA	LOW
5	Erosion of the top soil and reservoir sedimentation:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	SURROUNDING ENVIRONS	MODERATE
6	Skills Transfer to Locals:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
7	Dust Pollution:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	SURROUNDING ENVIRONS	MODERATE

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	IKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: EQUIPMENT MOBILISATION AND OPERATION								
8	Loss of wildlife habitat, flora and fauna:	-VE	CERTAIN	SHORT TERM	IMMEDIATE	LOW	PROJECT AREA	LOW
9	Erosion of the top soil and reservoir sedimentation:	-VE	CERTAIN	SHORT TERM	IMMEDIATE	MEDIUM	PROJECT AREA	MODERATE
ENVIRONMENTAL ISSUE: PRODUCTIVE AND SETTLEMENT LAND								
10	Displacement of people:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
11	loss of productive land/	-VE	CERTAIN/	PERMANENT	IMMEDIATE	HIGH	SURROUNDING ENVIRONS	MODERATE
12	historical and cultural sites:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
13	Loss of wildlife habitat, flora and fauna:	-VE	CERTAIN	MEDIUM TERM	IMMEDIATE	MEDIUM	PROJECT AREA	MODERATE

ITEM	TIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						ERALL IMPACT RATING
		'OSITIVE OR NEGATIVE IMPACT	IKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: BORROW PIT OPERATION AND MATERIAL HANDLING								
14	loss of productive land, historical and cultural sites:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	PROJECT AREA	INSIGNIFICANT
15	Loss of wildlife habitat, flora and fauna:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	PROJECT AREA	LOW
16	Erosion of the top soil	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
17	Dust Pollution:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	MEDIUM	SURROUNDING ENVIRONS	MODERATE
18	Loss of Cultural Sites:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT

ITEM		IMPACT CRITERION	

	TIAL ENVIRONMENTAL IMPACT	OSITIVE OR NEGATIVE IMPACT	IKELIHOOD OFOCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	ERALL IMPACT RATING
ENVIRONMENTAL ISSUE: WASTE MANAGEMENT								
19	Water Quality:	-VE	POSSIBLE	SHORT TERM	NEAR FUTURE	MEDIUM	SURROUNDING ENVIRONS	MODERATE
20	Human Health:	-VE	POSSIBLE	SHORT TERM	NEAR FUTURE	MEDIUM		MODERATE
ENVIRONMENTAL ISSUE: SOCIO-ECONOMIC AND CULTURAL								
21	Displacement of People:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
22	Loss of Historical and Cultural Sites:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
23	Employment Opportunities:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
24	Increase in Local Population:	+VE	POSSIBLE	LONG TERM	NEAR FUTURE	MEDIUM	PROJECT AREA	MODERATE

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						ERALL IMPACT RATING
		OSITIVE OR NEGATIVE	IKELIHOOD OFOCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	

		IMPACT						
ENVIRONMENTAL ISSUE: SOCIO-ECONOMIC AND CULTURAL								
25	Increase in Local Economic Activities:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	SURROUNDING ENVIRONS	HIGH
26	Loss of Social & Cultural Infrastructure:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
27	Boost to Local Industry	+VE	CERTAIN	SHORT TERM	IMMEDIATE	HIGH	SURROUNDING ENVIRONS	HIGH
28	Skills Transfer to Locals:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
29	Threat to Human Health:	-VE	POSSIBLE	SHORT TERM	NEAR FUTURE	MEDIUM	SURROUNDING ENVIRONS	MODERATE

ITEM	TIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERAL L IMPACT RATING
		'OSITIVE OR NEGATIVE IMPACT	IKELIHOOD OFOCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: DAM WALL AND SPILLWAY CONSTRUCTION								
1	Pollution due to increased usage of pesticides and fertilizers:	-VE	POSSIBLE	MEDIUM TERM	NEAR FUTURE	LOW	PROJECT AREA & SURROUNDING ENVIRONS	LOW
2	Deterioration in Water quality in downstream reaches of the stream:	-VE	CERTAIN	SHORT TERM	IMMEDIAT E	MEDIUM	SURROUNDING ENVIRONS	MODERATE
3	Encroachment of aquatic weeds and water quality of the reservoirs:	-VE	POSSIBLE	MEDIUM TERM	NEAR FUTURE	LOW	PROJECT AREA	LOW
4	Public health:	-VE	POSSIBLE	MEDIUM TERM	IMMEDIAT E	MEDIUM	PROJECT AREA	MODERATE
5	Dust Pollution:	-VE	POSSIBLE	SHORT TERM	IMMEDIAT E	MEDIUM	SURROUNDING ENVIRONS	MODERATE

ITEM	TIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	IKELIHOOD OFOCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: EQUIPMENT MOBILISATION AND OPERATION								
7	Erosion of the top soil and reservoir sedimentation:	-VE	CERTAIN	SHORT TERM	IMMEDIATE	MEDIUM	PROJECT AREA	HIGH
8	Soil and Water Pollution due to oil spills:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	SURROUNDING ENVIRONS	LOW
9	Skills Transfer to Locals:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH
10	Dust Pollution:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	MEDIUM	SURROUNDING ENVIRONS	MODERATE

ITEM	TIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						ERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	IKELIHOOD OFOCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	

ENVIRONMENTAL ISSUE: BORROW PIT OPERATION AND MATERIAL HANDLING								
11	Reservoir sedimentation:	-VE	UNLIKELY	N/A	N/A	N/A		INSIGNIFICANT
12	Human Health:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	PROJECT AREA	LOW
ENVIRONMENTAL ISSUE: PRODUCTIVE AND SETTLEMENT LAND								
13	Increased Fish Production:	+VE	CERTAIN	MEDIUM TERM	NEAR FUTURE	HIGH	PROJECT AREA	HIGH
14	Dust Pollution	-VE	POSSIBLE	MEDIUM TERM	IMMDIATE	MEDIUM	PROJECT AREA	MODERATE
15	Loss of Immovable Assets:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						ERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	IKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: DAM FILLING								
16	Deterioration in Water quality:	-VE	CERTAIN	SHORT TERM	IMMEDIATE	HIGH	BEYOND SURROUNDING	HIGH

							ENVIRONS	
17	Change in Water quantity in downstream reaches:	+VE	CERTAIN	SHORT TERM	IMMEDIATE	HIGH	SURROUNDING ENVIRONS	HIGH
18	Encroachment of aquatic weeds:	-VE	POSSIBLE	MEDIUM TERM	NEAR FUTURE	LOW	PROJECT AREA	LOW
ENVIRONMENTAL ISSUE: CHANGE IN GROUNDWATER LEVEL AND QUALITY								
17	Increase in Groundwater level	+VE	CERTAIN	MEDIUM TERM	NEAR FUTURE	MEDIUM	PROJECT AREA	MODERATE
18	Deteriorating Groundwater quality	-VE	POSSIBLE	SHORT TERM	NEAR FUTURE	LOW	PROJECT AREA	LOW
ENVIRONMENTAL ISSUE: WASTE MANAGEMENT								
19	Threat to Human Health:	-VE	POSSIBLE	SHORT TERM	IMMEDIATE	LOW	SURROUNDING ENVIRONS	LOW

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						OVERALL IMPACT RATING
		POSITIVE OR NEGATIVE IMPACT	IKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: SOCIO-ECONOMIC AND CULTURAL								

21	Employment Opportunities:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	BEYOND SURROUNDING ENVIRONS	HIGH
23	Boost to Economic Growth:	+VE	CERTAIN	LONG TERM	DISTANT FUTURE	MEDIUM	BEYOND SURROUNDING ENVIRONS	MODERATE
24	Increase in Local Population:	-VE	POSSIBLE	LONG TERM	NEAR FUTURE	MEDIUM	PROJECT AREA	MODERATE
25	Increase in Local Economic Activities:	+VE	CERTAIN	MEDIUM TERM	IMMEDIATE	HIGH	PROJECT AREA	HIGH

ITEM	POTENTIAL ENVIRONMENTAL IMPACT	IMPACT CRITERION						ERALL IMPACT RATING
		'OSITIVE OR NEGATIVE IMPACT	IKELIHOOD OF OCCURING	DURATION	TIMING	SIGNIFICANCE	EXTENT	
ENVIRONMENTAL ISSUE: SOCIO-ECONOMIC AND CULTURAL								
26	Threat to Human Health:	-VE	POSSIBLE	MEDIUM TERM	NEAR FUTURE	MEDIUM	SURROUNDING ENVIRONS	MODERATE
28	Break down in Social Cohesion:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
29	Loss of Immovable Assets:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT
30	Disruption of Livelihood:	-VE	UNLIKELY	N/A	N/A	N/A	N/A	INSIGNIFICANT

6.10 MITIGATION AND ENHANCEMENT MEASURES

IMPACT MITIGATION AND ENHANCEMENT MEASURES DURING CONSTRUCTION AND OPERATION STAGES

The proposed mitigation and enhancement measures to be carried out during all development stages of the project are elaborated in this section. These mitigation and enhancement measures have been arranged according to sequence of identified potential impacts under Chapter 5 of this report.

6.10.1. DAM WALL AND SPILLWAY CONSTRUCTION

6.10.1.1 Construction Stage

6.10.1.1.1 Mitigation: To prevent displacement of people:

No households are expected to be relocated due to inundation resulting from dam and spillway construction. Therefore, no mitigation measure is required.

6.10.1.1.2 Mitigation: To prevent loss of productive land, historical and cultural sites:

No mitigation is required for loss of historical and cultural sites since none are located within the impoundment area. However, loss of agricultural land is expected. This impact is moderate considering that only 55 Ha out of the total 1,800ha will be inundated. Nonetheless the developer will take the following measures;

i) Take a precautionary measure i.e. should any effect of historical nature be discovered during construction; relevant authorities will be notified immediately.

6.10.1.1.3 Mitigation: To prevent Loss of wildlife habitat, flora and fauna

Due to prolonged agricultural activities in the project area, there is limited wildlife habitat and biodiversity remaining, resulting in a low impact in this regard. To mitigate this, the following measures are proposed:

1. Restrict clearance of vegetation to critical areas only.

2. Implement awareness campaigns among staff and the community to emphasize the importance of nature conservation, based on a comprehensive awareness and sensitization program.

3. Enforce strict adherence to conservation best practices.

6.10.1.1.4 Mitigation: To prevent erosion of the top soil and reservoir sedimentation:

The use of heavy machinery in the project area may disturb topsoil, leading to soil erosion and subsequent silting of streams, posing a significant impact. To mitigate this, the following measures will be implemented:

1. Conduct reforestation of disturbed areas after construction activities, following guidelines outlined in Annex 9.

2. Restrict movement of heavy machinery to designated access routes and operational areas to minimize soil disturbance.

6.10.2 Enhancement: skills transfer to local people:

The construction of the dam wall necessitates skilled manpower to ensure safety. Company policy prioritizes local employment; thus, skills will be imparted to the local workforce. This impact is considered significant and vital, and will be enhanced by:

1. Implementing a comprehensive skill transfer program.

2. Categorizing staff and assigning dedicated skilled personnel for supervision and on-the-job training.

3. Promoting hands-on training through observation and supervised trials.

6.10.2.1 Operation Stage

6.10.1.2.1 Mitigation: To prevent pollution due to increased usage of pesticides and fertilizers:

The presence of a dam wall will entail increased storage of water and therefore increased agriculture usage throughout the year. Consequently, more agro chemicals are likely to be used posing a risk of pollution. This impact will be low. To minimize this impact, the following measures will be put in place;

1. stick to recommended dosage and frequency of application of agrochemicals (See annex 10 for general pesticides guidelines)
2. ensure recommended types of agro-chemicals are used
3. Conduct awareness campaign among communities on dangers of agrochemicals.
4.

6.10.1.2.2 Mitigation: To prevent deterioration in water quality:

Pollutant load can be influenced by increase or decrease in water quantity through dilution of the pollutant load. This impact is expected to be moderate and measures to minimize deterioration in water quality will include;

1. Stick to good practices of dam operation rules of ensuring minimum flows in times of low flow
2. Ensure prior clearance of all deadwood/vegetation prior to dam filling.

6.10.1.2.3 Mitigation: To prevent change in water quantity in downstream:

The initial damming of the river is expected to reduce downstream flow, particularly during wet months, with a significant impact anticipated. However, as excess flow during the summer season is intended for dam filling, the long-term significance of this impact is considered low. To address this, the following measures are proposed:

1. Ensure that the dam design includes adequate provisions, such as outlet valves, to maintain downstream flow even during dry months.

2. Implement standard dam operational rules to regulate water release.

3. Adhere to water right permit regulations and requirements to safeguard the rights of downstream water users.

6.10.1.2.4 Mitigation: Encroachment of aquatic weeds:

The encroachment of weeds may result due to increase nutrient load in the reservoir and is not likely to take place immediately. This impact will be of low significance in the short term. However, the developer will from the onset ensure that;

1. a buffer zone between the waterfront and settlement area is created
2. avoid discharge of any waste effluent into the dam
3. conduct awareness on invasive alien's aquatic weeds

6.10.1.2.5 Mitigation: Deterioration of public health:

Spread of mosquitoes and vectors of malaria are prone to reservoirs and immediate environment. This may threaten public health if no special attention and mitigation measures are put in place.

1. Employ disease vectors disruption techniques such as regulated reservoir operation to curb vectors for malaria and water borne diseases.
2. Encourage natural aquatic life that takes care of mosquito larva as part ofthe food chain

6.10.1.2.6 Mitigation: Dust Pollution:

Dam construction normally takes place in the dry season which is well known for dust circulation thus posing a danger to human health. Proposed mitigation measurewill include

i) Undertake watering of the area and surroundings regularly during construction stage

6.10.2 EQUIPMENT MOBILISATION AND OPERATION

6.10.2.1 Construction Stage

6.10.2.1.1 Mitigation: Loss of wildlife habitat, indigenous flora and fauna

There is not much wildlife habitat or indigenous fauna and flora left in the area. Instead, impoundment of the reservoir is expected to promote aquatic life as well as other small animals. The developer proposes to

1. encourage natural restocking of the area by educating the locals on the benefits of conserving nature
2. Discourage cutting of trees and unnecessary clearing of vegetation within the area.

6.10.2.1.2 Mitigation: Erosion of the top soil

Disturbed top due to construction activities may cause soil erosion mainly of top soil leading to siltation of the stream if not controlled. This impact is high. The following measures are proposed

1. limit use of heavy machinery to designated areas
2. avoid unnecessary clearing of the vegetation
3. rehabilitate heavily disturbed areas.

6.10.2.2 Operation Stage

6.10.2.2.1 Mitigation: Reservoir sedimentation

Soil erosion mainly of top soil may lead to sedimentation of reservoir if not checked. To avoid this developer proposes to;

1. Ensure a buffer zone is created between the water front and occupied areas of human settlement and agricultural activities.
2. avoid unnecessary clearing of the vegetation

6.10.2.2.2 Mitigation: Soil and water pollution due to oil spills

Not well maintained or serviced machinery usage may lead to leakages thuspolluting soils and consequently water resources. To minimize this;

1. ensure all machinery and equipment is regularly maintained
2. limit servicing and repair of machinery and equipment to designated areas
3. dispose any used oil at a designated place in accordance with the law

6.10.3.1 Enhancement: Skills transfer to locals

Employing as many local people as possible will enhance skill transfer thus building human capacity in the area. This impact will be high and to enhance it the following measures will be taken

1. adopt a deliberate policy of giving employment priority to locals
2. design on job training programmes
3. ensure skilled manpower is employed

6.10.3.1.1 Mitigation: Dust Pollution

Dust pollution is expected since the project implementation will take place during the dry season, well known for dust circulation. Measures to minimize this impact will include;

i) The project site will regularly be watered using an interval of two to three hours interval depending on intensity of sunshine.

6.10.4 BORROW PIT OPERATION, MATERIALS HANDLING AND REHABILITATION

6.10.4.1Construction Stage

Mitigation: Loss of productive land, historical and cultural sites:

No historical or cultural sites are expected to be lost. However, agricultural land will be affected though relatively of low significance. Mitigation Measures will include;

i) rehabilitation of affected areas through reforestation

6.10.4.1.1 Mitigation: Loss of wildlife habitat, indigenous flora and fauna

No direct disruption to existing wildlife reserves or national parks is anticipated, but there may be some loss of wildlife habitat and flora. To mitigate this, reforestation of affected areas will be conducted, with plant species carefully chosen to avoid introducing invasive alien species. Both exotic and indigenous plants will be selected in consultation with forestry experts.

6.10.4.1.2 Mitigation: Loss of Cultural Sites

No cultural site is reported at the proposed site and as such none is likely to be affected. Should any site be discovered during operation the matter will be brought to the attention of the relevant authorities.

6.10.4.2 Operation Stage

6.10.4.4.1 Mitigation: Erosion of the top soil and reservoir sedimentation

Use of heavy machinery may cause soil erosion causing siltation and sedimentation of rivers/ reservoirs in the Catchment if not controlled. The following measures are proposed;

1. Restrict movement of vehicles and equipment to designated areas
2. Restrict clearance of vegetation to critical areas

6.10.4.4 2 Mitigation: Dust Pollution

The project will take place in the dry season and dust pollution is expected. To minimize this following is proposed

i) Regularly water the area during construction works.

6.10.5 INUNDATION OF PRODUCTIVE LAND

6.10.5.1 Construction Stage

6.10.5.1.1 Mitigation: Loss of productive land, historical and cultural sites:

No historical and cultural sites were reported to be located within the project area. However, loss of agricultural land belonging to the project proponent though relatively small is expected.

6.10.5.1.2 Mitigation: Loss of wildlife habitat, indigenous flora and fauna

Years of human activity in the area has depleted wildlife habitat, flora and fauna. Nonetheless, the developer will

1. restrict unnecessary cutting of trees and clearing of vegetation to areas
2. conduct awareness campaigns on the benefit of conserving nature

6.10.6 CHANGE IN STREAM FLOW REGIME AND WATER QUALITY

6.10.6.1 Operation Stage

6.10.6.1.1 Mitigation: To avoid deterioration in water quality in downstream reaches of the stream

Impoundment may increase or decrease (dilution) the pollutant load of receiving waters while withdraws may indirectly lead to an increase of the pollutant loads affecting water quality. Measures will include;

1. Observe standard dam operation rules
2. Ensure minimum flows downstream at all times by opening the outlet valve.

6.10.6.1.2 Mitigation: To prevent change in Water quantity in downstream reaches of the stream

Nazilongo River will be completely impounded but will allow environmental flows for both the ecosystem and any other activity that may be undertaken downstream at any given time. Measures will include;

1. Ensure that excess flow during summer season is harnessed
2. Observe Water Right regulatory requirements
3. Opening of the outlet valve.

6.10.6.1.3 Mitigation: To prevent encroachment of aquatic weeds and water quality of the reservoirs

The aquatic ecosystem in newly constructed reservoirs is very unstable and water is often eutrophic as a result of the inundation of fertile land. To minimize this, the developer will;

1. conduct awareness campaigns among the staff and community on the dangers of invasive aquatic weeds
2. Promote sustainable fishing methods
3. Minimize nutrient loading through effective usage of agro chemicals.

6.10.7 CHANGE IN GROUNDWATER LEVEL AND QUALITY

6.10.7.1Operation Stage

6.10.7.1.1 Enhancement: To increase in groundwater level

The project area generally has poor groundwater yield. To enhance groundwater levels, the developer will:

1. Impound the Nazilongo River to promote percolation of water to deeper levels.

2. Construct the dam to a standard design to prevent dam wall seepage, minimizing losses and increasing retention time for percolation.

6.10.7.1.2 Mitigation: Deterioration in groundwater quality

Decay of organic matter, primarily from vegetation, can affect water quality in the reservoir, potentially contaminating groundwater. To mitigate this, the developer will:

1. Remove most vegetation from the area before dam filling to reduce the decay of organic matter.

2. Regulate the use of agrochemicals to preserve water quality in the reservoir.

6.10.8 WASTE MANAGEMENT

6.10.8.1 Construction Stage

6.10.8.1.1 Mitigation: To prevent pollution due to solid waste

Solid waste in form of rubble and litter is expected during construction. The developer will ensure that

1. waste is collected at selected points for proper disposal
2. Some of the rubble will be used for compaction in the construction of the dam wall.

6.10.8.1.2 Mitigation: Deterioration in water quality due to liquid waste

Water quality can be affected by receiving untreated human waste. The developerwill

i)provide portable sanitation facilities for construction workers.

6.10.8.2 Operation Stage

6.10.8.2.1 Mitigation: Threat to human health

Water pollution due to indiscriminate disposal of waste may lead to water borne diseases. To minimize this

1. encourage the community to have their own household pit latrines
2. Conduct awareness campaigns among the staff and the community.

6.10.9 SOCIO-ECONOMIC AND CULTURAL

6.10.9.1 Construction Stage

6.10.9.1.1 Mitigation: Displacement of people:

No mitigation measure is required since no single household is expected to be affected due to inundation resulting from dam and spillway construction.

6.10.9.1.2 Mitigation: To loss of productive land, historical and cultural sites:

No mitigation is deemed necessary for the loss of historical and cultural sites, as none are situated within the impoundment area. However, the project anticipates the loss of agricultural land belonging to the project proponent. To address this, the developer will:

- Implement a precautionary measure: In the event that any historical sites are discovered during construction, relevant authorities will be promptly notified.

6.10.9.1.3 Mitigation: Loss of wildlife habitat, flora and fauna

The project area has been subjected to years of human activities such as agriculture and as such not much wildlife habitat, flora and fauna is left. Therefore, this impact will be low. However, the following mitigation measures are proposed

1. Limit clearance of vegetation only to critical areas
2. Conduct awareness campaigns among staff and community on the need toconserve nature
3. Adopt strict good practices in conservation

6.10.9.2 Enhancement: Employment Opportunities

Construction of a dam creates opportunities for jobs mainly for the localcommunities. To enhance this

i) Local people will be given priority for employment as a deliberate company policy.

6.10.9.2.1 Mitigation: Increase in local population

During the construction, skilled personnel will add on to the population of the local community. There is also a possibility that the community will receive an influx of laborers looking for employment which will further add on to the local population. Measures will include;

1. Adopt selective employment opportunities targeting locals.
2. Ensure adequate facilities are provided for staff such as sanitation facilities

6.10.9.2.2 Enhancement: Increase in local economic activities

It is also expected that the presence of a dam will result in more fish production and other trading activities in the area. To enhance this developer will;

i) Ensue that the irrigation scheme is operated in a professional manner.

6.10.9.2.3 Mitigation: Loss of social and cultural infrastructure

No social or cultural infrastructure will be inundated and therefore no mitigation isrequired.

6.10.9.3 Operation Stage

6.10.9.3.1 Enhancement: Employment Opportunities

Construction of a dam creates opportunities for jobs mainly for the local communities. To enhance this, the developer will

1. Ensure that the irrigation scheme is operated in a professional manner.

6.10.9.3.2 Enhancement: Economic growth

Reliable water supply throughout the year will effectively enable farmers to increase their production levels to satisfy local demand while at the same time export thus earn the country the much needed foreign exchange thus contribute to overall economic growth. To enhance this, the developer will

i) Ensured effective management of the irrigation scheme

6.10.9.3.3 Mitigation: Increase in local population

During the construction, skilled personnel will add on to the population of the local community as well as an influx of laborers looking for employment. Measures will include;

i) Give priority for employment to local people

Enhancement: Increase in local economic activities

Dam construction will provide temporal employment to the local people as well as fishing and other trading activities. To enhance this, the developer proposes to;

i) Ensure that the irrigation scheme is operated in a professional manner.

6.10.9.3.4 Enhancement: Skills transfer to locals

Skills transfer through employment of local people will enhance human capacity building in the area. To enhance this, the developer will;

i) Develop a programme for job on training

6.10.9.3.5 Mitigation: Threat to human health

Dam construction will also expose the community to the foreign people who may lead to the spread of HIV/AIDS and other STIs. Measures to minimize this will include;

1. sensitize staff and community on the dangers of HIV/AIDs and STIs
2. support local programmes by Ministry of Health regarding HIV/AIDs

A summary of mitigation and enhancement measures are outlined inTable 6.1 below.

Table 6.4: Summary of Mitigation and Enhancement measures

Potential Impact	Proposed Mitigation and Enhancement Measures
Increase in local population	Local people will be given priority in employment.
Loss of cultural and historical Assets	No cultural and historical site is present at the site and therefore no loss is Expected
Loss of productive land	No mitigation required since the land belongs to the project developer
Noise pollution	Noise pollution will be limited to construction phase.
public health	Operation of the dam will be done in a manner that will disrupt disease vectors such as malaria
Soil Erosion	Designate buffer zones between settlement and water front
Erosion at construction site	Reforestation will be adopted to rehabilitate exposed areas after construction. Limit heavy machinery to designated routes
Distortion of flow patterns and	Use of recommended devices to be taken care of during design of the dam.

sediment loads of river	Recommended operating regimes will be adopted.
Distortion in landscape	Minimum access roads will be constructed and borrow pits will be rehabilitated using excess earth and applying reforestation
Air pollution (dust),	Dust will be minimized by regularly watering of construction area.
Destruction of vegetation	Unnecessary vegetation clearing will be prohibited. Reforestation disturbed
	Areas
Loss of vegetation, wildlife habitat	Prohibit unnecessary cutting of trees and vegetation clearing
Spread of aquatic weeds in Reservoir	Controlled usage of agro-chemicals to limit nutrient loading to the reservoir thus limiting proliferation of weeds
Fish mortality	Clear vegetation prior to dam filling Allow natural fish restocking
Spread of disease vectors in impoundment area	Disrupt disease vectors through controlled operations of reservoirs
Employment Opportunity	Give priority to local people
Economic growth	Effectively manage the irrigation scheme
Capacity Building	Conduct job on training
Change in river discharge	Observe Water Right regulatory requirements for downstream users and Environment
Deterioration in water quality due to fertilizer use	control usage of agro-chemicals to standard
Increase in Sedimentation of Reservoir	Buffer zones will be created and unnecessary tree cutting will not be permitted as this may lead to erosion enhancing sedimentation

2 ENVIRONMENTAL MANAGEMENT PLAN AND AUDIT

2.3 Introduction

This section delineates the measures to be implemented by the proponent, specifically Mulders Farm, to ensure the sustainable management of potential positive and negative impacts associated with the development. The aim is to optimize the benefits arising from positive impacts while effectively mitigating negative effects. The Environmental Management Plan offers guidance on interventions and measures to be undertaken during both the construction and operational phases, serving as a framework for achieving the highest environmental standards in project implementation.

2.4 Environmental Management Plan

Environmental management is conducted throughout all stages of the project, including Pre-construction, Construction, and Operational phases. Key stakeholders involved in environmental management activities include Mulders Farm, Zambia Environmental Management Agency, the Consultant, the Contractor, Government agencies, Local Authorities, and affected Local Communities. The Environmental Management Plan for managing identified environmental impacts comprises three main components:

1. Implementing the Impact Mitigation Plan
2. Monitoring the implementation of the EMP
3. Institutional Framework for Monitoring, Reporting, and Supervision of EMP

2.5 Impact Mitigating Plan

The impact mitigation plan outlines responsibilities for implementing mitigation measures to address negative impacts during the construction phase. Presented in Table-2 of this chapter, it includes cost estimates for mitigating adverse impacts. The plan addresses various components such as Land and Soil, Vegetation, Water Quality, Air Quality, Noise, Landscape and Aesthetics, Land-use and Surrounding Environment, Socio-economic issues, Cultural and Historic Sites, Quarries and Borrow Pits, Work Accidents, and Construction Camps.

2.6 EMERGENCY RESPONSE

The contractor is required to develop an Emergency Response Plan (ERP) as part of their Safety, Health, and Environment (SHE) plan for all worksites. This plan will outline procedures and communication arrangements to address various emergencies that could impact the site, such as injuries, sickness, evacuation, fires, chemical spills, and rescues. Specifically, the ERP should cover emergencies related to fire and explosions, structural collapses, dangerous chemical spills, bomb threats and criminal attacks, worker drownings, and natural disasters like landslides, earthquakes, and storms.

Arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring. The chain of command and the response persons of the contractor with their telephone numbers for quick communication shall be adequately communicated to workers.

The contractor shall also locate fire assemble points at project site and shall conduct on site emergency mock drills once in every month for all his workers and subcontractor workers.

Accident Reporting and Investigation

All incident records must be retained for the duration of the site contract. The contractor is required to maintain a register of employees along with their next of kin details on-site. Additionally, the contractor must prepare and submit a monthly Safety, Health, and Environment (SHE) report to the company. This report should cover activities at the worksite and include:

- - A list of significant hazards observed during the reporting period, along with descriptions of risk assessments and corrective actions taken to prevent their recurrence.

- - Documentation of injuries and occupational health issues occurring at the site.
- - Statistical data indicating the number of injuries, illnesses, lost work days, and total work days per month.
- - Records of incidents involving oil spills, leaks, and other environmental issues.
  The investigations and reporting of all incidents must be carried out in liaison with the company site project manager in accordance with the company incident investigation and reporting procedures to be posted at the employer' site offices

Personal protective Equipment (PPE)
The contractor is responsible for supplying all required personal protective equipment (PPE) to their workers, including items such as hard hats, safety boots, overalls, eye protection, ear defenders, gloves, and specialized PPE for tasks like welding, working at heights, and confined space entry. Clear and up-to-date records of all provided PPE must be maintained by the contractor.

2.7 ENVIRONMENTAL MONITORING

2.7.1 Introduction
Environmental monitoring ensures that predicted impacts are accurately assessed and that mitigation measures are effectively implemented. For the road upgrading project, a specific environmental monitoring plan is needed to address potential impacts. Supervision of project implementation initiates the monitoring process, aiming to ensure proper implementation of mitigation measures, adherence to design standards, and prevention of unforeseen negative impacts. The environmental management plan aims to minimize disturbance to land and restore it to its original state or a similar productivity level after the road upgrading process.

2.7.2 Surface Water Management
The surface water management program aims to maintain flows into and through the project site and nearby streams while preserving water quality. Monitoring of water quality, specifically sediment (SS) and oil, will be conducted monthly at major crossings during construction to ensure compliance with standards and minimize environmental impact.

2.7.3 Erosion Control and Sedimentation
2.7.4 The project areas, characterized by highly flocculated soils, are susceptible to erosion when disturbed. To address this, surface runoff from disturbed areas and those with elevated runoff coefficients will be directed through properly designed drainage systems to sediment traps. These traps will have adequate volume and retention time to facilitate the settlement of suspended sediment before release. Drain designs will consider peak flow characteristics for the predetermined design storm, ensuring discharge without causing erosion.

2.7.5 Vegetation
Several management initiatives will be implemented to minimize potential impacts on flora and vegetation:
- Workforce awareness programs will cover conservation issues and legal obligations specific to the project site.
- Project layout will be designed to minimize the area of clearing required.
- Access to areas of high conservation value will be clearly marked and restricted.
- Adequate drainage control systems will be provided along roads and access tracks.
- Dust suppression plans will be implemented in areas where dust generation is an issue.

- Topsoil and vegetation will be retained during clearing for restoration purposes.
- Disturbed areas will be progressively rehabilitated as they become available and are no longer needed for project operations.

2.7.6 Fauna

To mitigate potential impacts on fauna, the following measures will be implemented:

- - Disturbance and clearing of habitats will be minimized to only what is necessary for safe and efficient operations.
- - Disturbed areas will be progressively rehabilitated to re-establish habitats, minimizing long-term impacts on wildlife.

2.7.7 Construction Waste

All construction waste that has been generated will be backfilled in borrow pits.

2.7.8 Noise

Noise management will be limited by instructing drivers to observe speed limits. Noise generated from operations during upgrading is not expected to impact on local communities due low levels of emissions.

2.7.9 Management of Air Quality

Throughout dam construction standard water trucks will use water to suppress dust. The water trucks will continually apply water to potential dust generation areas such as the main detours and access roads.

2.7.10 Workforce Awareness

An environmental awareness induction plan will be implemented to ensure that all construction workers are aware of their environmental responsibilities.

2.8 Cost of Protecting the Environment

An environmental monitoring program will be established for the construction phase, focusing on noise impacts, air pollution water quality and protecting the undisturbed area around the project route corridor.

The cost of protecting the environment shall be reviewed periodically based on prevailing conditions.

3 DECOMMISSIONING AND CLOSURE PLAN

(i) Soil erosion compaction and contamination;
(ii) Historic safety & health risks of the persons and domestic animals if the pits are not adequately rehabilitated.
(iii) Increased soil erosion if no vegetation programme is instituted.

3.1 Impact Evaluation Criteria

The integrated environmental management procedure outline below was used to evaluate the impacts.

3.1.1 Nature of Impacts

This refers to the appraisal of the type of effect the proposed activity would have on the affected environmental component, and its description includes what is being affected and in what way.

3.1.2 Direct impacts

This is an impact (positive or negative) that appears instantaneously as a result of an activity of the project. The direct impacts are experienced mainly during the site preparation and clearing, and include effects on the physical environment, health and safety of the workers during the developmental phase.

3.1.3 Indirect Impact

This is a secondary impact related to the project. These impacts are primarily socio-economic in nature and extend beyond the project implementation.

3.1.4 Spatial Extent

The physical and spatial size of the impact is a description of whether the impact would occur on a scale described as follows: -

(i) *Site:* where the impact affects the whole or measurable portion of the site. Whether it is limited to the immediate area of the proposed project;
(ii) *Local:* where the impact affects the extended area adjacent to the site perhaps a neighborhood or small town.
(iii) *Regional:* where the impact affects the area including the outlying areas of the city, the transport routes and the adjoining towns,
(iv) *National:* - where the impact is as far as reaching international boundaries.

3.1.5 Frequency

Frequency is the incidence, occurrence, regularity, rate or rate of recurrence of the source of impact. This is measured by the number of times of occurrence of the source of impact due to the proposed development.

(i) Occurs once, where the source of impact will either occur once and disappear with mitigation or will be mitigated through natural process after occurring once due to the proposed development;
(ii) Occurs twice, where the source of impact will occur twice at any given phase of project implementation and thereafter it will be entirely negated; and
(iii) Occurs more than twice, where the source of impact will continue or occur more than two times for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter.

3.1.6 Duration

The lifetime of the impact: this is measured in the context of the lifetime of the proposed development.

(i) *Short term:* the impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the preparatory phase,
(ii) *Medium term:* the impact will last for the period of the preparatory phase, thereafter it will be entirely

negated,

(iii) *Long term:* the impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter,

(iv) *Permanent:* the only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.

3.1.7 Intensity

This is a description of whether or not the magnitude of the impact would be high, medium, low or negligible. Impact intensity is rated as follows:

(i) *Low:* where the impact will not have significant influence on the environment, and this will not be required to be significantly accommodated in the project design or implementation; the impact alters the affected environment in such a way that natural processes of functions are not affected in any significant way,

(ii) *Moderate:* where it could have an adverse influence on the environment, which would require modification of the project design or alternative implementation schedules; the affected environment is altered; however, function and process continue, albeit in a modified way,

(iii) *High:* where it could have significant influence on the environment but cannot be mitigated or be accommodated by the project environment by introducing alternative mitigation measures such as realignment at a particular stretch or adoption of different design measures. Function or process of the environment is disturbed to the extent where it temporarily or permanently ceases.

3.1.8 Severity

This describes whether the *harshness* or *gravity* of the impact would be high, medium, low or negligible. The severity of the impact is usually qualitatively determined on the components of the environment to be affected by taking into consideration the following questions. Is the impact harsh, serious or dangerous? Does it degrade the impacted environment, alter its functioning, or slightly modify its natural state?

These are rated as follows:

(i) *Low:* applies where the impact is very little and will not have significant influence on the environment. This will not be required to be significantly accommodated in the project design or implementation and the impact changes the affected environment in such a way that natural processes of functions are not affected in any significant way;

(ii) *Moderate:* applies where the impact could have an adverse influence on the environment and would require some modification of the project design or alternative implementation schedules. In this regard, the affected environment is altered while the function and process continue, albeit in a modified way; and

(iii) *High:* applies where the impact could have significant influence on the environment but cannot be mitigated or be accommodated by the project environment by introducing alternative mitigation measures such as realignment at a particular stretch or adoption of different design measures. In this regard, the function or process of the environment is disturbed to the extent where it temporarily or permanently ceases.

3.1.9 Probability

This describes the probability of the impacts really happening. The impact may occur for any length of time during the life cycle of the activity, and not at any given time.

The probability is rated as follows:

(i) *Unlikely:* the probability of the impact occurring is very low, due to the circumstances, design or experience, Possible, the impact could possibly happen, and mitigation planning should be undertaken,
(ii) *Probable:* it is most likely that the impact will occur at some or other stage of the development. Plans must be drawn up before the undertaking of the activity,
(iii) *Definite:* the impact will take place regardless of any prevention plans, and only migratory actions or contingency plans can be relied on to contain the effect.

3.1.10 Sensitivity

The sensitivity of the environmental component being impacted would be regarded as being high, medium, low or negligible:

(i) *Low:* where the sensitivity of the element being impacted will not have significant influence on the environmental component, and this will not be required to be significantly accommodated in the project design or implementation. The impact to the affected environment will be in such a way that natural processes of functions are not affected in any significant way;
(ii) *Moderate:* where the sensitivity of the element being impacted could have an adverse influence on the environmental component, which would require modification of the project design or alternative implementation schedules. The affected environment is altered while the function and process continue and the albeit in a modified way; and
(iii) *High:* where the sensitivity of the element being impacted could have significant influence on the environmental component but cannot be mitigated or be accommodated by the project environment by introducing alternative mitigation measures such as realignment at a particular stretch or adoption of different design measures. The function or process of the environment is disturbed to the extent where it temporarily or permanently ceases.

3.1.11 Determination of Significance

The project-affected community provides information on the characteristics of the impacts and the significance is determined based on this information. Significance is an indication of the importance of the impact in terms of physical extent, intensity and time scale, and therefore indicates the level of mitigation required.

The classes are rated as follows:

(i) *Negligible:* the impact is not substantial and does not require any mitigation,
(ii) *Low:* the impact is of little importance, but may require limited mitigation,
(iii) *Moderate:* the impact is of importance and therefore considered to have mitigation. Mitigation is required to reduce the negative impacts to acceptable levels or positive impacts maximized,
(iv) *High:* the impact is of great importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential. Positive impacts should be enhanced as a priority.

In addition, it is important to consider the duration of the impact and at what phase of the project it occurs, i.e. impacts during site preparation phase or impacts over the life of the bus terminus (operational phase) and whether the impacts are direct or indirect.

3.2 Evaluation of project impacts

The project impacts identified are evaluated using the criteria described above. Table 9 presents the summary of the evaluation.

Table 1: Summary Impact Evaluation

Phase	Impact Description	Type of impact	Spatial extent	Frequency	Duration	Intensity	Probability	Sensitivity	Significance
Preparation	Soil loosening during material collection for tests.	Direct	Local	Once	Short	Moderate	Definite	Low	Low
	Conflict with borrow pits neighbouring communities.	Direct	Local	> Twice	Short term	Moderate	Probable	High	High
Construction	Loss of Vegetation from clearing of trees for access road creation, and removal & stockpiling of overburden (especially at Sekute Borrow Pit).	Direct	Site	> Twice	Long term	Moderate	Probable	Moderate	Moderate
	Soil loosening, compaction and contamination;	Direct	Local	> Twice	Short term	Moderate	Probable	Moderate	Moderate
	Air pollution in form of dust & Carbon dioxide (from machinery).	Direct	Local	> Twice	Short term	Moderate	Probable	Moderate	Moderate
	Increased public & occupational safety & health risks	Direct	Local	> Twice	Short term	Moderate	Probable	High	High
	Groundwater contamination from improper faecal and wastewater management.	Direct	Site	> Twice	Short term	Moderate	Probable	Moderate	Moderate
	Disturbance of archaeological/cultural aspects, which are very significant	Direct	Site	> Twice	Short term	Moderate	Definite	Moderate	Moderate

	to tradition and indigenous beliefs.								
Operation									
	Noise generation from the machinery (excavators, front end loaders and tipper trucks).	Indirect	Local	> Twice	Short term	Moderate	Probable	Moderate	Moderate
	Air pollution from dust generated by mechanical handling of gravel & by tipper trucks hauling gravel and on unpaved roads.	Indirect	Local	> Twice	Short term	Moderate	Probable	Moderate	Moderate
	Contamination of leaves Reduced plant productive ability from leafy contamination by dust.	Indirect	Local	> Twice	Long term	Moderate	Probable	High	High
	Ground water contamination from improper handling of waste oils and fuels during repairing of the machinery (excavators & front-end loaders).	Direct	Site	> Twice	Long term	Moderate	Probable	High	High
	Loss of habitats for fauna; and	Direct	Site	> Twice	Short term	Moderate	Definite	Moderate	Moderate
	Increased public safety & health risks.	Direct	Local	> Twice	Long term	Moderate	Probable	High	Moderate
	Increased occupational safety & health risks	Indirect	Local	> Twice	Long term	Moderate	Probable	High	Moderate
Closure	Soil erosion, soil compaction & soil contamination.	Direct	Site	> Twice	Long term	Moderate	Probable	Moderate	Moderate
	Increased safety & health risks of the persons and domestic animals if the pits are not adequately rehabilitated.	Direct	Local	> Twice	Long term	Moderate	Probable	Moderate	Moderate
	Increased soil erosion if no vegetation	Direct	Site	> Twice	Long term	Moderate	Probable	Moderate	Moderate

	programme is instituted.								

Appendix 1: Soil Analysis

THE COPPERBELT UNIVERSITY

SCHOOL OF NATURAL RESOURCES

Department of Plant and Environmental Sciences

SOIL CHEMICAL PROPERTIES ANALYTICAL DATA SHEET

CHIKUMBI CONSULTANTS, DONALD CHILENGWE CHIKUMBI, NKANA EAST, KITWE

Accession details			[0.1M $CaCl_2$]	Electrical Conductivity	Ex Acidity	Kjeldahl	Total	NH_4OAC Extractable cation by AAS		Walkley Black			Exchangeable Heavy metals (micronutrients) AAS				NH_4OAC Extractable Basic cations by EDTA	
Lab No	Field No	Horizon Cm	pH	KCl 0.01mol.dm^{-3}	KCl 1mol.dm^{-3}	(N) %	P Ppm	(K) Ppm	Organic carbon %	Organic matter %	Total Carbon%	SOC Mg ha^{-1}	Pb ppm	Mn ppm	ZN ppm	Fe ppm	Ca me/100g	Mg me/10g
193	**S01**	0-20	4.7	1,333 µS/cm														
194	**S02**	0-20	4.8	1,399 µS/cm														
195	**S03**	0-20	4.7	1,345 µS/cm														
196	**S04**	0-20	5.0	1,340 µS/cm														

SOIL PHYSICAL PROPERTIES ANALYTICAL DATA SHEET

Accession details					Bulk density – in-situ core Gravimetric method					Munsell soil colour Dry soil		Soil Classification Bouyoucos Hydrometer 152 Method				
Lab No	Locality		Field No	Horizon Cm	MCg %	MCv %	Bulk g/cm^3	TPS %	Solids %	Notation	Colour	Clay %	Silt %	Total sand %	Texture (USDA)	FAO Soil order PU29
193		River bed	**S01**	0-20	N/A	N/A	N/A	N/A	N/A	7.5YR6/2	Pinkish gray	13.2	13.4	73.4	Loamy sand	
194		Upper land	**S02**	0-20	N/A	N/A	N/A	N/A	N/A	7.5YR6/4	Light brown	11.2	3.4	85.4	Loamy sand	
195		Dambo	**S03**	0-20	N/A	N/A	N/A	N/A	N/A	7.5YR6/1	Gray	9.2	5.4	85.4	Loamy sand	
196		Upper land	**S04**	0-20	N/A	N/A	N/A	N/A	N/A	7.5YR5/6	Strong brown	8.2	8.4	83.4	Loamy sand	

LABORATORY TECHNICIAN: Felix Chileshe SIGNATURE: Date: 2nd May 2024

HEAD OF DEPARTMENT: Dr. Darius Phiri SIGNATURE: Date: 2nd May 2024

Appendix 2: Pictures

Mweemba River

Drought affected maize fields at the nearest local village

Interview with community members South of the Maulders Farm and along the Mweemba River

Appendix 3: Dam Designs and Specifications

Nazilongo Dam – Kalomo

March 2024:

1. Background Data
   - Data used is SMRT & UTM & WGS84 format.
2. Illustrations and layout/Maps included:

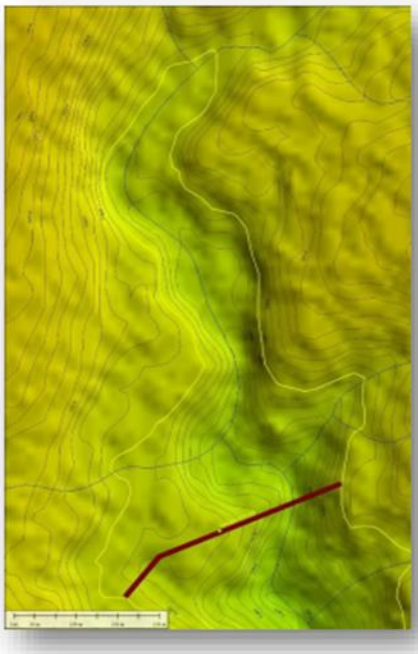
   I. Illustration of the Dam proposal at Level 1267m (FSL).
      - Table of estimated volumes

   II. Copy of PDF Nazilongo Dam design detail (G & S Juunza).

   III. Overview and orientation of Dams.
      - Nazilongo Dam
      - Existing East Dam
      - Proposed XL Dam to the South.

   IV. Upper Dam (Nazilongo) 1267m FSL to 1260m coloured profile map plus cross-sectional alignments.
      - X sections based off DEM data file.

   V. Catchment area (224 sqkm).



I. Illustration of the Dam proposal at Level 1267m (FSL).

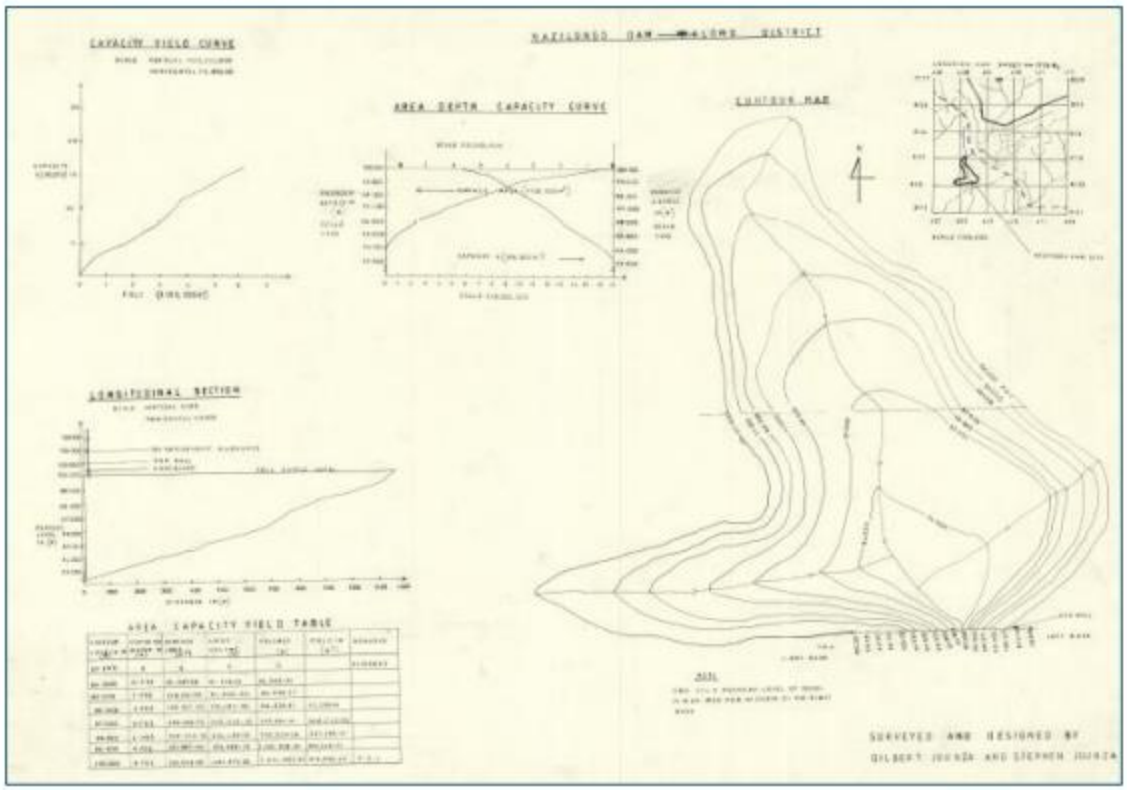
- Table of estimated volumes: determined by addition of layers (Surface area x depth x factor)

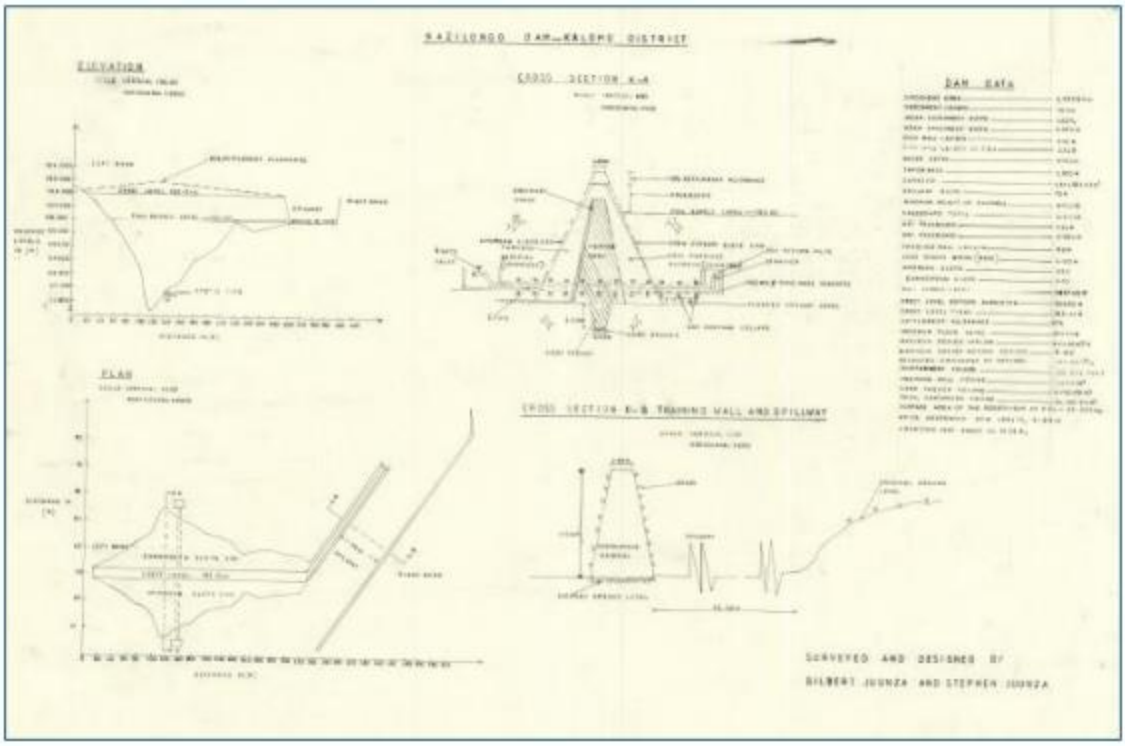
Nazilongo (Upper) Dam - BASED OF LATEST SMRT DATA FILES

Factor

Level masl	Surface area Sqkm	Surface area m^2	Depth m	squared volume m^3	Curve ratio	Theoretical volume m^3	Cumulative
1267.00	0.3649	364,900	1	364,900	0.90	328,410	936,374
1266.00	0.2468	246,800	1	246,800	0.88	217,184	607,964
1265.00	0.1782	178,200	1	178,200	0.86	153,252	390,780
1264.00	0.1265	126,500	1	126,500	0.85	107,525	237,528
1263.00	0.0749	74,900	1	74,900	0.85	63,665	130,003
1262.00	0.0497	49,700	1	49,700	0.84	41,748	66,338
1261.00	0.0261	26,100	1	26,100	0.8	20,880	24,590
1260.00	0.0053	5,300	1	5,300	0.7	3,710	3,710
				Estimated FSL Volume		**936,374**	*(volume m^3)*

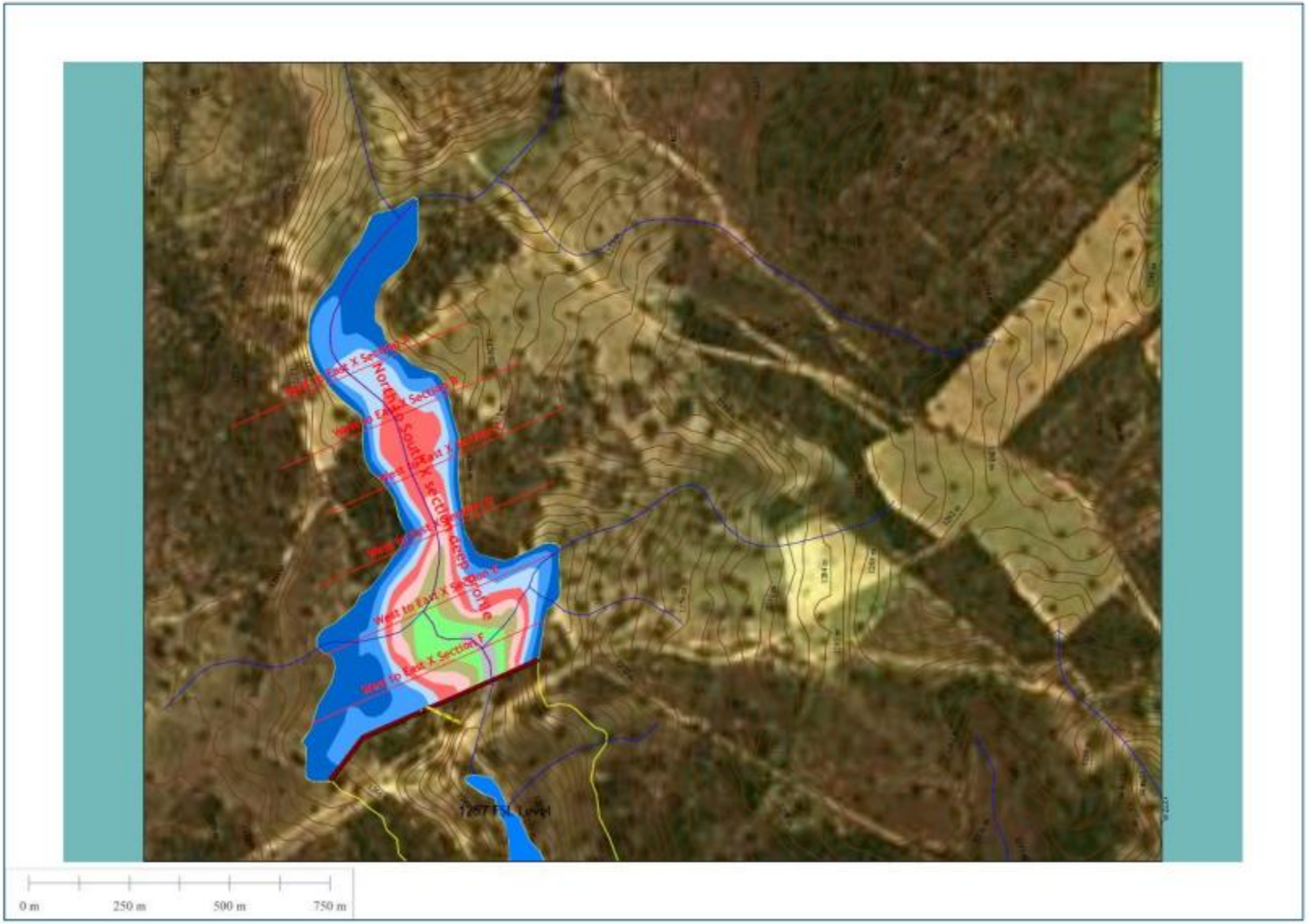
II. Nazilongo Dam – design data



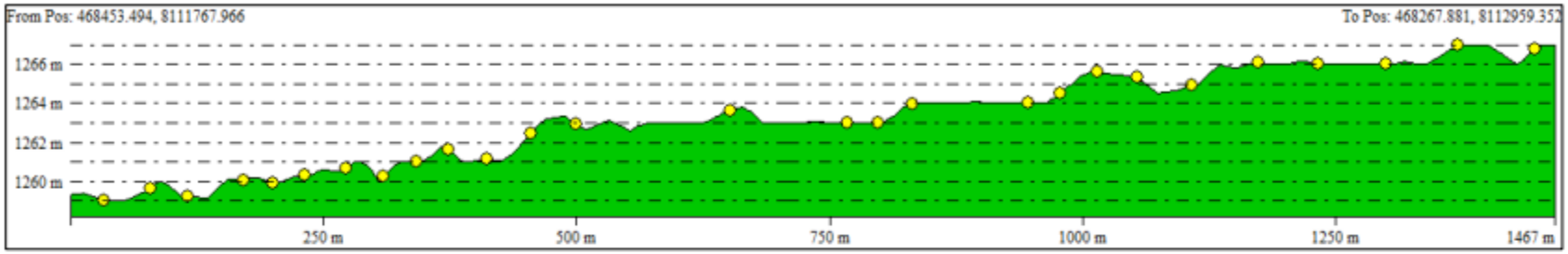

NAZILONGO DAM - KALOMO DISTRICT
ELEVATION
CROSS SECTION A-A
DAM DATA
PLAN
CROSS SECTION B-B TRAINING WALL AND SPILLWAY
SURVEYED AND DESIGNED BY
GILBERT JUUNZA AND STEPHEN JUUNZA

III. Overview of three Dam sites: Nazilongo

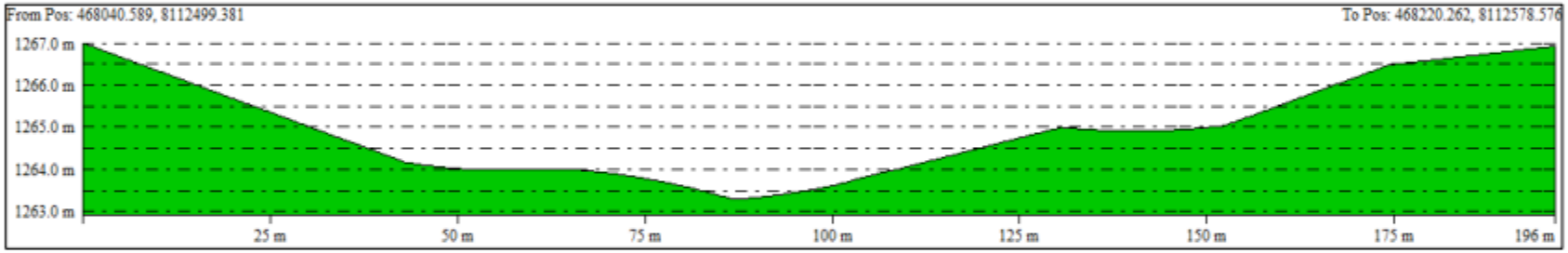
IV. Nazilongo Dam / X sections.



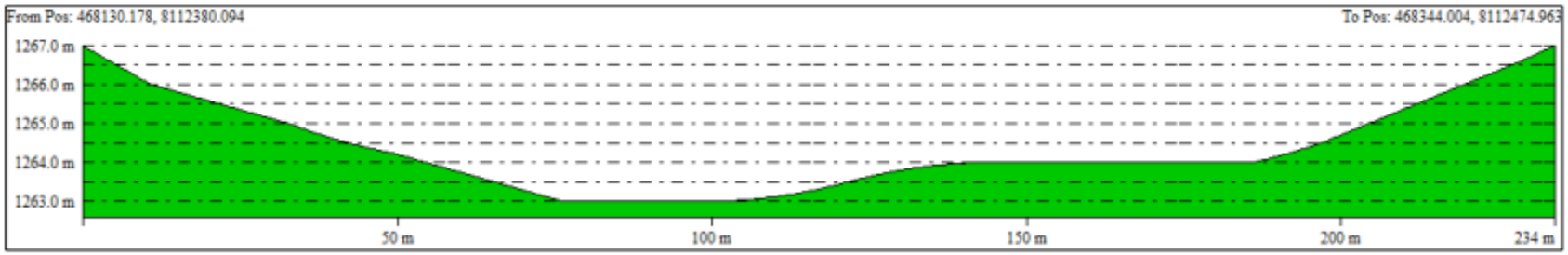
I. Profile from Dam Wall to upper reaches following the deep profile (North/South alignment).



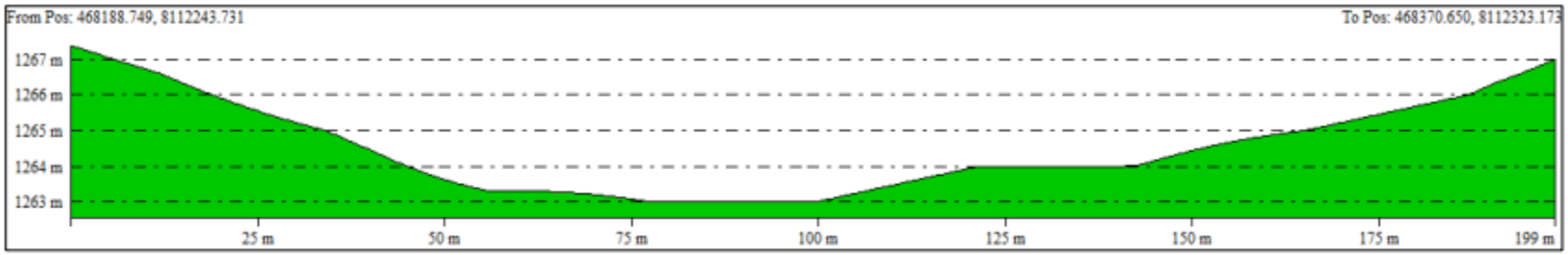
II. East to West X section A



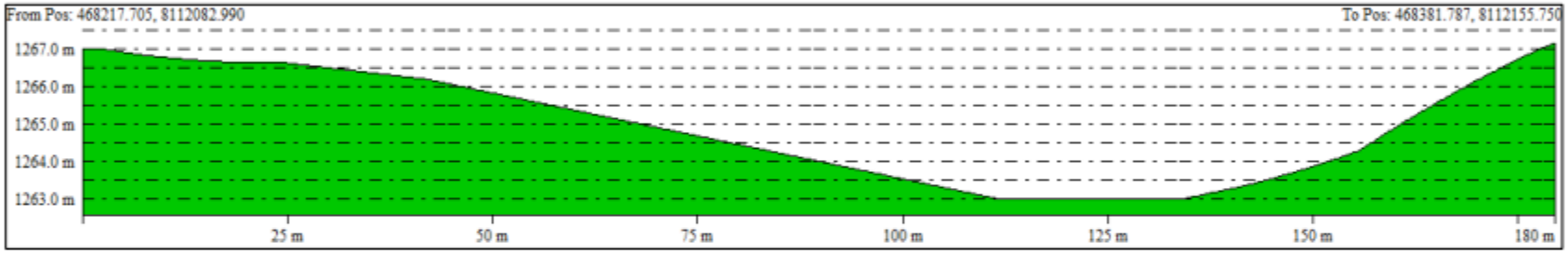
III. East to West X section B



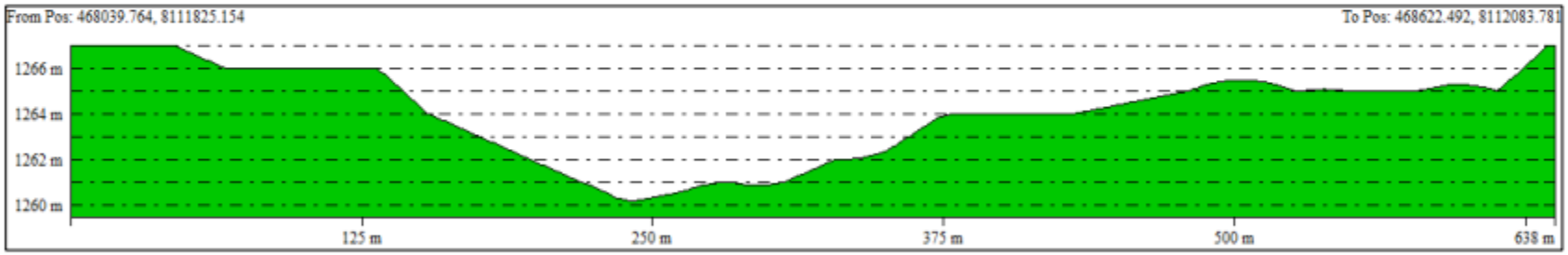
IV. East to West X section C



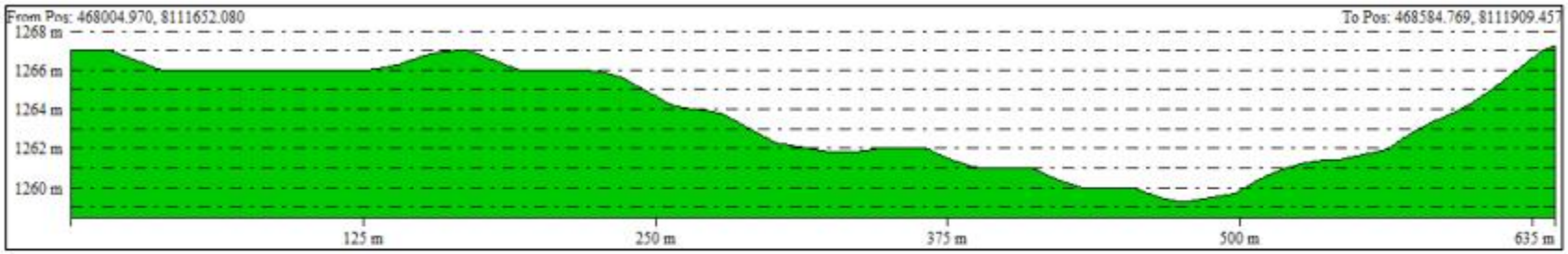
V. East to West X section D

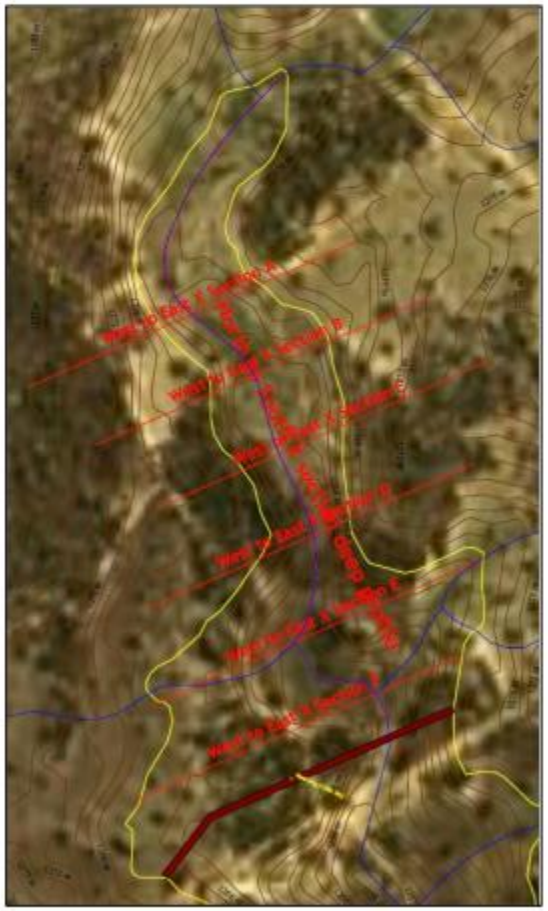


VI. East to West X section E

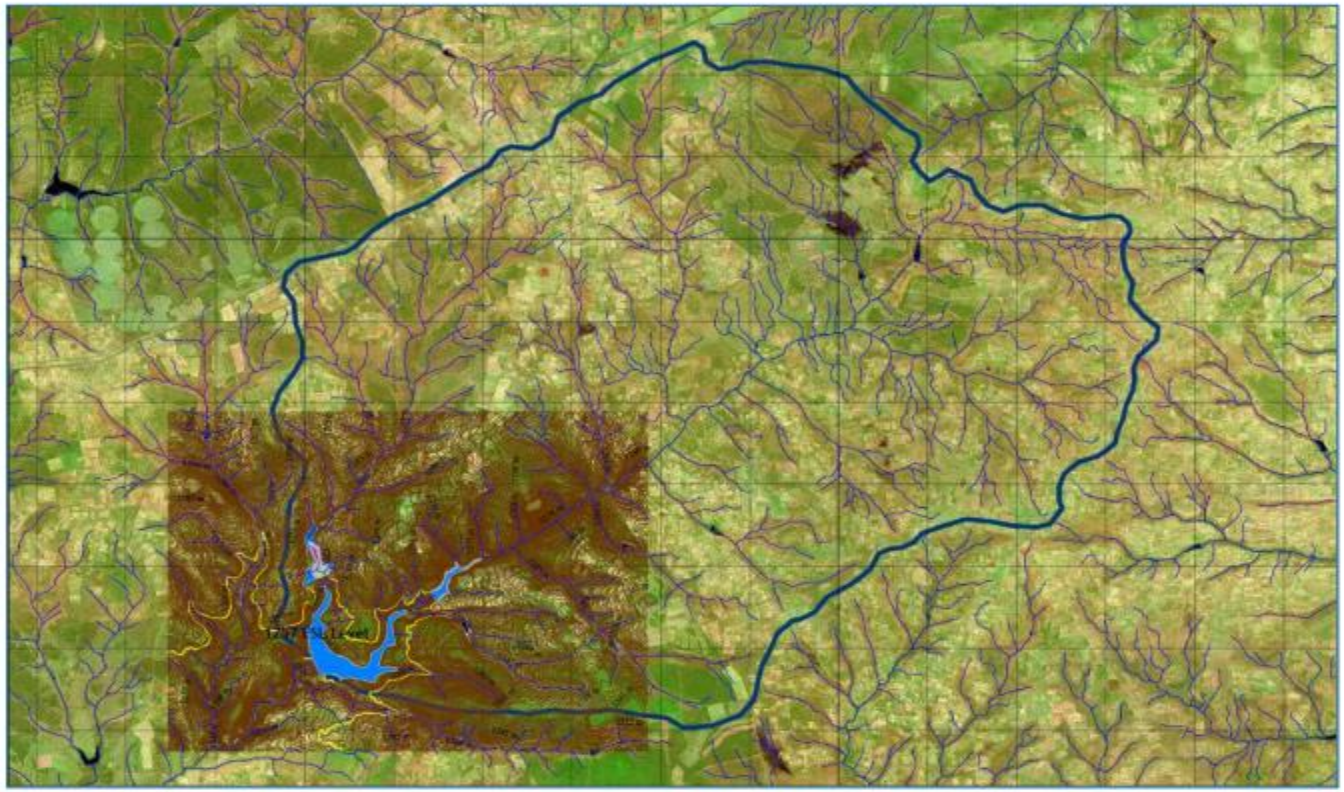


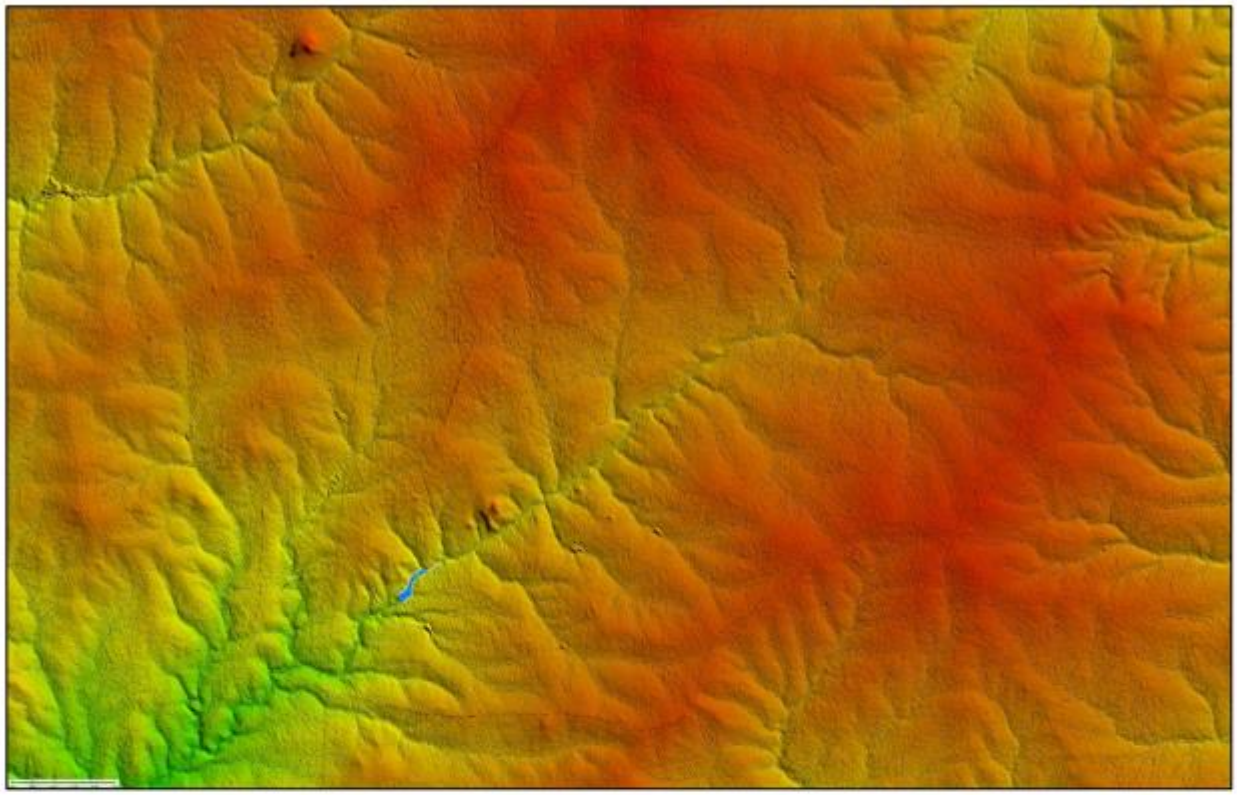
VII. East to West X section F

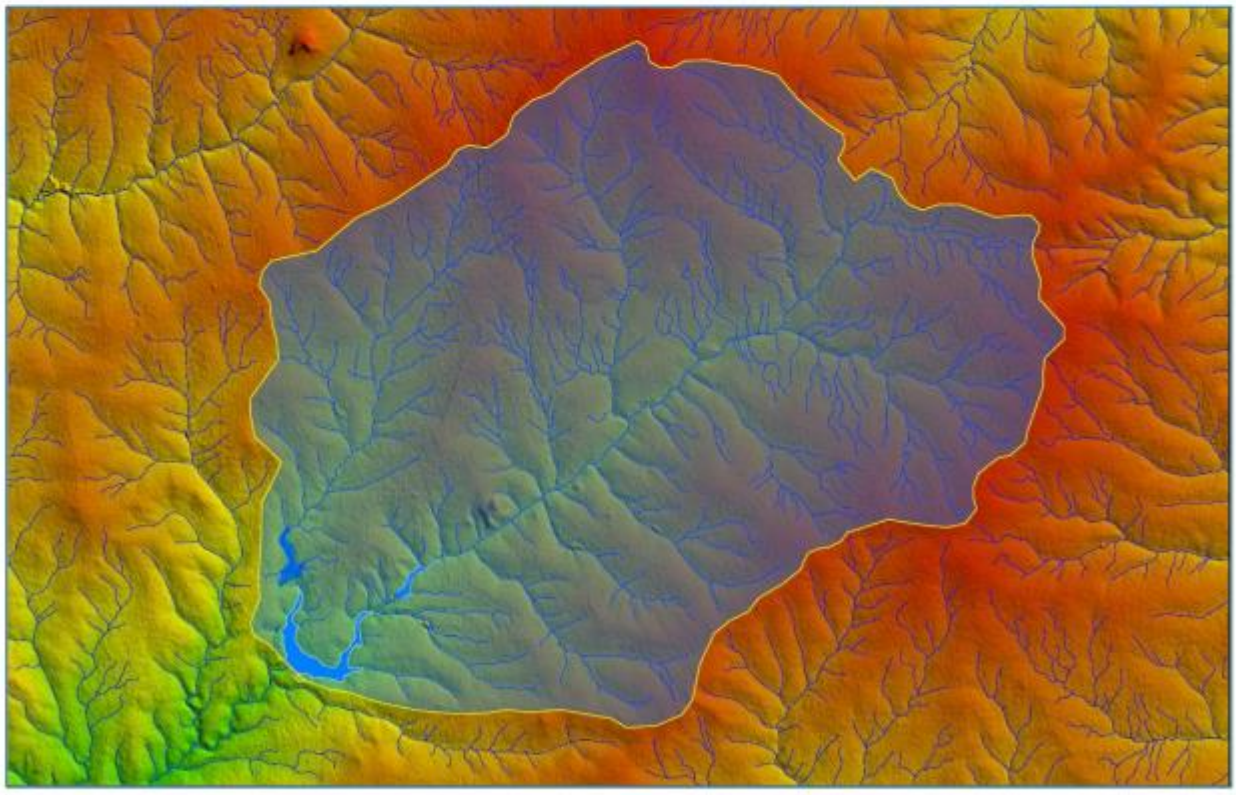


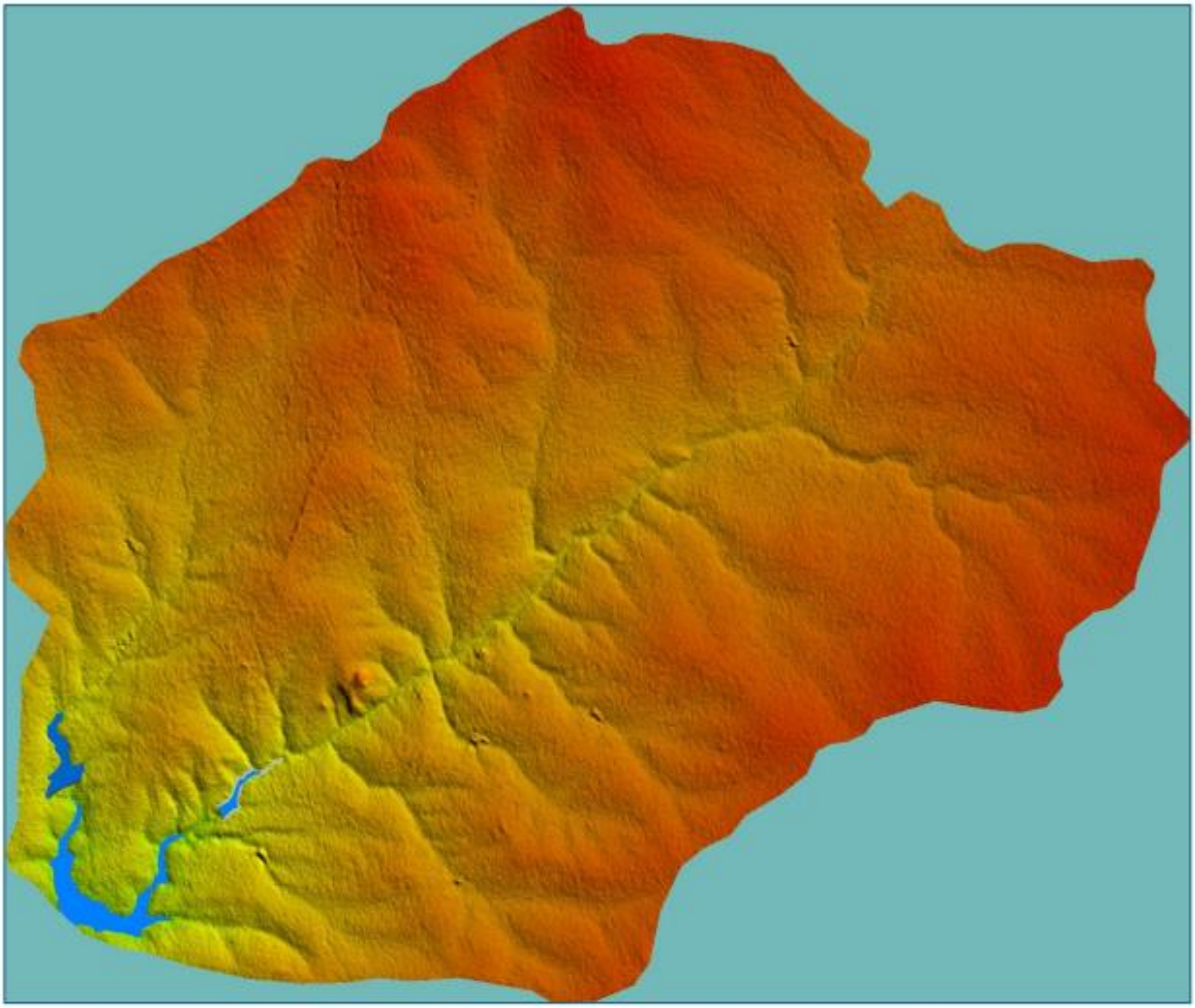


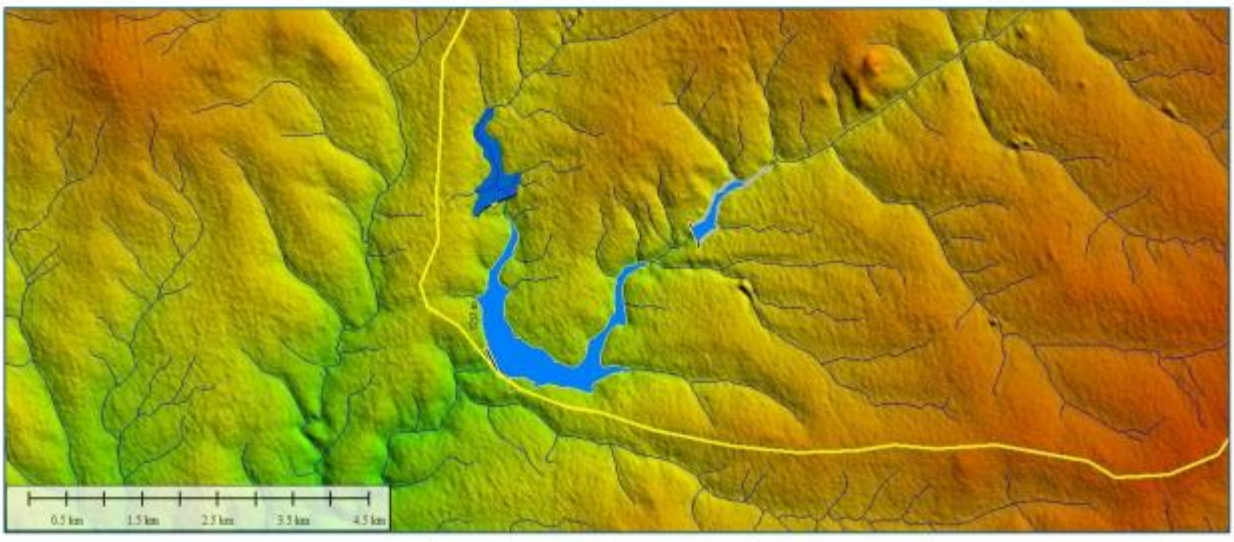
V. catchment area (224 sqkm).










0.5 km
1.5 km
2.5 km
3.5 km
4.5 km

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