MALAWI OF THE REPUBLIC GOVERNMENT

MINISTRY OF AGRICULTURE

SHIRE VALLEY TRANSFORMATION PROGRAM-1

UPDATED ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

FOR

CONSTRUCTION OF MAIN CANAL 3, SECONDARY CANALS AND REMAINING WORKS IN PHASE I

KOREA RURAL COMMUNITY CORPORATION
IN JOINT VENTURE WITH
DASAN CONSULTANTS CO. LTD.,
ISAN CORPORATION
AND
EMD CONSULTING ENGINEERING

DECEMBER 2021

FOREWORD

This Environmental and Social Management Plan (ESMP) for construction of Main Canal 3, secondary canals and remaining works in Phase 1 is an updated version of the original ESMP prepared in March 2017 by BRLi. This updated ESMP will be annexed to Volume3 3: ESMP for Shire Valley Transformation Program –Phase 1.

The update was initiated to address specific environmental and social impact assessment following preparation of Detailed Design Report for Main Canal 3, Secondary Canals, and Remaining Works in Phase 1 Area.

The updated report focuses on addressing the identified gaps but the integrity of the original ESMP report approved by Malawi Environmental Protection Authority (MEPA) remains valid and effective.

ACKNOWLEDGEMENT

The Consultant wishes to acknowledge with thanks the co-operative contribution of all persons and organizations involved in the preparation of this updated Environmental and Social Management Plan (ESMP). Their willingness to share information and views on the proposed project activities contributed to the richness of this updated ESMP.

Last but not least, the Consultant wishes to thank the local traditional leaders and their subjects in the project area for their support and assistance during field investigations despite being harvesting period.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

ADD	Agricultural Development Division
Ca	Calcium
CC	Construction contractor
DNPW	Department of National Parks and Wildlife
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
ESCOM	Electricity Supply Corporation of Malawi
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization of the United Nations
FGD	Focus Discussion Group
FS	Feasibility Study
GCM	Global Climate Model
GoM	Government of Malawi
Ha	Hectares
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
KRC	Korea Rural Corporation
LNP	Lengwe National Park
Masl	Meters above sea level
MEPA	Malawi Environmental Protection Agency
MWK	Malawian Kwacha (1$ US equals +/-800 MWK)
MoA	Ministry of Agriculture
N	Nitrogen
NWDP	National Water Development Project
P	Phosphorus
pH	power of Hydrogen
PPE	Protective Personal Equipment
PPP	Public Private Partnership
SC	Secondary canals
SRBMP	Shire River Basin Management Program
SVIP	Shire Valley Irrigation Project
SVTP	Shire Valley Transformation Project
TORs	Terms of Reference

EXECUTIVE SUMMARY

INTRODUCTION

This updated Environmental and Social Management Plan (ESMP) has been prepared for the Shire Valley Transformation Program-Phase 1. The Project is financing development of 42,000 ha irrigation program by constructing intake, main canals, secondary canals and other hydraulic infrastructure. The program is being implemented in two phases namely: Phase I would include (a) the existing Illovo Estate at Nchalo, (b) the existing cane out-grower scheme at Kasinthula, (c) new land in the vicinity of Kasinthula, (d) new land in the Mthumba Valley and (e) new land between the Mwanza River and Lengwe National Park. Water for irrigating this area would be supplied through the Main Canal 1 and 3, and partly the Main Canal 2.

Phase II of the project would extend over between Lengwe National Park and Bangula trading center. Water for irrigating this area would be supplied by the Main Canal 2. Implementation of the works was phased with commencement of construction of the intake at Kapichira, Main Canal 1 and part of Main Canal 2 in Phase I area. However, it was agreed during appraisal meetings of the financiers that the ESMP must be updated to take into consideration information from detailed design reports. To that end, it was determined that an update to the original ESMP has to be undertaken for construction of Main Canal 3, Secondary Canals and Flood Protection structures.

The ESMP is required to identify and assess environmental and social issues associated with the proposed activities and develop mitigation measures consistent with local and financiers environmental and social safeguards policies and regulations. This updated ESMP has been prepared as part of the overall environmental and social safeguards package for the program.

The proponent of the Project is the Ministry of Agriculture with financial support from the World Bank and the African Development Bank (AfDB). The ESMP has been developed following the World Bank Environmental and Social Framework (ESF), the AfDB environmental and social safeguard policies, national regulatory requirements.

OBJECTIVE OF THE ASSIGNMENT

The overall objective of this assignment is to prepare an ESMP that recommend tangible, feasible cost-effective mitigation and enhancement measures for potential environmental and social impacts to emanate from construction of Main Canal 3, Secondary Canals, and Flood Protection. Specifically, the assignment aims at analysing the environmental and social implications of the following construction activities: land clearing, excavation works, civil works and backfilling of trenches where canals cut roads.

SUMMARY OF SIGNIFICANT POTENTIAL POSITIVE IMPACTS AND ENHANCEMENT MEASURES

The overall benefit of the proposed project is to transform the lives of households in the Shire Valley and beyond by lifting them out of poverty through intensive irrigation agriculture aimed at shifting subsistence farming to commercial agriculture. Many households will be lifted out of

poverty due to significant improvements in their disposable income and livelihoods. The ESMP has established the following potential significant positive environmental and social impacts, which would be generated from implementation of the proposed project:

a) Creation of employment during construction phase

Enhancement measures

- Encourage contractors to prioritize employment of local community members
- Ensure women are given equal employment opportunities to promote gender equality

b) Surge in economic activities due to construction activities

Enhancement measures

- Prioritise purchase of locally available materials where practically possible
- Purchase materials at better prices to ensure local businesses generate profits

c) Increase in revenue generated through taxes and levies

Enhancement measures

- Procure construction materials from tax compliant suppliers
- Contract construction companies registered with NCIC

d) Increased water availability for irrigation

Enhancement measure

- Develop a robust preventative operation and maintenance plan to sustain operations of the infrastructure
- Timely respond to water supply problems

e) Increased resilience to climate variability

Enhancement measure

- Maintain operation of the conveyance system to ensure availability of water for irrigation
- Promote crop diversification

f) Improved protection of irrigation infrastructure and human settlements

Enhancement measure

- Maintain flood intervention structure regularly
- Integrate early flood warning system

g) Improved food security and incomes at household level

Enhancement measure

- Train farmers on improved farming practices such as land preparation, weeding, fertilizer application and other recommended practices that will help them realise high quality yields;
- Train farmers in food preservation and post-harvest storage

SUMMARY OF SIGNIFICANT POTENTIAL NEGATIVE IMPACTS AND MITIGATION MEASURES

The ESMP has identified several potential negative environmental and social impacts to be generated by the proposed project activities during design, construction and operation phases. The ESMP has devised several strategies which should minimize or abate negative impacts at the least

cost. The following negative impacts have been highlighted in the report as critical requiring special attention by the project during implementation:

a) **Disturbance and loss of livelihoods for projected affected persons due to acquisition** of land for construction of water pumping mains;
Mitigation measures
- Compensate all project affected persons in line with relevant legislations
- Provide adequate notice before implementing project activities
- Implement construction works after affected persons have harvested their crops

b) **Soil erosion due to stormwater management deficiencies in designs/construction**
Mitigation measure
- Design and construct appropriate storm water management structures such as check dams, French drains and riprap
- Construct soil erosion control structures especially section along Mwanza River

c) **Loss of vegetation due to site clearing**
Mitigation Measures
- Restrict clearing to areas earmarked for construction
- Design pumping mains alignment in such a way that mature indigenous trees are avoided where possible
- Replant trees and grass in disturbed areas

d) **Land degradation due to excavations and site clearing**
Mitigation measures
- Rehabilitate or revegetate site areas that were destabilized during construction
- Dispose construction wastes and domestic wastes in areas designated by Chikwawa District Council authorities

e) **Noise and vibration from construction machinery**
Mitigation measure
- Use low noise emitting machinery
- Restrict noise generating activities to daytime
- Provide ear muffs to workers
- Maintain construction machinery regularly

f) **Construction related accidents**
Mitigation measures
- Provide safety training and sensitization to workers and communities respectively
- Provide appropriate personal protective equipment
- Install signage to warn workers and community members of unsafe working areas
- Backfill excavated trenches to prevent people and animals from falling into trenches
- Provide first aid kit and associated training
- Conduct daily toolbox talks to workers

g) **Disruption of traffic flow and public mobility on areas where excavations cross roads and paths**

Mitigation measures

- Provide appropriate detours for motorist and pedestrians
- Backfill excavated areas to minimize traffic disruptions

h) **Labour abuse and exploitation**

Mitigation measure

- Provide mechanism for employees to lodge labour abuses and exploitation complaints

i) **Increased gender-based violence and sexual exploitation**

Mitigation measures

- Develop diversity inclusive gender policy and ensure all workers are sensitized on the policy
- Provide grievance avenues for workers and ensure appropriate actions are taken to address any complaints lodged

j) **Spread of sexually transmitted diseases including HIV and AIDS**

Mitigation measures

- Establish HIV and AIDS policy to guide management of HIV and AIDS incidences and cases for the project
- Provide additional care support to workers living with HIV and AIDS

k) **Increased spread of COVID-19**

mitigation measures

- Establish covid-10 preventative measures such as using masks, hand sanitizers and washing hands
- Encourage workers to go for vaccination

CONCLUSIONS AND RECOMMENDATIONS

The ESMP has established that construction of the main canal 3, secondary canals and flood protection facilities will significantly increase agricultural productivity in the project area. The option of installing HPDE pipes for the canals as opposed to open concrete canal will significantly reduce negative impacts for the proposed civil works. The identified negative impacts will be short term, localized and can easily be corrected by implementing appropriate mitigation measures outlined in this plan. Based on the findings established in this report, it is recommended that the project proceed as the benefits of the proposed works outweigh the negative impacts to be generated by the project. However, economic benefits envisaged for the project could be jeopardized if the following recommendations are not implemented:

1. SVTP must ensure that all mitigation measures recommended in this report are fully implemented to avoid or maintain the predicted negative impacts at the lowest level;
2. SVTP and contractors should provide adequate financial support for implementation of mitigation measures stipulated in the ESMP;

3. The Project must ensure that interests of vulnerable, disadvantaged and marginalised groups such as women and youth are considered during implementation of project activities; and
4. The project must ensure that Chikwawa District Council officials are involved in periodic compliance monitoring of project activities to ensure that provisions made in the ESMP are adhered to and corrective actions are timely instituted to address non-compliance.

CHAPTER ONE: BACKGROUND INFORMATION

1.1 INTRODUCTION

The Government of Malawi (GoM) through Ministry of Agriculture, Irrigation and Water Development (MoAIWD) is planning to implement the Shire Valley Irrigation Project (SVIP) in the Lower Shire Valley, after years of planning dating back to the 1940s. As part of preparatory studies for the feasibility of the SVIP, MoAIWD with assistance of the African Development Bank (AfDB) and the World Bank (WB) is in the process of carrying out seven studies to complement and supplement the detailed feasibility study to produce a 'bankable' project proposal. SVIP is part of the Shire Valley Transformation Program – I (SVTP-I) which includes a sub-component called "Sub-component 2.2 Natural Resources Management" that will be supported largely with GEF-6 funding. It will promote an inter-sectoral approach to the management of the Lower Shire landscape by addressing biodiversity conservation, protecting and enhancing the role forests, woodlands, rangelands and wetlands play in mitigating climate change, and promoting sustainable approaches to forest management which protect forest resources and deliver benefits to local communities. The principal objective of SVIP is "to sustainably enhance incomes and hence food security of about 100,000 households in Chikwawa and Nsanje Districts through increased agricultural productivity and profitability by establishing market-linked smallholder farming ventures and professionally operated irrigation services in 42,500 ha of land. Use the introduction of SVIP instead of confusing with SVTP so recast the introduction

The project has four components namely: 1) Irrigation Service Provision aiming at developing irrigation and drainage infrastructure in the SVIP-I area. This includes preparation of detailed designs and construction supervision and quality assurance, construction of the physical bulk water conveyance and main distribution system, major drainage and service and access roads; 2) Preparing land-based investments and natural resources management support focusing on support to address security of land tenure and organizing farmers for commercial production – as a first step in developing commercially oriented agriculture; 3) Agriculture Development and Commercialization with the objective of supporting activities of smallholder owned commercial farm enterprises to profitable agriculture production; and 4) Project Management and Coordination.

MoA through the SVTP Secretariat prepared Environmental and Social Impact Assessment (ESIA) and Pest Management Plan (PMP) for the project and was approved in November 2018 by Environmental Affairs Department. The ESIA report addressed potential impacts for the whole project and a separate ESMP was prepared for the project. However, implementation of the works was phased with commencement of construction of the intake at Kapichira, Main Canal 1 and part of Main Canal 2 in Phase I area. Implementation of the works revealed that some adjustments were required on ESMP to accommodate site specific issues which were not captured during the initial development of the original ESMP. To that end, it was determined that an update to the ESMP has to be undertaken for construction of Main Canal 3, Secondary Canals and Flood Protection facilities. Similarly, an update will have to the original ESMP will have to be undertaken prior to implementation of construction works in Phase II consisting of Main Canal 2 and secondary canals and their associated structures.

As indicated in the Main ESIA Report, implementation of the proposed civil works will generate various positive and negative impacts to the biophysical and socio-economic environment in the project area. Consequently, KRCC engaged the services of an Environmental Specialist to update the original Environmental and Social Management Plan (ESMP) by identify specific environmental and social impacts and devise appropriate measures to manage the predicted impacts.

1.2 CONSTRUCTION OF MAIN CANAL 3 AND OTHER HYDRAULIC STRUCTURES

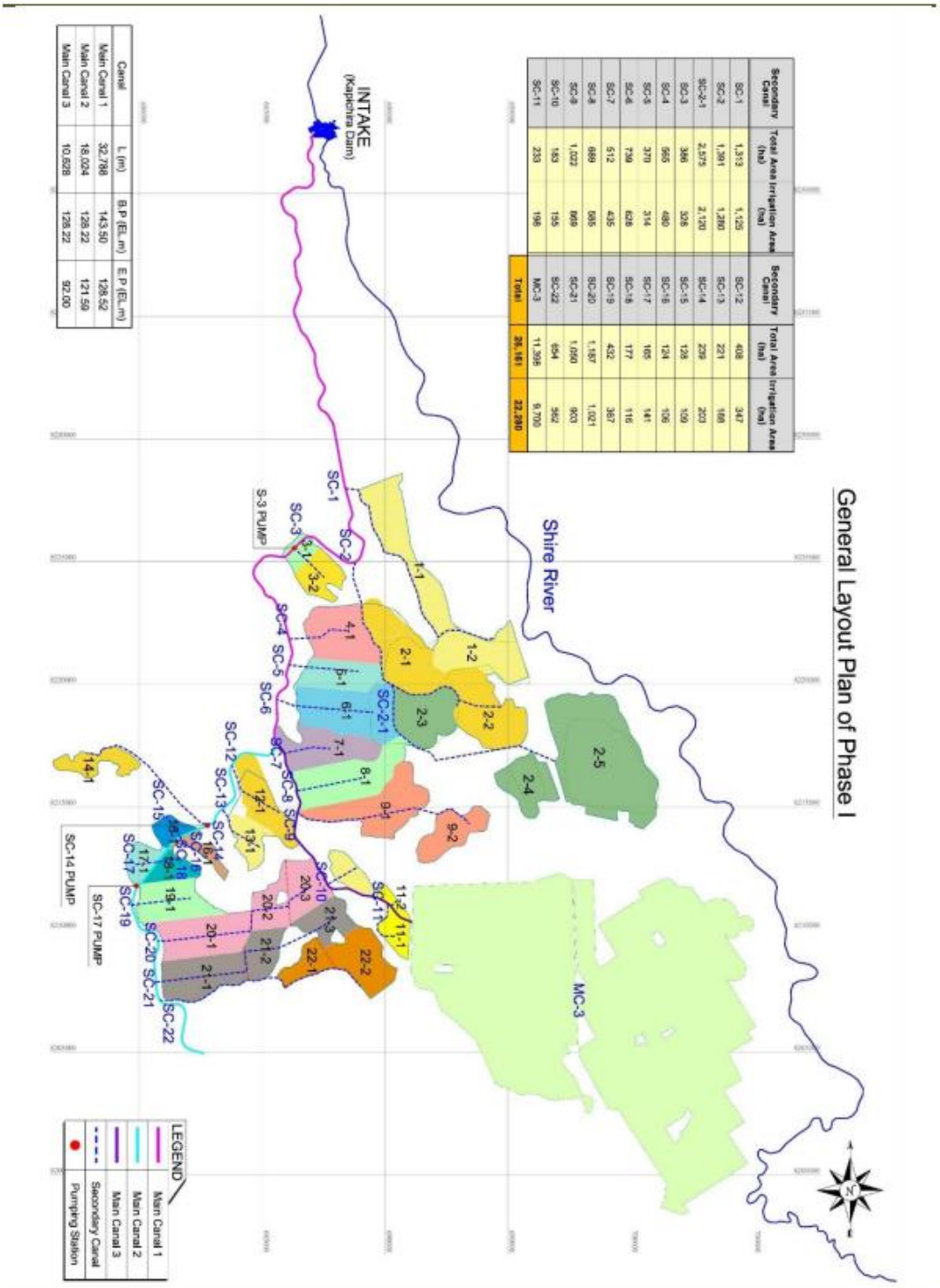
The ESMP will focus on part Main Canal 2 passing through Lengwe National Park, Main Canal 3, pipeline crossing the Mwanza River section, offtake gates, control valves, discharge facilities, air vents, sediment ejectors, secondary canals, access roads, drainage and flood protection structures as presented in Table 1. These project components will be carried out in four phases namely planning, construction, demobilization, and operation and maintenance phases.

Main Items	Considerations for the Detailed Design
Main canal 2	• Canal length for phase II: 69.9 km long (from Lengwe National Park to Bangula) • Serves the 3,580 ha part of Illovo and Kaombe estates and about 17,510 ha of proposed smallholder farms • Designed as a lined canal for a capacity of 29 m3/sec • Canal's cross section will keep on reducing in size with each subsequent withdrawal of water by secondary canals
Main canal 3	• Canal length: 10.6 km long (from the bifurcation structure to the entrance point of ILLOVO estate) • Serves the 10,000 ha ILLOVO estate and about 2,100 ha of small holder farms • Designed as a lined canal for a capacity of 15 m3/sec • Discussion with Illovo is required. • Canal's cross section will keep on reducing in size with each subsequent withdrawal of water by secondary canals
Secondary canals	• Phase I: 16 secondary canals (SCs) are planned with a total length of 91 kms • Phase II: 10 secondary canals (SCs) are planned with a total length of 86.5 kms • Designed as a lined canal based on the water requirements of blocks • Provide discharge measurement system for offtake structures on the secondaries • Design the secondary canals and the associated structures to accommodate all possible irrigation methods (surface / pressurized).
Major Hydraulic Structures	• Design major hydraulic structures include siphons, bridges, cross regulators, emergency spillways, cross drainage structures, and primary and secondary offtakes • Provide emergency facilities to mitigate wave-propagation in the canals • Provide devices to prevent siltation in the canals • Provide bridges at strategic location for animals and vehicles crossings • Provide safety structures, e.g. stairs, ladders, fences etc, particularly on main canals 2 and 3 and also on secondary canals • Provide cross drainage structures/aqueducts at strategic locations for safe crossing and disposal of drainage or storm water
Road networks	• Design road network of principal, service and access roads for ease of O&M activities, transporting farm inputs and products, etc. • Access roads are made of compacted earth material along the tertiary canals • Service roads would have gravel surface or similar suitable materials • Principal roads connect the project area with the existing main roads and will have gravel or tarmac surfacing
Drainage and flood protection works	• Design drainage canals to safely collect and dispose excess irrigation or storm water • Natural water courses shall be used as secondary or main drainage canals • Provide any river training works to facilitate drainage • Design flood protection dikes to protect irrigated areas • Provide flood map together with the proposed flood protection works

1.3 PROJECT LOCATIONS

The study area for the Main Canal 3 and associated structures includes part of Illovo Estates, Kaombe Estates, Lengwe National Park as well as the right-of-way of all canals. On a hydrological perceptive, the Study area is included in the Lower Shire River valley. It includes the Mwanza River confluence with Shire River and all rivers feeding both Mwanza and Shire rivers. The map in figure 1-1 shows the Study area.

.



Secondary Canal	Total Area Irrigation Area (ha)	Secondary Canal	Total Area Irrigation Area (ha)
SC-1	1,313	1,125	SC-12	408	347
SC-2	1,391	1,280	SC-13	221	188
SC-2-1	2,575	2,120	SC-14	239	203
SC-3	386	326	SC-15	128	109
SC-4	565	480	SC-16	124	106
SC-5	370	314	SC-17	165	141
SC-6	739	628	SC-18	177	116
SC-7	512	435	SC-19	432	367
SC-8	689	585	SC-20	1,187	1,021
SC-9	1,022	868	SC-21	1,060	903
SC-10	183	155	SC-22	654	562
SC-11	233	198	MC-3	11,396	9,700
			Total	26,161	22,280

Canal	L (m)	B.P (EL.m)	E.P (EL.m)
Main Canal 1	32,788	143.50	128.52
Main Canal 2	18,024	128.22	121.59
Main Canal 3	10,628	128.22	92.00

Figure 0-1: SVPT Phase 1 Project Areas

1.4 AIM AND OBJECTIVES OF THE ESMP

The ESMP has been prepared to identify environmental and social impacts that will be generated by the activities of the proposed project and enhancement and/or mitigation measures for maximising the positive impacts and mitigating the negative impacts as per the requirements of the Environment Management Act of 2017. Since the SVIP is financed by World Bank and African Development Bank, in addition to the national environmental and social regulatory and policy requirements, this updated ESMP also aligns align with the financiers Environmental and Social Safeguard Policies. The ESMP also provides an overview of the environmental and social baseline conditions on the direct impacted areas, summarizes the potential impacts associated with the proposed project and sets out measures for managing any potential impacts. The ESMP will be utilized by all stakeholders (as indicated in Section 1.7) in the water efficiency project and will form the basis of environmental and social management system for the contractors and subcontractors prior to commencement of the project works. It should also be noted that the contractors and subcontractors are also required to develop site-specific management plans to complement the ESMP such as the waste management plan, health and safety management plan and traffic management plan.

1.5 POTENTIAL USERS OF THE ESMP

The ESMP has been prepared for use by different stakeholders to be involved in the planning, implementation, management and monitoring of the proposed project activities. The users will include the contractors, subcontractors, SVTP, Environmental Affairs Department (Malawi Environmental Protection Authority (MEPA), Chikwawa District Council, Ministry of Lands, and project financiers during mission visits or project follow-ups. The plan contains useful information on policies and procedures to be adhered to, implementation modalities, analysis of potential environmental and social impacts and suggested mitigation measures at various stages of the project activities.

1.6 METHODOLOGY FOR THE ESMP

The ESMP was prepared based on final designs and drawings presented in the technical feasibility study as well as laws and regulations that have a bearing on the project.

Activities undertaken in the compilation of this ESMP included:

a) Desk study of proposed project activities;
b) Identification of all activities, inputs and outputs associated with the project as outlined in the technical feasibility study;
c) Identification of the environmental impacts associated with the activities, inputs and outputs at the proposed project site; and
d) Evaluation of significant environmental impacts and proposing feasible and least cost enhancement and mitigation measures.

1.8.1 LITERATURE REVIEW

Literature review involved acquisition and review of documents, reports maps and drawings relevant to the project. Some of the documents reviewed included previous study reports such as

Technical Feasibility Study for the project; different national and international policies, legislation and regulation for developing water distribution networks. Examples of information obtained from the different documents included project design and implementation details; planned project components, activities and their description; data on different physical, biological and social economic environment; policies, legislation and procedures to be adhered to, implementation modalities, analysis of potential environmental and social impacts and suggested mitigation measures at various stages of the project activities.

1.8.2 FIELD SURVEY

The field survey was undertaken to collect site specific biophysical and socioeconomic information which might have been missed in the original ESIA report.

The baseline studies concentrated on the biophysical and social economic environment of the project impact areas especially for main canal 3. The study on the physical environment determined the topography, soils and hydrology of the proposed project sites and looked at the potential impacts the proposed project will have on the existing physical environment within the project areas. The study on the biological environment determined the existing flora and fauna in the project areas that will be affected by the establishment and operation of the project.

In terms of the socioeconomic characteristics, the Consultants analysed the agricultural practices, commerce and industry, education, health and sanitation and land administration, tenure and use in the project areas.

The detailed information on the biophysical and social economic environment of the project areas is provide in Chapter 3 of the ESMP.

1.8.3 STAKEHOLDER CONSULTATIONS

Stakeholder consultations were conducted with selected households located along main canal 3. The purpose of the consultations was to solicit their views, concerns and suggestions on how problems can be mitigated and how benefits can be enhanced.

CHAPTER TWO: PROJECT DESCRIPTION

2.1 DESCRIPTION OF MAIN PROJECT ACTIVITIES AND PHASES

The main project activities will include construction of main canal 3, secondary canals, and flood protection works as described in the following sub-sections.

2.1.1 MAIN CANAL 3

MC-3 is a canal installed to supply irrigation water to the Illovo Estate, and is branched off from MC-1. Canal type is HDPE Pipeline type, and a single diameter of 2,000 mm pipe is applied throughout the entire section, and the total length is 10.5 km. This canal also supplies irrigation water to 5 irrigation sectors (3 sectors in the Zone I, and 2 sectors in the Zone A) around the canal route.

Main civil works for installation of the canals will include site preparation, excavations, laying of pipes, backfilling and restoration of degraded lands. Figures 2-1 and 2-2 present schematic layout of main canals and route of main canal 3.

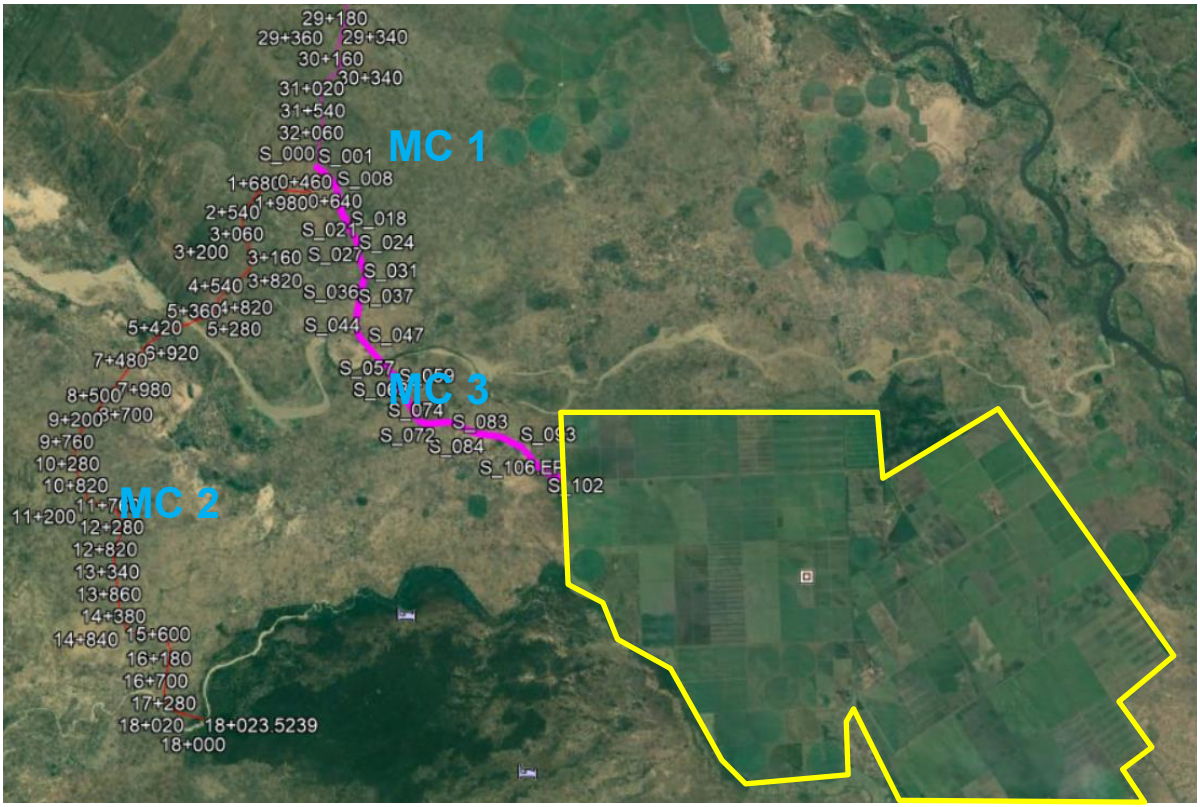


Figure 2-1: Layout of Main Canals and Illovo Estates

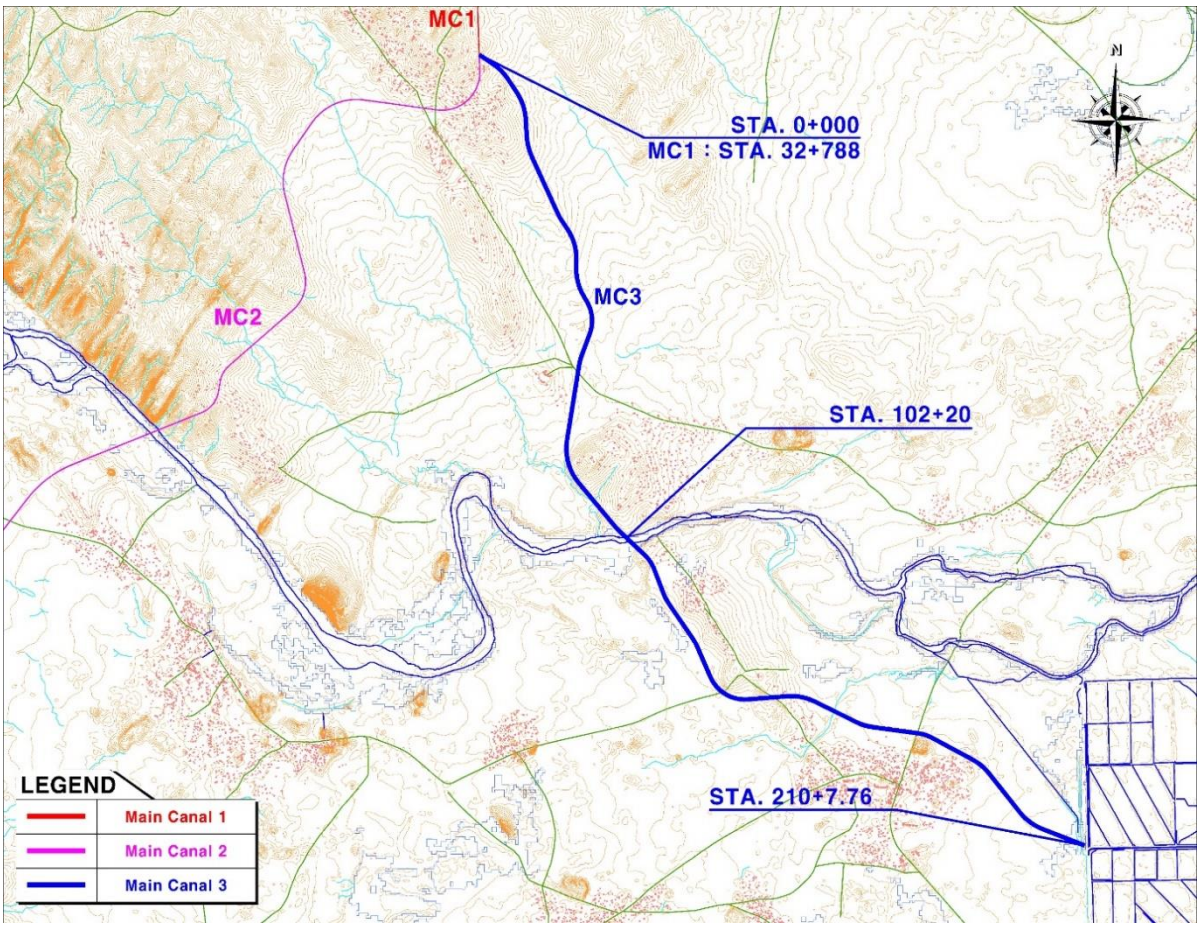


Figure 2-2: Route for Main Canal 3

2.1.2 HYDRAULIC ELEMENTS OF THE CANAL PIPELINE

MC-3 Pipeline will consist of only a single pipe diameter of 2,000 mm. For hydraulic calculation, the Hazen–Williams equation, which is most widely used for hydraulic analysis of water and sewage pipeline, was applied. For the Hazen–Williams coefficient C, a value of 150, which is generally applied to PE pipes, was applied.

The flow velocity of in the pipe becomes the maximum (3.92 m/s) at the start point where the flow rate is at its maximum, and becomes the minimum (3.06 m/s) at the end point at which the flow reaches Illovo Estate. The maximum flow velocity allowed in the PE pipe is 6 m/s, so it is suitable for the standard. This is the flow velocity that occurs when the maximum flow rate is supplied, the period of the year is very short, and its duration is very short throughout the year, and in most cases the flow velocity in the pipe will be maintained at below 3.0 m/s.

2.1.3 INSTALLATION OF PIPELINE

Installation works for the main canal will largely involve land clearing, excavations, levelling and backfilling. The main canal will predominantly consist of the following facilities offtake gates, control valve and flow meter rooms, discharge facilities, air vents, and sediment ejectors.

The pipeline was designed on the premise of ordinary ground conditions and will have foundation depth of 30 cm and width to 2.74 m. The design for the section of Mwanza River will be adjusted to prevent deflection of the pipe from heavy water flows during rainy season as such as the pipeline will be wrapped with concrete box.

Figures 2-3 and 2-4 show representative installation of pipeline for the general section and the Mwanza river section (No. 99-104), respectively. The installation design as shown in Figure 2-3 will be used where the canal crosses roads.

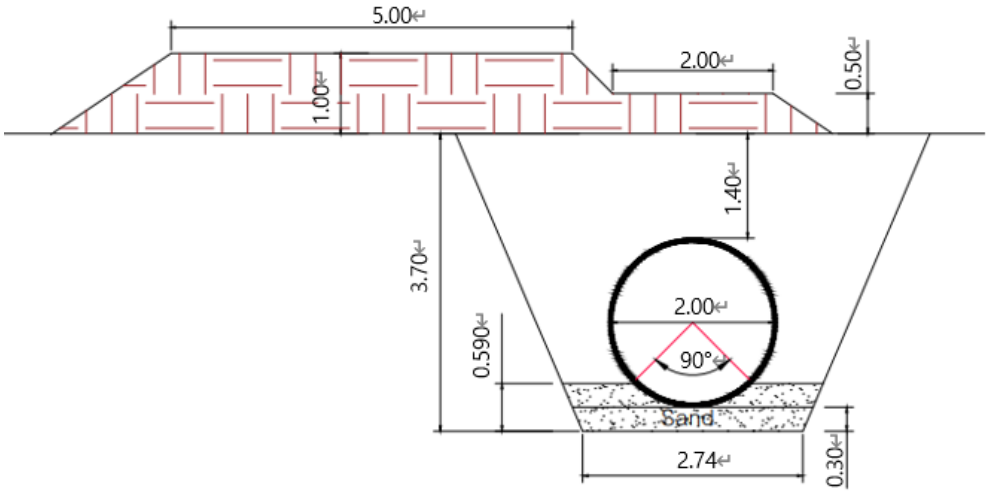


Figure 2-3: General schematic view of pipeline installation

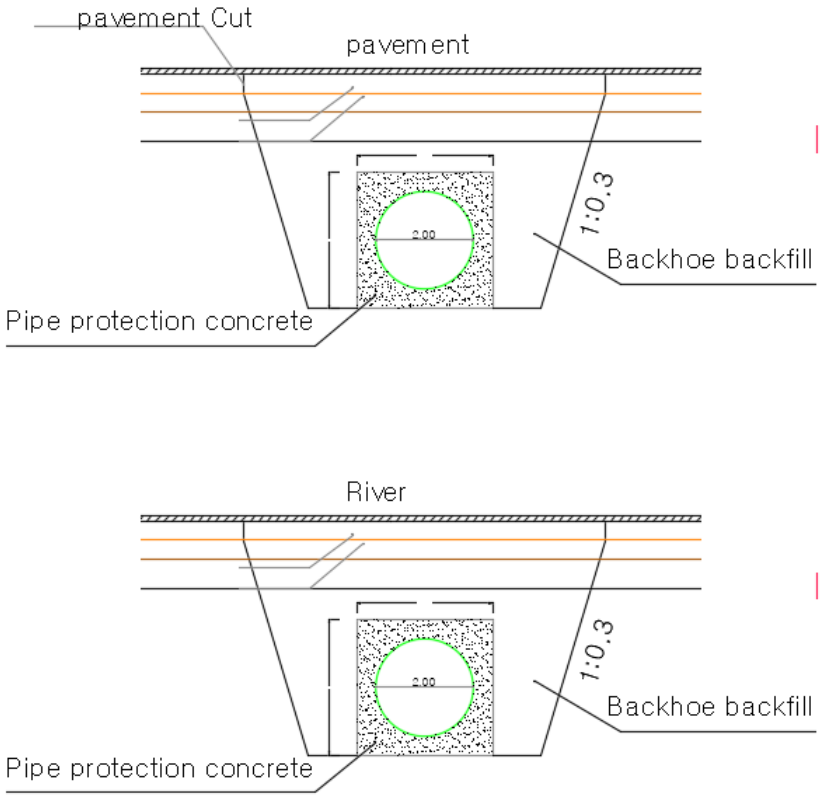


Figure 2-4: Pipeline installation along Mwanza River section

An Offtake gate will be installed at the entry gate of MC-3, which controls the entire flow from MC-1, an open canal, to MC-3, a pipeline canal. The actual amount of water supply will be controlled through control valves of 5 Secondary canals (SCs) branching from MC-3 and control valves installed at the end points of MC-3. The MC-3 branched off from MC-1 will pass through the offtake gate and the common basin section, and is connected to the pipeline.

The control valve and flow meter rooms are installed at the beginning of the pipeline, and the flow rate supplied to the entire MC-3 is controlled from here. The control valve and flow meter rooms are built on the ground, making it easy to carry in and install devices. The control valve and flow meter rooms are divided into separate rooms, and a second floor is prepared in the empty space between the two rooms to be used as an office and SCADA facility space.

Solar panels will be installed on the roof for power generation. In the operation of the SVTP pipeline irrigation system, flow meters will be installed at each SC and TC offtake point for accurate metering of the supply quantity. A total of 164 flow meters are installed on the MC-3 and SC pipelines in the Phase I area. There are various types of flowmeters, but the most used types are electromagnetic, ultrasonic and paddle wheel types. Figure 2-5 shows offtake gate for MC-3

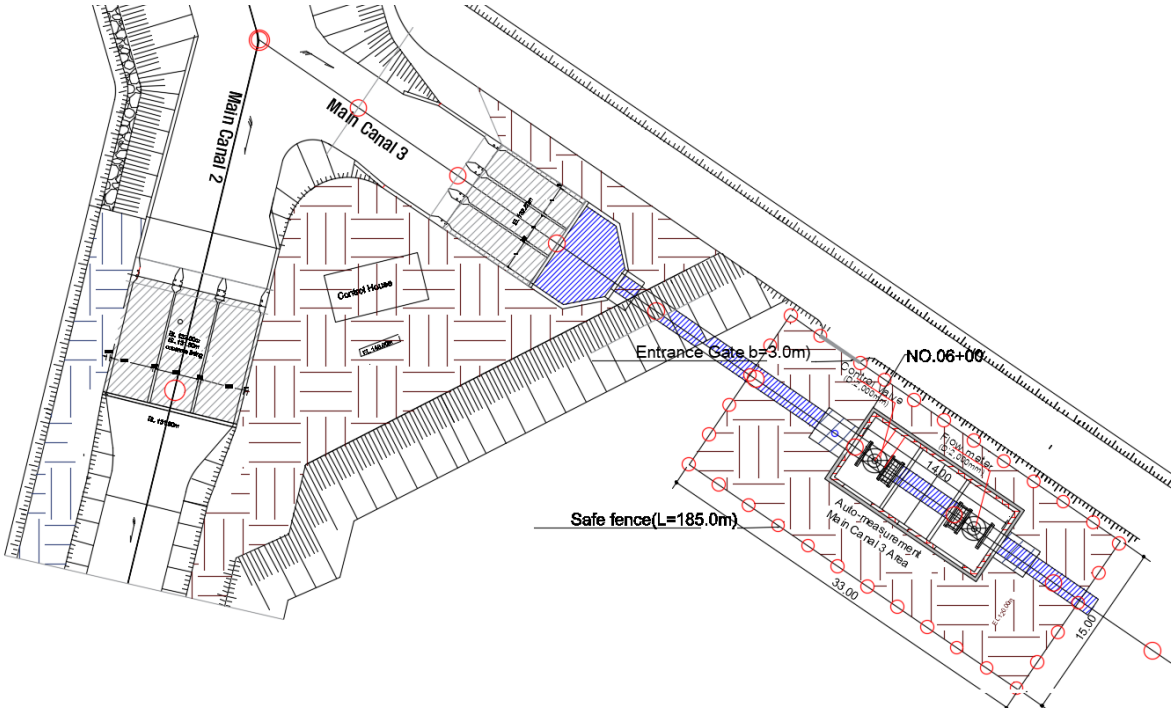


Figure 2-5: Offtake gate for Main Canal 3

The discharge part of the MC-3 Pipeline will be connected to the reservoir located at the highest point of Illovo Estate. The water level in the reservoir is always changing, but it is expected to remain high during the period of maximum required water supply. However, in consideration of a certain amount of margin, a 2 m lower elevation (EL.94.0m) was set from the embankment floor elevation (EL.96.0m), and the upper elevation of the MC-3 pipeline was set to the same height. Therefore, it was planned to be discharged into the water in the reservoir when the maximum amount of discharge occurs.

A surge protection facility is also installed in the control valve room. The flowmeter is installed at a distance of 50 m from the control valve to measure in a stable flow condition. Figure 2-6 shows the layout of Discharge Facilities.

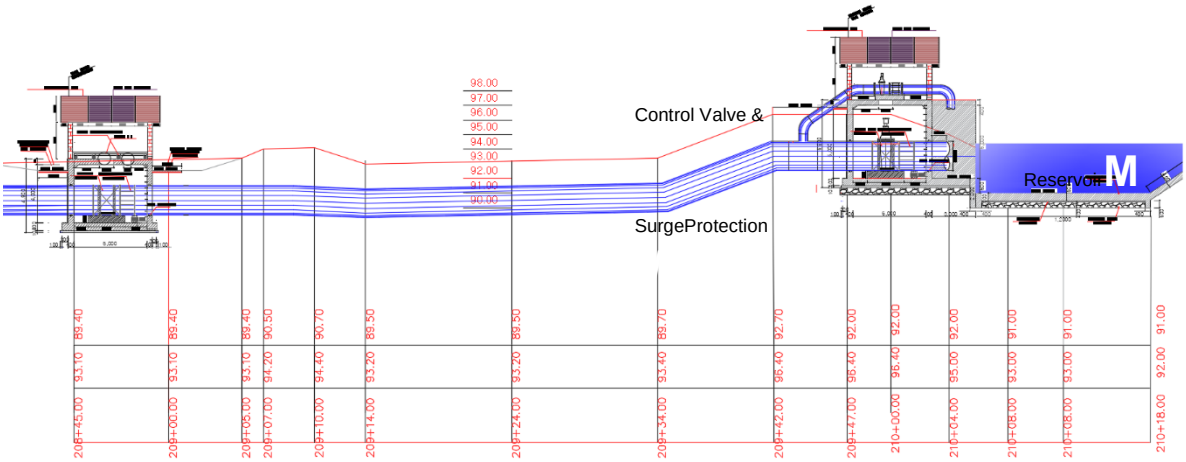


Figure 2-6: Layout of discharge facilities

When the fluid flows inside the pipe, the air generated by vortex, refraction, rotation, etc. and the air infiltrated from the inlet are gathered at a high place in the pipe to form an air pocket. These air pockets reduce the surface of the air passage, interfering with the flow of water and sometimes blocking the flow of water. Air vent is a device that removes air from the pipe by installing it at the apex of the convex point above the longitudinal line of the pipe. If an air vent of appropriate specifications is installed in consideration of the pressure in the pipe, it will eliminate the air in the large-capacity pipe within a short period of time.

The MC-3 Pipeline has a large diameter and flows by gravity, and the possibility of sediment accumulation in the pipe is very low because the minimum flow velocity in the pipe is always more than 0.6 m/s. However, in case of emergency, we planned to install sediment ejectors.

Sediment Ejectors consist of a discharge pipe, a control valve chamber and a discharge part. Install a 250 mm pipe in the direction perpendicular to the canal line under part of MC-3 pipeline and connect the control valve chamber and the discharge part. When the valve is opened, the sediment accumulated is ejected by the pressure inside the MC-3 and discharged to the outside through the discharge part. Sediment Ejectors will be installed in 5 locations on the MC-3 canal route, and Table 2 shows the locations and types of Sediment Ejectors while figure 2-7 shows sediment ejectors.

Table 2-1 Locations and Types of Sediment Ejectors Installed on the MC-3 Pipeline

Canal Name (Amount)	Station No	Design Level (EL.m)	Pipeline D (mm)	Discharge Pipe		Ejector Type
				D (mm)	Length (m)	
MC-3	No.38+0.0	106.70	2,000	250	30.0	Type-1-A
	No.85+0.0	101.70	2,000	250	30.0	Type-1-A
	No.100+0.0	94.75	2,000	250	30.0	Type-1-A
	No.141+0.0	93.14	2,000	250	30.0	Type-1-A
	No.155+35	91.30	2,000	250	30.0	Type-1-A

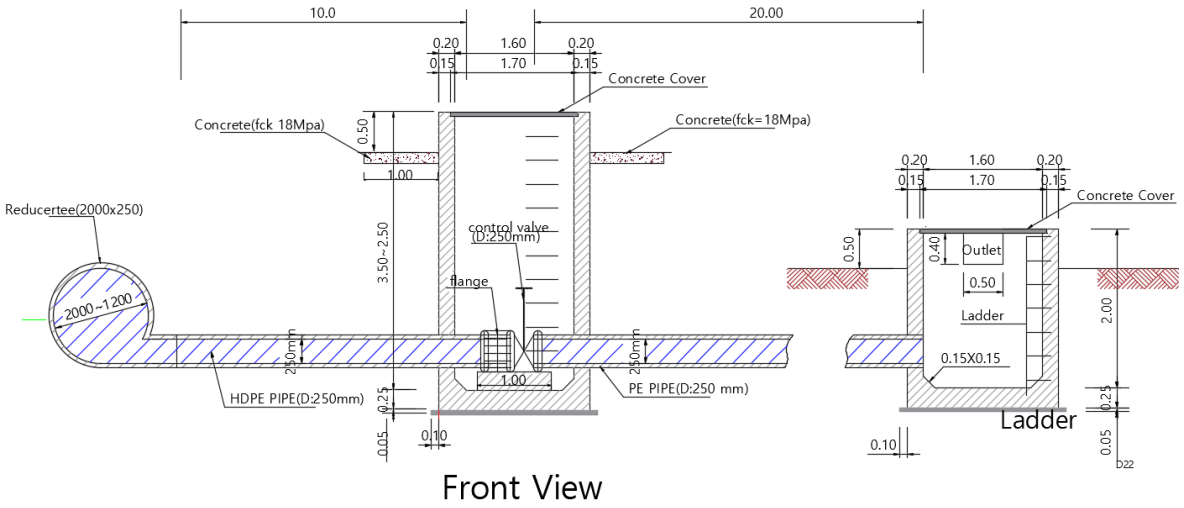


Figure 2-7: Drawing for Sediment Ejectors

2.1.4 SECONDARY CANALS FROM MAIN CANAL 3

A total of five secondary canals branch off the Main Canal 3, and Table 2-3 shows the detail information of these secondary canals.

2-2 Secondary Canals branch off the Main Canal 3

Secondary Canals	Location (Detailed Design)	Length(m)	B.P. El.(m)	E.P. El.(m)	Area(ha)	Q(m^3/s)
SC – 7	STA 14+000	1,900	123.4	102.9	435	0.48
SC – 8	STA 47+010	2,700	108.8	93.4	585	0.64
SC – 9	STA 65+010	8,000	105.9	86.8	869	0.95
SC – 10	STA 137+030	1,300	102.4	96.0	155	0.17
SC – 11	STA 186+000	2,100	96.4	94.1	198	0.22

2.1.4.1 Secondary Canal 7 (Pipeline)

The SC-7 pipeline branches off from MC-3 and supplies water to Irrigation Sector 7-1 (628 ha). Part of this area is also an area where the KAMA Farmers Association is planning to conduct pivot irrigation in the future.

The SC-7 Pipeline uses a pipe with a diameter of 558 mm in the beginning section of the pipeline, and gradually decreases the diameter of the pipe by considering the flow velocity in the pipe as it goes to the downstream area. A total of 5 different sections of pipes were applied to the entire pipeline. The flow velocity in the pipe becomes the maximum (1.95 m/s) in the beginning section where the flow rate is maximum, and the minimum (1.37 m/s) in the end section.

Design Elevation shows the head elevation of each point based on the hydraulic head of Main Canal 3 (EL.126.33 m). The head of the end point is 114.05 m and the ground elevation of this point is EL.102.90m, so there is an effective head of more than 12 m. Therefore, it is possible to supply water for a significant radius area around this point. Table 2-3 provides hydraulic calculations for secondary canal 7.

Table 2-3 Hydraulic Calculation Results of SC 7 Pipeline (Pipe Material: HDPE pipe)

Station		Length (m)	A (ha)	Q (m^3/s)	D (mm)	Coef. C	V (m/s)	Head Loss (m)	Design EL. (m)	
From	To								From	To
SC-7		**1,900**								
No.00+00	No.02+00	100	435.00	0.476	0.558	150	1.95	0.47	126.33	125.85
No.02+00	No.12+00	500	315.00	0.345	0.468	150	2.01	3.08	125.85	122.77
No.12+00	No.20+00	400	215.00	0.236	0.386	150	2.01	3.10	122.77	119.67
No.20+00	No.30+00	500	135.00	0.148	0.340	150	1.63	3.05	119.67	116.62
No.30+00	No.38+00	400	60.00	0.066	0.247	150	1.37	2.57	116.62	114.05
							Ground level of No.38+00			**102.90**
Total								**12.27**		

2.1.4.2 Secondary Canal 8 (Pipeline)

The SC-8 pipeline branches off from MC-3 and supplies water to Irrigation Sector 8-1 (585 ha). Part of this area is also an area where the KAMA Farmers Association is planning to conduct pivot irrigation in the future.

The SC-8 Pipeline uses a pipe diameter of 558 mm in the beginning section of the pipeline, and gradually decreases the diameter of the pipe in consideration of the flow velocity in the pipe as it goes to the downstream area. A total of 5 different sections of pipes were applied to the entire pipeline.

The flow velocity in the pipe becomes the maximum (2.62 m/s) in the beginning section where the flow rate is maximum, and the minimum (1.60 m/s) in the end section.

Design Elevation shows the water head elevation for each point starting from the hydraulic head of Main Canal 3 (EL.119.87 m). The head of the end point is 102.22 m and the ground elevation of this point is EL.93.40 m, so there is an effective head of more than 9 m. Therefore, it is possible to supply water for a significant radius area around this point. Table 2-4 provides hydraulic calculations for secondary canal 8.

Table 2-4 Hydraulic Calculation Results of SC 8 Pipeline (Pipe Material: HDPE pipe)

Station		Length (m)	A (ha)	Q (m^3/s)	D (mm)	Coef. C	V (m/s)	Head Loss (m)	Design EL. (m)	
From	To								From	To
SC-8		**2,700**								
No.00+00	No.04+00	200	585.00	0.641	0.558	150	2.62	1.65	119.87	118.22
No.04+00	No.14+00	500	465.00	0.509	0.511	150	2.49	4.14	118.22	114.07
No.14+00	No.24+00	500	345.00	0.378	0.468	150	2.20	3.65	114.07	110.43
No.24+00	No.34+00	500	245.00	0.268	0.468	150	1.56	1.94	110.43	108.49
No.34+00	No.44+00	500	150.00	0.164	0.386	150	1.40	1.99	108.49	106.50
No.44+00	No.54+00	500	70.00	0.077	0.247	150	1.60	4.28	106.50	102.22
							Ground level of No.54+00			**93.40**
Total								**17.65**		

2.1.4.3 Secondary Canal 9 (Pipeline)

The SC-9 Pipeline diverges from MC-3 and supplies water to Irrigation Sectors 9-1 (569 ha) and 9-2 (300 ha). Part of this area is also an area where the KAMA Farmers Association is planning to conduct pivot irrigation in the future.

The SC-9 Pipeline uses a pipe diameter of 838 mm in the beginning section of the pipeline, and gradually decreases the diameter of the pipe in consideration of the flow velocity in the pipe as it goes to the downstream area. A total of 6 different sections of pipes were applied to the entire pipeline.

The flow velocity in the pipe becomes the maximum (1.72 m/s) in the beginning section where the flow rate is maximum and the minimum (0.94 m/s) in the end section.

Design Elevation shows the head elevation of each point based on the hydraulic head of Main Canal 3 (EL.117.07m). The head of the end point is 97.47 m and the ground elevation of this point is EL.86.76 m, so there is an effective head of 11 m or more. Therefore, it is possible to supply water for a significant radius area around this point. Table 2-5 provides hydraulic calculations for secondary canal 9.

Table 2-5 Hydraulic Calculation Results of SC 9 Pipeline (Pipe Material: HDPE pipe)

Station		Length (m)	A (ha)	Q (m^3/s)	D (mm)	Coef. C	V (m/s)	Head Loss (m)	Design EL. (m)	
From	To								From	To
SC-9		**8,000**								
No.00+00	No.02+00	100	869.00	0.952	0.838	150	1.72	0.24	117.07	116.84
No.02+00	No.30+00	1,400	819.00	0.897	0.838	150	1.62	2.96	116.84	113.88
No.30+00	No.54+00	1,200	739.00	0.809	0.745	150	1.86	3.73	113.88	110.14
No.54+00	No.79+00	1,250	619.00	0.678	0.745	150	1.56	2.80	110.14	107.35
No.79+00	No.117+00	1,900	469.00	0.514	0.651	150	1.54	4.90	107.35	102.45
No.117+00	No.129+00	600	300.00	0.329	0.558	150	1.35	1.44	102.45	101.01
No.129+00	No.145+00	800	200.00	0.219	0.468	150	1.27	2.12	101.01	98.88
No.145+00	No.160+00	750	100.00	0.110	0.386	150	0.94	1.41	98.88	97.47
							Ground level of No.160+00			**86.76**
Total								**19.60**		

2.1.4.5 Secondary Canal 10 (Pipeline)

The SC-10 Pipeline branches off from MC-3 and supplies water to Irrigation Sector 10-1 (155ha). The SC-10 Pipeline uses a pipe diameter of 386 mm in the beginning section of the pipeline, and gradually decreases the diameter of the pipe in consideration of the flow velocity in the pipe as it goes to the downstream area. A total of 3 different sections of pipes were applied to the entire pipeline.

The flow velocity in the pipe becomes the maximum (1.45 m/s) in the beginning section where the flow rate is maximum, and the minimum (0.82 m/s) in the end section.

Design Elevation shows the water head elevation for each point starting from the hydraulic head of Main Canal 3 (EL.105.57 m). The head of the end point is 101.36 m and the ground elevation of this point is EL.96.90 m, so there is an effective head of more than 5 m. Therefore, it is possible to supply water for a significant radius area around this point. Table 2-6 provides hydraulic calculations for secondary canal 10.

Table 2-6 Hydraulic Calculation Results of SC 10 Pipeline (Pipe Material: HDPE pipe)

Station		Length (m)	A (ha)	Q (m^3/s)	D (mm)	Coef. C	V (m/s)	Head Loss (m)	Design EL. (m)	
From	To								From	To
SC-10		**1,300**								
No.00+00	No.09+00	450	155.00	0.170	0.386	150	1.45	1.90	105.57	103.67
No.09+00	No.17+00	400	100.00	0.110	0.340	150	1.21	1.40	103.67	102.27
No.17+00	No.26+00	450	50.00	0.055	0.292	150	0.82	0.91	102.27	101.36
							Ground level of No.26+00			**96.90**
Total								**4.21**		

2.1.4.6 Secondary Canal 11 (Pipeline)

The SC-11 Pipeline diverges from MC-3 and supplies water to Irrigation Sectors 11-1 (140 ha) and 11-2 (58 ha). The SC-11 Pipeline uses a pipe diameter of 468 mm in the beginning section of the pipeline, and gradually decreases the diameter of the pipe considering the flow velocity in the pipe as it goes to the downstream area. A total of 3 different sections of pipes were applied to the entire pipeline.

The flow velocity in the pipe becomes the maximum (1.26 m/s) in the beginning section where the flow rate is maximum and the minimum (0.42 m/s) in the end section.

Design Elevation shows the head elevation of each point based on the hydraulic head of Main Canal 3 (EL.100.02 m). The head of the end point is 97.48m and the ground elevation of this point is EL.94.07 m, so there is an effective head of more than 3 m. Therefore, it is possible to supply water for a significant radius area around this point. Table 2-7 provides hydraulic calculations for secondary canal 11.

Table 2-7 Hydraulic Calculation Results of SC 11 Pipeline (Pipe Material: HDPE pipe)

Station		Length (m)	A (ha)	Q (m^3/s)	D (mm)	Coef. C	V (m/s)	Head Loss (m)	Design EL. (m)	
From	To								From	To
SC-11		**2,100**								
No.00+00	No.04+00	200	198.00	0.217	0.468	150	1.26	0.53	100.02	99.49
No.04+00	No.22+00	900	120.00	0.131	0.419	150	0.95	1.58	99.49	97.91
No.22+00	No.42+00	1,000	45.00	0.049	0.386	150	0.42	0.43	97.91	97.48
							Ground level of No.42+00			**94.07**
Total								**2.54**		

2.1.5 FLOOD PROTECTION STRUCTURES

In Preliminary Design, the installation of embankments for flood protection was planned for the 10-year frequency flood. (See Figure 2-8) Embankments were planned at a total of 9 points, and the total length was estimated to be 31.2 km.

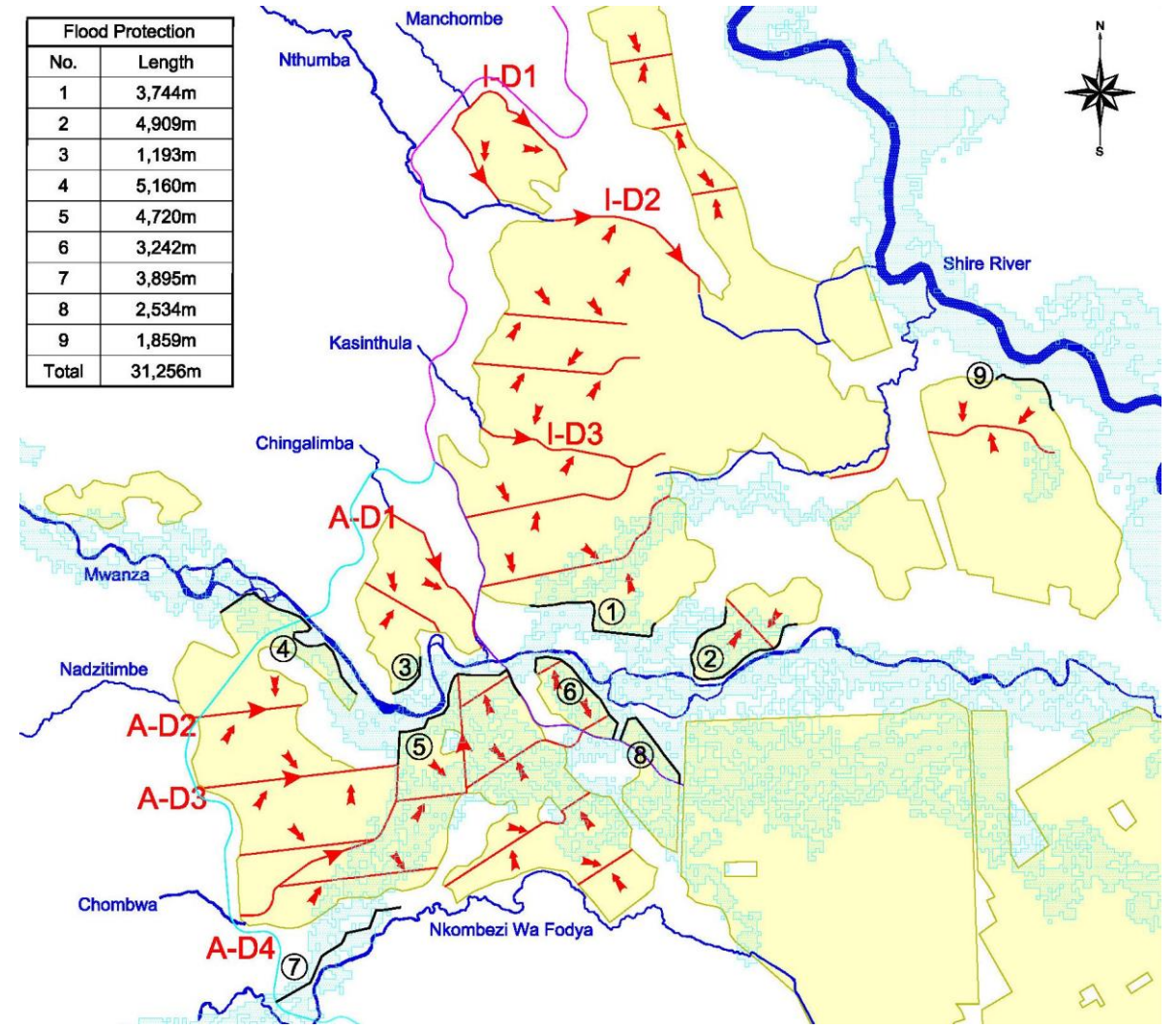


Figure 2-8 Flood Protection Plan for 10 Year Frequency (Preliminary Design)

2.1.6 EMPLOYMENT OF CONSTRUCTION WORKERS

Personnel on the project sites will include but not limited to the Project Manager, site agent (s), site foreman, site surveyor, mechanics, plant operators, drivers, brick layers, steel fixers, carpenters, general workers, site clerk, stores keeper and watchmen. Both men and women will be employed and classified according to gender and age group during the project duration. Child labour is strictly prohibited in accordance with section 21 of the Malawi Employment Act (2000).

2.1.7 CONSTRUCTION EQUIPMENT AND RAW MATERIALS

During construction, there will be a number of equipment such as excavators, vibrators, tippers, trucks, and trench compactors. *Table 2-8* summarises the equipment to be used during the project implementation. The raw materials that are expected to be used on the project are cement, coarse aggregate for concrete, fine aggregate, water and reinforcement wires, and bars and HPDE.

The main construction raw materials such cement will be bought from local cement manufacturing companies to promote buy Malawi initiative. Quarry stones and sand will be bought from licensed miners. Pipes, iron sheets, wires, reinforcement bars and other auxiliary construction materials will

be sourced from local suppliers unless the materials are not available in Malawi. These will be transported by trucks and tippers to the project sites. It is expected that transportation of construction materials will be done during off-peak hours to avoid unnecessary traffic congestion in the main streets.

Table 2-8: Summary of Equipment and Materials that will be used in the Project.

Key project stage or output	Main machines	Materials
Site preparation	● Excavators ● Backhoe Loader	Water, Timber and Iron Sheets
Construction of access road	● Grader ● Rollers/Compactors ● Tippers	Cement, cement blocks, sand, aggregate, reinforcement bars and water
Installation of HPDE pipes	● Backhoe Loader Rollers/Compactors ● Trucks ● Conveyor	HPDE pipes, aggregate, reinforcement bars and water
Finishing and fittings	● Chisels, hammers, cutters	Water pipes and fittings
Construction of parking lots	● Cement mortars ● Rollers/Compactors ● Tippers ● Mixers	Cement, quarry stones, bricks, sand, aggregate, reinforcement bars and water
Installation of sewer lines, water lines, telecommunication and electricity	● Drills	Pipes, wire and accessories

2.1.7 DEMOBILISATION PHASE

Demobilisation phase comes after completion of all construction works. During this phase, site activities shall constitute removal of all temporally structures such as site safety fence, site toilets, machinery, site work office, fuel storage tanks, standby generators, materials stockpiles and cancellation of any outstanding work permits.

The construction site will be cleared, and all areas affected by the construction works such as burrow pits, site clearing stockpiles, will be rehabilitated during this phase. It should be noted that depending on methods of removal or rehabilitation of the site temporary structures, negative impacts may arise at this stage.

2.2 ANALYSIS OF PROJECT ALTERNATIVES

2.2.1 DIFFERENT TECHNOLOGY OPTIONS

2.2.1.1 Comparison between the Pipeline System and the Lining Canal System

In the FS stage, the entire irrigation system was premised on applying the lining canal system. The reason is that the pipeline system is more expensive than the lining canal system.

However, when considering economizing water use and convenience of operation and management, the pipeline system has many advantages compared to the lining canal system. In addition, in terms of construction cost, the pipe material cost, which accounts for most of the construction cost of the pipeline system, is gradually decreasing, so the pipeline system is becoming an advantageous situation.

Therefore, in this detailed design stage, more realistic construction costs were estimated for the lining canal system and the pipeline system, and the advantages and disadvantages of the operation management aspect were compared. Table 2-9 provides a comparison of pipeline system versus lining canal.

[Table 2-9 Comparison between the Pipeline System and the Lining Canal System

Considerations	Pipeline System	Lining Canal System
Canal length	Water is delivered by pressure, so it is possible to install a pipeline even if there are slight topographical undulations. Therefore, the pipeline length is shorter than the lining canal by about 20%.	The canal route is established along the contour line, so the canal length is generally longer than the pipeline canal.
Longitudinal canal structures	Longitudinal structures such as drop structure, siphon, bridge, etc. are not needed. In this process, the canal length becomes shorter than the Lining canal.	Longitudinal structures such as drop structure, siphon, bridge, etc. are required. (In the case of MC3, several stages of drop structures or a long chute structure are required in the steep slope at the beginning of the canal, and a 1.2km long siphon is required to cross the Mwanza river.)
Canal section	The high-water head is an advantageous condition to increase the flow velocity in the pipe, so the canal section becomes smaller than the lining canal.	Lining canal does not allow flow velocity of 2.0m/s or more, so the canal section is enlarged.
Irrigation time	Irrigation can be performed continuously for 24 hours.	In most cases, irrigation is performed for 12 hours.
Night storage	As continuous irrigation is possible for 24 hours, night storage is unnecessary.	Since irrigation is possible only during the daytime, night storage is required.
Canal capacity	The canal capacity required to deliver the design flow is adequate.	Canal capacity is required to deliver water twice of the design flow.

Water conveyance loss	There is very little loss.	There is a loss of about 5-10%.
Cross drainage structures	Since it is buried in the ground, there is little need to install a cross drainage structure.	In some cases, cross drainage structures must be installed in several places.
Water conveyance time	Short time is required to take water.	It depends on the distance from the night storage.
Life Time	30-40 years (Aging progresses slowly.)	20-30 years (Aging progresses rapidly.)
Accessibility to water	No inequality by location	Inequality by location.
Automation	Both of Tele-metering and Tele-controlling is easier.	Tele-controlling is more difficult.
Water consumption measurement	More accurate, easier, and cheaper.	Less accurate, more difficult and more expensive.
Land occupancy	Less land area is required for pipeline installation.	Large area is required
Construction cost	Comparing the cost for the same canal route, the construction cost of the pipeline is 10-20% higher than that of the lining canal. However, the pipeline route is about 20% shorter than the lining canal, so the actual construction cost is similar to that of the lining canal	
O&M cost (year)	Less than 1% of construction cost.	2-3% of construction cost.

As a result of the comparison, the construction cost can be 10-20% higher for the pipeline system for the same canal route as the Lining canal system. However, since the pipeline has a shorter can al length, the overall construction cost may be similar or smaller than the lining canal. In addition to this, pipeline system has a comparative advantage in almost all aspects.

Based on the results of this comparison, it was decided to apply the pipeline system for the Main Canal 3 and Secondary canals.

2.2.2 TYPES OF PIPE MATERIAL

2.2.2.1 Selection of Pipe Materials

We compared the Pros and Cons of various types of pipes in order to select the proper type of pip e for the Conveyance Pipeline and Pipeline A and B. Table 4.3-1 compares the strengths and wea knesses of the four pipe types.

As described in Table 4.3-1, HDPE pipe and steel pipe have more advantages than other pipe mat erials in workability and durability. When the diameter of the pipe is small, the HDPE pipe is eas y to install and has a low price. However, when the pipe diameter is large, the thickness increases , resulting in a very heavy weight, a large price increase, and the connection and installation shall be challengeable. On the other hand, in the case of steel pipe, the connection and installation wor

k shall be relatively easy compared to HDPE pipe.

Considering this point, in this design, steel pipes are used for pipes with a diameter of 1,000-2,30 0 mm, and HDPE pipes are used for pipes with a diameter of less than 1,000 mm. Table 2-10 is a comparison of different types of pipes that can be used for main canal.

[Table 2.2-1] Pros and Cons for the Types of Pipe

Types of Pipe	Pros	Cons	Availability In Malawi
HDPE Pipe	- Easy to install for small size pipe - Low construction cost - Excellent chemical resistance and corrosion resistance - Strong to impact - Good pliancy to adapt to topography - Friction coefficient is very small	- Heavy weight for large size pipe - Expensive for large size pipe - Somewhat weak in external pressure strength - Vulnerable to buoyancy	- Small size pipes are available, but large size pipes should be imported.
Steel Pipe	- Risk of defect is low (at the joints) - Low construction cost - Strong to impact	- Heavy weight - Vulnerable to corrosion - Pipe price is expensive - Difficult to construct bends and branches.	- Small size pipes are available, but large size pipes should be imported.
PVC Pipe	- Strong against external pressure strength than PE pipe - There are many ways to connect. - Strong in acid, alkali and sea water - Strong in heat than PE pipe	- Easy to break by external impact - Difficult to bend the curved part - Vulnerable to buoyancy - More expensive than PE pipes for large size pipe	- Small size pipes are available, but large size pipes should be imported.
GRP Pipe	- Pipe price is the cheaper than other materials - Excellent physical properties and chemical resistance - Strong against acid, alkali corrosive - Friction coefficient is very small	- Easy to break by external impact - Difficult to bend the curved part	- Small size pipes are available, but large size pipes should be imported.

2.2.3 EXCAVATION METHODS

Compact excavators are popular, affordable and highly productive machines during construction. They can speed up the work and work reliably. They can do a lot of things especially when outfitted with attachments. They can be used for multi-tasking on the jobsite for different tasks such as

setting utilities, using a hammer for excavation or demolition works or a grapple for materials handling, or doing pit work. Versatility of these machines constitute a positive impact to the environment because number of machines on the job site can effectively be reduced without necessarily affecting the Work schedules.

Manual labour can be used where the delivery is aimed at optimising creating an enabling environment for employment opportunities through labour-intensive construction/excavation works. Manual excavation methods are generally used for small, shallow excavations (e.g. less than 1.5 metres deep) in soft soils. A person undertaking the manual work must manage the risks associated with hazardous manual tasks.

When working in proximity, workers should be kept sufficiently far apart to prevent injury from the use of picks or other hand tools. This applies particularly to work in trenches and small excavations for instance. Preparatory drilling activity and the use of hand drills may increase the risk of musculoskeletal disorders, including disorders associated with exposure to vibration.

Despite the risks and slow speeds associated with manual work, it tends to be a better choice when it comes to accessibility of areas with limited space. An average sized excavator will destabilize a big portion of land on a job site while manual labour is restricted to the designated or areas of interest only.

2.2.4 CONSTRUCTION MATERIALS

2.2.4.1 Burnt Bricks

Clay bricks are locally moulded using outdated technology and cured by means of firewood. This type of brick is rapidly becoming unpopular worldwide due to the technology involved in its mode of production.

Advantages

- Clay bricks are good insulators as wall materials, make walls heavy, dense and conduct heat slowly.
- The bricks do not warp, rust, split, peel or fade
- low maintenance and durability make the materials a cost-effective option for the exterior of a building
- The bricks do not burn and they reduce the possibility of catching fire when they are used

Disadvantages

- Use of burnt bricks in construction industry will lead to large scale deforestation that will result in loss of fertile topsoil. This could be a devastating environmental hazard.
- Clay bricks are manufactured using outdated technology and are inferior in quality with low compressive stress.

2.2.4.2 Cement Blocks

The detailed designs for this project have specified use of cement blocks as option materials due to quality and environmental concerns presented by burnt clay bricks.

Advantages

- Cement blocks are eco-friendly because they cure naturally, no need for firewood
- They provide better insulation properties for the building
- Cement block building is practically soundproof, which is great for trying to minimize noise pollution from outside or inside the building.

Disadvantages

- Cement block buildings/blocks tend to be a little bit more expensive to build than other buildings although they pay off in energy costs in the long run
- The price of cement fluctuates and will also vary depending on the region, so there isn't a set price for cement blocks
- Cement block buildings are also often plain and grey unless there are plans to add facing to the walls or add on a layer of cement that can be painted.

2.2.4.3 RECOMMENDATIONS ON ALTERNATIVE CONSTRUCTION METHODS, PROJECT SITES, ROUTES AND PROCESSES

In view of the above analysis, it is recommended to use both manual excavation methods and compact excavators during the construction phase of the project. Manual excavation is ideal in confined spaces while use of excavators will speed up the works and provide versatility in materials handling, demolition works and pit digging.

It is anticipated that use of cement blocks in all construction works will be maintained as they are eco-friendly; and they also aid in reduction of both internal and external noise pollution.

2.3.1 OPTIMISATION OF CONSTRUCTION METHODS

Construction of superstructures will be done in stages to avoid disturbing the entire construction site at once. This approach will allow the contractor to implement erosion control measures during construction and minimise incidents and hazards during construction works. This approach will also allow the contractor to effect proper management of the excavated materials and generated site waste.

2.3.2 POLLUTION CONTROL AND SAFETY MEASURES

The following standard measures have been considered for the construction works during planning to minimize occupational health and safety risks:

- The work will be carried out in well-ventilated areas or forced ventilation will be provided.
- Prolonged and repeated breathing of vapour fumes should be avoided. Where necessary chemical or dust respirators will be provided to staff
- Precautions will be taken to avoid contact with eyes or skin or clothing of workers.
- Appropriate PPE will be provided to staff.

CHAPTER THREE: ENVIRONMENTAL AND SOCIOECONOMIC SETTING OF THE PROJECT AREA

This chapter outlines the physical, biological and socio-economic environment of project area largely adapted from the main ESIA report. An understanding of the project area will assist in identifying the impacts that may emanate from the construction main canal, secondary canal and flood protection str.

3.1 BIOPHYSICAL ENVIRONMENT

3.1.1 TOPOGRAPHY

To the West, in Lengwe National Park, the topography is flatter with spares hills (Thambani Hills, the Salambidwe Hill, the Marangwe Range and the Matundwe Range) that climb up to 300 masl. This area marks the limit of the watershed between the Zambezi River (to the West, in Mozambique) and the Shire River (to the East).

3.1.2 CLIMATE

The climatic conditions of the project site are predominantly hot and dry with a slight change to cool and dry during winter because of the location close to escarpment. The project site experiences two annual seasons namely: the dry season from May to October and the rainy season from November to April. The average rainfall range is 750 to 820mm and there is a steady increase in rainfall with increasing topographical gradient from Shire River to the Western Hills where the average annual rainfall reaches 1,317mm. As shown in Table 3.1, the highest mean maximum temperatures of 35.8ºC are experienced in November. The lowest average annual temperatures occur during the months of June and July which are estimated at 14.3ºC.

3.1.3 GEOLOGY

The Lower Shire Valley forms a part of the Great African Rift Valley and is bounded by escarpments associated with major faults, which run in South West – North West direction. The escarpments are distinct in Northern and Eastern directions, but not to the West. Because of relatively flat slopes, the Lower Shire Valley (at 50-200 masl) is predominantly a depositional environment and filled with an estimated 50-150m thick sequence of Quaternary unconsolidated sediments. Groundwater is mostly found at 3-15m depth, with slight to moderate salinity.

3.1.4 SOILS

The soils in the Lower Shire Valley show a strong relationship with the geology of the area and the dominant sedimentary processes. The two major soils in the lower part of the Lower Shire Valley are Alluvial Soils and Vertisols (with grey), being subdivisions of Calcimorphic and Hydromorphic Soils. A different Soil Map of Malawi, however with similar legend approach (based on Young/Brown) was drawn by N.W. Lowole, showing dominant Vertisols around Ngabu, and also further upslope Vertisols associated with coarser gravelly soils.

3.1.5 FLORA

This area is dominated by savannah woodlands (savannah mixed species), typical vegetation of the Lower Shire Valley where one or more species of *Brachystegia* are found. The area also

contains *Combretum, neem* and *Acacia* species. Perennial wet grasslands are also present in the Elephant Marsh and the major components include *Typha australis*, *Vossia cuspidate (*Hippo Grass*), Pennisetum purpurea*, *Cyperus papyrus* and *Echnochloa pyramidalis*. The areas under Lengwe and Majete Parks and other surrounding hilly areas are composed of thickets without trees. The last large remaining thicket forest is located in Old Lengwe which has to be considered a highly important habitat.

Lowland tree savanna is the habitat type that will be crossed by the Bangula canal. Acacia and Combretum dominate this habitat in thicket communities in the Northern part of Old Lengwe. Thickets are made of dense tall shrubs or small trees between 3 and 8 meters high. In some area, the shrub Small-leaved bloodwood (*Pterocarpus antunesii*) dominates the landscape. Small patches of deciduous forest also occur in Old Lengwe. There is no wetland in the Park; however, riparian woodlands dominated by the very tall tree *Sterculia appendiculata* are present along the Nkombedzi Wa Fodya River.

In the Southern part of old Lengwe open wooded grassland with spares trees replace the forest/thickets communities. Around the Namitala River, riverine thicket dominates again. Namitala River area is rather dominated by *Cola clavata*. Thicket communities as found in the North-Western part of Lengwe are highly valuable habitats for many species not only mammals (such as the Nyala) but also birds which thrive in their closed canopy

3.1.6 FAUNA

The most common bird species observed in Elephant marsh are the Kingfishers (*Alcedo Atthis* and *A. cristata*), the African Fish Eagle (*Haliaeetus vocifer*), Cormorant (*Phalacrocorax lucidus*), Cattle Egret (*Bubulcus ibis*), Purple Heron (*Ardea purpurea*), African Openbill (*Anastomus lamelligerus*) and the Coucal (*Centropus sp*.).

Crocodiles are common in the marsh during the rainy season, sandbanks of the marsh are used as nests by female crocodiles. Hippopotamus are said to be common in the marsh but the population is declining due to past animal conflicts. The Elephant Marsh is also an attractive habitat for herpetofauna (reptiles and amphibians) and wetland-dependent insects such as dragonflies and or butterflies.

In general, the proposed project area is comprised of the following animals; Warthog, Nyala, Bushbuck, Kudu, Buffalo, Suni, Impala, Black rhino, Buffalo, Bushbuck, Bushpig, Crocodile, Duiker, Eland, Elephant, Grysbok, Hippopotamus, Impala, Klipspringer, Kudu, Nchima monkey, Leopard, Lichtenstein hartebeest, Lion (5), Nyala, Porcupine, Reedbuck, Sable, Waterbuck and Zebra (Majete aerial census results, 2015). Common fish found in the Shire include *Clarias gariepinus* (Mlamba), *Clarias ngamensis* and *Oreochromis mossambicus*.

3.1.7 SOCIOECONOMIC ENVIRONMENT

3.2.1 POPULATION AND HOUSEHOLD CHARACTERISTICS

With regard to demography, according to Population Census carried out in 2018, the population of Chikwawa District is estimated at 564,684 consisting of 287,794 females and 276,890 males. Much of the population is said to reside in the area of TA Ngabu. It is estimated that the population growth rate for Chikwawa District is 2.7 percent per annum which is lower than that of Malawi. By 2015, the density of population of the district was calculated at 93 persons per square kilometre and females comprise 52 percent of the population while males take up the remaining 48 percent.

3.2.2 LAND TENURE

The land in the project falls into public, private and customary land categories. Most of the land is under customary being managed by traditional leaders. The households indicated that they inherited their land from their ancestors and their land is not leased. Illovo own a large portion of farmland in the area.

3.2.3 AGRICULTURE

The type of agriculture widely practiced in the project area is subsistence farming. Wetlands and riverbanks are used for winter farming because they provide moist land and fertile soils. Common types of crops grown in the project area include Zea mays (Maize), Phaseolus vulgaris (Beans), and vegetables like Brassica species (Cabbage), Brassica napus (Rape), Allium cepa (Onion) and Lycopersican esculentum (Tomato). Livestock farming is also a key economic activity in the proposed project areas especially rearing of cattle, goats, pigs and poultry. Patches of mixed low altitude savanna and severely degraded grassland are used for grazing of mainly cattle, goats, sheep and pigs. The area carries one of the highest livestock populations in Malawi. With the exceptions of few ranches, livestock are kept on communal land under free range conditions. There is little productive relationship between livestock production and crop production. Occasionally crop residues and stubble are used for feeding livestock. Animal manure is rarely used to improve soil fertility for crop production.

3.2.4 HEALTH SERVICES

Communities within the project area access health services either at Chikwawa District Hospital and Nchalo Health Centre. Malaria is a significant problem and the leading cause of deaths in the project area. The results of the COWI survey (2016) also revealed that diarrhoea is the second common disease in the area. The disease is most common during the rainy season when water sources are contaminated. This is attributed to poor sanitation and hygiene practices. In Chikwawa district, the estimated entomological inoculation rate for Plasmodium falciparum is of 172 infective bites per human/year which is a high transmission rate (Boudowa et al., 2015). Surveys carried out in primary schools show a rate of 40% to 60% of the pupils infected by Plasmodium falciparum (asymptomatic carriers) (Mathanga et al., 2012). At the same time, 20% of pregnant women are also asymptomatic carriers.

CHAPTER FOUR: RELEVANT POLICIES, LEGAL AND ADMINISTRATIVE FRAMEWORK

4.1 RELEVANT POLICIES

4.1.1 NATIONAL ENVIRONMENTAL POLICY 2004

National Environmental Policy of 2004 aims at narrowing the gap between the degradation of the environment and depletion of the natural resources on one hand and development on the other. The policy promotes sustainable social and economic development through sound management of the environment and natural resources. The policy seeks among other things, to secure for all people and future generations an environment suitable for their health and well-being. This ESMP has been prepared to ensure that implementation of civil works will be done in a sustainable manner.

4.1.2 NATIONAL WATER POLICY 2005

This policy provides an enabling framework for integrated management and utilization of water resources in order to provide water of acceptable quality and enough quantities in Malawi. The policy also intends to ensure availability of efficient and effective water and sanitation services that satisfy the basic requirements of every Malawian, and for the enhancement of the country's natural ecosystem. Realising the challenges, threats and opportunities associated with implementation of activities in the irrigation sector similar to the proposed project, the GoM through the Ministry of Agriculture established the policy tailored at tackling any issues in the sector in an integrated manner, through involvement of all concerned stakeholders, including communities.

In general, the policy advocates for protection of water resources from unsustainable utilization, which may result in its depletion and degradation through pollution. SVTP will ensure that water from Shire River is not depleted or degraded because of the water abstraction by implementing mitigation measures and recommendation that are provided in this ESMP.

4.1.3 NATIONAL LAND POLICY 2002

The project will cause loss of land and property; damage to road pavements; damage to concrete driveway; damage to different building structures; obstruction to passage on the roads; and disruption of public service utilities. The land belongs to different individuals and institutions, which they are currently using for different livelihood activities. The policy guides land management and administration in Malawi. It introduces major reforms intended for land planning, use, management and tenure and provides clear definition of land ownership categories (Section 4); addressing issues of compensation payment for land (Section 4.6). The policy has provisions for environmental management, urban management of solid and liquid wastes, protection of sensitive areas, agricultural resource conservation and land use, community forests and woodland management. The National Land Policy has a few sections which briefly refers to matters relating to land acquisition. It alludes to necessity of having provisions in the land law that would give the Government the opportunity to acquire any piece of land required for public services following guidelines such as:

- Clearly spelling out or specifying the purposes for which Government may require the land to prevent possible abuse of the power of eminent domain;
- Payment of compensation in the event of the repossession of a leasehold interest on Government land, to be limited to the negotiated value of improvements made by the leaseholder; and
- No compensation to be paid for the land, when the private user rights granted as a result of the lease are terminated.

The Land Policy recognizes Government's duty to protect the free enjoyment of legally acquired property rights on land and a landholder's entitlement to fair and adequate compensation where the Government acquires property for public use. It further stipulates that compensation valuation for customary land, at the time of acquisition by the Government, be based on the open market value of the land and all improvements carried out on the land. The Policy notes that the inadequacy of compensation is always a direct result of excluding certain items or qualities from the factors considered when determining the value; and delays in payment of compensation. While this remains a policy document only and therefore not as binding as the legislation, it is significant in that it reflects the approach of the state to land management. Besides, given that this policy is later in time to the Constitution, it is arguable that the policy considers constitutional dictates unlike the previous pieces of legislation. Project management therefore need to have regard to the policy direction. The proposed project will require land for installation of the canals and associated facilities and will cause temporary disturbance of peoples' business and loss of land for different socio-economic activities. Thus, issues of compensation will arise.

4.1.4 NATIONAL GENDER POLICY 2008

The National Gender Policy provides guidelines for mainstreaming gender issues in various sectors of the economy to reduce gender inequalities. It is meant to enhance participation of women, men and the youth for sustainable and equitable development, as well as poverty eradication in the country.

SVTP should ensure that equal employment opportunities to men and women in line with the provisions of this policy and its application has also to extend to both Contractors and subcontractors. Employment of ladies who are 18 years and older shall contribute to women economic empowerment in the project areas.

4.1.5 NATIONAL HIV AND AIDS POLICY 2005

The National HIV and AIDS policy highlights that HIV and AIDS impact on the country is quite significant and affects a range of socio-economic activities be it in agriculture, fisheries, public sector, private sector and tourism in urban and rural areas among others. HIV and AIDS prevalence in the country varies from one region to the other and from rural to urban areas.

National HIV and AIDS Policy identifies migrant workers and women among highly vulnerable people to transmission of HIV and AIDS and other sexually transmitted diseases. The implication of this provision is that some single male migrant workers would be at an increased likelihood of contracting HIV and AIDS by indulging in extra marital affairs. This may be aggravated by the increased disposal of income of the migrant workers

FEPs will employ people from within the project areas to reduce the number of migrant workers in the area. They will also implement the following mitigation measures in order to minimise the risk:

- HIV and AIDS sensitization meetings for construction workers, community members and students before commencement of the project; and
- Distribution of HIV and AIDS Information, Education and Communication (IEC) materials.

4.1.6 NATIONAL DISASTER RISK MANAGEMENT (NDRM) POLICY (2015)

The overall goal of the NDRM Policy is to sustainably reduce disaster losses in lives and in the social, economic and environmental assets of communities and of the nation. The policy is aimed at creating and providing enabling framework for the establishment of a comprehensive disaster risk management system in Malawi. The priority areas the policy focuses on include mainstreaming of disaster risk management into sustainable development, establishment of comprehensive system for disaster risk identification, assessment and monitoring, development and strengthening of a people centred early warning system, promotion of a culture of safety, adoption of resilience enhancing interventions and the reduction of underlying risks. The strategies to implement the policy cut across several sectors including infrastructure development, agricultural diversification, microfinance initiatives, disaster risk insurance, social support schemes, reforestation and river training. This policy is very relevant to the proposed works at the canals and associated facilities could exacerbate flooding in the project area.

4.1.7 THE NATIONAL IRRIGATION DEVELOPMENT POLICY AND STRATEGY (2011)

This is the main guiding policy in the irrigation sector and it seeks to increase area under sustainable irrigation, extend cropping opportunities, facilitate crop diversification, create an enabling environment for irrigated agriculture, enhance capacity for irrigated agriculture and promote a business culture in the small-scale irrigated agriculture sector. It is aligned to the MGDS and realizes the importance of complying with environmental standards set in the National Environmental Policy. Most of its nine policy statements on irrigation are relevant to the SVTP. However, as far as ESIA considerations are concerned, the following are directly relevant:

- Environmental consideration shall apply for all irrigation and drainage projects as provided for in the Environmental Impact Assessment (EIA) Guidelines for Irrigation and Drainage Projects (2002);
- Conservation measures for irrigation projects catchment areas shall be vigorously pursued to ensure availability of water resources;
- Promotion of small-scale smallholder irrigation schemes in all potential areas;
- The transfer of management of government-owned schemes to smallholder beneficiaries in order to improve production and environmental management and
- Facilitating the participation of private sector in construction and maintenance of the irrigation schemes and in crop marketing from the schemes.

Under one of the specific development strategies that seek to identify and develop areas with irrigation potential to facilitate utilization of irrigable land in Malawi, the policy makes some demands with regard to environmental and social management considerations as follows:

- All irrigation development shall be integrated with other natural resource management activities to protect and conserve the environment;
- Environmental analysis shall be made to ensure that unacceptable environmental impacts are avoided and that features such as high water tables, salinity and erosion are monitored;

- Projects shall be designed, implemented and managed in compliance with the EIA guidelines for irrigation and drainage projects as defined by EAD; and,
- The impact of irrigation development on health shall be closely monitored and mitigated.

ESMP has established measures that will ensure integration of irrigation and natural resources activities and that issues of salinity, soil erosion and human health are monitored and mitigated.

4.1.8 THE NATIONAL FOREST POLICY OF MALAWI (1996)

Forestry resources play a major part in supporting livelihoods, infrastructure development and energy besides providing habitat for animals and providing protection for soil and water resources for agriculture and domestic use. The ecological services provided by forests in providing protection of watersheds that supply water to irrigation schemes are very important for sustainable irrigation development in Malawi making the sector policy relevant to SVTP.

The 1996 National Forestry Policy calls for a reduction in the dependence on wood fuel as a source of energy through switching to alternative sources of fuel and adopting wood fuel-saving devices.

The policy is being revised. Realising that biomass will remain a significant source of energy for the near future; the new policy advocates the promotion of sustainable charcoal production.
The project will have minimal impact on forest, as it takes place in an agricultural area. The ESMP has recommended cutting down of trees to areas earmarked for construction of main canal.

4.2 LEGAL FRAMEWORK

4.2.1 THE CONSTITUTION OF REPUBLIC OF MALAWI 1995

Section 13 (d) of the Constitution of the Republic of Malawi provides a broad framework for sustainable environmental management at various levels in Malawi. Among other issues, it calls for prudent management of the environment and accords future generations their full rights to the environment. The Constitution provides the fundamental principles that require the State to promote the welfare and development of the people by progressively adopting and implementing policies and legislation aimed at achieving gender equality, adequate nutrition, adequate health care and responsible management of the environment. Specifically, for the environment, the constitution makes the following provisions:

To manage the environment responsibly in order to:

- Prevent degradation of the environment;
- Provide healthy living and working environment for the people of Malawi;
- Accord full recognition to the rights of future generations by means of environmental protection and sustainable development of natural resources;
- Conserve and enhance the biodiversity of Malawi.

To enhance the quality of life in rural communities and to recognize rural standards of living as a key indicator of the success of Government policies.

With respect to gender equality, the Constitution under Section 13 (e) gives the State the responsibility to achieve gender equality for women through:

- Full participation of women in all spheres of Malawian society based on equality with men;

- The implementation of principles of non-discrimination and such other measures as may be required;
- The implementation of policies to address social issues such as domestic violence, security of the person, lack of maternity benefits, economic exploitation and rights to property.

In view of the environmental principles stipulated in the constitution, SVTP ensures that activities implemented under the project promotes environmental protection and sustainable socio-economic development of natural resources by effectively implementing environmental and social management as well as pest management plan in compliance with the government legislative requirements stipulated in acts, policies and approved guidelines applicable to environmental management.

The ESMP also addresses gender inequality issues between men and women and measures to ensure that women are included in implementation of project both during construction and operation phases.

4.2.2 ENVIRONMENT MANAGEMENT ACT (2017)

In Malawi, the Environment Management Act (EMA) provides the legal framework for environmental management and conservation in Malawi by prescribing environmental standards and environmental planning at national and district levels. The Act includes primary legislation regarding environmental standards, sustainable development, sustainable use of natural resources, soil quality, climate change, hazardous substances, environmental planning, enforcement and compliance, freshwater resources management and inland water. It includes legislation regarding the management of rivers, wetlands and wastes.

A key contribution of the Act is requirement for conducting environmental and social management assessment which is defined as "a systematic evaluation of a project to determine its impact on the biophysical, ecological and social environment and the conservation of natural resources". The Act requires that proposed projects which may significantly affect the environment or use of natural resources to conduct environmental and social assessment prior to implementation. The Act puts the Malawi Environment Protection Authority (MEPA) in charge of reviewing and approving the environmental and social management assessment. The Act through the Environment and Social Monitoring and Auditing provisions establish the processes regarding the project operator responsibilities before and during the project development.

The act has provisions on development of regulations to address specific environmental issues. Through the old act, Regulation 30 on waste management and sanitation was developed to promote waste reduction, minimization and treatment to protect the environment from pollution. Pollution of water resources in the surrounding is prohibited. Contractors should be encouraged to reduce and minimize generation of wastes.

4.2.3 FORESTRY ACT OF 1997

The Forestry Act (No. 4 of 1997) establishes legal framework for forest management, forest protection and conservation of forestry resources, and rehabilitation of environmentally fragile areas. The management of trees and forests under customary and private land as well as in protected areas is regulated by the Forestry Act, 1997. It provides for establishment of Forest Management Agreements between communities and the Department of Forestry that enhance co-management of forest resources. Forest Management Agreements lay the foundation for

sustainable forest management. It also provides for penalties for forest offences as well seizure of forest products and articles by forestry officers and police officers. The Forestry Act was recently amended in 2017 (No. 5 of 2017, to include details about community management, local government, land tenure, customary rights, legal and administrative proceedings. Sustainability of water supply schemes is very much dependent on proper management of catchment areas of rivers supplying water to schemes. The Act is very relevant to the proposed works as trees and forests are important for sustenance of ecological integrity of watersheds. The ESMP therefore advocates integration of irrigation scheme with natural resources management activities such as tree planting, catchment management and rehabilitation, natural resources management-based enterprises, riverbank protection and various options for reducing dependency on fuelwood, improving energy efficiency wood fuel and use of alternative renewable energy sources such as wind and solar energy.

4.2.4 THE LAND ACT 2016

The Land Act of 2016 establishes a legal framework for various matters relating to customary land, private land and public land. The Land Act also establishes land registration and land acquisition which includes compensation of people affected by any project.

Section 18 under section (1), (2) and (3), states that; "any person who by reason of any acquisition or temporary use suffers any disturbance of or loss or damage to any interest which he may have or immediately prior to the occurrence of any of the events referred to in this section, may have had in such land shall be paid such compensation for such disturbance, loss or damage as is reasonable."

The land to be used for this project is both private and customary. Where SVTP is acquiring or using customary land for temporary use, SVTP will have to pay compensation to the affected people before proceeding with the project. During field investigations it was established that SVTP had paid all the affected persons.

4.2.5 WATER RESOURCES ACT 2013

The Act provides for the management, conservation, use and control of water resources; for the acquisition and regulation of rights to use water; and for matters connected therewith or incidental thereto. It creates the National Water Resources Authority (NWRA) to replace the National Water Resources Board and creates Catchment Committees for different river basins. It also sets appropriate standards and techniques for the investigation, use, control, protection, management and administration of water resources and regulates public and private activities which may influence quality, quantity, distribution, use or management of water resources and also sets out the coordination, allocation and delegation of responsibilities. It enforces use of water resources; domestic, livestock watering, irrigation and agriculture, industrial, commercial and mining, recreation, hydro-electric power generation and other uses in ways which minimize harmful effects to the environment, control pollution and to promote the safe storage, treatment, discharge and disposal of waste and effluents.

This is a very important Act and ESMPs institute measures to ensure that proper utilization of water and regulate the quality (pollution), quantity, distribution, use or management of water resources within the project areas.

4.2.6 OCCUPATIONAL SAFETY, HEALTH AND WELFARE ACT 1997

The Act makes provisions for the regulation of conditions of employment in workplaces regarding safety, health and welfare of employees. It also provides for the inspection of certain plant and machinery, the prevention and regulation of accidents occurring to persons employed or authorised to go into the workplace, and for some related matters. The Act requires registration of workplaces and defines duties and responsibilities of employers and employees regarding health, safety and welfare and the notification, and investigation of accidents, dangerous occurrences and industrial diseases.

The key provisions relevant to the proposed expansion works include;

- Section 13(1) places a duty on every employer to ensure the safety, health and welfare of all his employees at work;
- Section 51(1) mandates that manufacturers, importers and suppliers of hazardous substances used at workplaces shall provide enough information on such substances as well as the precautions to be taken; and
- Section 81 (7) stipulates that where the use of hazardous chemicals is likely to penetrate the skin and cause rash, skin contact with hazardous chemical shall be avoided and personal hygiene and the type of clothing worn shall be such as to enable rapid removal of any chemical from skin contact

In relation to the proposed works, the Act is relevant as construction of water treatment plant, service water tanks, booster pumps and installation of pipelines will require workforce and use of motorized machinery that may require safety measures to be adhered to. The ESMP include mitigation measures to reduce accidents at workplace especially during the construction phase and operation of the constructed facilities. Specifically, the developer will establish stiff penalties for workers deliberately not adhering Occupational Safety, Health and Welfare.

4.2.8 LOCAL GOVERNMENT ACT, 1998

The Act, as read with Section 146 of the Constitution, mandates all local authorities to regulate planning, administration and implementation of various issues and development programmes within their jurisdiction and empowers them to have by-laws that specify how development projects should minimize and avoid environmental degradation. One of main function of the councils is that local environmental planning and management. Some of the environment management functions are provided in section 2 of the second schedule of functions of the council outlined in Local Government Act. These include town planning, building control, local afforestation programmes, land conservation, and appropriate management of solid and liquid wastes.

The proposed works are within the jurisdiction of Chikwawa District Council, and the board will have to collaborate with local assemblies during construction phase to integrate environmental planning in implementation of the project.

4.2.9 PUBLIC HEALTH ACT 1948

The Public Health Act is for the protection of public health from activities that might endanger human life. The Act prohibits any person from causing nuisance on any land or premises owned or occupied by another. SVTP and contractors are expected not to cause any nuisance during the construction phase.

The Act requires developers to provide adequate sanitary and health facilities to avoid harmful effects of waste on public waters. The contractor will provide mobile toilets for the workers during construction and the contractor will engage private garbage collection companies to dispose all the construction rubble that will be produced during construction in consultation with the Chikwawa District Council.

4.2.10 PHYSICAL PLANNING ACT 2016

The Act regulates the use of land and provides guidelines for the planning and management for all development activities in the country. It is therefore a requirement for all developers on any parcel of land in the country regardless of tenure to seek permission from the planning authority before being implemented.

SVTP is required to submit to Chikwawa District Council layout of the proposed canal for their endorsement before any development activities can commence in the district.

Section 50 of the Act requires consideration environmental impacts of any development project should be taken into consideration when approving plans to ensure that environmental negative impacts of projects are avoided or mitigated. The implication of this provision for the proposed project is that SVTP should ensure environmental protection during construction and that all necessary permits are obtained before commencement of the project activities.

4.2.11 GENDER EQUITY ACT 2013

The Act was developed to ensure that men, women, boys and girls equally and effectively participate in and benefit from different development processes. The Act was put in place to assist to: a) promote gender equality, equal integration, influence, empowerment, dignity and opportunities for men and women in all functions of society; b) prohibit and provide redress for sex discrimination, harmful practices and sexual harassment; and c) provide for public awareness on promotion of gender equality. Considering that the project will employ several people during construction phase, SVTP will be expected to apply provisions of this Act. The project will ensure that wherever there are any employment opportunities, 40% of the employees shall be women.

4.2.12 MONUMENTS AND RELICS ACT 1990

Graves are among the monuments that are protected under the monuments and relics act. The chief antiquities officer is given the power to preserve and protect all monuments entrusted to his care under section 4 (a) of the act. Section 13 (b) of the act states that no person shall without prior consent of the minister carry out any cultivation or mining project or other work to cause or likely to cause damage or disturbance to any protected monument or protected relic. SVTP will have to ensure that graves are not disturbed or damaged when they will be digging the trenches and installing pipelines as requested by village chiefs during field investigations.

4.2.13 LABOUR RELATIONS ACT, 1996

The Act was enacted to 'promote sound labour relations through the protection and promotion of freedom of association, the encouragement of effective collective bargaining and the promotion of orderly and expeditious dispute settlement, conducive to social justice and economic development.' The Act provides for establishment of grievance redress mechanisms for orderly settlement of dispute without impinging on workers freedom of association and social justice. The Act also prohibits discrimination on grounds of race, colour, nationality, sex, marital status, age,

family responsibilities, property or birth. As such, SVTP and contractors should ensure that workers unions and associations are allowed to be established.

CHAPTER FIVE: IDENTIFICATION AND ANALYSIS OF IMPACTS

5.1 PROJECT ACTIVITIES AND THE IMPACTED ENVIRONMENTAL COMPONENT

Project activities to impact on the environmental components are listed below in table 6.1. The assessment has considered the entire project cycle starting from the planning and designing phase, construction phase and operation phase including the decommissioning of the treatment plant, pipeline and storage tanks. Physical construction of the treatment plant, storage tanks and pipelines and their influence on the baseline environmental and social characteristics of the areas was examined. The components considered were ecosystems, land and soils resources, flora and fauna, rural livelihoods, local economy, HIV and AIDS aesthetic and amenity values and gender.

5.1.1 IMPACT IDENTIFICATION/PREDICTION

The project activities will generate several environmental and social impacts during construction and operation. This is because the activities involve extensive civil works during construction, and interaction of many people within a project location area.

Depending on the nature of activities the potential impacts on the environmental components differ. The determination of the potential impact is dependent on whether that particular activity in the opinion of the assessor and basing on the characteristics of the sites is likely to bring positive or negative change on that specific environmental component.
Based on the project activities, the approach followed included:

- Site investigations, focusing particularly on the areas of project influence to identify critical environmental and social elements to be affected including agricultural fields, soils, settlements, social infrastructure, cultural sites, water and sanitation, health, flora and fauna, soils and local economy and communities.
- Screening of the anticipated potential and significant impacts of the project, in accordance with the project stages of planning and design, construction, operation and decommissioning.
- Assessment of environmental and social impacts in order to describe the positive and negative impacts, both direct and indirect as identified at each stage of the project cycle.

5.1.2 CLASSIFICATION OF IMPACTS ACCORDING TO PHASES

To facilitate systematic impact determination and assessment, the project cycle is conveniently broken into the following project phases/stages:

1. planning and design;
2. construction;
3. operation; and
4. decommissioning.

5.1.3 DETERMINATION OF ENHANCEMENT AND MITIGATION MEASURES

For each potential negative impact of the project activities within the entire project cycle appropriate interventions are proposed that if properly implemented will reduce the magnitude of the impact or eliminate it. The mitigation measures recommended are those most likely to be implemented by the implementers at different stages and project beneficiaries during the operation phase.

For the potential positive impacts, appropriate measures are proposed that would enhance or maximize the positive benefits from the project interventions.

5.1.4 APPROACH AND METHODOLOGY OF IMPACT ANALYSIS

The approach to analysis of both negative and positive impacts has been based on a systematic rating of the various dimensions (characteristics) of the impacts outlined in table 6.1. In case of impacts for the proposed project, the analysis has focused on five dimensions of the impacts, and these dimensions are as follows:

(a) The relationship of the predicted impacts to certainty of occurrence (likelihood of occurrence)
(b) The relationship of an impact and its synergistic effects to temporal scale (time frame).
(c) The relationship of an impact and its synergistic effects to spatial scale (area of effects).
(d) The extent of the severity (seriousness) of the negative impacts in project impact area.
(e) The scope of the benefits of the positive impacts in project impact area.

Detailed descriptions of focus of each of the selected five dimensions, and criteria for systematic rating each of the selected dimensions on either negative or positive environmental and social impacts for the project are outlined in (a) to (d) below.

5.1.4.1. Rating Criteria on Risk of Impact Occurrence

This parameter analyses the likelihood of impact occurrence in the project impact area. The basis of analysis is on the proposed physical development plans, proposed nature and quantities of inputs, proposed strategy and activities of project implementation. In view of these considerations, it is likely that some impacts may occur while other may not due to some factors within the area. In case of the study of potential impacts for the proposed project, the analysis of the impacts has been guided by the definitions of likelihoods provided in Table 5-1.

Table 5-1: Rating Criteria of Impacts

Definition of risks	**Description of the likelihood**
Very unlikely to occur	The chances for these impacts are slim
Unlikely to occur	The chances occurring are slight, less than 25 %
May occur	The chances of occurrence are 50%
Definitely	The chances of occurrence are over 90 %

5.1.4.2. Rating Criteria on Risk of Impact Occurrence

The temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact. In case of the study of impact for the proposed project, the analysis of the impacts has been guided by the following time frame definitions in table 5-2 while Table 5-3 provides description of identified impacts and their sources.

Table 5-2: *Rating Criteria of Impacts*

Category of impacts	**Time scale of impact occurrence**
Short term impacts	Impact occurrence within 5 years
Medium Term impacts	Impact occurrence within 5 to 10 years
Long Term impacts	Impact occurrence over 10 years

Table 5-3: Description of negative impacts, their sources and potential risks			
Component of the environment to be affected.	**Potential environmental and social impacts**	**Source of impacts/cause of the impacts**	**Potential severity. Ranking Key: severe, moderate and marginal**
Construction Phase			
Land and Soil Resources	Soil erosion due to failure to manage storm water and control erosion	Land clearing, removal of ground cover; excavation of construction soil and sand	Moderate
	Increase in surface runoff and soil erosion.	Clearance of vegetation and compaction of topsoils	Moderate
	Generation of solid wastes	Use of materials such as metal scrap, excavated material, plastics, cartons, rejected material and empty containers	Moderate
	Loss of farmland	Excavation of trenches and laying pipelines	Moderate
	Land degradation due to excavations and site clearing	Land clearance and excavation of trenches	Moderate
Ecosystem	Loss of natural vegetation, trees, field crops and greenery beauty on sites earmarked for storage tanks and pipelines	Land clearance and excavations of trenches	Moderate

Description of negative impacts, their sources and potential risks			
Component of the environment to be affected.	**Potential environmental and social impacts**	**Source of impacts/cause of the impacts**	**Potential severity. Ranking Key: severe, moderate and marginal**
Construction Phase			

Local community	Risk of conflicts between migrant workers and local people	Interaction between workers and communities during construction phase	Moderate
	Spread of sexually transmitted diseases including HIV and AIDS	Interactions of workers with communities during construction phase	Moderate
	Noise and vibration from running of stand-by generator set during construction	During operation of stand-by generator	Moderate
	Disruption of traffic flow and public mobility on areas where excavations crossroads and paths	During excavation of trenches	Moderate
Occupational safety and health risk	Construction related accidents	Use of machinery during construction	Moderate

5-3 Description of positive impacts, their sources and potential benefits			
Component of the environment to be affected.	**Potential social and economic positive impacts**	**Source of impacts of positive impacts.**	**Remarks, Medium High**
Socioeconomic	Creation of employment during construction phase	Construction works for the project will attract people from both project area and beyond	High
	Surge in economic activities due demand for construction activities	Demand for construction materials and small business	Medium
	Increase in revenue generated through taxes and levies	Purchase of construction materials from VAT compliant suppliers	Medium
	Increased access to irrigation water	Construction of main canal and secondary canals will increase agricultural productivity	High
	Improved protection of public infrastructure and reduced economic losses and damage to property	Installation of flood protection facilities	High

5.15 EVALUATION OF MAIN NEGATIVE AND POTENTIAL MITIGATION MEASURES

5.1.5.1. Main Positive Impacts

1). Creation of employment during construction phase

Construction and installation main canal, secondary canals and flood protection facilities will require labour force both skilled and unskilled.

Recommended enhancement measures

- Encourage contractors to prioritize employment of local community members
- Ensure women are given equal employment opportunities to promote gender equality

2). Surge in economic activities due to construction activities

Construction and installation main canal, secondary canals and flood protection facilities will require purchase of construction materials such as pipes, cement, sand, steel, construction equipment and protective equipment.

Recommended enhancement measures

- Prioritise purchase of locally available materials where practically possible
- Purchase materials at better prices to ensure local businesses generate profits

3). Increase in revenue generated through taxes and levies

Contractors and consultants will be required to pay taxes and levies hence increasing government revenue. Value added tax is charged on construction materials and water tariffs will also increase government revenues.

Recommended Enhancement measures

- Procure construction materials from tax compliant suppliers
- Contract construction companies registered with NCIC

4). Improved socio-economic welfare of women, girls and community at large

With increased access to potable water, women and girls will spend less time in fetching for water hence freeing their time to participate in economic activities.

Enhancement measure

- Ensure that tariffs and new water connection fees are affordable to residents and ensure women headed households benefit from water supply
- Maintain continuous water supply to reduce time spent by women and girls fetching water from untreated sources

5.1.5.2. Main Negative Impacts

1). Disturbance and loss of livelihoods for project construction of canals

In areas where the pipeline will be laid, community members will likely have to give the land to SVTP for the project.

Recommended mitigation measures

- Compensate all project affected persons in line with relevant legislation

- Provide adequate notice before implementing project activities
- Implement construction works after affected persons have harvested their crops

2). Soil erosion due to poor storm water management deficiencies in design

Extensive ground clearing, removal of vegetation, excavations, and improper routing of storm water may lead to soil erosion.

Recommended mitigation measures

- The contractor must develop a storm water and erosion management plan
- Direct storm water to drains to minimize run-off water on stripped soils
- Implement soil erosion control measures such as planting vetiver grass in contour bands; check dams, and box ridges

3). Loss of natural vegetation due to site clearing

Site clearing in areas earmarked for construction and installation of pipelines will result in removal of vegetation. Development of access roads for machinery will result in clearance of vegetation.

Recommended mitigation measures

- Plant trees as part of restoration of disturbed areas
- Restrict clearing to areas earmarked for construction
- Design the pumping mains alignment in such a way that mature indigenous trees are avoided where possible

4). Land degradation due to excavations and movement of construction machinery

Construction works will involve some extensive excavations and movement of machinery resulting in degradation of land resources. Improper disposal of construction wastes from demolition of tanks at Chinungu Hills could also result in degradation of land resources.

Recommended mitigation measures

- Rehabilitate or re-vegetate site areas that were destabilised during construction
- Dispose construction wastes and domestic waste in areas designated by Chikwawa District Council

5). Generation of solid wastes

Construction activities will generate material like plastic bags, rubble, excavated material, scrap materials, empty containers and tins, rejected material etc. Lack of proper sanitary facilities could lead to health hazards to the workers, people around the project sites and the environment.

Recommended mitigation measures

- Provide temporally sanitary facilities for the workers on site e.g. pit latrines, dust bins etc.
- Encourage recycling of materials as other rejected and/or excavated materials can be used for back filling where necessary
- Sensitize and train all workers on good waste management practices

6). Construction related accidents

During construction, there are chances for accidents to occur as a result of using machinery, equipment and other construction materials. Turning vehicles from main roads into the project site can cause accidents.

Recommended mitigation measures

- Provide safety training and sensitization to workers and communities respectively
- Provide appropriate personal protective equipment
- Install signage to ward workers and community members of unsafe working areas
- Backfill excavated trenches to prevent people and animals from falling into the excavated areas

7). Disruption of traffic flow and public mobility from excavations and movement of machinery

There will be road closure when pipelines cross the road from one side to the other. Vehicle and machinery movement along access roads could disturb other road users.

Recommended mitigation measures

- Provide appropriate detours for motorist and pedestrians
- Back filling excavated areas to minimize traffic disruptions

8). Labour abuse and exploitation

During construction workers may work more than recommended working hours per day and receive wages below minimum wage rate in order to meet strict deadlines and as a source of cheap labour for the employer.

Recommended mitigation measures

- Provide mechanism for employees to lodge labour abuses and exploitation

9). Increased gender-based violence and sexual exploitationt

Some employers would want to take advantage to harass women sexually for special favours

Recommended mitigation measures

- Develop diversity inclusive gender policy and ensure all workers are sensitized on the policy
- Provide grievance avenues for workers and ensure appropriate actions are taken to address any complaints lodged

11). Spread of sexually transmitted diseases including HIV and AIDS

During construction phase of the project will result in the improvement of the financial status of the workers employed. This would result in promiscuous behaviour that may contribute to the increase in transmission of sexually transmitted diseases including HIV and AIDS

Recommended mitigation measures

- Establish HIV and AIDS policy to guide management of HIV and AIDS incidences and cases for the project; and
- Provide additional care support to workers living with HIV and AIDS

12) Generation of wastes during demolition of existing tanks at Chinungu Hill

Demolition of existing tanks will generate wastes in form of concrete rubble.

Recommended mitigation measures

- Sensitize and train all workers on good waste management practices; and
- Demolition wastes that cannot be reused should be disposed of at approved waste disposal sites.

13) Noise pollution from demolition of existing water storage tanks at Chinungu Hill

Residents close to Chinungu Hill may be disturbed by noise from the machinery used if they are not in good working condition. High vibration from heavy machinery may be another source of disturbance. Demolition of tanks could generate noise.

Recommended mitigation measures

- Sensitize residents on upcoming works that generate noise;
- Cordon off the construction sites with iron sheets; and
- Use low noise emitting machinery when demolishing tanks

14) Air pollution from demolition of existing tanks at Chinungu Hill

Dust particles will be generated into the atmosphere during demolition, levelling, and movement of construction machinery. Depending on wind speeds during demolition, the works could generate dust that could spread to adjacent communities.

Recommended mitigation measures

- Restrict demolition works to days with low wind speeds;
- Apply water regularly to civil works and earth access roads to the premises suppress dust; and
- Cordon off the construction sites with iron sheets to contain dust.

CHAPTER SIX: ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN

6.1 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

Construction of Main Canal 3, secondary canals and flood protection can induce and generate a wide range of physical and social changes to the environment and society during construction and operation phases of the project. This requires and necessitates the development of an Environmental and Social Management Plan (ESMP). An ESMP is an action plan that outlines environmental management measures for addressing the identified impacts. The purpose of the ESMP is to provide practical solutions to the impacts identified and the monitoring of activities that need to be undertaken pertaining to the project. In addition, an ESMP shows environmental impacts, mitigation, monitoring and institutional measures to be taken during project implementation and operation stages to avoid, reduce or eliminate negative environmental impacts. It also provides a record against which a project can be assessed.

The environmental management and monitoring plan provide quantifiable indicators, assign institutional responsibilities and provides an estimated budget for monitoring implementation of measures mitigating and enhancing identified impacts. It is envisaged that institutions assigned with monitoring responsibilities will incorporate the estimated costs for monitoring activities in their recurrent budgets to promote sustainability of monitoring activities after the project is phased out. ESMP for construction works has been provided in table 6-1. It outlines environmental impacts and their management measures, assigns implementation responsibilities to stakeholders within a given time frame and estimates costs of implementing the measures.

Table 6-1: Environmental and Social Management Plan

POSITIVE IMPACTS				
Potential Impact	**Recommended Enhancement/Mitigation/Management Measure**	**Period**	**Responsibility for management**	**Costs for managing impact**
CONSTRUCTION PHASE				
Creation of employment opportunity	● Encourage contractors to prioritize employment of local community members ● Ensure women are given equal employment opportunities to promote gender equality	During construction	Contractor	To be included in Project costs
Surge in economic activities	● The contractors should purchase as many local materials as possible during the construction phase.	During construction	Contractor	To be included in project Costs
Increase in revenues generated through taxes and levies	● Procure construction materials from tax compliant suppliers ● Contract construction companies registered with NCIC	During Operation	SVTP	To be included in project Cost
OPERATION AND MAINTENANCE PHASE				
Increased water availability to Illovo Estates and surrounding communities	● Develop a robust preventative operation and maintenance plan to sustain operations of the infrastructure ● Timely respond to water supply problems	During operation	SVPT	Annual Budget
Improved health and nutrition status of farmers and	● Develop a robust preventative operation and maintenance plan to sustain operations of conveyance system	During operation	SVPT	Annual Budget

other community members due to availability of food	● Timely respond to water supply problems			
Increased resilience to climate variability	● Maintain operation of the conveyance system to ensure availability of water for irrigation ● Promote crop diversification	During operation	SVPT	Annual Budget
Improved food security and incomes at household level	● Train farmers on improved farming practices such as land preparation, weeding, fertilizer application and other recommended practices that will help them realise high quality yields; ● Train farmers in food preservation and post-harvest storage	During operation	SVPT	Annual Budget
Improved protection of irrigation infrastructure and human settlements	● Maintain flood intervention structure regularly ● Integrate early flood warning system	During operation	SVPT	Annual budget
NEGATIVES IMPACTS				
Potential Impact	**Recommended Enhancement/Mitigation/Management Measure**	**Target/Goals/Dates**	**Responsibility of Implementation**	**Costs (MK)**
Disturbance and loss of livelihoods for projected affected persons due to acquisition of land for constructio	● Compensate all project affected persons in line with relevant legislations ● Provide adequate notice implementing project activities ● Implement construction works after affected persons have harvested their crops	During construction	SVPT	To be determined by RAP

n for installation of main canal and secondary canals				
Soil erosion due to storm water management deficiencies in design	● Design appropriate storm water management structures ● Install soil erosion control structures especially along Mwanza River section	During Design /Construction	Contractor	2,000,000
Loss of vegetation due to site clearing	● Design canal alignment in such a way that mature indigenous trees are avoided where possible ● Plant trees as part of restoration of disturbed areas ● Restrict clearing to areas earmarked for construction	During construction	Contractor	5,000,000
Land degradation due to excavations and site clearing	● Rehabilitate or re-vegetate site areas that were destabilized during construction ● Dispose construction wastes and domestic wastes in areas designated by Chikwawa District Council	During construction	Contractor	1,600,000
Generation of solid wastes	● Provide temporally sanitary facilities for the workers on site e.g. pit latrines, dust bins etc. ● Encourage recycling of materials as other rejected and/or excavated materials can be used for back filling where necessary ● Sensitize and train all workers on good waste management practices	Throughout construction	Contractor	5,000,000

Construction related accidents	● Provide safety training and sensitization to workers and communities respective ● Provide appropriate personal protective equipment ● Install signage to warn workers and community members of unsafe working areas ● Backfill excavated trenches to prevent people and animals from falling into the excavated areas	During construction	Contractor	2,000,000
Disruption of traffic flow and public mobility from excavations and movement of machinery	● Provide appropriate detours for motorist and pedestrians ● Back filling excavated areas to minimize traffic disruptions	During construction	Contractor	4,000,000
Air pollution from construction works	● Apply water regularly to civil works and earth roads to suppress dust; ● Control the speeds of construction vehicles to reduce generation of dust	Throughout construction	Contractor	4,000,000
Soil contamination	● Maintain machinery regularly ● Maintenance works should be carried out at the contractor's yard ● Fuel for construction vehicles should be refilled at the contractor's premises	Throughout construction	Contractor	3,000,000
Labour abuse and exploitation	● Provide mechanism for employees to lodge labour abuses and exploitation	During construction	Contractor	N/A
Increased gender-	● Develop diversity inclusive gender policy and ensure all	During construction	Contractor	N/A

based violence and sexual exploitation	workers are sensitized on the policy ● Provide grievance avenues for workers and ensure appropriate actions are taken to address any complaints lodged			
Spread of sexually transmitted diseases including HIV and AIDS	● Establish HIV and AIDS policy to guide management of HIV and AIDS incidences and cases for the project ● Provide additional care support to workers living with HIV and AIDS	During construction	SVPY/Contractor	1,000,000
Spread of COVID-19	● Provide masks, hand sanitizers and washing stations ● Encourage workers to go for vaccination	During Construction	SVPT/Contractor	5,000,000
Noise pollution from construction machinery	● Sensitize residents on upcoming works that generate noise; ● Use low noise emitting machinery	During construction	Contractor	2,000,000
NEGATIVE IMPACTS DURING OPERATION PHASE				
Increased risk of Water logging and salinization of the soils.	● Ensure correct application regime using an irrigation schedule to avoid over application of water ● Ensure that there are suitable and sufficient drainage systems in place.	During operation	SVPT	Included in operation costs
	●			

6.2 ENVIRONMENTAL AND SOCIAL MONITORING PLAN

The Environmental and Social Monitoring Plan (ESMP), presented in Table 6.2, provides for monitoring to checking implementation of the mitigation measures proposed in the ESMP. The monitoring plan gives monitoring indicators, means of their verification, frequency of monitoring and the stakeholders responsible for monitoring. The costs for carrying out the monitoring activities include travel expense and allowances to get to the project site and to monitor implementation of the ESMP.

The environmental monitoring plan helps to verify the magnitude, duration and scope of the predicted impacts during and after implementing the mitigation measures. It also helps to detect any unforeseen impacts at an early stage so that corrective measures can be taken, before significant damage takes place on society or the environment. Hence monitoring implementation of the ESMP requires dedication and persistent follow up, especially during the construction and operation phases of the project. It requires coordination with professionals from the various key stakeholders to verify that all mitigation measures in the ESMP are being implemented on time and as recommended.

Table 6.2: Environmental and Social Monitoring Plan

Item	Potential Impact	Recommended Mitigation Measures	Monitoring Indicator	Means of verification	Frequency	Responsible Authority	Estimated Cost
POSITIVE IMPACTS							
1	*Creation of employment opportunity*	Encourage contractors to prioritize employment of local community members Ensure women are given equal employment opportunities to promote gender equality	Number of local people employed disaggregated by gender	Employment Record	Monthly	Ministry of Labour/SVPT	500,000
2	*Surge in economic activities*	Prioritise purchase of locally available materials where practically possible Purchase materials at better prices to ensure local businesses generate profits	Budget on Locally purchased materials	Procurement Records	Quarterly	Chikwawa District Council	500,000
3	*Increase in revenues*	• Procure construction	Taxes remitted to MRA	Financial records	Annually	NCIC/MRA	Included in SVPT

	generated through taxes and levies	materials from tax compliant suppliers ● Contract construction companies registered with NCIC	Levies remitted to NCIC	Meeting minutes			operation costs
4	*Improved health and nutrition status of farmers and other community members due to availability of food*	● Develop a robust preventative operation and maintenance plan to sustain operations of conveyance system ● Timely respond to water supply problems	No of faults registered	Operations /Maintenance Records	Annually	SVPT	Included in SVPT operation costs
6	*Increased resilience to climate variability*	● Maintain operation of the conveyance system to	No of faults recorded	Operations/ Maintenance Records	Annually	SVPT	Included in SVPT operation costs

		ensure availability of water for irrigation ● Promote crop diversification Maintain adequate water storage in all tanks to cushion water problems in the event the treatment plant is under maintenance or has broken down					
7	*Improved food security at household level*	● Train farmers on improved farming practices such as land preparation, weeding, fertiliser applicati	Number of food secure families	Operations/ Maintenance	Annually	SVPT	3,000,000

		on and other recommended practices that will help them realise high quality yields; ● Train farmers in food preservation and post-harvest storage ● Construct sustainable irrigation structures at the irrigation scheme to ensure continuous production of crops for household consumption.					
8	*Improved protection of irrigation infrastructure and human settlements and reduced*	● Maintain flood intervention structure regularly ● Implement early flood	Number of irrigation infrastructure and property protected	Operations/ Maintenance	Annually	SVPT	3,000,000

	economic losses and damage to property	warning system					
NEGATIVE IMPACTS							
1	*Disturbance and loss of livelihoods for projected affected persons due to acquisition of land for construction of water pumping mains*	● Compensate all project affected persons in line with relevant legislations ● Provide adequate notice implementing project activities ● Implement construction works after affected persons have harvested their crops	Compensation paid versus standard compensation schedules	Compensation Records	Before construction	SVPT	N/A
2	*Soil erosion due to stormwater management deficiencies in designs/*	● Design appropriate storm water management structures ● Install soil erosion	Number of erosion control structures	Site Inspection	Quarterly	MEPA	1,000,000

	construction	control structures especially along Mwanza River section					
3	*Loss of vegetation due to site clearing*	• Design canal alignment in such a way that mature indigenous trees are avoided where possible • Plant trees as part of restoration of disturbed areas • Restrict clearing to areas earmarked for construction	Number of affected trees Number of trees planted	Site Inspection	Quarterly	MEPA	1,000,000
4	*Land degradation due to excavations and site clearing*	• Rehabilitate or revegetate site areas that were destabilized during	Total area disturbed	Site Inspection	On-going	MEPA	3,000,000

		construction ● Dispose construction wastes and domestic wastes in areas designated by Chikwawa District Council authorities					
5	*Noise and vibration from running of standby genset during Construction*	● Use low noise emitting gensets ● Restrict noise generating activities to daytime	Complaints by communities	Inspection of complaints record	Monthly	MEPA	500,000
6	*Construction related accidents*	● Provide safety training and sensitization to workers and communities respectively ● Provide appropriate personal	No of accidents/incidents recorded	Accident/Incident Records	Monthly	Chikwawa District Council/Ministry of Labour	1,000,000

		protective equipment ● Install signage to ward workers and community members of unsafe working areas ● Backfill excavated trenches to prevent people and animals from falling into the excavated areas					
7	*Disruption of traffic flow and public mobility from excavations and movement of machinery*	● Provide appropriate detours for motorist and pedestrians ● Back filling excavated areas to minimiz	No of complaints received	Site Inspection	Daily	Chikwawa District Council	500,000

		e traffic disruptions					
8	*Air pollution from construction works*	• Apply water regularly to civil works and earth roads to suppress dust; • Control the speeds of construction vehicles to reduce generation of dust	Frequency of water application Speed limit signs in place	Site Inspection	Quarterly	MEPA	1,000,000
9	*Soil contamination*	• Maintain machinery regularly • Maintenance works should be carried out at the contractor's yard • Fuel for construction	Incidences of fuel and oil leakages	Visual inspection	Quarterly	MEPA	500,000

		vehicles should be refilled at the contractor's premises					
10	*Labour abuse and exploitation*	● Provide mechanism for employees to lodge labour abuses and exploitation	No of cases Registered	Staff Complaints records	Quarterly	Ministry of Labour	500,000
11	*Increased gender-based violence and sexual exploitation*	● Develop diversity inclusive gender policy and ensure all workers are sensitized on the policy ● Provide grievance avenues for workers and ensure appropriate actions are taken	No of cases registered	Staff Complaints Records	As Reported	Ministry of Labour	500,000

		to address any complaints lodged					
13	*Spread of sexually transmitted diseases including HIV and AIDS*	• Establish HIV and AIDS policy to guide management of HIV and AIDS incidences and cases for the project • Provide additional care support to workers living with HIV and AIDS	HIV/AIDS policy Care support given to PLWHA	Inspection of records	During construction	Chikwawa District Council	500,000
14	*Spread of COVID-19*	• Provide masks, hand sanitizers and washing stations • Encourage workers to go for vaccination	No. of masks, sanitizers or hand washing stations provided	Inspection of records	During construction	Chikwawa District Council	500,000

15	*Noise pollution from construction machinery*	• Sensitize residents on upcoming works that generate noise; • Use low noise emitting machinery	Number of complaints lodged	Inspection of records	During construction	Chikwawa District Council	100,000
NEGATIVE IMPACTS DURING OPERATION							
1	*Increased risk of Water logging and salinization of the soils.*	• Ensure correct application regime using an irrigation schedule to avoid over application of water • Ensure that there are suitable and sufficient drainage systems in place.	Levels of salinity in the soil	Site inspection	Bi-annually	MEPA	500,000

CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSION

The ESMP has developed as an addendum to the original ESMP prepared for the SVPT specifically for construction of Main Can 3, Secondary Canals and Flood Protection facilities. Overall, constructions will increase water available for irrigation to both commercial farmers and smallholder farmers in the valley.

However, as with any other construction activity, the proposed developments will likely generate negative impacts on the biophysical environment as well as socioeconomic environment. Assessment and evaluation of impacts undertaken in this ESMP has established that the negative impacts will be short term and localised and the ESMP has been designed to avoid, minimize, reduce or mitigate negative environmental and social impacts to emanate from implementation of the activities. It will be incumbent upon SVTP to ensure contractors working on the projects implement the ESMP and that qualified personnel are recruited to monitor implementation of the ESMP.

Therefore, SVTP can be allowed to proceed with implementation of the construction activities on the understanding that this ESMP will be implemented and that stakeholders assigned the responsibility of monitoring the implementation of the mitigation measures will be fully engaged throughout the project life.

7.2 RECOMMENDATIONS

To ensure successful implementation of the ESMP, it is recommended that management of SVTP should implement the mitigation measures that have been proposed in this Environmental and social management plan so that the construction activities are implemented in an environmentally sustainable manner. The monitoring plan will be implemented so that modifications to the mitigation measures can be made in cases where they do not seem to work. Specifically, the following recommendations are made:

1. SVTP must ensure that all mitigation measures recommended in this report are fully implemented to avoid or maintain the predicted negative impacts at the lowest level;

2. SVTP and contractors should provide adequate financial support for implementation of mitigation measures stipulated in the ESMP;

3. The selection of the construction contractor will require a conscious decision by project proponent and financing agencies prior to tendering. In any agreement the names of standard guidelines to be used are indicated.

4. In addition, many measures proposed in the ESMP involve costs for the construction contractor, call for tender shall be clear on the requirement to quantify measures in the Bills of Quantities;

5. The Project must ensure that interests of vulnerable, disadvantaged and marginalised groups such as women and youth are considered during implementation of project activities; and

6. The Project should ensure that District Environmental Officer are involved in periodic compliance monitoring of project activities to ensure that provisions made in the ESMP are adhered to and corrective actions are timely instituted to address non-compliances.

7. It will help in ensuring that the contractor and management of each of the beneficiary school are complying with the proposals that have been put forward in this ESMP during all the phases of the project.

REFERENCES

Government of Malawi (2013) ***Water Resources Act,*** Ministry of Water Development,

Government of Malawi (1994**)** ***National Environmental Action Plan. Volume* 1**, Department of Research and Environment Affairs

Government of Malawi (1995) ***Constitution of the Republic of Malawi***, Ministry of Justice and Constitutional Affairs

Government of Malawi (1996) ***Environmental Management Act***, Number 23, Department of Environmental Affairs

Government of Malawi (2004 and 2002) **The** ***National State of Environment Report,*** Department of Environmental Affairs.

Government of Malawi (1996) ***National Forestry Policy.*** Forestry Department

Government of Malawi (1996) ***National Environmental Policy***. Ministry of Research and Environmental Affairs

Government of Malawi (1997). ***Forestry Act.*** Forestry Department

Government of Malawi (2000) ***Pesticides Act***, Ministry of Agriculture and Food Security

Government of Malawi (2000**)** ***Agriculture Extension in the New Millennium Policy,*** Ministry of Agriculture and Food Security

Government of Malawi (2000) ***National Irrigation Policy and Development Strategy***, Department of Irrigation

Government of Malawi (2000) ***National Land Resources Management Policy and Strategy,*** Ministry of Agriculture and Food Security

Government of Malawi (2001) ***National Fisheries and Aquaculture Policy***, Ministry of Agriculture and Food Security

Government of Malawi (2002**)** ***National Land Policy,*** Ministry of Lands, Physical Planning and Surveys

Government of Malawi (2016) the ***Land Act***

Government of Malawi (2016) ***the Customary Land Act***

Government of Malawi (1998), Customary Land Utilisation Study (1998). Special Land Tenure Study: The Ndunda Land Registration Component; Lilongwe Land Development Programme.

Government of Malawi (2003) ***HIV/AIDS in the Agriculture Sector Policy and Strategy 2003-2008****;* Ministry of Agriculture and Food Security

Government of Malawi (2010**)**. ***Malawi Demographic and Health Survey.*** National Statistical Office

Government of Malawi (2004) ***National Water Policy.*** Ministry of Water Development