Ministry of Agriculture, Mechanization and Irrigation Development
Republic of Zimbabwe

The Preparatory Survey on the Project for Irrigation Development for Nyakomba Irrigation Scheme in the Republic of Zimbabwe

Final Report

September 2015

Japan International Cooperation Agency
(JICA)
NTC International Co., Ltd.

RD
CR
15-050

PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparation survey and entrust the survey to NTC International Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of Zimbabwe, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two counties.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Zimbabwe for their close cooperation extended to survey team.

September, 2015

KITANAKA Makoto
Rural Development Department
Japan International Cooperation Agency

Summary

1. Background of the Project

Agricultural sector in Zimbabwe is recognized as one of the most important sectors in the country because it accounts for 20% and 40% of Gross Domestic Product (GDP) and total export amount respectively. Moreover, it is estimated that the agricultural sector creates job opportunities for 30% of total population in the country. The Government of Zimbabwe (GOZ) planned to introduce irrigation agriculture for smallholder farmers in communal lands, known as low productivity area that are fragile against drought, and the GOZ officially requested the Government of Japan (GOJ) for support of irrigation development in 1985. Based on this request, Japan International Cooperation Agency (JICA) has implemented Feasibility Survey (F/S) through the development study titled as Nyakomba Irrigation Plan (1989-1990). By this context, the GOZ requested the GOJ the irrigation facility development project of Block A, B, C, D and E in Nyakomba irrigation area by the Japanese grant aid scheme. Based on the request, the basic design by Japanese grant aid for Block B and C was conducted and the irrigation facilities were constructed and completed as Phase 1. As same as Block B and C, the basic design of Block A, D and E was conducted and the only the Block D was completed as Phase 2. Total area irrigated by the aforesaid support in Block B, C and D is estimated as 430 hectares.

In 2000, radical land resettlement, known as the First Track Land Reform (FTLR) program implemented by the GOZ led to the deterioration of economic outlook resulted from economic sanctions by donor's country which leads to hyperinflation. In addition, confrontation between the ruling and opposition parties occurred during the national presidential and parliamentary election in 2008 triggered violence which leads to further security deterioration. With this background, most of the JICA's development assistances in the country including the irrigation development project in Block A have temporarily been stopped except for a few cooperation schemes through some international organizations.

Signs of recovery began to appear in 2009. Through the intervention by regional economic communities such as African Union (AU), Southern African Development Community (SADC) etc., the GOZ established coalition government of both parties in and out of power, and also adopted international currencies i.e. US dollar instead of the local currency with aim of bringing down the hyperinflation and solving the political unrest. In 2012, the GOZ has re-requested the GOJ for the implementation of the project. In order to restart the project by Japanese Grant Aid scheme which is relatively large scaled financial support, the GOJ set several conditions. They are: the revision of constitutional authority of the president and constitution itself and implementation of peaceful and impartial national election under the new constitution. In the late July 2013, presidential and parliamentary election was held under the new constitution, and the incumbent president Robert Mugabe swept the candidates of opposition parties, and was re-elected. The result of the election was declared free and fare and was approved by other countries and regional economic communities

such as AU, and SADC including GOJ, though a few western countries disagreed. Therefore, the GOJ finally agree to restart the Japanese Grant Aid for GOZ.

Accordingly, in March 2013, JICA has organized field survey to Nyakomba Irrigation area and realize the insufficiency of pumping ability toward the irrigation area. The area has been hit by hurricane in 2000 and 2006, which have caused the complete flooding of the pump stations in Block B, C, and D. During the 2006 hurricane, for example, the high water level of the flood reached 30 cm above the floor elevation of the pump stations, so that pump facilities installed in the basement of the pump stations were completely submerged and were filled with soil deposit. Based on these findings, consideration of rehabilitation on Block B, C, and D are incorporated as part of the Project.

This survey, the preparatory survey on the Project for Irrigation Development for Nyakomba Irrigation Scheme in the Republic of Zimbabwe (hereinafter referred as the Preparatory Survey), focused on the followings points i) the confirmation of validity and necessity of the Project, ii) conducting the appropriate preliminary designing as a Japanese Grant Aid, iii) the formulation of the project plan and rough estimation of the project cost. Besides, the preparatory survey examines the current status of Block B, C, and D especially in the pump stations where the site was submerged by the flood, and then formulates the plan and estimate the rough cost after the validity of the rehabilitation on those blocks were confirmed.

2. Outline of the Field Survey and Contents of the Project

2.1 Schedule of Field Survey

The Preparatory Survey team was conducted the survey in Zimbabwe from November 19, 2014 to February 9, 2015. Through the survey in Zimbabwe, the Preparatory Survey team performed a series of discussion with headquarter of Ministry of Agricultural Mechanization and Irrigation Development, Irrigation Department, AGRITEX, Department of Mechanization and ZINWA to build the structure of O&M for irrigation facilities and conducted field inspection and data collection. Thereafter, the contents of request and validity of cooperation were confirmed and proper scale and contents of the Project were examined during study in Japan. Based on the examination in Japan, the draft final report was prepared by the Preparatory Survey team.

JICA decided to dispatch the Preparatory Survey team to Zimbabwe to discuss the contents of the draft final report from July 2 to July 10, 2015. The Preparatory Survey team discussed and explained the contents of the draft final report and Zimbabwe side agreed the contents of the draft final report. Finally, both side concluded the Minutes of Meeting.

2.2 Objective of the Project

The objectives of the project are i) to increase amount of agricultural production and ii) to contribute continuous and stable practices of agricultural production through the following activities such as i) to construct the irrigation facilities in Block A, ii) to realize to practice irrigation agriculture

in Block A and iii) to execute the flood prevention works in Block B, C and D.

2.3 Outline of the Project

The main components of the Project are composed of following six (6) items such as i) water intake facility, ii) irrigation and drainage facility, iii) road, iv) land leveling, v) flood prevention works and vi) softcomponent as shown in the table below.

Table Main Component of the Project

Block	Component	Specification
Block A	Water intake facility	Pump station (Lifting pump φ250×3 nos)
	Irrigation facility	Headrace (Steel pipe φ500× 980m)
		Farmpond (B×L×H = 13m× 24m× 2m, V=620m^3)
		Distribution pipeline (L=4,403m, PVC φ150 to 400)
		Branch canal (RC open canal, L=10.6 km)
	Road	Farm road (Gravel pavement, Width= 5m, L=4.69 km)
	Drainage facility	Drainage canal (Earth canal, L=18.7 km)
	Land leveling	Land leveling and land sharing (A=146 ha, conducted by Zimbabwe side)
Block B	Flood prevention	RC retaining wall (156.6 m)
	Water resource facility	Replacement of electrical pump facility, arrangement of pump mechanics in the site and replacement of mechanical parts
Block C	Flood prevention	RC retaining wall (152.4 m)
	Water intake facility	Replacement of electrical pump facility, arrangement of pump mechanics in the site and replacement of mechanical parts
Block D	Irrigation facility	Pump station (Lifting pump φ300×3 nos)
		Headrace (Steel pipe φ600× 365m)
	Road	Farm road (Gravel pavement, Width= 5m, L=0.30 km)
All Blocks	Soft component	i) Guidance of maintenance of irrigation facilities ii) Guidance of maintenance and repairing of pump facilities iii) Promotion of contract farming

2.4 Design Policy

(1) New Development Area (Block A)

Based on of the result of field inspection, Block A is divided into eight sub-blocks namely A1 to A8 owing to topographic condition stream flowing and total irrigation area with 146 ha was confirmed. For disturbing irrigation water to all the area with 146 ha, pump station abstracting water from Gairezi River will be constructed and pumping up irrigation water to farmpond. After farmpond, irrigation water will be distributed to all the beneficiary area by gravity. Design policy for construction of irrigation facilities in Block A is as shown in the table below.

Table Design Policy for Block A

Type of Works	Quantity	Design Policy
Pump Station	1 set	- The structure of pump station should be ensured not to intrude flood water into basement of pump station. - Bank and bed protection at up and down stream of pump station will be installed to prevent erosion by flood water. - Plural numbers of pump will be installed to cope with seasonal water requirement and diversification of risk.

Type of Works	Quantity	Design Policy
Headrace (pipeline)	980 m	- Headrace will be installed as the pipeline facility connecting between pump station and farmpond. - Since design water pressure with 100 m and diameter of 500 mm are required, type of pipe will be selected considering the reliability of the performance of the joint.
Farmpond	1 set	- Since pump can not restart immediately after pump stop by accident, storage capacity equivalent to 30 minutes of pump operation with 620 m^3 will be ensured in farmpond as same as the necessary site with 30 m× 20 m. - RC structure will be necessary.
Distribution pipeline	4.4 km	- Distribution pipeline will be installed to connect from farmpond to each surge tank to be constructed in sub-block of A1 to A8. - As water pressure is low, PVC will be utilized.
Surgetank	8 places	- Surgetank will be installed in each sub-block of A1 to A8 as water tank to connect between pipeline and open canal. - Surgetank will be provided the structure for utilizing domestic water.
Branch canal (open canal)	11.3 km	- Branch canal will be installed to connect from surgetank to each field, and to distribute irrigation area to all beneficiary area. - The existing canals constructed by Zimbabwe side will be utilized. Since length of existing canals is short and, which can not cover all the beneficiary area, the existing canals will extend to distribute irrigation water to all beneficiary area by grant aid Project. - In the existing canals, cracks are found and some portions such as drops and division works have been not constructed yet. Therefore, canal repairing and construction if drops and division works will be implemented under the softcomponent.
Main road	Repairing of culverts 3 places	- Improvement of main road was requested by Zimbabwe side. However, since improvement of main road can be improved considering technical standard of Zimbabwe, improvement of main road will be not implemented by the grant aid Project. - Existing three (3) culverts are recognized to receive damages and hindered smooth traffic and these three (3) culverts will be improved by the grant aid Project,
Farm road	5.0 km	- Farm road will be constructed for the ordinal maintenance of surgetank located at each sub-block from A1 to A8 in Block A. Farm road diverges from main road. - Farm road will be constructed for the ordinal maintenance of new pump station in Block D.
Land leveling	146 ha	- Land leveling will be performed by DOI as same as Block B, C and D in the past. - The necessary equipment for land leveling such as tractor and attachment will be supplied by the grant aid Project.

(2) Existing Irrigation Area (Block B, C and D)

1) Flood Disaster Prevention (Block B and C)

Nyakomba irrigation scheme has experienced huge damage due to flood caused by the 2000 and 2006 cyclone that hit the area. The flood water level reached about 30 cm above the floor level of pump house in Block B and C and 100 cm above floor level of Block D. Consequently, flood water intruded into basement of pump station and submerged all the pumps that result in huge damage on pump equipment.

From the result of field survey, since surrounding river bank of pump station and embankment of connecting road to these pump stations were not eroded during the 2006 flood, it is believed that the velocity of flood might be slow at Block B and C. Therefore, the provision of retaining wall surrounding pump station against flood is believed to be sufficient to be used as flood disaster prevention structure for Block B and C.

Utilizing the record of flood water level in 2006 and surveying data, hydraulic analysis will be examined to calculate flood discharge and flood level at pump station site including clearance. Top elevation of retaining wall will be determined by adding flood level and a certain clearance that avoid intrusion of flood water. Additionally, the access road to the pump station will be modified and constructed to secure smooth accessibility to the pump station.

2) Relocation of Pump Station (Block D)

From the result of field survey, flood hit pump station at Block D every year and the surround area of pump station is progressively eroded. If construction of retaining wall is provided, the base of retaining wall might be eroded from the flood that comes once every year during rainy season so that it will be difficult to secure the sustainability of Project at Block D. Therefore, Block D is determined to be relocated to other safe site. With the relocation of pump station, new pipes connecting the pump station to existing headrace should be installed.

3) Basic Policy of Restoration of Pump Equipment

Since main parts of pump are still in good conditions, pump can be restored if some parts are replaced and adjustment and refabrication are conducted. However, although some other accessories and electric equipment including cables are available, the functionality of these accessories is not reliable because of progressing corrosion and damages. Therefore, it is recommended that all electrical equipment of pump facilities should be replaced anew considering sustainability of the Project.

With the relocation of pump station and change of cropping pattern, discharge and pump head will be increased. Since discharge and head of pump is changed in Block D, the existing pump does not have the capacity to pump the required water for irrigation. Therefore, new pumps should be installed in Block D.

Table Basic Policy of Restoration of Pump Station

No.	Equipment	Basic Policy of Restoration	Remarks
1.	Main pump	Replacement of parts and adjustment and arrangement in Block B and C. New pumps will be installed in Block D	Bearing, sealing parts, electric valve for small diameter pipe, etc, are required to be replaced and be adjusted.
2.	Motor for main pump	Replacement	Low reliability
3.	Electric discharge valve for main	Replacement	Improvement of reliability

No.	Equipment	Basic Policy of Restoration	Remarks
	pump		
4.	Main plumbing, manual suction/discharge valve and check valve	Using existing one. All are replaced in Block D.	
5.	Accessories (drainage pump, vacuum pump, etc.,)	All are replaced	Improvement of reliability
6.	Small diameter pipe	Using existing one. All are replaced in Block D.	Some pipe will be replaced in necessary.
7.	Electrical equipment (panel, measuring devices cables, etc.,)	All are replaced.	Improvement of reliability

2.5 Outline of the Facilities

The facilities constructed by the Project are as shown in the table below.

Table Outline of the Facilities

Structure	Unit	Quantity	Remarks
Pump station			
New construction of pump station	set	2	Block A and Block D
Repairing and/or replacement of pump equipment	set	2	Block B and Block C
Irrigation Facilities			
Head race	m	980	SPφ500, Block A
Head race	m	365	SPφ600, Block D
Farm pond	set	1	RC retaining wall structure with V=620m^3
Distribution pipeline	m	4,403	PVC, φ150 to φ400
Branch canal	m	10,570	Made by RC structure
Surge tank	nos	8	Made by RC structure
Drainage	m	18,680	Earth canal, Block A
Flood protection works			
Retaining wall	m	156.6	Block B, RC structure
Retaining wall	m	152.4	Block C, RC structure
Access road	m	42.3	Block B
Access road	m	25.1	Block C
Road			
Rehabilitation of culvert in main road	nos	3	RC pipe with RC structure
Farm road	km	4.99	Gravel pavement, 11 lines

3. Implementation Schedule and Rough Cost Estimate

3.1 Implementation Schedule

Climate at the Project site is clearly categorized into two seasons namely dry and rainy season. Two pump stations will be constructed in the Project. These basements of pump stations shall be constructed during dry season to prevent flood water. Since one basement of pump station require one dry season, construction period is needed two dry seasons.

In case Exchange Note (E/N) of the Project will be concluded at October, 2015, the contract signing with Contractor is assumed at the middle of June, 2016. Since two dry seasons are necessary for construction of pump stations, construction period is required three fiscal years.

- Detailed design and supervision: From December, 2015 to March, 2018
- Construction period: From July, 2016 to March, 2018

3.2 Rough Cost Estimate

Project cost to be borne by Japan's Grand Aid is estimated as 1,781 million JPY and project cost to be borne by Zimbabwe side is estimated as 72.5 million JPY.

(1) Project Cost to be borne by Japan Side

Rough Project Cost: 1,781 Million JPY

Table Project Cost to be borne be Japan Side

Items	Cost (Million JPY)	Remarks
Construction cost	1,535	
Cost for equipment procurement	0	Including in construction cost
Softcomponent	19	
Consultant fee	142	
Contingency	85	5%
Total	1,781	

(2) Project Cost to be borne by Zimbabwe Side

Table Project Cost to be borne be Zimbabwe Side

Items	Project Cost	
Land leveling with 146 ha	27,000 US$	3.2 million JPY
Extension of power line and installation of transformer in Block A	65,000 US$	7.7 million JPY
Installation of transformer in Block B	42,000 US$	5.0 million JPY
Installation of transformer in Block C	42,000 US$	5.0 million JPY
Extension of power line and installation of transformer in Block D	24,000 US$	2.9 million JPY
Commission for B/A and A/P	28,000 US$	3.3 million JPY
Refund for VAT	381,000 US$	45.4 million JPY
Total	609,000 US$	72.5 million JPY

Exchange rate: 1 US$ = 119.06 JPY

4. Project Evaluation

4.1 Relevance

The Project is judged possessing relevance to be implemented under grant aid program of Japan due to the reasons mentioned below.

(1) Relation with Development Plans in Zimbabwe

Zimbabwe Agenda (Zim Asset) ranked with the super goal of national plan toward sustainable socio-economy aims at development of agriculture sector through displaying food security and poverty reduction in order to achieve stable growth of agriculture in the area. Simultaneously, Zimbabwe National Irrigation Master Plan, July 2012 describes that i) there are potential area for irrigation

development with an area of 2.24 million ha and ii) irrigation facilities will be developed in these area within 50 years. Nyakomba irrigation scheme is:

- Developed on the basis of idea of Zim Asset,
- Belongs to short term development plan for cooperate agriculture sector in national irrigation master plan, and
- Included in the project list for 127 thousand ha to be developed within 5 years.

Thus, the Project is in line with Zim Asset , National Irrigation Master Plan, etc.

(2) Reducing Inequality and Disaster Restoration

In comparison of farm income of Block A and developed three blocks namely Block B, C and D, the farm income of Block A is only one third because of the non-existence of irrigation facilities in Block A. The objective of the irrigation development in Block A is to promptly correct the income disparity. While, in the developed three blocks, the irrigation areas are obliged to be reduced by flood damages. Resumption of the entire area is possible by the implementation of flood measures including relocation of pump station, repair work of pump facilities at the site, renewal of electric appliances, etc. Recovery to the previous irrigated agriculture is possible through correction of the regional disparity by construction of the irrigation facilities in Block A and restoration from damages.

4.2 Effectiveness

The prospected quantitative and qualitative effectiveness after implementation of the Project is as follows and judged possessing relevance.

(1) Quantitative Effectiveness

The quantitative effectiveness expected by the Project is as follows.

Table Target Indicator

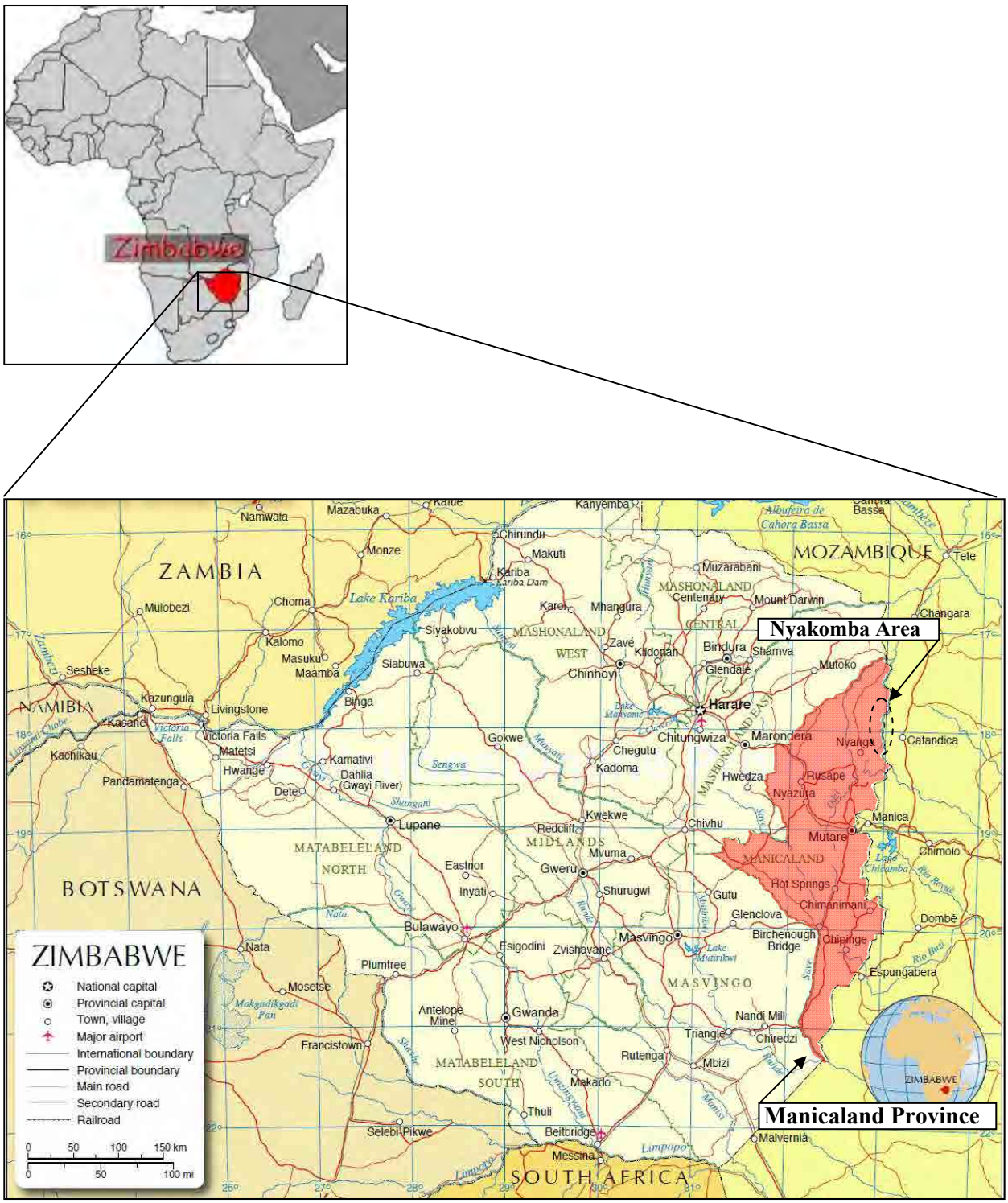
Indicator	Present Value Year of 2014	Target Value Year of 2021 3 years after completion
Irrigation area (ha)	261	580
Cultivating area (ha)	764	1,045
Crop production in the top 3 crops		
Green maize (ton)	485	1,727
Sugar bean (ton)	333	534
Onion (ton)	648	2,160

Irrigation area, cultivating area and crop production are total of Block A to D.
Present value is based on the data collected from Project Office, Nyakomba, AGRITEX.

(2) Qualitative Effectiveness

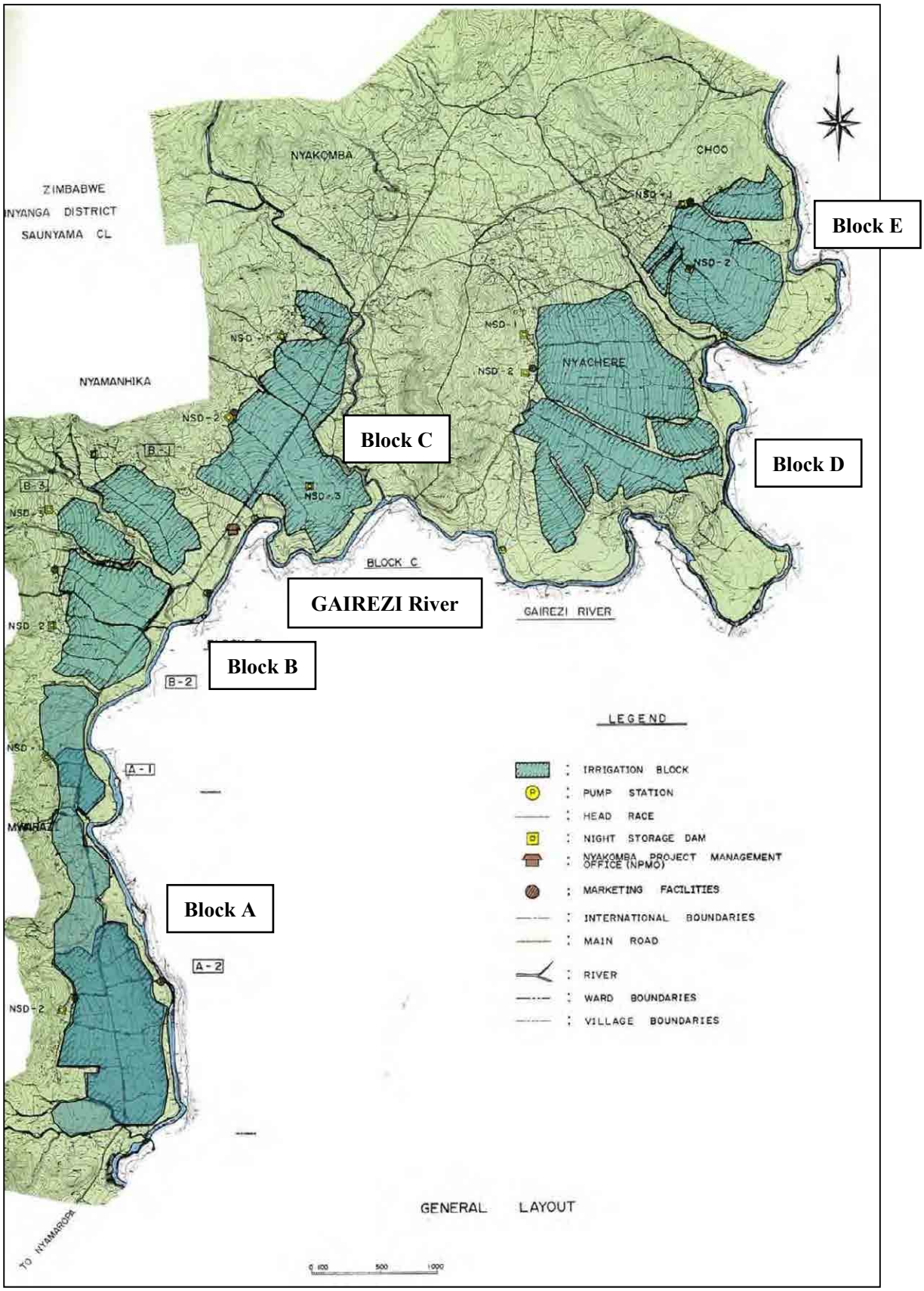
The qualitative effectiveness expected by the Project is as follow:

- Agricultural production will increase and stabilize food supply in Nyakomba area
- Profitable crops will be introduced by introducing irrigation agriculture.



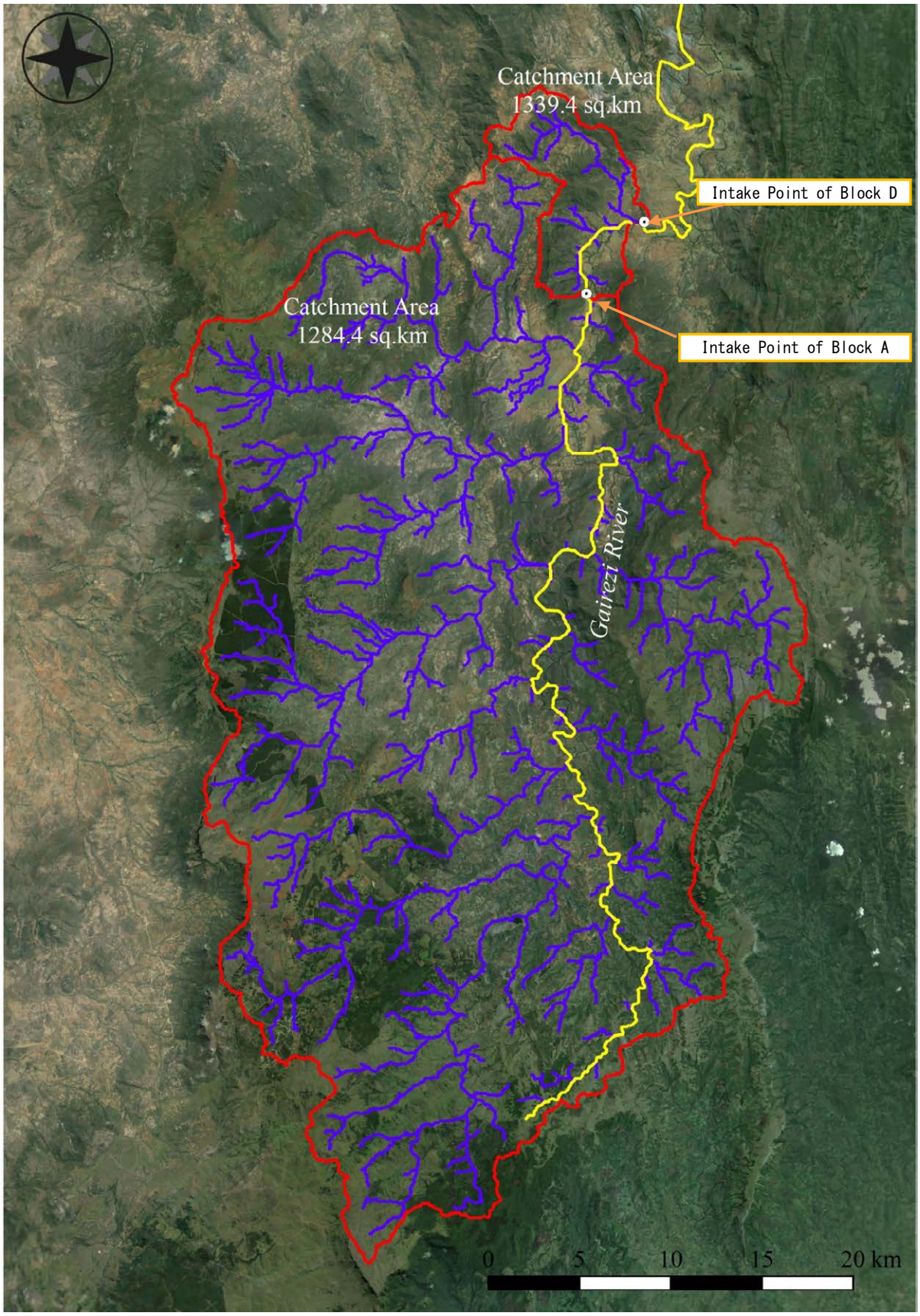
(Prepared by Nation Online Project)

Project Area (1/2)

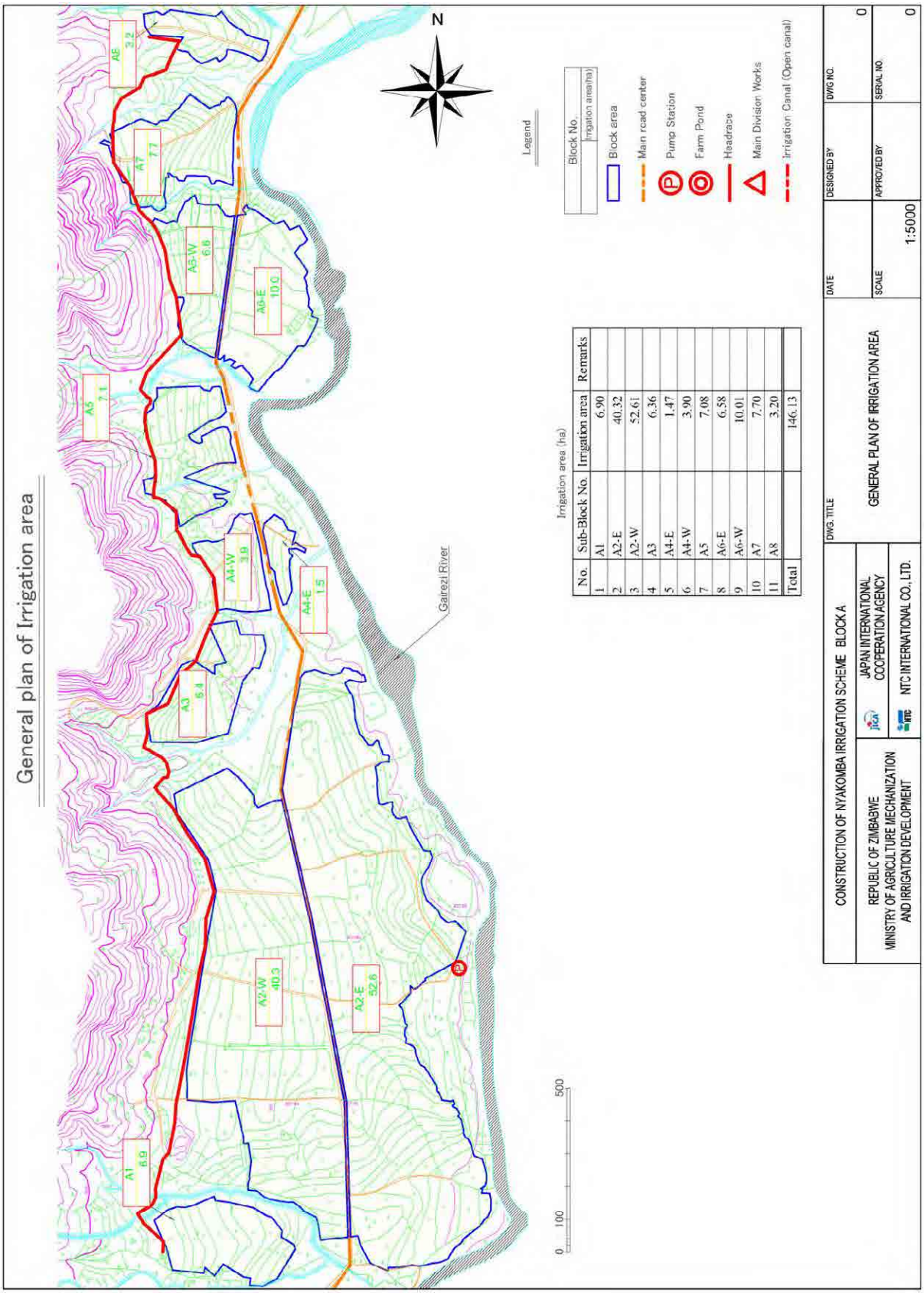


Source: The Feasible Study on the Nyakomba Irrigation Development Project, 1990

Project Area (2/2)



Gairazi River



General Plan of Block A


Nyakomba Irrigation Scheme for Block A
Pump Station
Farm Pond
Irrigation Canal

Republic of Zimbabwe
The Preparatory Survey on the Project
for Irrigation Development for Nyakomba Irrigation Scheme

Final Report

Contents

Page

ANNEX

List of Figure

List of Table

Page

Abbreviations

Abbreviation	English
ACBF	African Capacity Building Foundation
AfDB	African Development Bank
AGRITEX	Department of Agricultural, Technical, and Extension Services
AU	Africa Union
BS	British Standard
CIDA	Canada International Development Agency
DCIP	Ductile Cast Iron Pipe
DFID	Department for International Development
DOI	Department of Irrigation
E/N	Exchange of Note
EIA	Environmental Impact Assessment
EMA	Environmental Management Agency
EMA	Environmental Management Act
EMP	Environmental Management Plan
FRP	Fiber Reinforced Plastics
FTLR	First Track Land Reform
G/A	Grant Agreement
IEE	Initial Environmental Examination
IMC	Irrigation Management Committee
JICA	Japan International Cooperation Agency
M/D	Minutes of Discussion
MAMID	Ministry of Agriculture, Mechanization and Irrigation Development
MC	Management Committee
MCC	Mazowe Catchment Council
MEWC	Ministry of Environment, Water, and Climate
MLGPWNH	Ministry of Local Government, Public Works and National Housing
MLRR	Minister of Lands and Rural Resettlement
MOEPD	Ministry of Electricity and Power Development
MOFED	Ministry of Finance and Economy Development
MOHCC	Ministry of Health and Child Care
OIMC	Overall Irrigation Management Committee
RAW	Readily Available Water
RC	Reinforced Concrete
SADC	Southern African Development Community
SANS	South Africa National Standard
SAZ	The Standards Association of Zimbabwe
SIDA	Swedish International Development Agency
SNV	Netherland Development Organization
SP	Steel Pipe
TAW	Total Available Water
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WMC	Water Management Committee
ZAMCOM	Zambezi Watersource Commission
ZESA	Zimbabwe Electric Supply Authority
ZIMRA	Zimbabwe Revenue Authority
ZINWA	Zimbabwe National Water Authority

Chapter 1 Background of the Project

Chapter 1 Background of the Project

1.1 Project

1.1.1 Background

Agricultural sector in Zimbabwe is recognized as one of the most important sectors in the country because it accounts for 20% and 40% of Gross Domestic Product (GDP) and total export amount respectively. Moreover, it is estimated that the agricultural sector creates job opportunities for 30% of total population in the country. The Government of Zimbabwe (GOZ) planned to introduce irrigation agriculture for smallholder farmers in communal lands, known as low productivity area that are fragile against drought, and the GOZ officially requested the Government of Japan (GOJ) for support of irrigation development in 1985. Based on this request, Japan International Cooperation Agency (JICA) has implemented Feasibility Survey (F/S) through the development study titled as Nyakomba Irrigation Plan (1989-1990). By this context, the GOZ requested the GOJ the irrigation facility development project of Block A, B, C, D and E in Nyakomba irrigation area by the Japanese grant aid scheme. Based on the request, the basic design by Japanese grant aid for Block B and C was conducted and the irrigation facilities were constructed and completed as Phase 1. As same as Block B and C, the basic design of Block A, D and E was conducted and the only the Block D was completed as Phase 2. Total area irrigated by the aforesaid support in Block B, C and D is estimated as 430 hectares.

In 2000, radical land resettlement, known as the First Track Land Reform (FTLR) program implemented by the GOZ led to the deterioration of economic outlook resulted from economic sanctions by donor's country which leads to hyperinflation. In addition, confrontation between the ruling and opposition parties occurred during the national presidential and parliamentary election in 2008 triggered violence which leads to further security deterioration. With this background, most of the JICA's development assistances in the country including the irrigation development project in Block A have temporarily been stopped except for a few cooperation schemes through some international organizations.

Signs of recovery began to appear in 2009. Through the intervention by regional economic communities such as African Union (AU), Southern African Development Community (SADC) etc., the GOZ established coalition government of both parties in and out of power, and also adopted international currencies i.e. US dollar instead of the local currency with aim of bringing down the hyperinflation and solving the political unrest. In 2012, the GOZ has re-requested the GOJ for the implementation of the project. In order to restart the project by Japanese Grant Aid scheme which is relatively large scaled financial support, the GOJ set several conditions. They are: the revision of constitutional authority of the president and constitution itself and implementation of peaceful and impartial national election under the new constitution. In the late July 2013, presidential and

parliamentary election was held under the new constitution, and the incumbent president Robert Mugabe swept the candidates of opposition parties, and was re-elected. The result of the election was declared free and fare and was approved by other countries and regional economic communities such as AU, and SADC including GOJ, though a few western countries disagreed. Therefore, the GOJ finally agree to restart the Japanese Grant Aid for GOZ.

Accordingly, in March 2013, JICA has organized field survey to Nyakomba Irrigation area and realize the insufficiency of pumping ability toward the irrigation area. The area has been hit by hurricane in 2000 and 2006, which have caused the complete flooding of the pump stations in Block B, C, and D. During the 2006 hurricane, for example, the high water level of the flood reached 30 cm above the floor elevation of the pump stations, so that pump facilities installed in the basement of the pump stations were completely submerged and were filled with soil deposit. Based on these findings, consideration of rehabilitation on Block B, C, and D are incorporated as part of the Project.

This survey, the preparatory survey on the Project for Irrigation Development for Nyakomba Irrigation Scheme in the Republic of Zimbabwe (hereinafter referred as the Preparatory Survey), focused on the followings points i) the confirmation of validity and necessity of the Project, ii) conducting the appropriate preliminary designing as a Japanese Grant Aid, iii) the formulation of the project plan and rough estimation of the project cost. Besides, the preparatory survey examines the current status of Block B, C, and D especially in the pump stations where the site was submerged by the flood, and then formulates the plan and estimate the rough cost after the validity of the rehabilitation on those blocks were confirmed.

1.1.2 Objective

The Project (Preparatory Survey) will review the contents of the Basic Design Study conducted in 1999 utilizing the result of the study made in 1999. In addition, the overall design and cost estimation in conformity with appropriate scope and scale will be executed by the Project considering the effects, the technical and economical validity and grasping the background objective and contents of the Project. At the same time, to achieve the outcome and objective of the Project items to be borne and to be covered by Zimbabwe side during the implementation, operation and maintenance plan would be proposed in this Study. Moreover, the objectives of the Project determines the scope and contents of the Project and rough estimate of the Project cost considering flood disaster prevention for pump stations at Block B, C and D based on the confirmation of the validity of those restorations.

1.1.3 Outline of the Project

Outline of the Project is as follows.

Table 1.1.1 Outline of the Project

Items	Contents
Project Site	Nyakomba Irrigation Scheme, Nyanga District, Manicaland Province
Responsible Organization	Ministry of Agriculture, Mechanization and Irrigation Development, MAMID
Implementing Organization	Department of Irrigation, DOI
Overall Goal	Food security and livelihood of benefitted farmers in Block A, B, C and D would be secured and improved.
Project Purpose	Agricultural productivity and income of formers would be improved through irrigation agriculture in Block A. Moreover, agricultural productivity would be stabilized in Block B, C and D.
Outcome	1. Necessary irrigation facilities will be constructed in Block A. 2. Irrigated agriculture in Block A will become possible. 3 Flood disaster prevention will be executed in Block B, C and D.
Input/Activities	The proposed activities/input of Nyakomba Irrigation Scheme 【Block A】 1. Construction of pump facilities (φ250× 90kW × 3nos) 2. Construction of irrigation facilities including headrace with 0.98 km, distribution pipeline with 4.4 km and open canal with 10.6 km 3. Construction of farm road with 4.7 km 4. Construction of drainage canal with 18.7 km 5. Procurement of equipment: including two numbers of tractor with attachments and one motorbike 【Block B】 1. Construction of retaining wall against flood and connection road 2. Repairing and arrangement of pump mechanical parts and replacement of electric facilities for pump 【Block C】 1. Construction of retaining wall against flood and connection road 2. Repairing and arrangement of pump mechanical parts and replacement of electric facilities for pump 【Block D】 1. Construction of pump facilities (φ300× 132kW × 3nos) 2. Construction of headrace with 365m 3 Construction of farm road connecting to pump station with 300m 【Overall】 1. Soft component a) Guidance of maintenance method for irrigation facilities b) Guidance of maintenance and repairing for pump facilities c) Promotion of contract farming
The Scale of the project (Beneficiary, Area, land holding)	【Block A】 1. Numbers of beneficiary farmers: 228 households 2. Irrigation Area: 146 ha 3 Average farmland area per household: 0.64 ha 【Block B】 1. Numbers of beneficiary farmers: 128 households 2. Irrigation area: 128 ha 3 Average farmland area per household: 1.00 ha 【Block C】 1. Numbers of benefited farmers, 165 households 2. Irrigation area: 115 ha 3 Average farmland area per household: 0.70 ha 【Block D】 1. Numbers of benefited farmers: 239 households 2. Irrigation area: 191 ha 3 Average farmland area per household: 0.80 ha

1.1.4 Past Japanese Grant Aid Project

Block B and C were completed on March 1998 during Phase 1 of the Project for the Nyakomba

Irrigation Development Project though the Japanese Grant Aid Scheme. Moreover, Block D was completed on December 2000 during Phase 2 of the Project for the Nyakomba Irrigation Development Project. The summary of the past Japanese Grant Aid Project are as follows.

Table 1.1.2 Past Japanese Grant Aid Project

Contents	Specification	Block B	Block C	Block D
Pump Facilities				
Diameter	Horizontal centrifugal pump	φ250	φ250	φ300
Motor		132 kW	150 kW	132 kW
Numbers		3 nos	3 nos	3 nos
Pipeline	DCIP, PVC, FRP	3.7 km	3.8 km	2.3 km
Farm pond	RC	1 place	1 place	1 place
Irrigation canal	RC open canal	12.0 km	15.0 km	16.2 km
Drainage canal	Earth canal	14.2 km	16.3 km	16.3 km
Main road	Gravel pavement	0.15 km	0.16 km	1.1 km
Farm road	Gravel pavement	3.92 km	4.10 km	
Administration office	603m2		1 building	
Workshop	272m2		1 building	
Warehouse	162m2		1 building	
Fuel storage	52m2		1 building	
Marketing house	270m2			1 building

1.1.5 Existing Condition of Block B, C and D

Nyakomba Irrigation Scheme has received huge damages caused by cyclone that hit the region in 2000 and 2006; especially the 2006 cyclone has brought remarkable damages to the pump facilities of the project. Maximum flood level reached 30 cm above the floor level of pump houses in Block B and C and 100 cm above the floor level in Block D. Therefore, plenty of flood water intruded into inside of basement of pump house. Since pumps were installed in the basement of the pump house they were submerged and damaged and all function of pump facilities were lost completely.

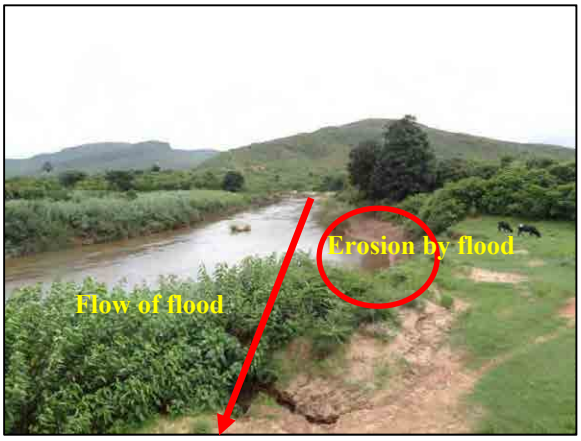
Thereafter, recovery works were conducted by Government of Zimbabwe, and one pump at least per one pump station was recovered to be operational. In spite of losing the value of fund collected as water fee by the farmers owing to hyper inflation and abolish of Zimbabwe dollar, Nyakomba Irrigation Scheme continue to be operational until today by the contribution of benefited farmers and support from AGRITEX on the distribution of agricultural inputs. However, the pumps were not operating on their full capacity because they were not recovered fully as a result the total irrigable area of the project was inadequate. Before the rehabilitation made on June 2013 at the pump station of Block D only 135ha (65ha of Block B and 70ha of Block C) of the total 434ha of irrigable land were developed. And even after the recovery of pump at Block D the project can develop only 241ha of land out of the total proposed irrigable area. At the time of the survey, the condition of irrigation system at Nyakomba is presented in the table below.

Table 1.1.3 Irrigation Condition in Developed Area

Items	Block B	Block C	Block D	Total
Developed Area (ha)	128	115	191	434
Irrigable Area (ha)	65	70	106	241
Number of Pump Installed	3	3	3	9
Operating Pump Number	1	1	2	4

1.1.6 Flood Damage

Through the field survey, the extent of flood damages were not confirmed at Block B and C after the 2006 cyclone hit the area and the size of erosion around pump station was not also confirmed. On the other hand, river course at Block D has been changed after the big flood of 2006, and it is become clear that flood water in Block D hit pump station directly every year. A flood occurred in March 2014 result in huge erosions around pump station at Block D including a complete washout of soil beneath the footstep and damage on pipes laid underground although flood intrusion into basement of pump station was not occurred. At the same time, since huge sediment accumulated around the intake point, big efforts were made by famers against removing sedimentation.



Flood hits pump station in Block D

Damages of pump house of foot step by flood at March 2014

Since flood damages continue to occur every year at Block D, drastic measures against the issue is found to be necessary such as relocation of pump station and others.

1.1.7 New Development Area of Block A

Some portion of irrigation canals with 9 lines and with total length of about 3,660 m were already constructed through famers' participation under the instruction of DOI based on the request from farmers in Block A. Though some cracks and incomplete parts of the facilities were confirmed, these constructed canals can be utilized after repair. IMC has already been established in Block A and great needs concerning new construction of irrigation facilities are confirmed.

Canals constricted by DOI in Block A

1.2 Environmental and Social Considerations

1.2.1 Key Issues Considered

Based on the Guidelines for environmental and social considerations of JICA, April 2010, hereinafter referred to as JICA's ESC Guidelines, the preparatory survey team made surveys and interviews with cooperation by the responsible organizations of the project, i.e. DOI, and stakeholders such as EMA, ZINWA, Ministry of Land, Ministry of Local Government, etc.

Key Environmental and Social Considerations Issues in this Project

1) Although this project is categorized as the Category B based on the JICA's ESC guidelines, the preparatory survey team will confirm whether full-scaled Environmental Impact Assessment (EIA) is necessary or not.

2) The preparatory survey team will reconfirm the contents and approval procedures of EIA on the development project in Zimbabwe. Also, necessary documents to be submitted by the implementing organization of the project, and detailed schedule for the environmental approval on the project should be confirmed. At the same time, the preparatory survey team will support the Government of Zimbabwe (GOZ) in order them to implement the survey in align with the JICA's ESC Guidelines.

3) The requests by the GOZ include development of the main road and farm road, but some candidate sites of the new road construction seems to be straddling existing farm lands. Since previous grant aid schemes in Block B, C, and D have also constructed similar roads in each block, processes of land acquisition/ compensation, and both positive/negative impacts caused by the land acquisition in those projects shall be studied and lessons learnt must be utilized into Block A. In case negative impacts on the previous blocks were confirmed by the study, the preparatory survey team will discuss with organizations concerned of GOZ, and propose a mitigation option. In case irrigation facilities are installed in Block A, land reallocation of 0.64ha per beneficial farmers are considered. This requires the confirmation of the process, amount of compensation, compensation method, and consensus formation against potentially-impacted farmers. These are: farmers having a right of cultivation, secondly leasehold farmers, newly immigrated farmers, wage workers, etc.

4) Affordable water management fee by the poor should be considered during the survey, because it is expected that levy of water management fees will be started after the construction.

5) Progress of the preparatory survey including overall design plan will be disclosed, and opinions of local residents and organizations concerned should be accepted during the stakeholder meeting and incorporated in the plan.

1.2.2 Description of the Project Components

Project components consist of 1) Water intake facility, 2) Irrigation facility, 3) Road, 4) Farm land consolidation, 5) Flood control measure and 6) Softcomponent.

1.2.3 General Conditions of the Project Area

(1) Land Use

Land Apportionment Act of 1930 was legislated to attract immigrants and raise revenues, while the great numbers of African traditional landowners were forced to resettle to the Communal lands where unsuitable for agriculture.[1] It still drags on the current land classification in the country. They are: i) State land, ii) Commercial land, and iii) Communal land.[2] Nyakomba irrigation scheme where project targeted is located in the Communal land at Nyanga district, Manicaland province. According to the Communal Land Act(CAP 20:24) of Zimbabwe, State land and Communal land is a part of governmental properties and maintenance work at those lands are delegated to the Ministry of Lands and Rural Resettlement (MLRR) and Ministry of Local Government, Public Works and National Housing (MLGPWNH) respectively. Positional relationship between the project targeted area and the nearest sanctuaries is shown in the Figure 1.2.1. Nyakomba belong to the ward number 11 in the Nyanga district having a border with Mozambique.

[1] Sato 1984:58, 1989:91
[2] Government of Zimbabwe. Ministry of Environment, Water and Climate, March 2014, Hwange Sanyati Biodiversity Corridor (HSBC) Project. Process Framework. Smallholder production scheme and slightly larger scale called A1 and A2 respectively are belongs to State Land.

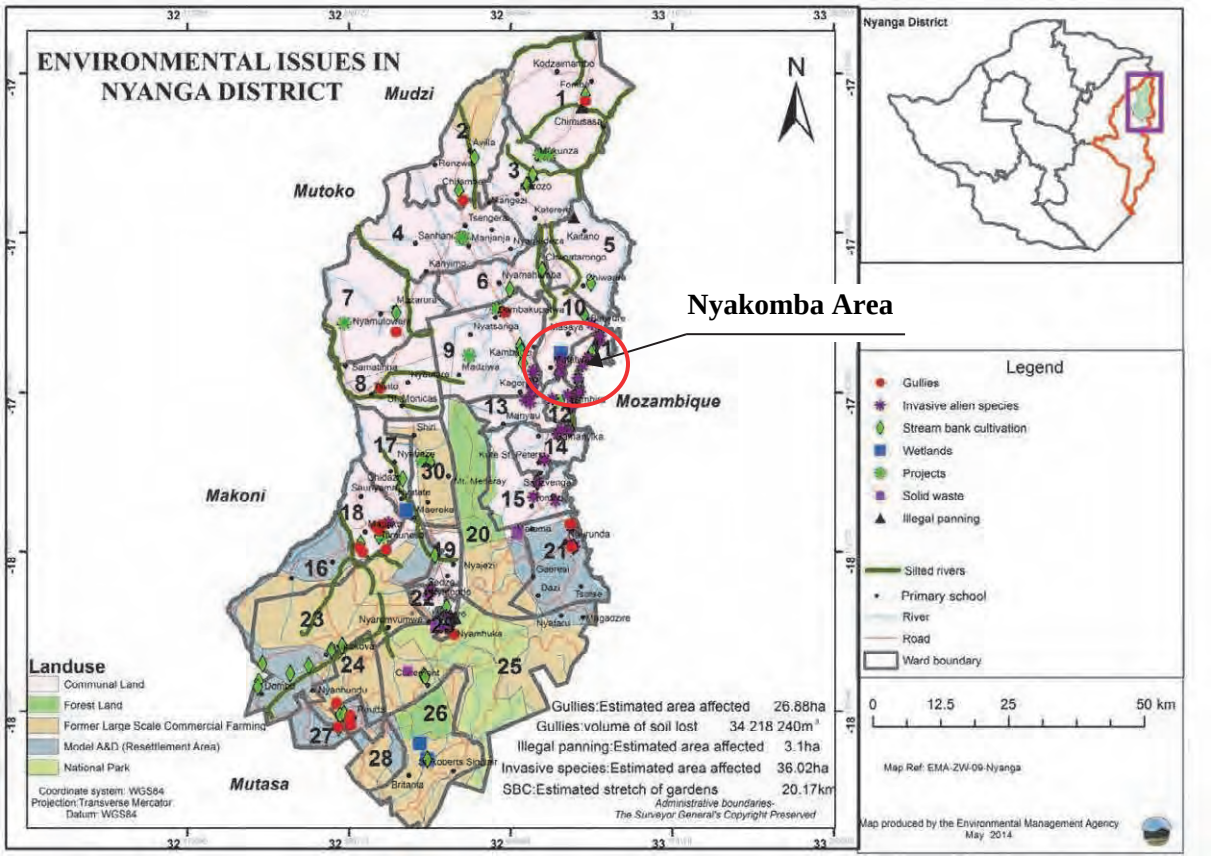


Figure 1.2.1 Land Use and Sanctuaries in Nyanga District[3]

(2) Natural Environment

In the western part of the project site, mountains as high as 1,300 m.a.s.l runs north to south overlooking the targeted villages to the east which consists school, houses, church, etc. Farm lands are developed on the gentle slope of about 5% from the village up to the Gairezi River. The farm land area is bisected by numerous gullies running from the mountain toward the river. With reference to Zimbabwe Natural Region and Provisional Farming Areas classification, the target project area is categorized as Zone IIa: Intensive Farming Region (annual rainfall amount ranges between 750-1,000mm) and Zone III: Semi-Intensive Farming Region (showery annual rainfall amount ranges between 650-800mm), and formed by rainy season from November to March and dry season during other months in general.[4] Legume shrub is major vegetation in the area. Local useful trees grow up on the mountains and close to the villages, while Lantana Camara L., one of the registered invasive alien spices widely grows all over the road and nearby small rivers (see Table 1.2.1). Environmental Management Agency (EMA) is trying to control the species, but significant result up to date is not shown yet. It is also confirmed at Environmental Management Agency, Manicaland Provincial office that there are no particular ecologically important habitats in the project site.

[3] Environmental Management Agency, Manicaland Provincial Office, Jan. 2015
[4] Zimbabwe Natural Region and Provisional Farming Areas, 1998

Table 1.2.1 Major Trees Grown and Way of Use in Nyakomba

Species Name		Gregariousness	Use						
Scientific/ Botanical	Shona		Fire	Pole	Hoe Handle	Fence	Oxen plow	Rope	Const.
1. Lantana Camara L.	Mugupa	All around				X			
2. Piliostigma Thonningi	Musekesa		XX						
3. Combretum Apicultum	Mugado		X						
4. Bauhinia Petersiana	Munando	Swamp	X						
5. Peltophorun Africanum	Muzeze		X	(X)					
6. Dichrostachys Cinerea	Mupangara		X	X					
7. Acacia Nigrescens	Muguunga		X	X		X			
8. Terminalia Sericea	Mususu		X	X			X		X
9. Brachystegia Spiciformis	Musasa	Mountain	XX	X	X		X	X	X
10. Brachystegia*1	Munondo	Mountain	X					X	X
11. Brachystegia*1	Mupfuti	Mountain	X					X	

*1: Couldn't identify
XX: Often used, X: Used, (X): Used somehow

(3) Socio-economic Condition

The preparatory survey team with cooperation from AGRITEX staffs conducted a questionnaire survey to 10 households at each block, paying attention to random sampling and gender balance of household head. The purpose of the survey is to grasp the annual income, HH distribution and employment condition of the community. The survey result is shown below.

Table 1.2.1 Socio-economic Conditions in Nyakomba

Block	No. of HH[5] (HH)	Area Benefitted (ha)	Area per HH (ha)	Gross Agricultural Income (US$/year)
A	228	146	0.64	1,196
B	128	124	0.97	4,877
C	118	114	0.97	3,887
D	205	191	0.93	2,231
Total/Avg.	679	575	0.85	3,048

Table 1.2.2 Age Distribution per HH

Block	< 14	15-64	<65	Total
A	2.1	2.7	0.3	5.1
B	1.9	3.2	0.5	5.6
C	2.5	3.2	0	5.7
D	1.6	2.6	0.1	4.3
Average	2.0	2.9	0.2	5.2

Table 1.2.3 Employment condition per HH

Block	Agriculture	Permanent Employee	Wage Worker	Total
A	2.9	0.1	0	3.0
B	3.2	0.5	0.1	3.8
C	3.4	0	0	3.4
D	2.5	0	0.2	2.7
Average	3.0	0.2	0.1	3.2

[5] Survey Data. AGRITEX Extension Workers. Jan. 2015

(4) Traditional Leaders

In terms of religion, the community in project area consists of two groups one professes traditional religion called Kupira Wazimo, and the other does Christian religion. Other than the religious division the community has traditional leader. These Traditional Leaders have the power to make a decision in the village. Figure 1.2.1 shows structure of the traditional leaders in Nyakomba Block A. The communities of the target area are sub-divided into two villages namely: Dandadzi and Mutandakamwe which is also the name of each clan as well as village head. These village heads are delegated by MLGPWNH: Ministry of Local Government, Public Works and National Housing to manage Communal land practice as well as to work as conciliator and troubleshooter for the community in the target area. Allowance to the Traditional Leaders is paid by the said ministry. This project does not require significant land expropriation; however the traditional leaders shown below with supervision of MLGPWNH will be responsible for the complaint management system only if complains arise from communities.

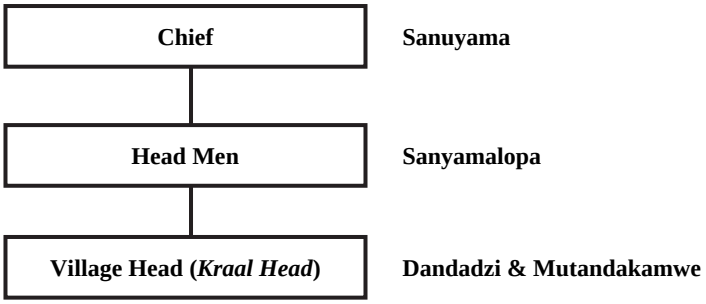


Figure 1.2.2 Structure of Traditional Leaders at Block A in Nyakomba

(5) History of the Village

A *Shona* word *Kuyeredze* means a flood sluices people or something away. After British changed location name all over the country, it's changed to Gairezi for their easy pronunciation. Main targeted area of the project, Block A, is consists of two clans: They are *Mutandakamue* and *Dandadzi*. The former professes traditional religions called as *Kupira Wazimo* praying to the spirits of their ancestors, while the later has professed Christian religion and been forced by the Government of the day in 1950s to immigrate from their original place, inland of the country. Border of two groups in the Block A can be clearly identified by referring to the original basic design of the Nyakomba irrigation scheme (Phase 2) drawn in 1990s. That is to say, most of the targeted village at that time was *Dandazi*.[6] This is because, the original irrigation development plan targeted immigrants forced to resettle so that most of the beneficiaries were Dandadzi that exclude the original people unfairly. However, the Preparatory team confirmed that nowadays the two groups are not being stuck in the past or origin, rather working together peacefully as one community of Block A. E.g., Irrigation Management Committee (IMC) of Block A shall be composed of 5 member from each village namely:

[6] Interview with Village Head 2014

either one of two groups which definitely will cause negative impact in the community. As a conclusion, it is decided that targeted area in the Block A covers both community living inside Mutandakame and Dandazi village, consequently the block is subdivided into sub blocks A1 to A8 to cover the two villages.

(6) Sacred Place

As one of their traditional events, the communities pray for good rain on or about every September to October two months ahead to the rainy season on the mountain This culture is still practiced in *Mutandakamwe as part of their religion*, while not in *Dandadzi* for last three years. Modernization and/or conversion to Christianity from the *Kupira Wazimo* especially among young generation might be one of the reasons promoted the change. On the other hand there is a burial of the first village head that is located on the top of the mountain near by the residence of present *Mutandakamwe's* village head; it is a sacred place where nobody is allowed to enter into the area. Fortunately, this burial place and praying place is out of the project area so that the project plan will not affect it.

1.2.4 Institutional and Legislative Framework of Environmental and Social Considerations

(1) Institutional and Legislative Framework

Institutional and legislative framework of Environmental and Social Considerations (ESC) in Zimbabwe is summarized in the following table.

Table 1.2.4 Institutional and Legislative Framework of ESC in Zimbabwe

Category	Organizations Concerned	Laws, and Articles Concerned
EIA	Ministry of Environment, Water, and Climate Ministry of Health and Child Care EMA: Environmental Management Agency Environmental Planning and Monitoring Unit	Environmental Management Act CAP 20:27 PART XI Environmental Impact Assessment, Audit, and Monitoring of Projects PART XVI General "First Schedule"
Land expropriation	Minister of Local Government, Public Works and National Housing Minister of Lands and Rural Resettlement Nyakomba RDC: Rural District Council	Communal Land Act CAP 20:04 Rural District Council Act CAP 29:13
Water use fee	Ministry of Environment, Water, and Climate Ministry of Agriculture, Mechanization, and Irrigation Development ZINWA: Zimbabwe National Water Authority Mazowe Catchment Council ZESA: Zimbabwe Electric Supply Authority	Water Act CAP 20:24

Source: Environmental Management Act CAP 20:27, Communal Land Act CAP 20:04, Water Act CAP 20:24

According to the Environmental Management Act CAP 20:27 PART XVI, Article 97, projects listed in the First Schedule is projects which must not be implemented without EIA.[7] This project is classified under Category 2 Drainage and Irrigation corresponding to (b) irrigation schemes, according to the following table.

[7] PART XVI, First Schedule, Environmental Management Act Chapter 20:27

Table 1.2.5 Projects that require EIA

Category	Detail
1. Dams and artificial lakes	-
2. Drainage and Irrigation	(a) drainage of wetland or wild life habitat; (b) irrigation schemes
3. Forestory	(a) conservation of forest land to other use; (b) conservation of natural woodland to other use within the catchment area of reservoirs used for water supply, irrigation or hydropower generation or in areas of adjacent to the Parks and Wild Life Estate.
4. Housing developments	-
5. Industry	(a) chemical plants; (b) iron and steel smelters and plants, (c) smelters other than iron and steel, (d) petrochemical plants; (e) cement plants, (f) lime plants; (g) agro-industry; (h) pulp and paper mills; (i) tanneries; (j) breweries; (k) industries involving the use, manufacture, handling, storage, transport of disposal of hazardous or toxic materials.
6. Infrastructure	(a) hiways; (b) airports and airport facilities; (c) new railway routes and branch lines; (d) new towns or townships; (e) industrial sites for medium and heavy industries;
7. Mining and quarrying	(a) mineral prospecting; (b) mineral mining; (c) ore processing and concentrating; (d)quarrying
8. Petroleum production, storage and distribution	(a) oil and gas exploration; (b) pipelines; (c) oil and gas separation, processing, handling and storage facilities; (d)oil refineries
9. Power generation and transmission	(a) thermal power stations; (b) hydropower schemes; (c) high-voltage transmission lines
10. Tourist, resorts and recreational developments	(a) resort facilities and hotels, (b) marinas; (c) safari operations
11. Waste treatment and disposal	(a) toxic and hazardous waste; (b) municipal solid waste; (c) municipal sewage
12. Water supply	(a) groundwater development for industrial, agricultural or urban water supply; (b) major canals; (c) cross-drainage water transfer; (d) major pipelines

As mentioned above, since EIA is required for irrigation scheme before its implementation, Department of Irrigation (DOI) has submitted the inquiry letter dated on Dec. 4, 2014 to Environmental Management Agency in order to clarify whether the project is required to do full scaled EIA or not. Then, the written answer from Environmental Management Agency has arrived on Dec. 9, 2014 saying full-scaled EIA is not necessary, however compilation and submission of Environmental Management Plan (EMP) to Environmental Management Agency by DOI is required (See Annex 6). Contents which EMP should fulfill are shown in the following table, so that the Preparatory survey team and DOI has agreed the EMP has equivalent function as the Initial Environmental Examination (IEE) that is required by JICA ESC Guideline for Category B project.

Table 1.2.6 Contents of Environmental Management Plan (EMP)

1	An executive summary
2	A table of contents
3	List of acronyms
4	Introduction / project background
5	Full project description including maps
6	Stakeholder consultation
7	Legal framework
8	Environmental baseline analysis
9	EMP
10	EMP implementation plan and the associated cost
11	Disposal Plan
12	List of beneficiaries

Although deadline to submit the EMP to EMA is not clearly specified but just said before

commencement of the project, a customary rule which DOI used to follow these days is to submit the EMP by or about three months after receiving the letter from EMA, and EMA reply the result of inspection within another sixty days. Currently, as of Mar. 2015, deputy director of DOI in charge of planning is processing the compilation of EMP and will submit it as soon as completed. Following chart illustrates flow of EIA process in Zimbabwe developed based on the country's report[8] as well as information gathered from the organizations concerned.

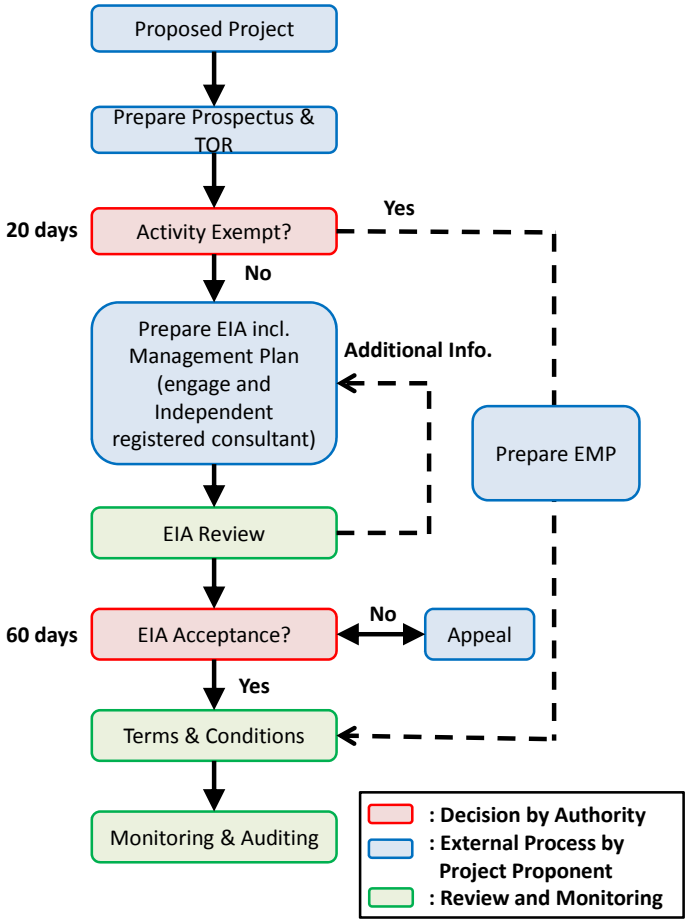


Figure 1.2.3 EIA Process in Zimbabwe

(2) Organizations Concerned to the Environmental and Social Considerations

The Ministry of Agriculture, Mechanization, and Irrigation Development as an implementing body of the project take entire responsibility of the project including Environmental and Social Considerations. Any size of land acquisition in communal lands will be done under the supervision of Minister of Local Government, Public Works and National Housing, Minister of Lands and Rural Resettlement, and Nyakomba RDC: Rural District Council.

EMA: Environmental Management Agency, a parastatal under the MEWC: Ministry of Environment, Water and Climate, is statutory body responsible for ensuring the sustainable use of

[8] Country Report, Zimbabwe. P.Spong, V. Boooth, and B. Walmsley. Figure.6 The EIA process

natural resources and the protection of environment and coming up with plans to prevent pollution and environmental degradation. EMA has two operational departments which are the Environmental Protection (EP) and the Environmental Management Services (EMS).[9] Environmental Planning & Monitoring Unit under the department of EMS is responsible for implementation of the EIA: Environmental Impact Assessment (See Figure 1.2.4).

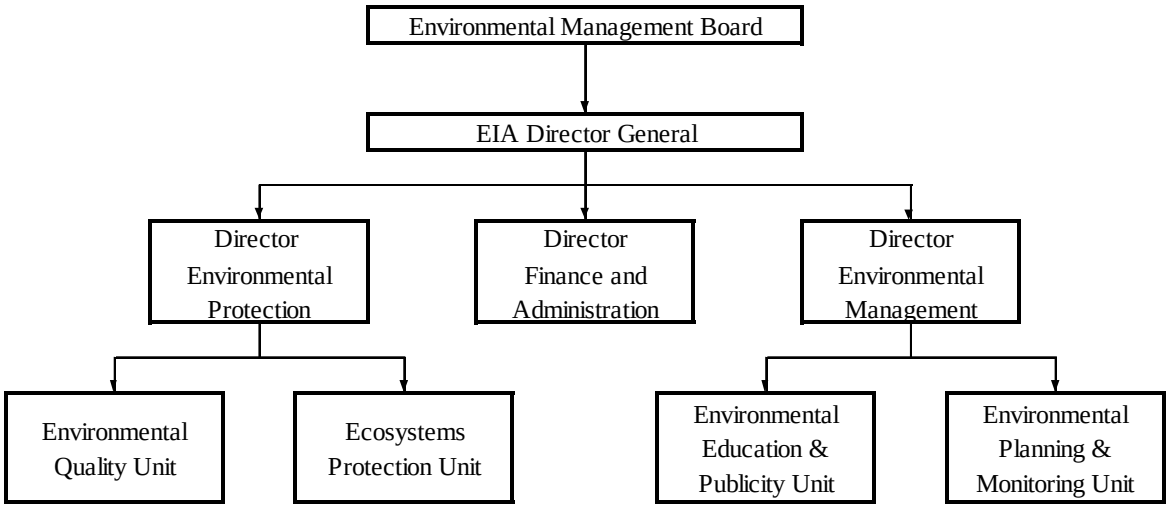


Figure 1.2.4 Organanogram of Environmental Management Agency

1.2.5 Environmental and Social Considerations

(1) Examination of Alternatives

Table 1.2.7 shows result of the comparative examination of alternatives including Zero option. As a result, this project is evaluated that it will bring positive impact toward the beneficial area in terms of increase of agricultural productivity as well as economic development of the area.

Table 1.2.7 Result of Examination of Alternatives including Zero Option

Item	Plan A: RC Retaining Wall	Plan B: Reconstruction of Pump Stations	Plan C: A+B	Plan D: Zero Option
Abstract	A plan aims at protecting pump stations against future flood by reinforced concrete retaining walls constructed on all sides of each station.	A plan for new construction of all pump stations at safer place than current location against the future flood.	Mixed plan of Plan A and Plan B, i.e. New construction at Block A and D, while construction of RC retaining walls at Block B and C.	A plan, without any construction, that tackles protection of the irrigation facilities against future flood.
Technical point of view	To construct RC retaining walls on all sides of each pump station. The situation of existing pump stations is	This plan needs boring test at candidate construction sites, and also shifting pipelines to the new pump stations instead of the existing	The result of the preparatory survey advised to employ Plan A for Block B and C, and Plan B for Block A and D.	Since pump facilities has been submerged by cyclone in 2006, for several weeks, the pump and electrical facilities are not functioning properly. In particular, control panels are

[9] Environmental Management Agency, About EMA

Item	Plan A: RC Retaining Wall	Plan B: Reconstruction of Pump Stations	Plan C: A+B	Plan D: Zero Option
	categorized into two types by degree of flood damage. One, like block B and C, where indirectly hit by flood but its foundation is firm and not eroded by the flood, and the other one, Block D, where directly hit by flood and damaged seriously. The former can be solved by construction of RC retaining walls, but protecting the pump station at Block D by the same way may be challenging technically. Therefore, fundamental measure, i.e. relocating the station to another site is best solution	one. In terms of flood management, this plan is the most reliable among alternatives, and able to stably-provide water to the people.	Stream regime at selected candidate site for new construction of pump stations in Block A and D was relatively stable, and rock exposure was also observed. Boring test result showed presence of rock stratum at 10m depth from the top level. Hence, the candidate sites are judged as appropriate for the construction.	not in good condition, and nobody knows when stacked. To operate and maintain aforesaid conditioned facilities by ZINWA or DOI for distributing water to the people seems beyond their capacity from technical point of view. By Zero option, development of irrigation scheme in all existing blocks is nearly impossible.
Cost	Cheaper than the Plan B.	Most uneconomical plan due to cost for construction of new pump stations and replacement of pipeline.	Expensive than Plan A, but cheaper than Plan B.	Most inexpensive way among four plans.
Social environment	-Workload of water drawing from Gairezi River by children and women will be relieved that leads to having enough time for schooling by the children but announcement to the community by setting signboards and/or controller to prevent traffic accident is necessary. -Due to the introduction of irrigation scheme production will increase especially in dry season, and scale up of contract farming in addition to the existing one are forecasted. These will increase income of beneficiaries, and create more job opportunity especially seeding and harvesting works. Eventually, the area will economically grow. - Involuntary resettlement will never happen.			-Children and women are obligated to fetch water from Gairezi River 4 to 5 times a day taking several hours of the day. Less time for schooling -No irrigation development in Block A alone definitely creates a sense of distrust and inequity. -Rain fed cultivation does not lead economic growth so that economy may be stagnant.
Natural environment	-Very limited impact may happen on ecosystem due to tree cutting. -Though partially, elimination of invasive alien spices growing around the construction sites is expected. -Culverts damaged by gully erosion will be rehabilitated.			-Degree of negative impact to the ecosystem is insignificant. -Keeping the culvert damaged by gully erosion without any rehabilitation leads difficulty of road transportation in the near future.
The best plan and reason	This plan is NOT recommended, because this is not fundamental solution against flood.	This plan is NOT recommended in terms of the cost and time for construction.	This plan is recommended, because it coordinates stable water use and economic growth.	This plan is NOT recommended because of following reasons: -Unreliable economic impact and possibility of creating conflicts between the blocks. -Forcing children and women to continue the water drawing labor works.

(2) Scoping for Initial Environmental Examination (IEE)

Regarding the examination of degree of environmental impacts by the project, Scoping is done, and some environmental parameters in which negative impacts are likely to be caused, are identified. For these parameters, terms of reference (TOR) to identify study method of environmental impacts are prepared. Scoping of environmental impacts and TOR are presented as follows:

Table 1.2.8 Scoping Result

Category		Likely Impact	Rating[1]		Description and Reason of Rating
			D/C	O	
Pollution	1	Air Pollution	B-	D	Construction Stage: Dust and emission will occur temporary due to increase of construction vehicles. Operation Stage Pump station in this project is electric driven so that carbon dioxide (CO_2), sulfur oxides (SOx) and soot and dust by internal combustion (IC) will not be discharged.
	2	Water Pollution	B-	C+	Construction Stage Flow of muddy water to the river is expected. Operation Stage Volume of soil runoff from the field to the river will be reduced by installation of irrigation/drainage canal, as well as land leveling.
	3	Solid Wastes	B-	D	Construction Stage Solid wastes by the project (construction of pump station and general construction) are expected such as excavated soils that are unfit for backfilling.
	4	Soil Contamination	D	C-	Operation Stage Minor soil contamination will occur by development of irrigation agriculture with application of chemical fertilizer.
	5	Noise and Vibration	C-	D	Construction Stage Some impacts are expected by construction machines, but the impact is limited because most of the construction site is isolated from the houses.
	6	Ground Subsidence	D	D	There is no work to cause grand subsidence.
	7	Offensive Odor	D	D	There is no work to cause offensive odour.
	8	Bottom Sediment	D	D	There is no work to cause bottom sediment.
Natural Environment	9	Protection Area	D	D	There are no national parks and sanctuaries nearby the site. The nearest wetland is totally blocked out by mountain ridge with 1,300 m.a.s.l. Hence, no impact on the protection area is expected.
	10	Ecosystem	C+/-	C+	Construction Stage C-: Minor impact on ecosystem such as cutting trees and land reclamation during the construction will occur. Operation Stage C+: On the other hand, uproot of invasive alien spices growing around the construction site contributes to reduce number of the trees.
	11	Hydrological Situation	D	D	No impact is expected since intake volume is small enough comparing with the total flow volume found in Gairezi River.

Category		Likely Impact	Rating[1]		Description and Reason of Rating
			D/C	O	
	12	Topography and Geographical Features	D	D	No impact is expected.
Social Environment	13	Involuntary Resettlement	D	D	There is no work to cause involuntary resettlement.
	14	Vulnerable social groups, such as indigenous and ethnic people	D	D	Project targeted area belongs to communal land where current beneficiary farmers has been forced to move in 1960s to 70s, and since the project also benefit the indigenous people, there will be no vulnerable social groups, such as indigenous and ethnic people.
	15	Local economy such as employment and livelihood, etc	B+	B+	Both Stage In the past grant aid scheme, farmers in the Block B, C, and D were employed as casual workers during the construction phase and seasonal labors for harvesting horticulture crops in dry season during the operation phase, and their income was increased. Likewise, positive economical impact by this project is expected.
	16	Land use and utilization of local resources	D	B+/ C-	Operation Stage By-laws prepared by IMC will promote efficient land use and protection of natural resources. However, reclamation of dry lands close to the irrigation scheme may cause certain negative impact such as improper land use, mismanagement of natural resources, etc.
	17	Water Use	B-	B+	Construction Stage Construction of new pump stations in dry season will cause water drawing from the Gairezi River Operation Stage After complete of the construction, stable water use not only from the Gairezi River, but farm pond, canal etc will be available.
	18	Existing social infrastructures and services	C-	B+	Construction Stage Construction vehicles and machines during the construction stage cause regional traffic jam. Operation Stage Rehabilitated existing infrastructures will improve the transportation and accessibility; furthermore enhancement of public and social services is expected.
	19	Social asset and decision making organizations at local	D	B+/ C-	Operation Stage Development of agricultural infrastructures mainly irrigation will promote establishment of IMC. However, proper distribution of water and levy of water tariff from the users can be challenging if the organization were not functional enough.
	20	Misdistributio n of benefit and damage	D	D	Beneficiaries were agreed with equal land distribution in the past grant aid scheme, same manner is expected in this project as well.
	21	Local Conflict of Interest	D	D	No impact is expected.
	22	Cultural Heritage	D	D	Religious graves and mountains for praying for good rainfall are located out of the project area. Thus, no impact on cultural heritage is expected.
	23	Landscape	D	C-	Operation Stage Although significant negative impact is not expected, RC retaining walls constructed on all sides of the stations in Block B and C against the flood may make a bad impression to the onlookers. In addition, the wall will make access to the river difficult for this portion of the river
	24	Gender	D	B+	Operation Stage

Category		Likely Impact	Rating[1]		Description and Reason of Rating
			D/C	O	
	25	Children's Right	D	B+	No negative impact on gender is expected. Rather, water source becomes much closer to the villages, so that women and children's workload and time to fetch water from the Gairezi River will be reduced. Children will get enough time for their education. In addition, economic growth by the project will support the parents to send their children to secondly or higher schools.
	26	Hazards(Risk) Infectious diseases such as HIV/AIDS	C-	D	Construction Stage Majority of construction workers will be local people; therefore occurrence of infectious diseases is limited.
	27	Working Conditions, Occupation Safety	B-	D	Construction stage Some possibility of the neglecting working conditions and safety is expected.
Others	28	Accident	B-	D	Construction stage Some possibility of the neglecting warning and safety measure during the construction stage is expected.
	29	Monitoring	D	D	No impact is expected.
	30	Water Permit for new irrigation scheme	C-	D	Gairezi River is boundary river between Zimbabwe and Mozambique. However, volume of water intake by this project is considerably minimal. No troubles between two countries have been reported for last 15 years after the last grant aid scheme completed. ZINWA with support of DOI, MAMID already started communicating and informing the responsible body in charge of the river management issue on the Mozambique side; therefore depute between the two countries will not be expected.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is slight or unknown.
(A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.
*[1] D: Design Stage, C: Construction Stage, O: Operation Stage

(3) TOR for Initial Environmental Examination (IEE)

For those parameters which are evaluated as negative or unknown, namely, A, B, and C mentioned above, study methods are proposed as shown below.

Table 1.2.9 Terms of Reference

Parameters May affect		Survey Items	Survey Methodology
Examination of alternatives		Selection of the project site and measures against future flood	(1) Field visit and haring from the beneficiaries and stakeholders (2) Discussion with experts within the study team
1	Air pollution	(1) Confirmation of discharge standards (2) Confirmation of situation at construction site (3) Confirmation of situation at operation stage	(1) Collection of existing data (2) Review of construction contents, methodology, location, field survey, hearing from beneficiaries and organization concerned, and traffic analysis (3) Traffic analysis, field survey and hearing from beneficiaries and organization concerned

Parameters May affect		Survey Items	Survey Methodology
2	Water pollution	(1) Confirmation of environmental standards (2) Confirmation of water quality of Gairezi River during construction stage (3) Confirmation of usage of river water	(1) Review of existing information and standards (2) Review of construction contents, methodology, location, field survey, hearing from beneficiaries and organization concerned, traffic analysis, and lessons learnt from the similar projects (3) Field survey and hearing from the beneficiaries and organizations concerned.
3	Solid wastes	(1) Confirmation of situations at the construction and disposal sites	(1) Review of contents, size, method, location, duration of construction, and hearing from the beneficiaries and organizations concerned.
17	Water usage	(1) Confirmation of situation at the construction sites nearby water resource	(1) Hearing from the beneficiaries about impact of partial limitation of water use on their water drawing from the Gairezi River.
27	Working Conditions, Occupation Safety	(1) Confirmation of health and safety management system	(1) Review of similar cases
28	Accident	(1) Confirmation of situation during the construction (2) Confirmation of situation during the operation stage	(1) Confirmation of positional relationship between the construction sites and inhabited area, type of construction, duration, type and quantity of equipment. (2) Traffic analysis, Speed analysis
30	Water right for new irrigation scheme	(1) Confirmation of water permit status by ZINWA (domestic) (2) Confirmation of water use agreement with Mozambique (bilateral)	(1) Follow up process of water permit from ZINWA (2) Follow up process of water use agreement between Zimbabwe and Mozambique.

(4) Survey Result Including Results Predicted

Table 1.2.10 Survey result including results predicted

Parameters may affect		Survey result including results predicted
Examination of alternatives		See the previous chapter named “Examination of Alternative”.
1	Air pollution	Although some air pollution by dust may be caused during the construction, most of the sites are covered by shrub and health effects on the communities and houses will not be significant. Besides, presently the number of traffics per day in the area is estimated as ten to twenty vehicles approx. The number will slightly be increased because of construction equipment such as pick-up, dump truck, tractor, dozer, grader, excavator, but will still be limited. Usage of vehicles only qualified standards set by SAZ[10], and limited usage of the equipment only in the construction phase will affect neither human health nor serious air pollution beyond country’s discharge standards[11].

[10] SAZ: Standards Association of Zimbabwe. Final Draft SAZ Standard for Air Quality and Emission. 2014. Limits Values for Vehicle Emissions: Co: 25000ppm, HC 670ppm, NOx:480ppm, PM:100mg/m^3, Opacity: 45%

[11] SAZ: Standards Association of Zimbabwe. Final Draft SAZ Standard for Air Quality and Emission. 2014. Related parameters are excerpted from the Requirements of Ambient Air as followings; CO: <100mg/m^3(ex.15min.), NO_2: 40 μ g/m^3(ex. annual mean), SO_2: 20 μ g/m^3(ex. 24hr mean)

2	Water pollution	At Block A and D where planned to construct pump stations on the bank of Gairezi River may temporary produce muddy water due to construction. Since the construction work at the pump stations will be schedule during dry season from July to November, the water level during this period is relatively low because, and heavy equipment will be operated within the temporary coffering made by sand bags so that water pollution is not expected. Proper setting up of the sand bags will reduce the volume of muddy water that might induced to the river. Hence, the quality of effluent discharge is not expected to be far beyond the standards set by SAZ.[12]
3	Solid wastes	Excavation at pump house, trench for for pipeline and rehabilitation of road might cause some solid wastes. However, existence of harmful wastes is not expected. In addition most of the excavated materials will be reused as back fillings such as in the gabions of revetment works in block A, and there were no any solid wastes problems during the past grant aid scheme, according to the communities of block B, C, and D.
17	Water usage	Hearing unveiled that none of the beneficiaries felt discomfort on water drawing during disturbance by the construction. One of the reasons they mentioned was that there were several alternatives points to get water from the Gairezi River. In this project, as an alternative, a simple pass way for the people and livestock get water smoothly from the river will be developed, which enables minimizing negative impact upon them.
27	Working conditions, occupation safety	Hearing result also shown that there were no troubles and accident between the contractor and the community in the past grant aid scheme. Careful investigation on the profile of candidate contractors in the similar projects and condition of agreement is recommended to prevent entry of maliciousness business.
28	Accident	During the construction stage, potential risks such as traffic accident led by increased number of traffic and transport of construction equipment are a big concern. After completion of the construction, amount of traffic may be increased, but still low in absolute terms. As a recommendation setting of necessary traffic signs for both drivers and pedestrians is very important.
30	Water right for new irrigation scheme	Regarding the domestic permission, according to ZINWA, which is in charge of water permit in Zimbabwe, once an official water permit is issued, bills for water and electricity to the users are also issued in no time. However, M/D: Minutes of Discussion says "It is agreed that the Department of Irrigation, MAMID will apply for the water permit to Mazowe catchment council. The copy of application form and response from the council will be shared to the Team by the end of December, 2014[13]". With these background, DOI and ZINWA discussed and agreed with getting provisional water permit for the time being , and will issue the official one when the construction complete (See Annex 12). On the other hand, Nyakomba Irrigation Scheme is taking water from Gairezi River which is a trans-boundary river between Zimbabwe and Mozambique. Even though Nyakomba irrigation scheme is initiated before any agreement is made among the riparian countries of Zambezi catchment, it is paramount to have mutual agreement between the two countries when a project is planned on the river. The available agreement such as Revised Protocol on Shared Water Agreement which resulted in the establishment of ZAMCOM (A commission for Zambezi River basin) stated that a river shared by two countries shall be treated with the agreement made between the two countries. However, the Agreement on trans-boundary River made between Zimbabwe and Mozambique which was signed in 2002 doesn't stipulate on how to develop water shared between the two countries. Therefore, there was a need to clarify this matter with stakeholders. Then, a meeting was conducted with the Minister of Environment, Water and Climate in relation to the issue on February 3, 2015 and it is agreed that the MAMID will write a letter to inform the intention of the project and asking the agreement from the responsible body in the Mozambican side. Accordingly, in June 2015 a letter of communication has been already made by MEWC to the counterpart in Mozambique. After getting the understanding and agreement from the Mozambique side, there will not be any problem related to trans-boundary water right.

(5) Impact Evaluation

[12] SAZ: Standards Association of Zimbabwe. Recommended limits for effluent discharge into receiving water bodies: SS: <25.0+/-0.1 mgL^{-1}, Temperature: <35.0+/-0.1^{o}C, pH: 6.00-9.00+/-0.01, DO: >0.60+/-0.01 mgL^{-1}

[13] Minutes of Discussion signed by MAMID and JICA, issue of water permit

Based on the results of the initial environmental examination, the evaluation of environmental impacts is summarized in the table below.

Table 1.2.11 Summary of Impact Evaluation at both stages

Parameters may affect			Evaluation at Scoping[*1]		Evaluation based on IEE		Reasons of Evaluation
			D/C	O	D/C	O	
Pollution	1	Air Pollution	B-	D	B-	D	Construction Stage: Dust and emission will occur temporary due to increase of construction vehicles. Operation Stage Pump station in this project is electric driven so that carbon dioxide (CO2), sulfur oxides (SOx) and soot and dust by internal combustion (IC) will not be discharged.
	2	Water Pollution	B-	C+	B-	C+	Construction Stage Some muddy water is expected. Operation Stage Volume of soil runoff from the field to the river will be reduced by installation of irrigation/drainage canal, as well as land leveling.
	3	Solid Wastes	B-	D	B-	D	Construction Stage Solid wastes by reconstruction of pump station, and industrial waste by general construction are expected.
	4	Soil Contamination	D	C-	D	C-	Operation Stage Minor soil contamination will occur by development of irrigation agriculture with application of chemical fertilizer.
	5	Noise and Vibration	C-	D	C-	C-	Construction Stage Some impacts are expected by construction machines, but Impact is limited because the construction site is isolated from the houses. Operation Stage There is no work to cause neither noise nor vibration at operation stage. Farmers living in Block B, C, and D witnessed that distance between the irrigation facilities are well isolated from their houses so that they have never uncomforted. Moreover, new pump station to be constructed is 200m and 500m away from the nearest residences respectively, thus negative impact is not expected.
	6	Ground Subsidence	D	D	―	―	There is no work to cause grand subsidence.
	7	Offensive Odor	D	D	―	―	There is no work to cause offensive odour.
	8	Bottom Sediment	D	D	―	―	There is no work to cause bottom sediment.
Natural Environment	9	Protection Area	D	D	―	―	There are no national parks and sanctuaries nearby the site. The nearest wetland is totally blocked out by mountain ridge with 1,300 m.s.l. Hence, no impact on the protection area is expected.
	10	Ecosystem	C+/-	C+	C+/-	C+	Construction Stage C-: Minor impact on ecosystem such as cutting trees and land reclamation during the construction will occur. Operation Stage C+: On the other hand, uproot of invasive alien spices growing around the construction site contributes to reduce number of the trees.

Parameters may affect			Evaluation at Scoping[*1]		Evaluation based on IEE		Reasons of Evaluation
			D/C	O	D/C	O	
	11	Hydrological Situation	D	D	－	－	No impact is expected since intake volume is small enough comparing with the one of Gairezi River.
	12	Topography and Geographical Features	D	D	－	－	No impact is expected.
Social Environment	13	Involuntary Resettlement	D	D	－	－	There is no work to cause involuntary resettlement because bylaw of IMC restricts construction of houses in the irrigation scheme (irrigation land), and nobody lived in the area.
	14	Vulnerable social groups, such as the poor, indigenous and ethnic people	D	D	－	C+/-	Project targeted area belongs to Communal land where current beneficiary farmers has been forced to move in 1960s to 70s, so that there are no vulnerable social groups, such as indigenous and ethnic people. However, in terms of distribution of benefit, the project may cause minor impact such as conflict due to jealousy on the neighboring communities. Therefore, this issue should be monitored by implementing organization of the project with consultation with Traditional leaders during the operation stage.
	15	Local economy such as employment and livelihood, etc	B+	B+	B+	B+	<u>Both Stage</u> In the past grant aid scheme, farmers in the Block B, C, and D were employed as casual workers during the construction, phase, and seasonal labors for harvesting horticulture crops in dry season during the operation phase, and their income was increased. Likewise, positive economical impact by this project is expected.
	16	Land use and utilization of local resources	D	B+/ C-	D	B+/ C-	<u>Operation Stage</u> By-laws prepared by IMC will promote efficient land use and protection of natural resources. However, reclamation of dry lands close to the irrigation scheme may cause certain negative impact such as improper land use, mismanagement of natural resources, etc.
	17	Water Use	B-	B+	B-	B+	<u>Construction Stage</u> Construction of new pump stations in dry season will cause water drawing from the Gairezi River <u>Operation Stage</u> After complete of the construction, stable water use not only from the Gairezi River, but farm pond, canal etc will be available. As necessary, a simple pass way in order people and livestock smoothly get the water will be prepared, which enables to minimize negative impact upon them.
	18	Existing social infrastructures and services	C-	B+	C-	B+	<u>Construction Stage</u> Construction vehicles and machines during the construction stage cause regional traffic jam. <u>Operation Stage</u> Rehabilitated existing infrastructures will improve the transportation and accessibility; furthermore enhancement of public and social services is expected.

Parameters may affect			Evaluation at Scoping[*1]		Evaluation based on IEE		Reasons of Evaluation
			D/C	O	D/C	O	
	19	Social asset and decision making organizations at local	D	B+/ C-	D	B+/ C-	Operation Stage Development of agricultural infrastructures mainly irrigation will promote establishment of IMC. However, proper distribution of water and levy of water tariff from the users can be challenging if the organization were not functional enough.
	20	Misdistribution of benefit and damage	D	D	－	－	Beneficiaries were agreed with equal land distribution in the past grant aid scheme, same manner is expected in this project as well.
	21	Local Conflict of Interest	D	D	－	－	No impact is expected.
	22	Cultural Heritage	D	D	－	－	Religious graves and mountains for praying good rainfall are located away from the project area. Thus, no impact on cultural heritage is expected.
	23	Landscape	D	C-	D	C-	Operation Stage Although significant negative impact is not expected, RC retaining walls constructed on all sides of the stations in Block B and C against the flood may make a cold impression.
	24	Gender	D	B+	D	B+	Operation Stage No negative impact on gender is expected. Rather, water source becomes much closer to the villages, so that women and children's workload for drawing water from the Gairezi River will be reduced. In addition, economic growth by the project will support the parents to send their children to secondly or higher schools.
	25	Children's Right	D	B+	D	B+	
	26	Hazards(Risk) Infectious diseases such as HIV/AIDS	C-	D	C-	D	Construction Stage Majority of construction workers will be local people; therefore occurrence of infectious diseases is limited.
	27	Working Conditions, Occupation Safety	B-	D	B-	C+/-	Construction stage Some possibility of the neglecting working conditions and safety is expected. Simple maintenance work on fence and irrigation canals by maintenance committee of IMC is expected in the operation stage.
Others	28	Accident	B-	D	B	D	Construction stage Some possibility of the neglecting warning and safety measure during the construction stage is expected.
	29	Monitoring	D	D	－	－	No impact is expected.
	30	Water Permit for new irrigation scheme	B-	D	B-	B-/C+	Gairezi River is boundary river between Zimbabwe and Mozambique; however volume of water intake by this project is inconsiderable. No troubles between two countries have been reported for last 15 years after the last grant aid scheme completed. ZINWA with support of DOI, MAMID already started to communicate to organization in charge of the river management issue in Mozambique side; therefore troubles between two countries are not expected.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is slight or unknown.

(A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.
*[1] D: Design Stage, C: Construction Stage, O: Operation Stage

(6) Mitigation Measures

Result of the mitigation measures during the construction and operation stage are summarized below.

Table 1.2.12 Mitigation Measures for the Adverse Impacts

Adverse Impacts		Proposed Mitigation Measures	Implementing Organizations	Responsible Organizations	Budget
<Construction Phase>					
1	Air Pollution	• To pay attention to the dust control during the construction nearby housing area, e.g. water sprinkling.	Contractor	Contractor	Construction cost
2	Water Pollution	• For the temporary coffering, to set sand bags and set them gently and slowly so that the turbidity of the water will not increase aberrantly. • To make sure to reduce flow out materials that may influence water quality such as oil, waste water to the river directly	Contractor	Contractor	Construction cost
3	Solid Wastes	• To reuse excavated materials as fillings in the gabions, earth fillings, and back-fillings. • To temporary keep soil wastes occurred by rehabilitation of existing facilities at the place well isolated from villages and river, and then discard it to the place where community members agreed with.	Contractor	Contractor	Construction cost
5	Noise and Vibration	• To limit construction hours to only day time if construction site is near by the houses. • To properly maintain heavy equipment and vehicles so that abnormal noise and vibration will be prevented.	Contractor	Contractor	Construction cost
10	Ecosystem	• To provide persons concerned an ecological orientation especially type of useful trees and invasive alien spices. Supports by EMA and/or AGRITEX may be considered as necessary. • To announce persons concerned that unnecessary hunting and logging of trees around the construction site are prohibited.	Contractor	Contractor	Construction cost
17	Water Use	• To draw up an appropriate construction plan through meeting with beneficiaries in order to minimize the disturbance of supplying daily water or irrigation water.	Contractor	Contractor	Construction cost
18	Existing social infrastructures and services	• To create awareness of a community before start canal works along with the main roads. • To employee traffic controllers or establish traffic sign boards on the roads in advance so as negative impact to the ordinal transportation will be reduced.	Contractor	Contractor	Construction cost

Adverse Impacts		Proposed Mitigation Measures	Implementing Organizations	Responsible Organizations	Budget
26	Hazards(Risk) Infectious diseases such as HIV/AIDS	• To brief persons concerned especially workers about risk of infectious diseases such as HIV/AIDS, a norm of gentle action.	Contractor	Contractor	Construction cost
28	Accident	• To set traffic sign boards and traffic operators in particular well-trafficked site and blind curve. • To let workers understand contents of works every day, and make sure everybody is aware safety measures for each works. • To maintain heavy equipment properly.	Contractor	Contractor	Construction cost
30	Water Permit for new irrigation scheme	• To send a written notice to organizations concerned in Mozambique regarding the water intake from the Gairezi River. • To submit an application form to ZINWA regarding the water permit from the Gairezi River as soon as the construction complete.	MAMID, ZINWA	MEWC	Administrative expenditure
<Operation Phase>					
4	Soil Contamination	• To train farmers in IMC especially newly established one in Block A; in order them to be able to apply chemical fertilizer, pesticide, and fungicide to their irrigation scheme in line with the guideline recommended by AGRITEX.	AGRITEX Officer in Nyakomba	MAMID	Administrative expenditure
5	Noise and Vibration	• To maintain and check the condition regularly by using noise meter and vibration meter, and immediately stop the operation when certain abnormal noise or vibration are confirmed. Because, abnormal noise or vibration is most probably a precursor of break down.	ZINWA	ZINWA	Administrative expenditure
14	Vulnerable social groups, such as the poor, indigenous and ethnic people	• To have a meeting under the supervision of the Traditional Leaders regarding the management of interests between villages or groups.	Traditional Leaders, AGRITEX	MLGPWNH, MAMID	Administrative expenditure
16	Land use and utilization of local resources	• To ask beneficiaries to discuss with Traditional leaders, AGRITEX, and EMA when they want to open the Dry Lands up for the agricultural use, so that land degradation and misuse of natural resources will be prevented.	Traditional Leaders, AGRITEX EMA	MLGPWNH, MAMID	Administrative expenditure
19	Social asset and decision making organizations at local	• To inspect the contents of by-laws on IMC in Block A, before IMC starts its activity. Besides, let IMC members and AGRITEX officers in Block B, C, and D share their experiences and recommendation with. To the one in Block A in particular tips of water levy from the users, and organizational management.	IMC, AGRITEX, DOI, ZINWA	MAMID, ZINWA	Administrative expenditure
23	Landscape	• To purchase minimum input such as brushes and paint for the children so that their paintings on the RC retaining walls will make people calm and smile.	IMC, ZINWA	ZINWA	Administrative expenditure

Adverse Impacts		Proposed Mitigation Measures	Implementing Organizations	Responsible Organizations	Budget
27	Working Conditions, Occupation Safety	• To provide a safety orientation, under supervision of DOI, to the residents who are employed as construction workers by referring lessons learnt from the other blocks. Because, Maintenance Committee (MC) and Water Management Committee (WMC) are expected to take in charge of rehabilitation of irrigation canal and operation and simple maintenance of gate and valve.	IMC(MC/WMC), DOI	MAMID	Administrative expenditure
30	Water Permit for new irrigation scheme	• To submit an application form to ZINWA regarding the water permit from the Gairezi River as soon as the construction complete.	MAMID, ZINWA	ZINWA	Administrative expenditure
Total Budget (USD)					To be Estimated

(7) Environmental Monitoring Plan (EMP)

Parameters that might cause adverse impacts will be monitored during the construction and operation stage by Contractor and Zimbabwean governmental organizations respectively. Although responsible body and implementing entity for each monitoring parameter are nominated, flexible involvement of stakeholders such as Traditional leaders for complaint handling system, and related organizations in the specific fields for effective monitoring is recommended. See the monitoring plan proposed below:

Table 1.2.13 Environmental Management Plan Proposed

Environmental Items	Monitoring Items	Monitoring Methodology	Monitoring Point	Frequency	Implementing Organizations	Responsible Organizations
<Construction Phase>						
Air pollution	Dust	To do visual observation and confirm whether dust affect residences and agricultural fields or not. If necessary, sprinkling the working surfaces water is applied.	Specific construction site	Every morning	Contractor	Contractor
Water pollution	Suspended Solids (SS)	To examine amount of SS converted from permeability measured by transparent gauge.	Sites around the pump stations and box culverts	Every morning	Contractor	Contractor
Solid wastes	Volume of surplus soil and solid wastes discarded	To review records of construction (Daily report including volume of solid wastes and surplus soil, disposal measure, availability of community's involvement for deciding location of disposal site	Specific construction site	Once a month	Contractor	Contractor

Environmental Items	Monitoring Items	Monitoring Methodology	Monitoring Point	Frequency	Implementing Organizations	Responsible Organizations
Noise and Vibration	Noise level and Vibration level	To measure noise and vibration by each tester.	Construction sites close to the residences	Every morning	Contractor	Contractor
Ecosystem	Number of hunting and unnecessary logging of trees.	To review record of hunting and unnecessary logging of trees	Specific construction site	Once a month	Contractor	Contractor
Water Use	Record of complaint management	Complaint management system	All project sites	Once a month	Contractor	DOI Manicaland provincial office, AGRITEX Nyanga district office
Existing social infrastructure and services	Record of complaint management	Complaint management system	All project sites	Once a month	Contractor	DOI Manicaland provincial office, AGRITEX Nyanga district office
	Number and degree of traffic accident	To review the construction record including aforesaid items and details of car accident happened, presence of traffic controllers and signboards then.	All project sites	Once a month	Contractor	Contractor
Hazards(Risk) Infectious diseases such as HIV/AIDS	Record of complaint management	To review a record of complaint management and research of persons infected conducted by MoFCC as part of their ordinal works.	All project sites	Once a month	Contractor	AGRITEX Nyanga district office, MoHCC Nyanga district office
Working Conditions, Occupation Safety, and Accident	Number and degree of accident	To review records of accidents at working sites whether appropriate traffic controller and road signs were dispatched. Besides, log of safety instruction to the workers, and maintenance of heavy equipment shall be reviewed too.	All project sites	Once a month	Contractor	Contractor
Water Permit for new irrigation scheme	Agreement with Mozambican government, & Provisional Water Permit	Internationally, to obtain an agreement of intaking water from the boundary river, signed by Mozambican government. Domestically, to get a provisional water permit from ZINWA.	---	Before start operation stage	MAMID, ZINWA	MAMID, ZINWA
<Operation Phase>						

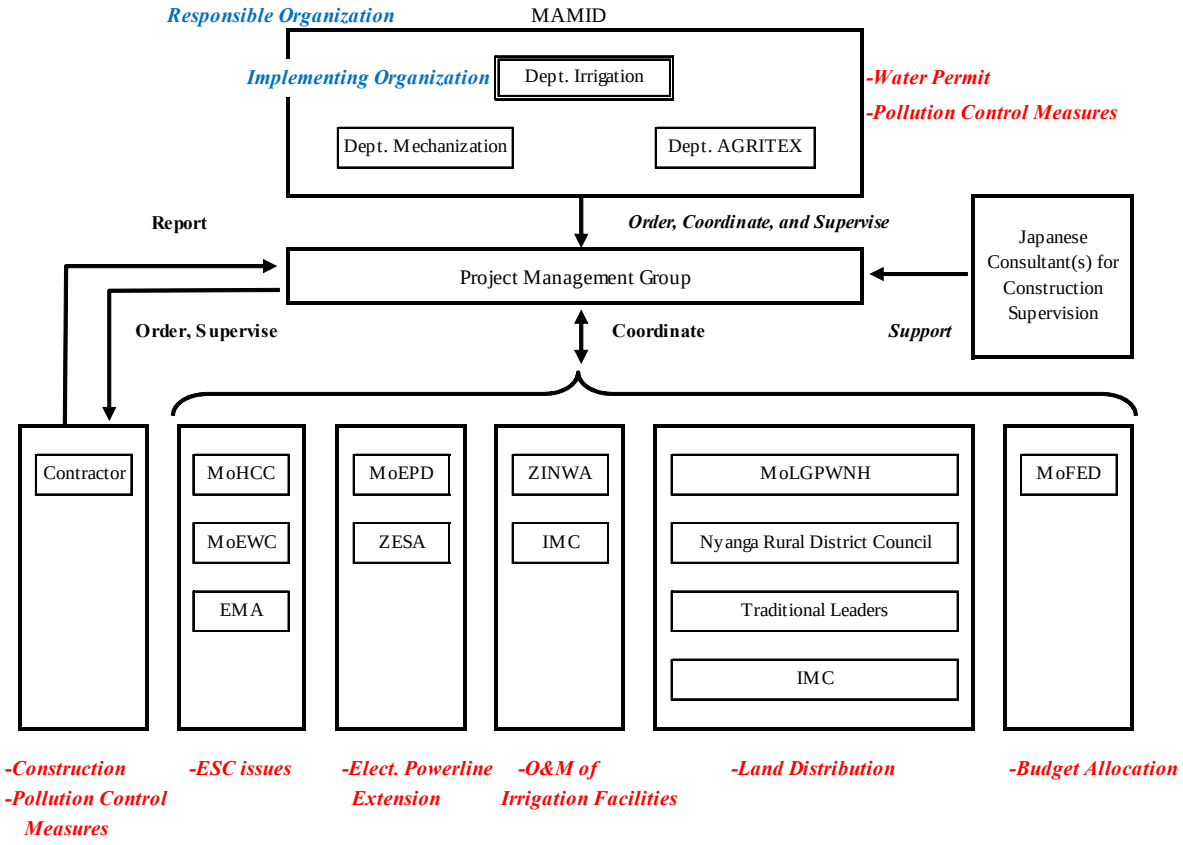
Environmental Items	Monitoring Items	Monitoring Methodology	Monitoring Point	Frequency	Implementing Organizations	Responsible Organizations
Soil contamination	Amount and way of applying fertilizer and chemicals to the irrigation scheme	Hearing to the community members. Sample Survey	All project sites	Once each of dry and rainy seasons (3 years)	AGRITEX Extension officer in Nyakomba area	MAMID
Noise and Vibration	Noise level, Vibration level	To refer to the record of pump operation including abnormal noise and vibrations.	Pump stations	Every operation day (max. 25 years)	ZINWA Mazowe sub-catchment office	ZINWA Mazowe sub-catchment office
Vulnerable social groups, such as the poor, indigenous and ethnic people	Number of complaint management between the villages	To review the record by complaint management system	All project sites	Once a year (3 years)	Traditional Leaders, AGRITEX	MLGPWH, MAMID
Land use and utilization of local resources	Number of new reclamation on Dry Lands	Hearing to IMC Hearing to EMA	All project sites	Once a year (3 years)	Traditional Leaders, AGRITEX, EMA	MLGPWH, MAMID
Social asset and decision making organizations at local	Contents of bylaws, Process of IMC member selection, Number of complaint management, Record of water levy collection and payment	Monitoring of followings: -Bylaw: Existence of bylaws -IMC: minutes of meeting when IMC committee members are selected -Complains: Records of complaints managed -Water levy: accounting book recorded by IMC treasures, and also bills issued by ZINWA and ZESA	All project sites	Once a year (3 years)	IMC, AGRITEX, DOI, ZINWA, ZESA	MAMID、ZINWA
Landscape	Availability of painting	Taking pictures at site	On the RC retaining wall	Once a year (3 years)	IMC, ZINWA	ZINWA
Working Conditions, Occupation Safety	Number and degree of accident	Records of safety meeting held in order MC and WMC under the IMC of block A newly established learn tips of safety operation and maintenance works on irrigation scheme from the senior IMC members in block B, C, and D.	All project sites	Once a year (3 years)	IMC(MC/WMC), DOI	MAMID

Environmental Items	Monitoring Items	Monitoring Methodology	Monitoring Point	Frequency	Implementing Organizations	Responsible Organizations
Water Permit for new irrigation scheme	Water Permit	An official water permit from ZINWA. Note: This is NOT provisional one.	---	Before start operation stage (Only once)	MAMID, ZINWA	ZINWA

Table 1.2.14 Standards for Environmental Monitoring

Environmental item	Survey Item	Standards	Source
Air pollution	Particle Matter	PM: 100mg/m^3	SAZ: Final Draft Standard for Air Quality and Emission. 2014
Water pollution	Suspended Solids (SS)	25.0+/-0.1 mgL^{-1}	SAZ. Recommended limits for effluent discharge into receiving water bodies
Noise and Vibration	Noise level Vibration level	9am-6pm: < 65dB 5am-9am/6pm-10pm: < 65dB 10pm-5am: < 55dB	SAZ: Noise and Vibrations Standards

Proposed structure for environmental monitoring plan during the construction phase is shown in Figure 1.2.5. This construction is characteristically associated with a large number of stakeholders in each field such as environmental and social considerations, operation and maintenance of irrigation facilities, electricity, land distribution, complain management, budget allocation, water permit, etc. Therefore, rather than the contractor communicates each organization one by one, it is recommended to establish Project Management Group (PMG) which comprises the DOI, DOM, and AGRITEX, that will be consulted by the contractor. The PMG will receive the periodical monitoring report from the contractor, and will share the report within MAMID and other organizations concerned, and may acquire suggestions or advices from the subject matter specialized organizations as necessary. Those feedbacks shall be delivered to the contractor through PMG. The lessons of environmental monitoring learnt during the construction phase will be utilized by the PMG during the operation phase.



Note: Words discribed by the red color indicate major category of the monitoring items

Figure 1.2.5 Structure of Monitoring System Proposed

(8) Stakeholder Meeting

Ahead of the preparatory survey, workshops with beneficiaries and stakeholders have been held by DOI and JICA's experts several times, moreover, the grant aid scheme by the government of Japan has been implemented in block B, C, and D 15 years ago, so that the communities' awareness about this project was well built already. After commencement of the preparatory survey, meetings with beneficiaries were held with participation of stakeholders concerned such as DOI, AGRITEX, IMC, and ZINWA. An engineer of DOI in charge briefed project description to the participants, and discussed mainly about equal land distribution, operation and maintenance of facilities, area to be benefited. Major questions from the participants and answers by DOI are summarized in the following table.

Table 1.2.15 Q&A in the Meeting with the Communities

Comments and Questions	Answers
Block A node. 9, 2014	
As far as possible, please consider distributing Dandadzi's land to Dandadzi, and Mutandakamwe's land to Mutandakamwe even after the development of irrigation scheme.	Agree with the comment.

Comments and Questions	Answers
Like block B, C, and D, please constructs community hall and storage in block A as well.	Construction of those buildings was not requested by the Government of Zimbabwe, so that additional request at this stage won't be acceptable.
Please include the lands which where were out of scope (A-3, A-4, and A-5) into the irrigation scheme.	Will consider including or not based on the result of the field survey.
When will construction begin?	Can't answer because we'll have to wait for the decision by cabinet.
Block B on Dec. 8, 2014	
Please remind ZINWA to maintain the pump station.	Not only maintenance of pump station, but demarcation of operation, maintenance, and ownership of other irrigation facilities should be clearly made among ZINWA, DOI, and IMC. They will have to make a written agreement on this issue.
Block C on Dec. 10, 2014	
No particular comments	
Block D on Dec. 10, 2014	
Please repair the pump sooner.	First of all, functional diagnostic of pump by experts will unveil the degree of damage, and then we'll consider the measures.
We, members of IMC in block D, has worked for desilting work at intake of pump station instead of ZINWA, however up to date we have not received any payment from them.	Demarcation of operation, maintenance, and ownership of irrigation facilities including the pump station will be clearly made among ZINWA, DOI, and IMC. Also, they will make a written agreement on this issue. So, accordingly, please take necessary action.

(9) Resettlement and Land Acquisition

1) Necessity of Resettlement and Land Expropriation

In general

As described earlier, the Communal land where the project targeted is a part of governmental properties and maintenance work at the land is delegated to the Ministry of Local Government, Public Works and National Housing (MLGPWNH). Hence, no body's lands will be expropriated by this project. In addition, it was confirmed by the preparatory survey that nobody construct his/her residences in the irrigation scheme, because bylaw of IMC prohibit construction of houses inside the irrigation scheme, and farmers strictly obey the rule. Therefore, the preparatory survey confirmed that there is no resettlement by this project at all.

Regarding these points, the preparatory survery team has organized stakeholder meetings several times, and confirmed followings:

- There is no resettlment of the communities at all,
- Some lands acquired by the project for construction of irrigation scheme are taken from the communities who are temporarily using the state land, and to those lost some portion of lands will be amicably managed by equal land distribution among beneficiaries,
- Same procedures of compensation were taken in block B, C, and D, but no trouble happened up to date,
- For the farmers whose land size is about to decrease comparing with pre-development, Traditional leaders will take necessary compensations in their traditional manner. For example,

(a) allocating them some of dry lands in addition to the irrigation lands, (b) when decide the reallocation of the land after completion of the construction, those farmers will be given a priority to choose their new irrigation land eariler than the one whose land size were not decreased.

In Block B, C, and D

Regarding the construction of pump stations and retaining walls, neither land acquisition from individual farmers nor involuntary resettlement are expected, because construction sites of retaining walls in block B and C are just around the existing pump station. In block D where the most serious flood damage happened continously, location for construction of new punp station is already agreed by the communities during the meeting held on Dec. 2014 in block D.

In Block A

Likewise, construction site of new pump station in block A is also approved by the community during the meeting held on Dec. 2014. Candidate site for construction of farm ponds is currently a farm land. But the "owner" who is residing in Harare requested for his two brothers to be considered as the beneficiary of the land redistribution after the construction of the land which was agreed by the communities. Accordingly on Jan. 30, 2015, an agreement with the "owner" for contributing his land for construction of farm pond was signed (See the Annex 10). Regarding the land consolidation for irrigation scheme in block A, stakeholders meetings were held several times by DOI and JICA's expert ahead of times, and equitable land distribution among the beneficiaries of block A without any compensations for the land and trees or plants are agreed between DOI and village head with witness of all 228 beneficiaries (See Annex 9). In addition, 8 farmers using the lands where surge tank is to be constructed agreed without compensation. (See Annex 11)

Table 1.2.16 Summary of land expropriation and agreement in each block

Block	Facilities required land expropriation and condition of agreement
Block A	Land consolidation and equitable land distribution: 146ha (Agreed with the communities, and stakeholders) Farm pond: 50m x 50m (Agreed with land user) Pump station: 30m x 20m (Agreed with village head and IMC) Distribution water tank: 5m x 5m (Agreed with land users)
Block B	Retaining walls: 50m x 40m (Agreed with beneficiaries)
Block C	Retaining walls: 50m x 40m (Agreed with beneficiaries)
Block D	Pump station: 30m x 20m (Agreed with beneficiaries)

1.3 Agriculture and Farming

(1) Cropping Conditions

Cropping conditions such as cultivating crops, cropping seasons, production amounts, yields and sales amount between irrigable area of Block B, C and D and rainfed area of Block A are significantly different. Cropping conditions of 2013/14 season for each Block are as shown in the following table.

Table 1.3.1 Cropping Conditions of 2013/14 Season for Each Block

Items	Block A	Block B	Block C	Block D	Total
1. Developed Area (ha)	146	128	115	191	580
2. Irrigating Area (ha)	0	65	70	106	241
3. Number of HH	228	128	165	239	760
4. Cultivating Area (ha)					
(Summer)					
White Maize	80	70	60	120	330
Tabasco Chili	0	19	16	10	45
Paprika	20	5	4	10	39
Tobacco	0	4	0	0	4
Sugar Bean	26	0	0	0	26
Popcorn	14	4	3	10	31
Groundnuts	2	0	0	0	2
Sunflower	4	0	0	0	4
(Late Summer)					
Sugar Bean	0	10	11	20	41
(Winter/Irrigating Crop)					
Wheat	0	10	14	10	34
Onion	0	14	8	2	24
Potato	0	7	7	17	31
Sugar Bean	0	20	20	30	70
Green Maize	0	10	15	25	50
Butternuts	0	3	3	5	11
Green Pepper	0	3	3	5	11
Egg Plant	0	3	3	5	11
Total	146	182	167	269	764

Source: AGRITEX Nyakomba Office
Cropping pattern is classified into three (3) types namely summer, late summer and winter. Sugar bean is cultivating in all three cropping seasons.

The total cultivated area is about 770 ha including the rainfed area of Block A. Cropping ratio is 132 % in total and cropping ratio of irrigating area is 144 %. Major crops grown are white maize with 330 ha (43%), followed by sugar bean with 137 ha (18%), green maize with 50 ha (6%), tabasco chili with 45 ha (6%) and paprika with 39 ha (5%). These five crops namely white maize, sugar bean, green maize, tabasco chili and paprika are the major representative crops in the area.

(2) Cropping Calendar

The present cropping calendar of Block A, and Block B, C and D are presented in the Figure 1.3.1 and Figure 1.3.2 respectively. As cropping calendars among Block B, C and D of irrigable area are almost same, one representative calendar is applied.

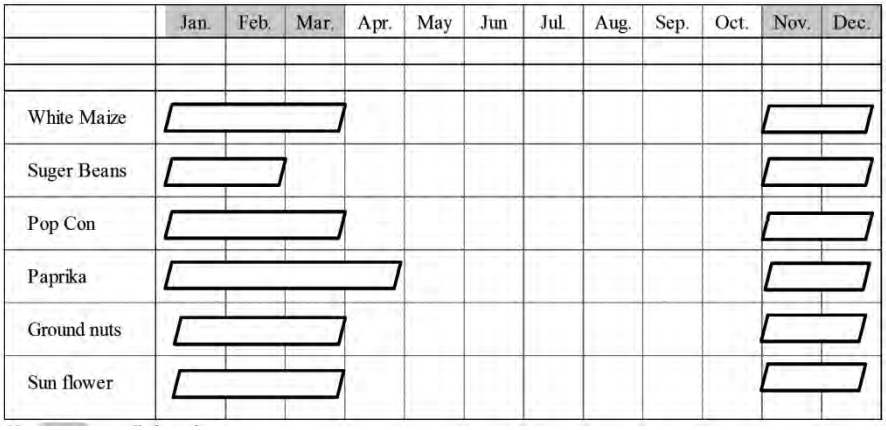


Figure 1.3.1 Present Cropping Calendar in Block A

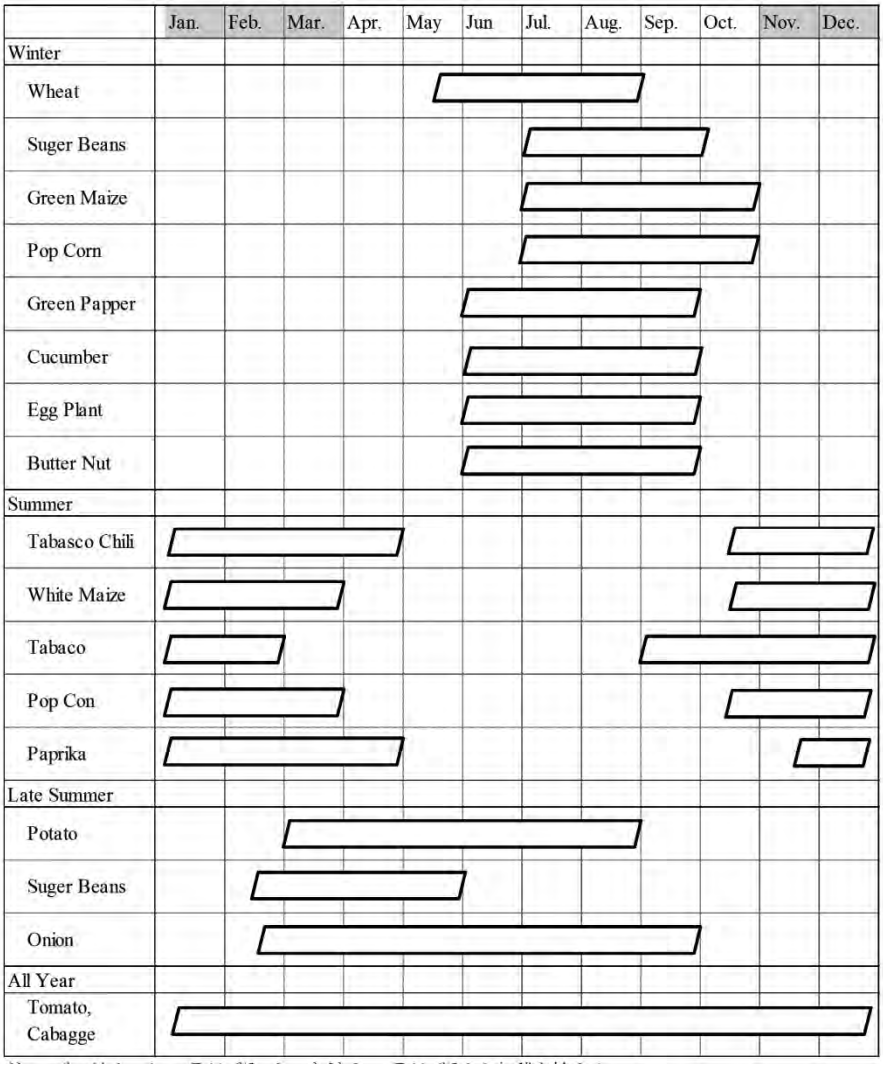


Figure 1.3.2 Present Cropping Calendar in Block B, C and D

Farmers in Block A are cultivating white maize which is staple food, sugar bean and pop corn which are staple/cash crops, paprika and ground nut as a cash crop during rainy season only. Crops

in late summer and winter season are not cultivating in Block A.

On the other hand, farmers in Block B, C and D are cultivating various crops in three seasons namely summer, late summer and winter. In summer season, farmers are cultivating white maize as a staple food, tabasco chili, tobacco, paprika and pop corn as a cash crop. In late summer, farmers are cultivating potato, sugar bean and onion. Additionally, in winter farmers are cultivating wheat, sugar bean, green maize, green pepper, cucumber and butter nuts. Farmers can cultivate tomato and cabbage in not only winter season but all seasons,

(3) Cultivating Area

Table 1.3.2 shows main crops in each block. Though main crops are slightly different in each block, the top two crops are white maize and sugar bean in all blocks and these crops are representative crops in the area. Among the top five crops in Block B, C and D that uses irrigation, the following four crops such as white maize, sugar bean, tabasco chili and green maize are common and there is no big differences concerning cultivating area among the irrigable area of these blocks. Other crops in the area followed by the above four common crops are onion, wheat and potato.

Table 1.3.2 Main Crops in Each Block

Ranking	Block A	Block B	Block C	Block D
1	White Maize	White Maize	White Maize	White Maize
	55% (80ha)	38% (70ha)	36% (60ha)	44% (120ha)
2	Sugar bean	Sugar bean	Sugar bean	Sugar bean
	18% (26ha)	16% (30ha)	18% (31ha)	18% (50ha)
3	Paprika	Tabasco chili	Tabasco chili	Green Maize
	14% (20ha)	10% (19ha)	9% (16ha)	9% (25ha)
4	Pop corn	Onion	Green Maize	Potato
	10% (14ha)	8% (14ha)	9% (15ha)	6% (17ha)
5	Sunflower	Green Maize	Wheat	Tabasco chili
	3% (4ha)	5% (10ha)	8% (14ha)	4% (10ha)

(4) Crop Production and Yield

Crop production and yield in the area are as presented in the Table 1.3.3 below. The total volume of production collected from all four blocks among the major crops such as white maize, tabasco chili, potato, onion and sugar bean are 2,675ton, 669ton, 682ton, 648ton and 359ton respectively. Comparing the yield per unit area of the crops, a difference of around three times is recognized between irrigation and not irrigation field.

Table 1.3.3 Crop Production and Yield

Crop	Rainfed			Irrigable Area									Total		
	Block A			Block B			Block C			Block D					
	Area	Yield	Quant.	Area	Yield	Quant.	Area	Yield	Quant.	Area	Yield	Quant.	Area	Yield	Quant.
	ha	t/ha	ton	ha	t/ha	ton	Ha	t/ha	ton	ha	t/ha	Ton	ha	t/ha	ton
(Summer)															
White Maize	80	3.5	280	70	8.5	595	60	10.0	600	120	10.0	1200	330	8.0	2675

Crop	Rainfed			Irrigable Area									Total		
	Block A			Block B			Block C			Block D					
	Area	Yield	Quant.	Area	Yield	Quant.	Area	Yield	Quant.	Area	Yield	Quant.	Area	Yield	Quant.
	ha	t/ha	ton	ha	t/ha	ton	Ha	t/ha	ton	ha	t/ha	Ton	ha	t/ha	ton
Tabasco Chili	0	-	-	19	14.0	266	16	15.5	248	10	15.5	155	45	15.0	669
Paprika	20	1.5	30	5	4.0	20	4	4.0	16	10	4.0	40	39	3.4	106
Tobacco	0	-	-	4	2.0	8	0	-	-	0	-	-	4	2.0	8
Sugar Bean	26	1.0	26	0	-	-	0	-	-	0	-	-	26	1.0	26
Popcorn	14	0.2	3	4	0	0	3	0.6	2	10	0.6	6	31	0.5	11
Groundnuts	2	1.5	3	0	-	-	0	-	-	0	-	-	2	1.5	3
Sunflower	4	2.0	8	0	-	-	0	-	-	0	-	-	4	2.0	8
(Late Summer)															
Sugar Bean	0	-	-	10	3.0	30	11	3.0	33	20	3.0	60	41	2.3	123
(Winter)															
Onion	0	-	-	14	27.0	378	9	27.0	216	2	27.0	54	24	20.3	648
Potato	0	-	-	7	22.0	154	7	22.0	154	17	22.0	374	31	16.5	682
Sugar Bean	0	-	-	20	3.0	60	20	3.0	60	30	3.0	90	70	2.3	210
Green Maize	0	-	-	10	8.5	85	15	10.0	150	25	10.0	250	50	7.1	485
Butternuts	0	-	-	3	8.5	26	3	10.0	30	5	10.0	50	11	7.1	106
Green Paper	0	-	-	3	3.0	9	3	3.0	9	5	3.0	15	11	2.3	33
Egg Plant	0	-	-	3	4.0	12	3	4.0	12	5	4.0	20	11	3.0	44

Source: AGRITEX Nyakomba Office

(5) Cropping Pattern

White maize (Gramineae) and sugar bean (Fabaceae) are the two core rotational crop in the area for both irrigation area and rainfed area.

Cropping pattern in Block A is presented in figure 1.3.1 above. As indicated above, Block A is fully a rainfed area and no crops are cultivating during dry season. The crop rotation practiced in this block is as follow.

- White maize – Sugar bean (2 years rotation by 2 crops)
- White maize – Sugar bean – Paprika (3 years rotation by 3 crops)

On the other hand, in Block B, C and D, since farmers can cultivate throughout the year (in all seasons), more variations of cropping pattern is practiced comparing with rainfed area. Basically, cropping patterns in irrigation area are as follows.

- White maize – Sugar bean – Tabasco chili (3 years rotation by 3 crops)
- White maize – Sugar bean – Wheat (2 years rotation by 3 crops)

(6) Marketing

Marketing method in the area is divided into contract farming and common market. Farmers are cultivating tabasco chili, paprika and tobacco based on the contract farming. Contract Company distributes seeds, seedlings, fertilizer and chemical based on the contract agreement made with each farmer and purchases crops in the fixed price set at the time of the agreement. Farmers are requested certain quality and standards by contract company. Marketing characteristics per each crop are

shown in the Table 1.3.4 below.

Table 1.3.4 Marketing Characteristics in Nyakomba Area

Crop	Market	Characteristics
White Maize	Self consumption and selling to GMB	Mainly for self consumption. Surplus is sold to GMB (Grain Marketing Board). Maize in Zimbabwe has been replaced to hybrid and there is a possibility of export.
Sugar bean	Harare, Mutare, Rusape	Merchants come to purchase and farmers go to local market to sell.
Tabasco chili	Better Agriculture Company	Based on the contract agreement, chili is sold to Better Agriculture Company after dried and grinded by farmers. Better Agriculture Company export the product to Tabasco Company headquarter in USA.
Paprika	Capsium Company and Hyveld Company	Based on the contract agreement, paprika is sold to Capsium Company and Hyveld Company after dried by farmers. Both companies export it to South Africa through trader.
Tobacco	Savana Tobacco Company Harare auction	Base on the contract, tobacco was sold to Savana Tobacco Company previously. After 2014, tobacco is sold to tobacco auction in Harare.
Onion	Supermarket in Harare and Mutare and Local Market	Merchants come to purchase and farmers go to local market to sell.
Potato	Local Market	Farmers go to local market to sell.
Green maize	Market in Harare and Mutare and Local Market	Merchants come to purchase and farmers go to local market to sell.
Green Pepper	Local Hotel (Nyanga)	Merchants come to purchase.
Tomato	Mutare, Nyanga, Rusape Local Boarding School, Hotel	Merchants come to purchase and farmers bring to local hotel and school.
Wheat	Grain Marketing Board	GMB recommend wheat cultivation in the irrigation area from the view point of food security.

Source: AGRITEX Nyakomba Office

Marketing Committee composed of beneficiary farmers share market and price information among farmers before selling.

(7) Profitability

Profitability of main crops is summarized in the Table 1.3.5. The order of high profitability crops are onion, potato tomato and paprika by irrigation which is followed by tobacco and tabasco chili produced by rained.

Table 1.3.5 Profitability of Crops

Crops	Yield (a) t/ha	Unit Price (b) $/t	Production (c) = (a)*(b) $/ha	Cost (d) $/ha	Profit (e) = (c)-(d) $/ha
White maize by irrigation	8.5	390	3,315	610	2,705
Tabasco chili by rainfed	14.0	570	7,980	2,387	5,593
Sugar bean by irrigation	3.0	1,100	3,300	675	2,624
Paprika by irrigation	4.0	2,000	8,000	1,146	6,854
Green maize by irrigation	50,000cobs	1$/12cobs	4,170	755	3,415
Onion by irrigation	27.0	667	18,000	3,270	14,730
Potato by irrigation	22.0	667	14,670	2,825	11,845
Tomato by irrigation	30.0	500	15,000	1,142	13,858
Wheat by irrigation	5.0	550	2,750	835	1,915

Crops	Yield (a) t/ha	Unit Price (b) $/t	Production (c) = (a)*(b) $/ha	Cost (d) $/ha	Profit (e) = (c)-(d) $/ha
Tobacco by rainfed	2.0	4,000	8,000	1,938	6,061
White maize by rainfed	3.5	390	1,365	548	717
Sugar bean by rainfed	1.0	1,050	1,050	639	411
Paprika by rainfed	1.5	1,800	2,700	1,035	1,665
Groundnut by rainfed	1.5	800	1,200	436	746

Source: AGRITEX Nyakomba Office

(8) Farm Economy

Household survey was conducted by AGRITEX extension officer to grasp farm economy condition through selecting 10 households from each block as a sample chosen randomly without partiality but intentionally adding female headed household.

1) Property of Survey Household (HH)

According to the information collected from AGRITEX Nyakomba Office, in Nyakomba, out of the total 760 HH in the area 166 HH (22%) of HH are female headed household. In this survey, out of 40 families surveyed, 24 HH are male headed households and 16 HH are female headed household. Three (3) households belong to female headed household where their husbands are migrant workers.

Table 1.3.6 Sex of Household Head

Block	Head of household			Total
	Male	Female		
		Widow	Male go out for work	
A	6	4	0	10
B	6	3	1	10
C	6	4	0	10
D	6	2	2	10
Total	24	13	3	40

Table 1.3.7 Age of Household Head

Block	Head of household			Ave.
	Male	Female		
		Widow	Male go out for work	
A	37	59	-	46
B	50	46	52	49
C	49	51	-	50
D	46	58	49	49
Ave.	46	54	50	49

2) Composition of Family and Employment Condition

Average numbers of family per household is 5.2 persons of which about 3.2 persons are engage in agriculture, permanent worker or casual worker.

Table 1.3.8 Number of HH

Block	Less than 14	15 to 65	More than 65	Total
A	2.1	2.7	0.3	5.1
B	1.9	3.2	10.5	5.6
C	2.6	3.2	0.0	5.7
D	1.6	2.6	0.1	4.3
Total	2.0	2.9	0.2	5.2

Table 1.3.9 Employment Condition of HH

Block	Agriculture	Permanent worker	Casual worker	Total
A	2.9	0.1	0.0	3.0
B	3.2	0.5	0.1	3.8
C	3.4	0.0	0.1	3.4
D	2.5	0.0	0.2	2.7
Average	3.0	0.2	0.1	3.2

3) Livestock

Livestock conditions are summarized in the Table 1.3.10. Cattle is utilizing for draft animal and compost. Small livestock such as poultry, pig and goat are raised for self consumption and selling.

Table 1.3.10 Livestock per HH

Block	Bull	Cow	Goat	Pig	Poultry	Total
A	1.4	0.7	4.0	1.2	11.9	19.2
B	2.0	1.8	4.2	1.2	19.6	27.8
C	1.7	2.2	3.2	0.8	21.1	29.0
D	0.6	2.3	0.6	0.3	4.6	8.4
Average	1.4	1.8	3.0	0.9	8.4	21.1

4) Family Income

The average income per family is about 3,800 US$ per year of which around 16% of family income is comes from non agriculture activities. Non agriculture income includes livestock, petty trade, permanent work, casual work, wage and remittance.

Table 1.3.11 Family Income

Block	Agriculture	Non agriculture	Total
A	1,328	228	1,556
B	4,902	1,384	6,286
C	4,383	571	4,954
D	2,299	195	2,494
Average	3,228	594	3,822

Unit: US$

1.4 Survey on the Present Condition of Pump

Pump function survey was conducted by the preparatory survey team to grasp the existing conditions the pumps, extent of damaged pump facilities and thereby to propose appropriate countermeasure for repair and or replacement based on the result of the survey on the existing condition of pump functionality.

(1) General

Through the this survey, it is found that the conditions of existing pump mechanical and electrical facilities in Block B, C and D are in bad shape owing to long term submergence of the facilities caused by the 2006 cyclone. Especially, some of electrical facilities such as parts of control panel, electric appurtenances, etc, and measuring device such as thermometer, pressure gauge, limit switch, etc., are found broken or dead. In other words, pump facilities in general are not reliable.

Most of the failures of the equipment are due to breakdown of electrical parts which were found muddy and progressing corrosion so that the cause of the failure can not be identified.

(2) Main Pump Facilities

Though part of main pump bearings and some consumable supplies should be replace, main parts of pump are mechanically in sound conditions. After the overhaul inspection on pump No. 2 of Block D, nevertheless some abrasions of impeller are confirmed slightly, other parts are still well conditioned. In addition, other operating pumps in the other blocks were surveyed and it was confirmed that pump performances were almost the same as its original conditions.

On the other hand, all motors are found generating noises. These motors can be operational but the conditions of the motors are poor.

(3) Transformer

The transformers are the property of ZESA. The voltage installed is AC 400V which is difference from the required voltage for the pump facility which is 380V and it is recommended to make the correction accordingly.

After the 2006 flood, all transformers have been replaced by smaller sizes comparing with original sizes which are not satisfactory for the necessary capacity required for staring the second pump. Therefore, transformer should be replaced by ones that satisfy the necessary capacity.

(4) Operating Conditions

Since inbuilt drawings and operating manuals were not provided on the site, supervisor and pump operator are operating without necessary information. These drawings and operating manuals should be provided in the site.

Additionally, tools and measuring devices for common maintenance practice were not provided on site. Minimum required measuring devices for common maintenance such as tester, dial gage, etc. should be provided. The quality and ability for operation and maintenance of pump facilities would be increased if necessary materials such as documents, drawings and manuals are provided in the site and supervisor and pump operator receive proper training from expert.

Before the survey, No. 2 pump in Block C was recognized as not functioning owing to the failure of appurtenant equipment which is not related to the main pump equipment. During pump function survey in the site, Japanese expert arranged and corrected the setting of accessory part to the pump. After simple arrangement and alignment the pump could be restated and operated well. Thus, if operation manuals of pump equipment are provided, setting of accessory could be conducted by Zimbabwe side.

The composition of pump facilities are described in

Table 1.4.1 and existing conditions of pump facilities are shown in Table 1.4.2.

Table 1.4.1 Composition of Pump Facilities

No.	Item	Description	Quantity	Block B	Block C	Block D
1	Main Pump	Horizontal double suction centrifugal pump	3 nos	6.14 m^3/m H=74m φ250×φ150	6.73m^3/m H=82m φ250×φ150	8.63 m^3/m H=58m φ300×φ200
2	Motor	Squirrel-cage motor	3 nos	132kW 4P	150kW 4P	132kW 4P
3	Clack valve	Swing Type	3 nos	250A	250A	300A
4	Electric discharge valve	Sluice/butterfly valve	3 nos	250A Sluice	250A Butterfly	300A Butterfly
5	Suction/discharge valve	Manual sluice valve	3 nos	250A Suction side	250A Suction side	250A Suction side
6	Vacuum pump	Water sealing type	2 nos	0.3CMM 700mmHg	0.3CMM 700mmHg	0.3CMM 700mmHg
7	Drain pump	Portable type	2 nos	0.07 m^3/m 10.6m	0.1 m^3/m 10.6m	0.1 m^3/m 10.6m
8	Bilge pump	Portable submersible pump	1 nos	0.5 m^3/m 20m	0.5 m^3/m 22.9m	0.5 m^3/m 22.9m
9	Well pump	Deep well submersible pump	1 nos	0.23 m^3/m 50m	0.23 m^3/m 50m	0.23 m^3/m 50m
10	Elevated tank	FRP tank	1 nos	3 m^3	3 m^3	3 m^3
11	Ventilation fan	Duct fan	2 nos	180 m^3/m 15mmAq	180 m^3/m 15mmAq	180 m^3/m 15mmAq
12	Crane	Chain block	1 or 2	1 ton	1 ton	1 ton
13	Panel	Incoming panel, pump starting panel, auxiliary machinery panel, control panel	1 set			

Table 1.4.2 Existing Conditions of Pump Facilities

No.	Items	Block B	Block C	Block D	Reference
1	Main pump	One can operate but two not functioning	Two can operate (one could operate during pump function survey) but one not functioning	Two can operate but one not functioning	Pumps to be functioning are almost good condition but motors are generating noises.
2	Vacuum pump	One can operate but another not functioning	One can operate but another not functioning	Not installed	
3	Drain pump	All two can operate	One can operate but another not functioning	One can operate but another not functioning	All drain pump pumps are muddy and conditions are bad.
4	Deep well pump	Operatable	Operatable	Operatable	Well pump in Block D could be operatable by adjustment during pump function survey.
5	Bilge pump	Not functioning	Not functioning	Not functioning	
6	Ventilation fan	One can operate but another not functioning	One can operate but another not functioning	All two can operate	

No.	Items	Block B	Block C	Block D	Reference
7	Crane	Operatable with some problem,	Operatable	Operatable with some problem,	
8	Electrical equipment	Function of electrical equipment in general is not reliable because of siltation and corrosion.			Some equipment are not functioning owing to electrical problem even if mechanical condition is operatable.
9	Transmission	Capacity of transmission is not enough for multiple units of pump operation because of replacement of original one after flood.			

Chapter 2 Contents of the Project

Chapter 2 Contents of the Project

2.1 Outline of the Project

Main components of the Project are composed of 1) water intake facilities, 2) irrigation and drainage facilities, 3) road, 4) land consolidation and leveling, 5) flood protect and 6) softcomponents. These components are described in Table 2.1.1.

Table 2.1.1 Components of the Project

Block	Component	Description
A	Water intake facilities	New construction of pump station (lifting pump φ250×3nos)
	Irrigation facilities	Headrace (Steel Pipe φ500× 980m)
		Farm pond (B× L× H = 13m× 24m× 2m, V=620m^3)
		Distribution canal (L=4,400m, PVCφ400～150)
		Branch irrigation canal (RC open canal, L= 10.6 km)
	Road	Farm road (gravel pavement, W=4m, L=4,690m)
	Drainage	Drainage canal (earth canal, L=18.7 km)
	Land consolidation and leveling	Leveling and land distribution (A=146ha, covered by Zimbabwe side)
B	Flood protection	Construction of RC retaining wall, 1 set
	Water resource facilities	Replace pump electrical facilities and arrange mechanical conditions
C	Flood protection	Construction of RC retaining wall, 1 set
	Water resource facilities	Replace of pump electrical facilities and arrange mechanical conditions
D	Water resource facilities	New construction of pump station (lifting pump φ300×3nos)
	Irrigation facilities	Headrace (Steel Pipe φ600× 365m)
	Access Road	Farm road (gravel pavement, W=4m, L=300m)
All	Soft component	Capacity building for O&M of irrigation and pump facilities and promotion of contract farming

2.2 Outline Design of the Japanese Assistance

2.2.1 Deign Policy

(1) Confirmation of Project Site

1) Block A

Initially the beneficiary target area based on the request by Zimbabwe side was 115 ha in total which covers 103ha at sub-block A-2 and 12 ha from part of sub-block A-6. However, since additional area in Block A are confirmed to be cultivated and suitable to distribute irrigation water by gravity from the satellite picture and topographic map of 1/5,000, the beneficiary area was determined based on the result of field survey and discussion with the Zimbabwean side. From the result of field survey and discussion, both sides agreed that other area not including in the initial request was decided to include as the beneficiary area. Finally, beneficiary area increase to 146 ha as shown in Table 2.2.1.

Naturally the area in Block A is divided by the streams/gullies flowing toward the river. These gullies form the boundary of sub-block in Block A so that Block A is sub-divided into eight (8)

sub-blocks.

Table 2.2.1 Beneficiary Area in Block A

Sub-block	Beneficiary Area (ha)	Remarks
A-1	6.9	
A-2	92.9	
A-3	6.4	
A-4	5.4	
A-5	7.1	
A-6	16.6	
A-7	7.7	
A-8	3.2	
Total	146.1	

2) Existing Irrigation Area (Block B, C and D)

After the 2006 flood, pump stations at Block B and C have not received big damage by flood and it was confirmed that river course was stabilized. Therefore, both sides agreed that the countermeasures against flood will be executed at the existing places without change of the site of pump station.

However, it was confirmed that pump station in Block D is continued to be hit directly by flood based on the field survey of both sides so that site of pump station of Block D was determined to be relocated to other site where river course is stabilized. The survey team identified two potential site for relocation of pump station of Block D as D1 and D2 considering conditions of river bed, river course, etc. Comparing with proposed site between D1 and D2 from the field inspection by survey team, it was judged that D1 was more suitable as new site of pump station of Block D. Figure 2.2.1 shows the proposed alternative sites for pump relocation.

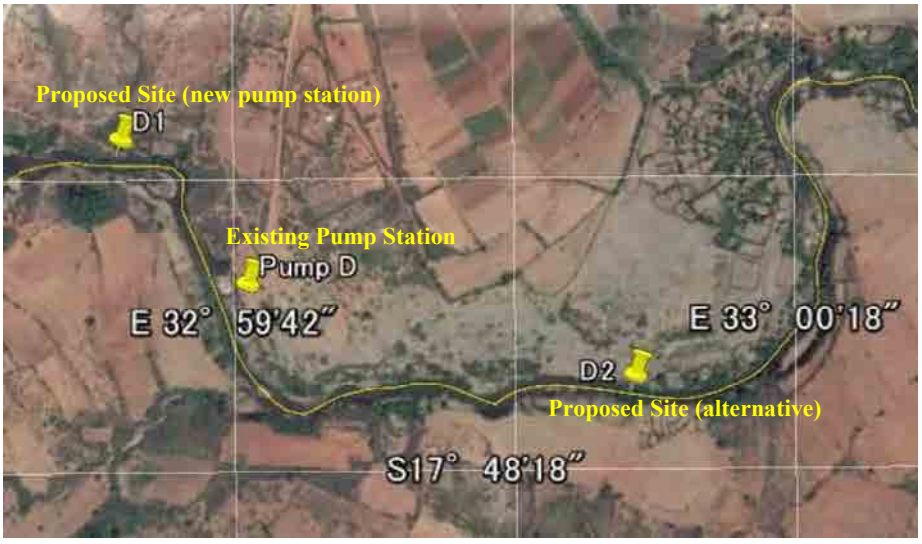


Figure 2.2.1 Site of Existing Pump Station and New Pump Station

(2) Design Policy

1) New Construction of Block A

Block A will serves a total of 146ha beneficiary area and sub-divided into eight (8) sub-blocks considering topographic conditions along with stream. Pump station as water intake facility will be constructed to pump water up to farm pond. After farm pond, irrigation water will be distributed to all beneficiary area by gravity.

The contents of facilities to be constructed in Block A are shown in following Table 2.2.2.

Table 2.2.2 Outline of Block A

Items	Quantity	Contents
Pump Station	1 set	Pump station should provide the structure that flood shall not intrude into inside of basement of pump station. River bed and river banks upstream and downstream of pump station should be protected by gabions against scouring by flood. Additionally, connection road, buried pipe and power line and transmission should be protected from attack by flood. Numbers of pumps required are determined considering the risk diversification and accommodating seasonal water requirement.
Headrace (pipeline)	L=980m	Pipeline connecting between pump station and farm pond. Selected Pipe shall have 500mm diameter and design water pressure of 100m and reliability of pipe joint.
Farm pond	1 set	Capacity of farm pond is fixed to secure thirty (30) minutes discharge (for around 620 m^3) to cope with sudden stoppage of pump operation. Farm pond shall be constructed by the RC structure on a secured area of 30m× 20m.
Distribution canal (pipeline)	2 lines	Pipeline connecting from farm pond to surge tank (discharge chamber) at each sub-block namely A1 to A8. Considering low pressure and economic efficiency, PVC pipe will be used.
Surge tank (Discharge chamber)	8 places	Surge tank will be installed at highest place of each sub-block for connecting between pipeline and open canal. In addition, a small domestic water supply tank will be secured close to each surge tank.
Branch irrigation canal (open canal)	10.6 km	Branch irrigation canal will be installed for conveying water from surge tank to each field. Existing canal will be utilized and new canal will be constructed which shall be connect to the existing canals. Repairing and rehabilitation of the existing canals will be performed as part of softcomponent.
Main road	Improvement of culverts with 3 places	Improvement of main road was requested by Government of Zimbabwe from Nyamalopa junction to Nyakomba shopping center with the section of 10 km. However, through the result of field survey, it was confirmed that improvement of main road can be implemented by Zimbabwe side considering technical standard. As a result, only damaged culverts at 3 places will be improved by Japanese grant aid project.
Farm road	5.0 km	For the maintenance of surge tank installed in each sub-block namely A1 to A8 and improvement of accessibility of farming, farm road will be installed. In addition, for the operation and maintenance of new pump station in Block D, farm road will be constructed.
Land leveling	146ha	Land leveling and equal land distribution will be executed by DOI in the same way as Block B, C and D. Necessary equipment for land leveling such as tractor and attachments will be provided by the Japanese side.

2) Flood Disaster Prevention (Block B and C)

Nyakomba irrigation scheme has experienced huge damage due to flood caused by the 2000 and 2006 cyclone that hit the area. The flood water level reached about 30 cm above the floor level of pump house in Block B and C and 100 cm above floor level of Block D. Consequently, flood water intruded into basement of pump station and submerged all the pumps that result in huge damage on pump equipment.

Since catchment area of Gairezi River is large with more than 1,300 km^2 at the intake points, flood discharge of several thousand m^3/s might occurred during a certain design period. In this study, flood flow occurred in 2006 will be examined by method of hydraulic analysis considering record of flood level and river survey including topographic and cross sectional data. The result of hydraulic analysis will be reflected on the design of the new pump station at Block A and D and for flood measures in Block B and C.

Table 2.2.3 Procedure of Flood Analysis

Step	Activities	Analysis
1	Analysis of daily rainfall data	From the analysis of daily rainfall data, return period of rainfall in 2006 will be examined.
2	Calculation of flood water level by hydraulic analysis	Using the river survey data, flood discharge and flood level will be calculated.
3	Examination of clearance	Based on Japanese Structural Ordinance, relationship between flood discharge and clearance will be examined and the elevation of floor level of new pump station and scope of the flood measure of existing facilities will be determined.

From the result of field survey, since surrounding river bank of pump station and embankment of connecting road to these pump stations were not eroded during the 2006 flood, it is believed that the velocity of flood might be slow at Block B and C. Therefore, the provision of retaining wall surrounding pump station against flood is believed to be sufficient to be used as flood disaster prevention structure for Block B and C.

Utilizing the record of flood water level in 2006 and surveying data, hydraulic analysis will be examined to calculate flood discharge and flood level at pump station site including clearance. Top elevation of retaining wall will be determined by adding flood level and a certain clearance that avoid intrusion of flood water. Additionally, the access road to the pump station will be modified and constructed to secure smooth accessibility to the pump station.

3) Relocation of Pump Station (Block D)

From the result of field survey, flood hit pump station at Block D every year and the surround area of pump station is progressively eroded. If construction of retaining wall is provided, the base of retaining wall might be eroded from the flood that comes once every year during rainy season so that it will be difficult to secure the sustainability of Project at Block D. Therefore, Block D is determined to be relocated to other safe site. With the relocation of pump station, new pipes connecting the

pump house to existing headrace should be installed.

4) Basic Policy of Restoration of Pump Equipment

Since main parts of pump are still in good conditions, pump can be restored if some parts are replaced and adjustment and refabrication are conducted. However, although some other accessories and electric equipment including cables are available, the functionality of these accessories is not reliable because of progressing corrosion and damages. Therefore, it is recommended that all electrical equipment of pump facilities should be replaced anew considering sustainability of the project.

With the relocation of pump station and change of cropping pattern, discharge and pump head will be increased. Since discharge and head of pump is changed in Block D, the existing pump does not have the capacity to pump the required water for irrigation. Therefore, new pumps should be installed in Block D.

Table 2.2.4 Basic Policy of Restoration of Pump Station

No.	Equipment	Basic Policy of Restoration	Remarks
1.	Main pump	Replacement of parts and adjustment and arrangement in Block B and C. New pumps will be installed in Block D	Bearing, sealing parts, electric valve for small diameter pipe, etc, are required to be replaced and be adjusted.
2.	Motor for main pump	Replacement	Low reliability
3.	Electric discharge valve for main pump	Replacement	Improvement of reliability
4.	Main plumbing, manual suction/discharge valve and check valve	Using existing one. All are replaced in Block D.	
5.	Accessories (drainage pump, vacuum pump, etc.,)	All are replaced	Improvement of reliability
6.	Small diameter pipe	Using existing one. All are replaced in Block D.	Some pipe will be replaced in necessary.
7.	Electrical equipment (panel, measuring devices cables, etc.,)	All are replaced.	Improvement of reliability

5) Machinery and Equipment

Some equipment that are not directly being utilized for the maintenance of Nyakomba irrigation scheme are included in the request by Zimbabwe side such as lorry, truck, tipper and low bed. Types and numbers of equipment will be determined in accordance with the necessity for operation and maintenance required in Nyakomba irrigation scheme, and will be selected among requested equipment. According to the analysis made using field survey and the experience from the previous grant aid project, it was decided to include machinery that are of importance to the operation and maintenance of this project, such as tractor equipped with its accessories.

6) Softcomportnent

The activities considered as softcomponents are composed of 1) guidance for operation and maintenance of irrigation facilities, 2) guidance for operation and maintenance of pump facilities, 3) promotion of contract farming.

As part of the softcomponent activity 1) above, the existing canal shall be rehabilitated by the beneficiary farmers under the guidance of expert from DOI.

2.2.2 Basic Design

(1) Proposed Cropping Pattern

Based on the existing cropping pattern of irrigation area at Block B, C and D, the cropping areas of the existing and plan are summarized in Table 2.2.5. Accordingly, the design cropping pattern is presented in Figure 2.2.2 below.

Table 2.2.5 Existing and Design Cropping Area

Item		Block A		Block B		Block C		Block D		Total		
		Present	Plan	Present	Plan	Present	Plan	Present	Plan	Present	Plan	
1. Developed Area (ha)		146	146	128	128	115	115	191	191	580	580	-
2. Irrigated Area (ha)		0	146	65	128	70	115	106	191	241	580	-
3. No. of Households		228	228	128	128	165	165	239	239	760	760	-
Rainfed	(Summer)											
	White Maize	80	80	70	70	60	60	120	120	330	330	-
	Tabasco Chili	0	15	19	25	16	20	10	15	45	75	-
	Paprika	20	25	5	10	4	10	10	15	39	60	-
	Tobacco	0		4		0		0		4	0	-
	Sugar Bean	26		0		0		0		26	0	-
	Popcorn	14		4		3		10		31	0	-
	Groundnuts	2		0		0		0		2	0	-
	Sunflower	4		0		0		0		4	0	-
	Rainfed Total	146	120	102	105	83	90	150	150	481	465	-
Irrigated	(Late Summer)											
	Sugar Bean	0		10		11		20		41	0	-
	(Winter)											
	Wheat	0		10		14		10		34	0	-
	Onion	0	20	14	18	8	16	2	26	24	80	14%
	Potato	0	16	7	14	7	13	17	21	31	64	11%
	Sugar Bean	0	45	20	39	20	35	30	59	70	178	31%
	Green Maize	0	45	10	39	15	35	25	59	50	178	31%
	Butternuts	0		3		3		5		11	0	-
	Green Pepper	0		3		3		5		11	0	-
	Egg Plant	0		3		3		5		11	0	-
	(All Year)											
	Cabbage	0	10	0	9	0	8	0	13	0	40	7%
	Tomato	0	10	0	9	0	8	0	13	0	40	7%
	Irrigated Total	0	146	80	128	84	115	119	191	283	580	100%
Total		146	266	182	233	167	205	269	341	764	1045	-
Cropping Intensity		100%	182%	142%	182%	145%	178%	141%	179%	132%	182%	-

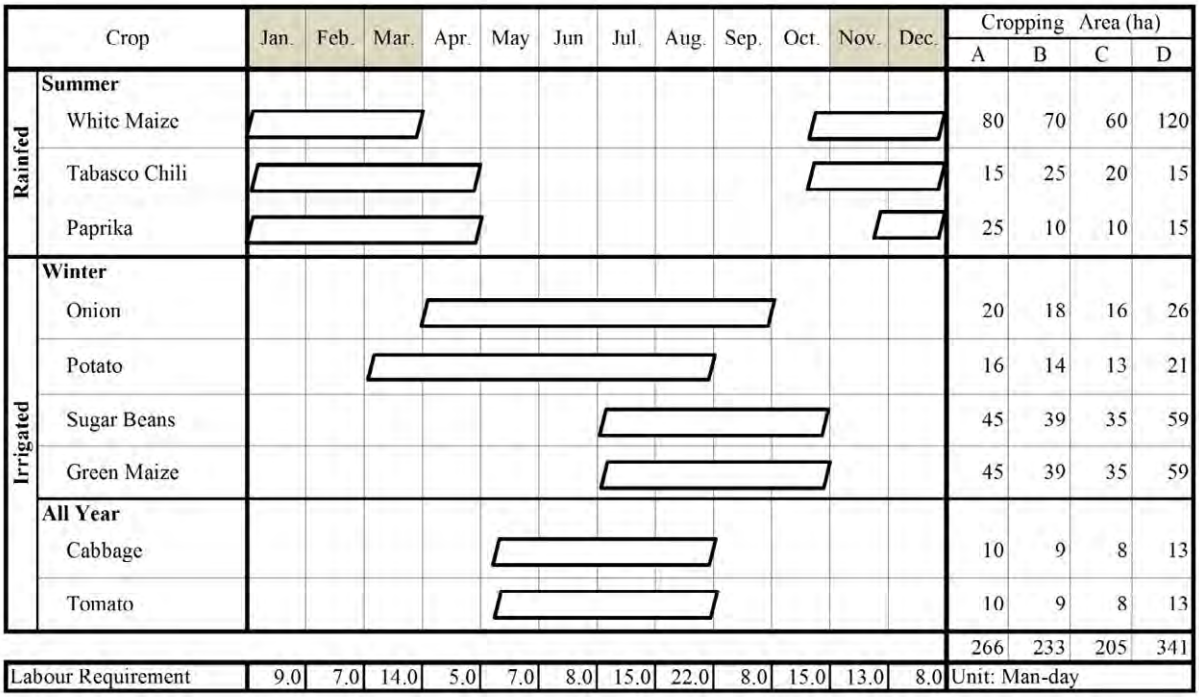


Figure 2.2.2 Design Cropping Pattern

(2) Basic Irrigation Plan

1) Reference Crop Evapotranspiration (ETo)

Reference crop evapotranspiration (ETo) is calculated by FAO Penman-Monteith method in accordance with guidelines for computing crop water requirements under FAO Irrigation Drainage Paper No. 56. Recently, Penman-Monteith method divided into aerodynamics and radiation, which is commonly used for calculation of crop evapotranspiration. Six items namely latitude, altitude, temperature, wind speed, relative humidity and sunshine hours are used as parameter for calculation. The calculation result of monthly ETo is described in Table 2.2.6.

Table 2.2.6 Monthly Reference Crop Evapotranspiration (ETo)

Item	Unit	Jan	Feb	Mar	Apr	May	Jan	Jul	Aug	Sep	Oct	Nov	Dec
ETo	mm/day	4.7	4.9	4.8	4.4	3.5	2.8	2.8	3.7	4.9	5.5	5.4	4.6

Calculation of ETo with Penman-Monteith Method (FAO)

Country:	**Zimbabwe**
Place:	**Nyakomba**
Latitude (φ)	**-17.80** (deg) → -0.31 (rad)
Altitude (Z)	**820** (m)

$ET_0 = ETaero + ETrad$

$$ETaero = \frac{\gamma \frac{900}{T+273}}{\Delta + \gamma(1+0.34u2)} u2(Es - Ea)$$

$$ETrad = \frac{0.408\Delta(Rn - G)}{\Delta + \gamma(1+0.34u2)}$$

P= 92.0 (Kpa)
λ= 2.45 (MJ/kg)
γ= 0.061 (Kpa/°C)
α= 0.23

Item	Unit	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
T (mean)	**°C**	**24.7**	**25.0**	**23.9**	**22.5**	**20.5**	**18.7**	**18.2**	**20.7**	**23.4**	**25.4**	**26.0**	**25.3**
Wind Speed (uz)	**m/s**	**5.2**	**5.3**	**6.3**	**6.4**	**5.9**	**5.9**	**6.3**	**7.0**	**7.6**	**7.8**	**6.8**	**5.8**
RH (mean)	**%**	**70.4**	**67.9**	**63.4**	**62.7**	**67.4**	**74.0**	**75.6**	**72.7**	**69.7**	**69.9**	**67.2**	**71.4**
Sunshine Hours (n)	**hr**	**6.1**	**7.0**	**7.0**	**7.7**	**8.2**	**8.3**	**8.3**	**9.1**	**9.6**	**9.3**	**7.4**	**5.5**
J		15	45	74	105	135	166	196	227	258	288	319	349
u2	m/s	2.34	2.34	2.81	2.87	2.61	2.65	2.80	3.11	3.37	3.50	3.05	2.56
Δ	Kpa/°C	0.186	0.189	0.178	0.166	0.149	0.135	0.131	0.150	0.173	0.193	0.199	0.191
Δ+γ(1+0.34u2)	Kpa/°C	0.296	0.298	0.297	0.287	0.264	0.251	0.250	0.276	0.304	0.327	0.323	0.306
Es	Kpa	3.11	3.17	2.96	2.73	2.41	2.16	2.09	2.44	2.87	3.25	3.36	3.22
Ea	Kpa	2.19	2.15	1.88	1.71	1.62	1.59	1.58	1.78	2.00	2.27	2.26	2.30
γ900/(T+273)		0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18
Es-Ea	Kpa	0.92	1.01	1.08	1.02	0.79	0.56	0.51	0.67	0.87	0.98	1.10	0.92
ETaero	**mm/day**	**1.3**	**1.5**	**1.9**	**1.9**	**1.5**	**1.1**	**1.1**	**1.4**	**1.8**	**1.9**	**1.9**	**1.4**
δ	rad	-0.37	-0.24	-0.05	0.17	0.33	0.41	0.37	0.24	0.04	-0.17	-0.33	-0.41
ωs	rad	1.70	1.65	1.59	1.52	1.46	1.43	1.44	1.49	1.56	1.63	1.68	1.71
dr		1.03	1.02	1.01	0.99	0.98	0.97	0.97	0.98	0.99	1.01	1.02	1.03
Ra	MJ/m2/day	41.4	40.0	37.0	32.1	27.6	25.2	26.1	29.9	34.8	38.7	40.9	41.6
N	hr	13.0	12.6	12.1	11.6	11.2	10.9	11.0	11.4	11.9	12.4	12.9	13.1
n/N		0.47	0.56	0.58	0.66	0.73	0.76	0.75	0.80	0.81	0.75	0.58	0.42
Rs	MJ/m2/day	20.13	21.14	19.92	18.68	16.99	15.86	16.29	19.39	22.76	24.09	21.98	19.08
Rns	MJ/m2/day	15.5	16.3	15.3	14.4	13.1	12.2	12.5	14.9	17.5	18.6	16.9	14.7
Rso	MJ/m2/day	31.75	30.69	28.33	24.61	21.16	19.32	20.00	22.90	26.66	29.64	31.32	31.89
Rnl	MJ/m2/day	2.6	3.0	3.4	4.0	4.3	4.4	4.3	4.5	4.3	3.8	3.0	2.3
Rn=Rns-Rnl	MJ/m2/day	12.9	13.2	11.9	10.4	8.8	7.8	8.2	10.5	13.2	14.8	13.9	12.4
ETrad	**mm/day**	**3.3**	**3.4**	**2.9**	**2.5**	**2.0**	**1.7**	**1.8**	**2.3**	**3.1**	**3.6**	**3.5**	**3.2**
ET_0	**mm/day**	**4.7**	**4.9**	**4.8**	**4.4**	**3.5**	**2.8**	**2.8**	**3.7**	**4.9**	**5.5**	**5.4**	**4.6**

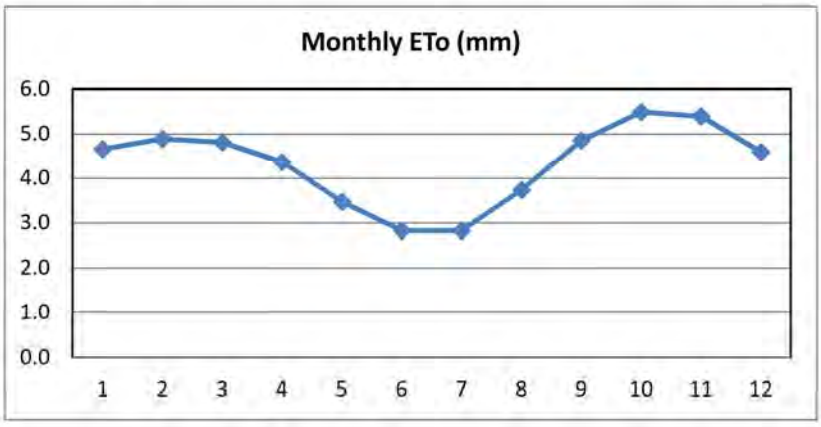


Figure 2.2.3 Calculation of Monthly Reference Crop Evapotranspiration (ETo)

2) Crop Evapotranspiration (ETCrop)

Based on FAO Irrigation Drainage Paper No. 56, Crop Evapotranspiration (ETCrop) is calculated as followings.

- ETCrop = Crop Coefficient (KC) ×Reference Crop Evapotranspiration (ETo) x Crop Ratio

Based on the designed cropping pattern indicated above, the crop ratio to be introduced is determined as onion with 14%, potato with 11%, sugar beans with 31%, green maize with 31%, cabbage with 7% and tomato with 7%

Table 2.2.7 Calculation of ETCrop

No.	Crop	C/R (%)	Month	Apr	May	Jun	Jul	Aug	Sep	Oct	Remarks
			ETo (mm/day)	4.4	3.5	2.8	2.8	3.7	4.9	5.5	
(1)	Onion	14	KC	1.05	1.05	1.05	1.05	1.05	0.75		
			ETCrop (mm/day)	0.63	0.50	0.40	0.40	0.53	0.50	0.00	(1)=ETo*KC*C/R (Onion)
(2)	Potato	11	KC	1.15	1.15	1.15	1.15	0.75			
			ETCrop (mm/day)	0.56	0.44	0.36	0.36	0.31	0.00	0.00	(2)=ETo*KC*C/R (Potato)
(3)	Sugar Beans	31	KC				0.40	1.15	1.15	0.55	
			ETCrop (mm/day)	0.00	0.00	0.00	0.35	1.31	1.74	0.93	(3)=ETo*KC*C/R (Sugar Beans)
(4)	Green Maize	31	KC				0.40	1.15	1.15	0.55	
			ETCrop (mm/day)	0.00	0.00	0.00	0.35	1.31	1.74	0.93	(4)=ETo*KC*C/R (Green Maize)
(5)	Cabbage	7	KC	1.05	1.05	0.95					
			ETCrop (mm/day)	0.32	0.25	0.18	0.00	0.00	0.00	0.00	(5)=ETo*KC*C/R (Cabbage)
(6)	Tomato	7	KC	1.00	1.00	0.80					
			ETCrop (mm/day)	0.30	0.24	0.15	0.00	0.00	0.00	0.00	(6)=ETo*KC*C/R (Tomato)
Total		100	ETCrop (mm/day)	1.8	1.4	1.1	1.4	3.5	4.0	1.9	(7)=(1)+(2)+(3)+(4)+(5)+(6)

C/R: Cropping Ratio

From the result of Table 2.2.7, maximum monthly ETCrop is 4.0 mm/day in September and this value shall be used as the value for facility design.

3) Irrigation Interval

Irrigation intervals are determined through the relationship between water holding capacity of soil and water consumption. Irrigation interval is calculated as 5 days based on the Irrigation Drainage Pepper No. 56, Chapter 8 as shown in followings.

- Irrigation interval = RAW (Readily Available Water) / ETCrop

  TAW (Total Available Water) = 1,000 (Qfc – Qwp) Zr

  Qfc, Qwp: Coefficient, 0.15, 0.06 respectively for Loamy Sand soil

  Zr: Rooting depth (=0.5 m)

Main Crop	Rooting Depth（m）
Onion	0.40
Potato	0.60
Beans	0.40

Source: FAO Irrigation Drainage Paper No. 56

TAW = 1,000 × (0.15 - 0.06) × 0.5 = 45 mm

RAW = p·TAW

p: Fraction (0.45, beans)

RAW = 0.45 × 45 = 20.3 mm

Irrigation interval = RAW / ETcrop = 20.3 / 4.0 = 5.1 ⇒5 days

From the hearing survey of farmers at Block B, C and D, the irrigation interval practiced was between 5 to 7 days on average which is almost the same as the result of calculation. Therefore, irrigation interval with 5 days is adopted as an irrigation planning for Block A as well.

(Reference)
Selection of soil type based on the soil survey

Sample pt	Atterberg limit		Particle size distribution		Soil Type
A	Liquid Limit, WL	28.7%	>2 mm	0.2%	Sandy Loam
	Plastic Limit, WP	17.6%	0.075~2 mm	42.3%	
	Plastic Index, IP	11.1%	< 0.075 mm	57.5%	
B	Liquid Limit, WL	46.1%	>2 mm	0%	Silty Loam
	Plastic Limit, WP	25.9%	0.075~2 mm	18.7%	
	Plastic Index, IP	20.2%	< 0.075 mm	91.3%	
C	Liquid Limit, WL	37.3%	>2 mm	0.1%	Loamy Sand
	Plastic Limit, WP	20.9%	0.075~2 mm	49.8%	
	Plastic Index, IP	16.4%	< 0.075 mm	50.1%	

From the result of Atterberg limit and soil particle size distribution with 3 samples, soil type is selected as Loamy Sand and Qfc are Qwp become 0.15 and 0.06 respectively.

4) Irrigation Efficiency

Irrigation efficiency is adopted as 0.60 as shown in the table below.

Table 2.2.8 Application Efficiency and Irrigation Efficiency

Classification	Application efficiency	Conveyance loss	Irrigation efficiency
Surface irrigation	70%	5～10%	60～65%

Source: Planning and Design Standard "Irrigation Water" (Upland), MAFF, Japan

5) Irrigation Water Requirement

Irrigation water requirement will be determined by peak ETo, irrigation efficiency and irrigation hours. Irrigation hour is adopted as 8 hours which is the same as existing irrigation scheme of Block B, C and D.

Irrigation water requirement = ETCrop / Irrigation efficient / Irrigation hours
= 4.0 (mm/day) / 1,000 × 10,000 (m^2) / 0.60 / 8 (hr) / 3,600 (s)
= 2.315 ℓ/s/ha

6) Domestic Water

Domestic water of 650 liters per family per day should be considered; which is the same as used for Block B, C and D.

Domestic water (Block A) = 650 (ℓ/day) × 228 (families) / 8 (hr) / 3,600 (s) = 5 (ℓ/s)
Domestic water (Block B) = 650 (ℓ/day) × 128 (families) / 8 (hr) / 3,600 (s) = 3 (ℓ/s)
Domestic water (Block C) = 650 (ℓ/day) × 165 (families) / 8 (hr) / 3,600 (s) = 4 (ℓ/s)
Domestic water (Block D) = 650 (ℓ/day) × 229 (families) / 8 (hr) / 3,600 (s) = 5 (ℓ/s)

7) Design Discharge

Design discharge will be determined by adding the irrigation water requirement and domestic water.

Design Discharge (Block A) = 2.315 (ℓ /s/ha) × 146 (ha) + 5 (ℓ/s) = 0.343 (m^3/s)
Design Discharge (Block B) = 2.315 (ℓ /s/ha) × 128 (ha) + 3 (ℓ/s) = 0.299 (m^3/s)
Design Discharge (Block C) = 2.315 (ℓ /s/ha) × 115 (ha) + 4 (ℓ/s) = 0.270 (m^3/s)
Design Discharge (Block D) = 2.315 (ℓ /s/ha) × 191 (ha) + 5 (ℓ/s) = 0.447 (m^3/s)

(3) Examination of Flood

1) Return Period

Return period of 2006 that brought about serious flood damages will be examined using daily rainfall record from 2000 to 2012 in Mutare because accurate rainfall data in 2006 are not recorded in the nearest station of Nyanga. Maximum daily rainfall and maximum 3 days continuous rainfall are 149.0 mm and 209.5 mm and these are corresponding to 40 to 50 years probability according to the result of return period by logarithmic normal distribution.

Table 2.2.9 Maximum Daily Rainfall and Maximum 3 Days Continuous Rainfall

Year	Maximum Daily Rainfall (mm)		3 Days Continuous Rainfall (mm)	
	Rainfall (mm)	Return Period	Rainfall (mm)	Return Period
2000	45.9	Less than 2 years	111.6	3 years
2001	44.0	Less than 2 years	92.6	Less than 2 years
2002	69.0	Less than 2 years	75.5	Less than 2 years
2003	88.5	4 years	112.0	3 years
2004	84.5	3 years	154.0	10 years
2005	72.4	2 years	96.4	Less than 2 years
2006	149.0	38 years	209.5	51 years
2007	65.3	Less than 2 years	97.0	Less than 2 years
2008	55.6	Less than 2 years	72.3	Less than 2 years
2009	86.7	4 years	94.4	Less than 2 years
2010	71.8	2 years	100.4	Less than 2 years
2011	65.1	Less than 2 years	113.5	3 years
2012	98.2	6 years	105.3	2 years

2) Record of Flood Water Level

Flood water level in 2006 (maximum flood water level in the past) was recorded as follows.

Table 2.2.10 Flood Water Level in 2006

Block	Location	Flood Water Level	Remark
B	Pump station	813.85 m	Flood traces
C	Pump station	813.65 m	Flood traces
D	Pump station	810.00 m	Flood traces

3) Calculation Method of Flood Discharge

River flood discharge will be calculated at pump station D until it reaches the 2006 flood water level of 810 meters by trial and error method using varied flow calculation as shown in following procedure.

- Determination of river slope (I_0) from the result of river topographic and longitudinal survey
- Assumption of initial flood discharge (Q_0) and calculation of initial energy height using the value of (Q_0) and (I_0)
- Calculation of flood water level at the point of pump station in Block D
- If flood water level in the river cross-section at pump station of Block D is not 810 meters, the assumption of flood discharge should be change
- Until flood water level become 810 meters, varied flow calculation continue by changing assumption flood discharge

4) Result of Flood Discharge Calculation

As the result of the trial and error calculation, at flood discharge of Q=2,300 m^3/s, flood water level become around 810 meters at the site of existing pump station D. Therefore, flood discharge at the flood of 2006 is estimated as Q=2,300 m^3/s and calculation result is as shown in Table below.

Table 2.2.11 Flood Discharge and Flood Water Level at the Flood of 2006

Place	Flood Discharge (m^3/s)	River Bed (m)	Water Depth (m)	Flood Water Level (m)
D+0.0 (existing Pump D)	2,300.0	800.228	9.836	810.064≒810
D1+0.0 (proposed Pump D)	2,300.0	800.437	9.844	810.281≒810.30

Hydraulic Longitudinal Profile in Block D is described in Figure 2.2.4

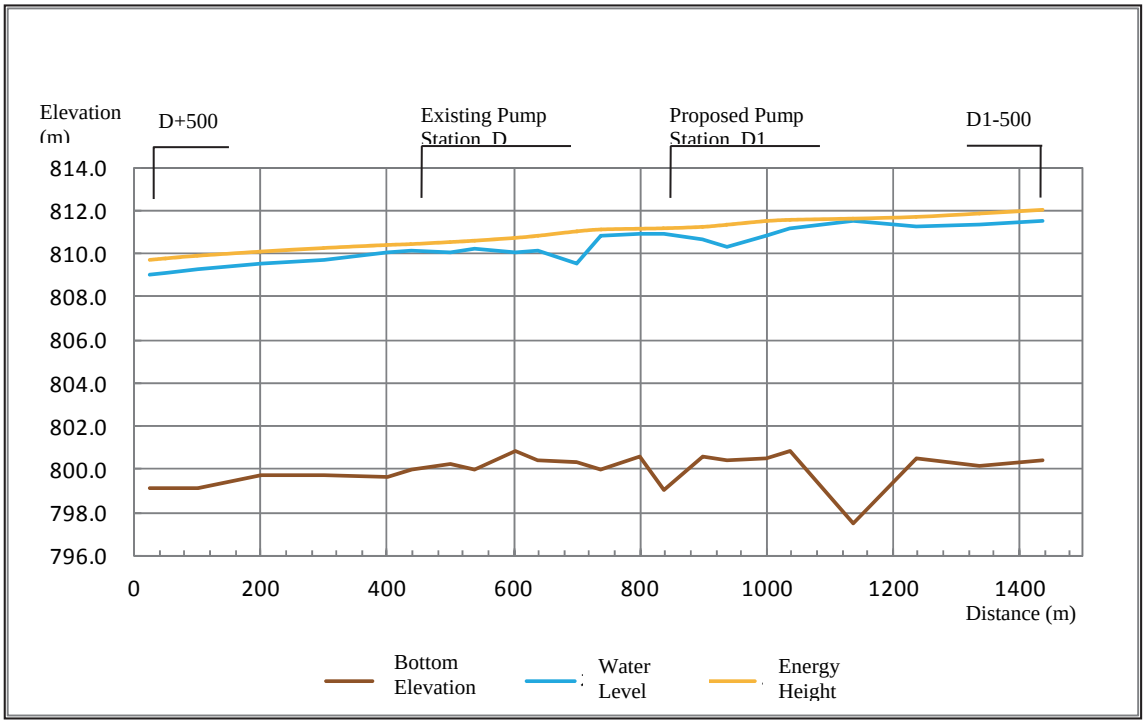


Figure 2.2.4 Hydraulic Longitudinal Profile (Block D)

5) Design Flood Water Level in Block A

Based on the result of Q=2,300 m^3/s obtained from the calculation at Block D, design flood water level in Block A was determined using same calculation method by changing the flood water level. From the result of this trial and error calculation, the design flood water level, for the design discharge of Q = 2,300m3/s, at pump station Block A become 820 meters.

Table 2.2.12 Design Flood Water Level at the site of pump station in Block A

Station	Discharge (m^3/s)	River Bed (m)	Water Depth (m)	Flood Water Level (m)
A+0.0	2,300.0	810.080	9.883	819.963≒820.00

Hydraulic Longitudinal Profile at Block A is presented in Figure 2.2.5.

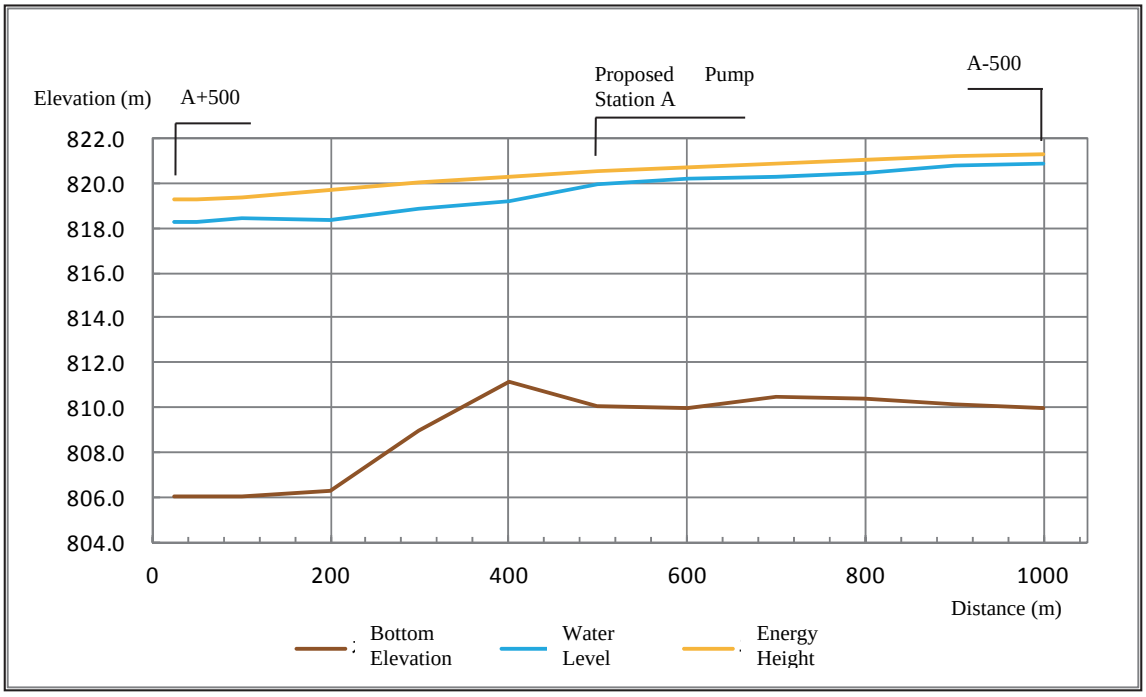


Figure 2.2.5 Hydraulic Longitudinal Profile (Block A)

(4) Pump Facility

1) Pump Diameter and Number of Pump

The difference in crop evapotranspiration varies more than three (3) times between June at 1.1 mm/day and September which is 4.0 mm/day and water requirement is changing on monthly basis during the irrigation period. Though single number of pump is economically efficient in the initial cost and might be possible to meet seasonal water requirement to adjust valve opening degree, single number of pump might bring some problems such as i) electrical charges might become expensive as pump efficiency reduce, ii) lifespan of pump equipment such as not only impeller but also casing, shaft, bearing might shorten and iii) risks diversification could not be performed in case of trouble.

In the previous Grant Aid Project, i) plural numbers of pump were introduced considering risk

diversification and coping with seasonal water requirement, ii) the plural numbers of pump with same diameter were introduced considering facilitation of repairing and maintenance ensuring common use of spare parts, these are basic concept for facility design for pump. Accordingly, these two previous concepts will be adopted in this design. Pump diameter and pump numbers are determined to be the same diameter for plural numbers and the capacity of one pump is determined to accommodate minimum seasonal water requirement.

Since the difference between maximum and minimum water requirement are found to be three times during the irrigation period, three (3) numbers of pump will be installed to cope with seasonal water requirement. During the time of minimum water requirement, only one pump will operate to satisfy the requirement and during the time of maximum water requirement, three pumps will operate to satisfy the requirement. Thus, three pumps operation can cope with seasonal water requirement. Relationships between diameter and discharge in centrifugal pump are as shown in Table 2.2.13.

Table 2.2.13 Relationship Between Diameter and Discharge in Centrifugal Pump (50Hz)

Pump Diameter (mm)	Discharge (m3/min)	Remarks
200	3.00～5.00	
250	5.00～8.00	Applicable to Block A (Q=6.86 m3/min) Applicable to Block B (Q=5.98 m3/min) Applicable to Block C (Q=5.40 m3/min)
300	8.00～12.00	Applicable to Block D (Q=8.94 m3/min)
350	12.00～18.00	

Source: Planning and Design Standard "Pump Station", MAFF, Japan

- Required maximum pump discharge (Block A) = 0.343 (m^3/s)×60 (s) / 3 (nos) = 6.86 (m^3/min)
- Required maximum pump discharge (Block B) = 0.299 (m^3/s)×60 (s) / 3 (nos) = 5.98 (m^3/min)
- Required maximum pump discharge (Block C) = 0.270 (m^3/s)×60 (s) / 3 (nos) = 5.40 (m^3/min)
- Required maximum pump discharge (Block D) = 0.477 (m^3/s)×60 (s) / 3 (nos) = 9.48 (m^3/min)

The relationship between seasonal pump lifting discharge determined by water requirement and pump operation numbers is presented as follows.

Table 2.2.14 Relationship Between Seasonal Pump Lifting Discharge and Pump Operation Numbers

Month	Seasonal Pump Lifting Discharge (m^3/min)				Pump Operation Numbers
	Block A	Block B	Block C	Block D	
Apr	9.43	8.18	7.43	12.24	2
May	7.40	6.40	5.83	9.58	2
Jun	5.88	5.07	4.63	7.60	1
Jul	7.40	6.40	5.83	9.58	2
Aug	18.04	15.74	14.22	23.51	3
Sep	20.58	17.96	16.21	26.83	3
Oct	9.93	8.62	7.83	12.90	2

2) Design Water Intake Level

Minimum water level in the river is examined for Block A and Block D where new pump station will be installed. Design water intake level will be determined considering field observation record in dry season and specific run-off during drought which is Q=4.00 m^3/s (q=0.30 m^3/s/100km^2) might be equivalent to 10 years return period of minimum run-off. Design water intake level is determined as minimum water level with 10 years return period water level. Minimum water level is calculated by varied flow calculation during the section for up/down stream of pump station using topographic river survey data based on the condition with minimum discharge is Q=4.00 m^3/s. The calculation result of minimum water level is described in Table 2.2.15

Table 2.2.15 Drought Water Level in Block A and Block D

Station	Discharge (m^3/s)	Bed Elevation (m)	Water Depth (m)	Minimum Water Level (m)
D1+0.0 (Block D)	4.00	800.437	0.947	801.384
A+0.0 (Block A)	4.00	810.080	1.090	811.170

Relationship between observation record in dry season and minimum water level is as shown in Table 2.2.16. As the result, minimum water level is lower than observation record in each block. Design water intake level will be determined considering safety for scouring river bed because of steep river bed slope with 1/500 to 1/700.

Table 2.2.16 Design Water Intake Level

Block	Observation record in dry season (m)	Minimum water level (m)	Design water intake level (m)
A	811.5	811.17	811.00
D	801.5	801.38	801.00

Specific minimum run-off is assumed as Q=4.00 m3/s as empirical value with 0.30 m3/s/100km2

3) Pumping Water Level and Pump Head

Total pump head is determined by adding gross pump head and pipe head loss. Gross pump head is as follows.

Table 2.2.17 Gross Pump Head

Block	Pumping water level (m)	Intake water level (m)	Gross pump head (m)
A	852.5	811.0	41.5
B	861.5	801.3	60.2
C	863.5	801.1	62.4
D	852.2	801.0	51.2

Diameter of pipe from pump station to farm pond will be determined in accordance with table below.

Table 2.2.18 Velocity and Pipe Diameter

Pipe diameter (mm)	Average velocity (m/s)	Block A	Block B	Block C	Block D
		Pipe diameter velocity	Pipe diameter velocity	Pipe diameter velocity	Pipe diameter velocity
450 ～ 800	1.2 ～ 1.8	500 mm 1.747 m/s	500 mm 1.523 m/s	500 mm 1.375 m/s	600 mm 1.581 m/s

Source: Planning and Design Standard "Pipeline", MAFF, Japan
Design discharge (Block A): Q = 0.343 (m/s), Design discharge (Block B): Q = 0.299 (m/s)
Design discharge (Block C): Q = 0.270 (m/s), Design discharge (Block D): Q = 0.477 (m/s)

Pipe head loss will be determined by Hazen–Williams equation.

$$H_f = 10.667 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L \times (1+\alpha) + Hg$$

H_f: Pipe head loss (m)
C: Velocity coefficient (Steel pipe: 130, FRP: 150)
D: Pipe diameter (m)
Q: Discharge (m^3/s)
L: Pipe length (m)
α: Other loss (=10%)
Hg: Pipe loss in pump station (=2.50m)

$H_{fA}= 10.667 \times 130^{-1.85} \times 0.50\text{-}^{4.87} \times 0.343^{1.85} \times 1{,}000 \times 1.10 +2.50 = 8.32$ m (Block A)
$H_{fB}= 10.667 \times 130^{-1.85} \times 0.50^{-4.87} \times 0.299^{1.85} \times 1{,}656 \times 1.10 + 2.50 = 9.98$ m (Block B)
$H_{fC}= 10.667 \times 130^{-1.85} \times 0.50\text{-}^{4.87} \times 0.270^{1.85} \times 1{,}941 \times 1.10 + 2.50 = 9.76$ m (Block C)
$H_{fD}= H_{fD1}+ H_{fD2} = 1.25 + 3.57 +2.50 = 7.32$ m (Block D)
$H_{fD1}= 10.667 \times 130^{-1.85} \times 0.60^{-4.87} \times 0.447^{1.85} \times 320 \times 1.10 = 1.25$ m (New line in Block D)
$H_{fD2}= 10.667 \times 150^{-1.85} \times 0.60\text{-}^{4.87} \times 0.447^{1.85} \times 1{,}190 \times 1.10 = 3.57$ m (Existing in Block D)

Therefore, the total pump head will be as follows.

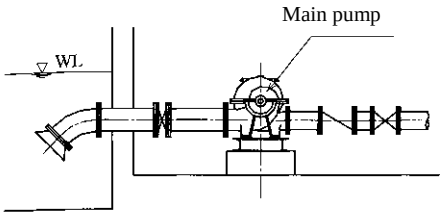
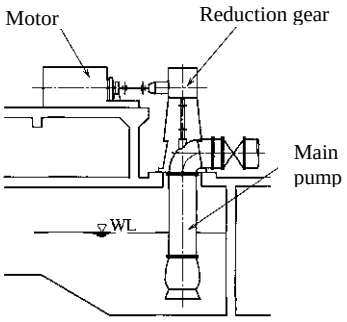
Table 2.2.19 Total Pump Head

Block	Gross pump head (m)	Pipe head loss (m)	Total pump head (m)
A	41.5	8.5	51
B	60.2	10.0	71
C	62.4	9.8	73
D	51.2	7.3	59

4) Pump Axis

Type of pump axis is generally composed of horizontal axis and vertical axis. Type of pump axis will be selected considering site condition, suction performance, operation/maintenance, economic efficiency and other condition. The comparison between horizontal axis and vertical axis is presented as follows. In this study, horizontal axis type which providing the advantage of operation/maintenance and economic efficiency is selected.

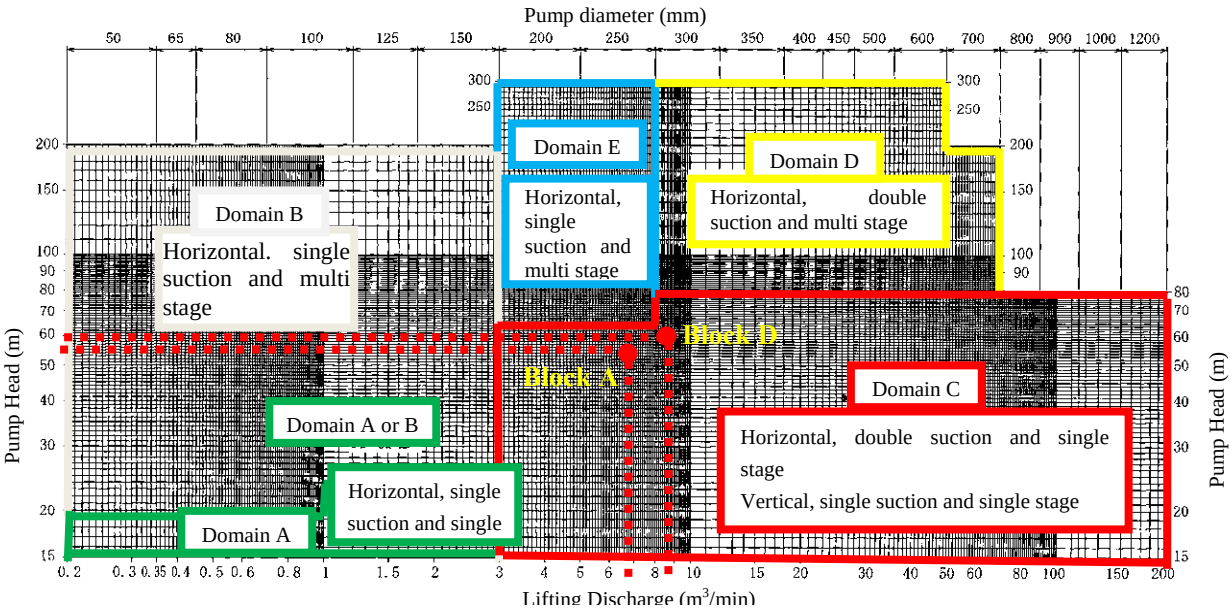
Table 2.2.20 Comparison Between Horizontal Type and Vertical Type

Item \ Type	Horizontal axis type		Vertical axis type	
Structure of pump station	 Floor area is bigger than vertical type but structure of pump station is simple. Heights of pump house and crane capacity become smaller.	○	 Floor area is smaller but pump load directly affects concrete member so that concrete member will be thicker. Cost is not much difference but horizontal type will be advantage because of simple structure. In places where water level fluctuates remarkably vertical type have disadvantage over economic efficiency.	△
Site condition	In case there is no restriction on the size of area to be used, horizontal type has an advantage.	○	In case site area is restricted, vertical type can demonstrate effectiveness. However, since this design does not receive the restriction of site area, merits of vertical type can not demonstrate.	△
Suction performance	Generally, vertical type is more superior. But intrusion type is introduced in this design so that there is no difference as for suction performance because elevation of impeller is set lower than intake water level.	○	There is no difference as for suction performance.	○
Inspection	Inspection of pump inside is possible by removing casing and easier than vertical type	○	Inspection of pump inside is difficult because main pump should be lifted up to outside and needed to dismantle for inspection	△
Cost	More economical	○	Expensive	×
Evaluation	From the viewpoint of operability and economic efficiency, horizontal type is more suitable and is adopted. In addition, since existing pumps are horizontal type, pump operator is accustomed to operate horizontal type.			

○: Excellent, △: Acceptable, ×: Not suitable

5) Pump Type

Pump type will be determined from the relationship between total pump head and lifting discharge in accordance with pump application diagram. Block A and Block D belong to domain C and 1) horizontal pump with double suction and single stage or 2) vertical pump with singe suction and singe stage are applicable. From the examination of pump axis mentioned above, horizontal type is adopted.



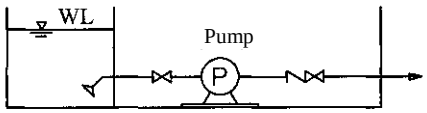
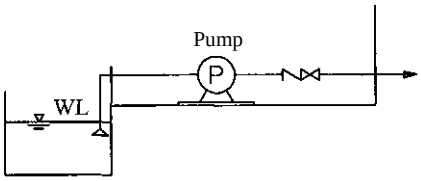
Source: Planning and Design Standard "Pump Station", MAFF, Japan

Figure 2.2.6 Pump Application Diagram for Centrifugal Pump with High Pump Head (50 Hz)

6) Suction Type

Pump suction has two types namely intrusion type and pumping up type. In intrusion type, position of impeller is set lower than water intake level. On the other hand, pumping up type is set higher than water intake level. The comparisons of both types are as shown in the table below.

Table 2.2.21 Comparison of Suction Type

Item \ Type	Intrusion type		Pumping up type	
Structure	 Position of impeller is lower than intake water level so that cavitation phenomenon might be not occurred.		 Position of impeller is higher than intake water level so that cavitation phenomenon should be examined.	
Equipment system filling with water	Not necessary	○	Should be required.	△
Startability	Water filling process is not necessary so that startability is quickly. In the Project site, since power failure is frequent, quick startability is required because of restriction of farm pond capacity. From the viewpoint of smooth pump operation, startability of pump is important factor.	○	Water filling process is required so that startability is slow.	△
Maintenance	Since appurtenances are not many, intrusion type has an advantage concerning maintenances.	○	Since appurtenances are many such as vacuum pump, etc. which might bring about troubles.	△
Civil cost	Intrusion type tends to be more expensive. However, since foundation of basement should be	△	If geological condition is suitable for foundation, height of basement could be	○

Type / Item	Intrusion type		Pumping up type	
	set on the rock, there is no difference much comparing with pumping up type from the geological condition.		set around 3m higher than intrusion type.	
Equipment cost	Cheaper than pumping type	○	More expensive than intrusion type	△
Evaluation	Pumping type was introduced in Phase-1 from the economical efficiency. However, considering safety against cavitation, convenience of startability and risks of troubles, intrusion type was introduced in Phase-2. In this study, from the view points of risk of troubles and startability form restoration of power failure, intrusion type should be introduced.			

○: Excellent, △: Acceptable, ×: Not suitable

7) Capacity of Motor

Capacity of motor will be determined as follows.

$$P = 0.163\ Q \cdot H \cdot (1 + R) / (\eta P \cdot \eta g)$$

P: Generating power (kW)
Q: Lifting discharge of main pump (m^3/min)
H: Total pumping head (m)
R: Allowance (=10%)
ηP: Pump efficiency (Ns=160)
ηg: Transmission efficiency of reduction gear (=1.0)

In accordance with the formula mentioned above, generating power of motor for each block is as determined as shown in the table below.

Table 2.2.22 Generating Power of Motor in Each Block

Item	Block A	Block B	Block C	Block D
Q: Lifting discharge (m^3/min)	6.86	5.98	5.40	9.48
H: Total pumping head (m)	51	71	73	59
1 + R (allowance)	1.10	1.10	1.10	1.10
ηP: Efficiency of main pump	0.75	0.68	0.68	0.77
P: Generating power (kW)	84	112	104	130
Rated Power Output (kW)	90	132	132	132

Upper row: New installation (new design standard), Lower row: Repairing (former design standard)
Rated power output is determined considering allowance with 10%.
Normalized rated power outputs are 75, 90, 110, 132, 160 kW.

8) Description of Pump Facility

Description of pump facilities for Block A (New installation)

Item	Specification	Quantity
Main Pump	Horizontal centrifugal pump, double suction and single stage Suction diameter with 250 mm×outlet diameter with 150 mm Design discharge: 6.86 m3/min Total head: 51 meters	3 nos
Motor	Frequency: 50 Hz Revolution: 1,450 rpm (4 pole) Voltage: 400 V (3 phases) Rated Power Output: 90 kW Starting method: Squirrel cage induction motor	3 nos

Description of pump facilities for Block B (Repairing)

Item	Specification	Quantity
Main Pump	Horizontal centrifugal pump, double suction and single stage Suction diameter with 250 mm×outlet diameter with 150 mm Design discharge: 6.14 m3/min (initial), 5.98 m3/min (revised) Total head: 74 meters (initial), 71 meters (revised) Existing pump will be repaired by replacement of parts and will be adjusted.	3 nos
Motor	Frequency: 50 Hz Revolution: 1,450 rpm (4 pole) Voltage: 380 V with 3 phases (initial), 400 V with 3 phases (revised) Rated Power Output: 132 kW Starting method: Squirrel cage induction motor Motor and electric equipment will be replaced because of improvement of reliability	3 nos

Description of pump facilities for Block C (Repairing)

Item	Specification	Quantity
Main Pump	Horizontal centrifugal pump, double suction and single stage Suction diameter with 250 mm×outlet diameter with 150 mm Design discharge: 6.73 m3/min (initial), 5.40 m3/min (revised) Total head: 81.5 meters (initial), 73 meters (revised) Existing pump will be repaired by replacement of parts and will be adjusted.	3 nos
Motor	Frequency: 50 Hz Revolution: 1,450 rpm (4 pole) Voltage: 380 V with 3 phases (initial), 400 V with 3 phases (revised) Rated Power Output: 132 kW Starting method: ：Squirrel cage induction motor Motor and electric equipment will be replaced because of improvement of reliability	3 nos

Description of pump facilities for Block D (New installation)

Item	Specification	Quantity
Main Pump	Horizontal centrifugal pump, double suction and single stage Suction diameter with 250 mm×outlet diameter with 150 mm Design discharge: 6.73 m3/min (initial), 5.40 m3/min (revised) Total head: 81.5 meters (initial), 73 meters (revised) New pumps will be installed to meet design discharge and total head..	3 nos
Motor	Frequency: 50 Hz Revolution: 1,450 rpm (4 pole) Voltage: 380 V with 3 phases (initial), 400 V with 3 phases (revised)	3 nos

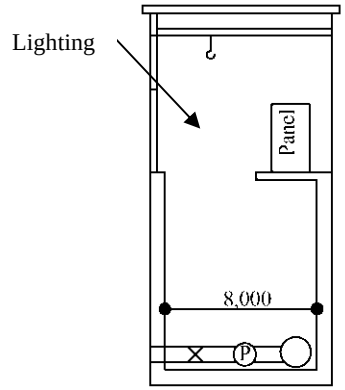
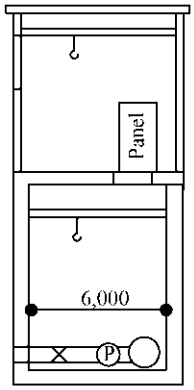
Item	Specification	Quantity
	Rated Power Output: 132 kW Starting method: : Squirrel cage induction motor Motor and electric equipment will be replaced because of improvement of reliability	

(5) Plan of Pump Station

1) Type

Existing pump station B and D are introduced open type. On the other side, existing Block D is introduced box type. Both types are compared and described in table below. As a result after examination, open type will be introduced for new pump station of Block A and D.

Table 2.2.23 Comparison of Type of Pump Station

Type	Open type	Box type
Figure		
Merit and demerit	(Merit) - Power cut is occurring frequently in the site. Open type can be lightened by sunshine and can be continued the activities of operation and maintenance even during power cut. Additionally, after recovery of power cut, pump operation can be restarted quickly comparing with box type. (Demerit) - The structure becomes bigger to ensure the panel space on the floor.	(Merit) - The structure become smaller and has an advantage from the aspect of construction cost. (Demerit) - Operation activities can not be continued during power cut. - Two numbers of cranes are required.
Evaluation	- Power cut is occurring frequently in the site. During power cut, pump operator must escape from basement to climb 10 meter up to surface floor in the dark. To escape in the dark, it must be dangerous. Therefore, open type will be introduced because of ensuring safety activities with brightness.	

2) Layout

Layout of pump station including intake and suction tank considering flood water level and intake water level is described in the table below. The structure of pump station is determined considering the following items as shown in the table below.

Table 2.2.24 Design Policy of Structure of Pump Station

Items	Contents to be examined
Dimensions of	Dimensions of ceiling crane determined by the length of suction pipe, sluice valve, centrifugal

Items	Contents to be examined
longitudinal section	pump, reducer, and dimensions panel and warehouse.
Dimensions of cross section	Three (3) sets of centrifugal pump and motor, and space of duct and stairs
Bottom elevation	Determined considering intake water level and setting elevation of centrifugal pump
Floor elevation	Determined by flood water level plus clearance (1.20m is introduced because of flood discharge with Q=2,300m3/s Block A: 820.00 (flood water level) + 1.20 (clearance) = 821.20m Block D: 810.30 (flood water level) + 1.20 (clearance) = 811.50m
Concrete thickness	To ensure the weight for resistance force against buoyancy and up-lift Structural thickness will be determined by structural analysis. Minimum thickness should be required 35 cm.
Pumping house	Column and beam structure shall be introduced. Wall is composed of bricks
Ceiling crane	3 ton crane is required to install pump and plumbing.
Slope protection	Gabions will be used for the protection of slope with 1:2.0. Banquette will be installed inside of slope and concrete side wall will be installed at the end of gabions.

(6) Retaining Wall

1) Water Level and Top Elevation

Retaining wall will be installed for flood protection in Block B and C. Top elevation of retaining wall will be determined as follows.

Top elevation of retaining wall = Maximum water level in the past at 2006 + Clearance

Clearance will be determined in accordance with Structural Standards for River Management Facilities by Japanese cabinet order.

Table 2.2.25 Height of River Bank

Items	1	2	3	4	5	6
Design flood discharge (m^3/s)	Less than 200	200 to 500	500 to 2,000	2,000 to 5,000	5,000 to 10,000	More than 10,000
Clearance (m)	0.6	0.8	1.0	1.2	1.5	2.0

Source: Structural Standards for River Management Facilities by Japanese cabinet order

Since the design flood discharge at the Project site is 2,300m^3/s, clearance with 1.20 m is introduced in these designs. Considering clearance, top elevation of retaining wall for flood protection will be determined and described in the following table.

Table 2.2.26 Top Elevation of Retaining Wall

Place	Design flood discharge (m3/s)	Clearance (m)	Top elevation of the wall (m)
Block B	813.85	1.20	815.05
Block C	813.65	1.20	814.85

2) Cross Section of Retaining Wall

Considering up-lift and seepage control, cross section of retaining wall will be determined as follows.

- Examination of up-lift
  Resistance force / up-lift force > safety factor = 1.1
  Up-lift force (10.8 ton/m)
  Resistance force (12.9 ton/m)
  Safety factor: 12.9 / 10.8 = 1.2 > 1.1, OK
- Penetration depth
  C < （L/3+ Σℓ） / ΔH
  C: Creep ratio (coarse sand = 5)
  L: Length of bottom slab (=3.0m)
  Σℓ: Creep length of vertical direction (=0.70×2 + 1.75×6 = 11.9m)
  ΔH: Maximum water level difference (=813.85 – 811.50 = 2.35m)
  C = (3.0/3+ 11.9) / 2.35 = 5.5 > 5, OK

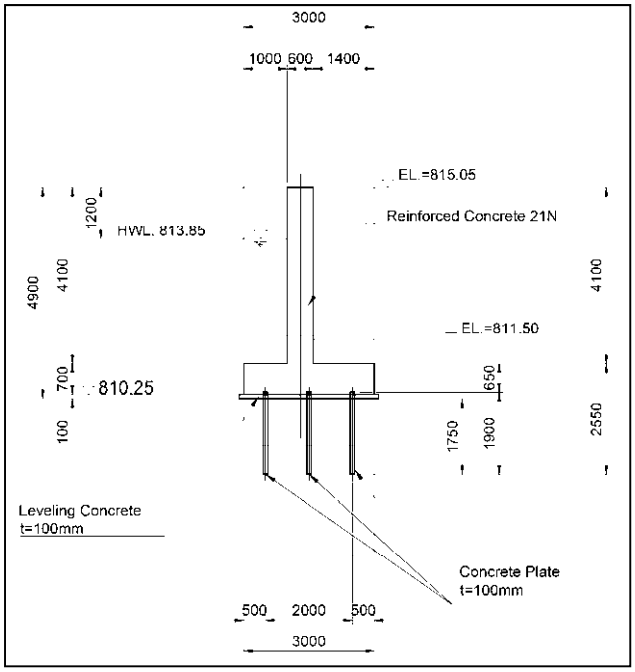


Figure 2.2.7 Typical Cross Section of Retaining Wall

3) Layout

Layout of retaining wall will be determined considering items indicated in the table below.

Table 2.2.27 Design Policy of Retaining Wall

Items	Contents to be considered
Top elevation	Determined by flood design water level plus clearance (Block B: 813.85+1.20=815.05m, Block C: 813.65+1.20=814.85m
Access road	Access road with the slope of 8% will be installed to ensure smooth accessibility.

Items	Contents to be considered
Length of wall	Determined by the formation of the access road.

(7) Water Distribution Plan

1) Diagram of Water Distribution

Irrigation water will be utilized from Gairezi river and pumped up to farm pond. After farm pond, irrigation water will be distributed to all the beneficial area by gravity as shown in the figure below.

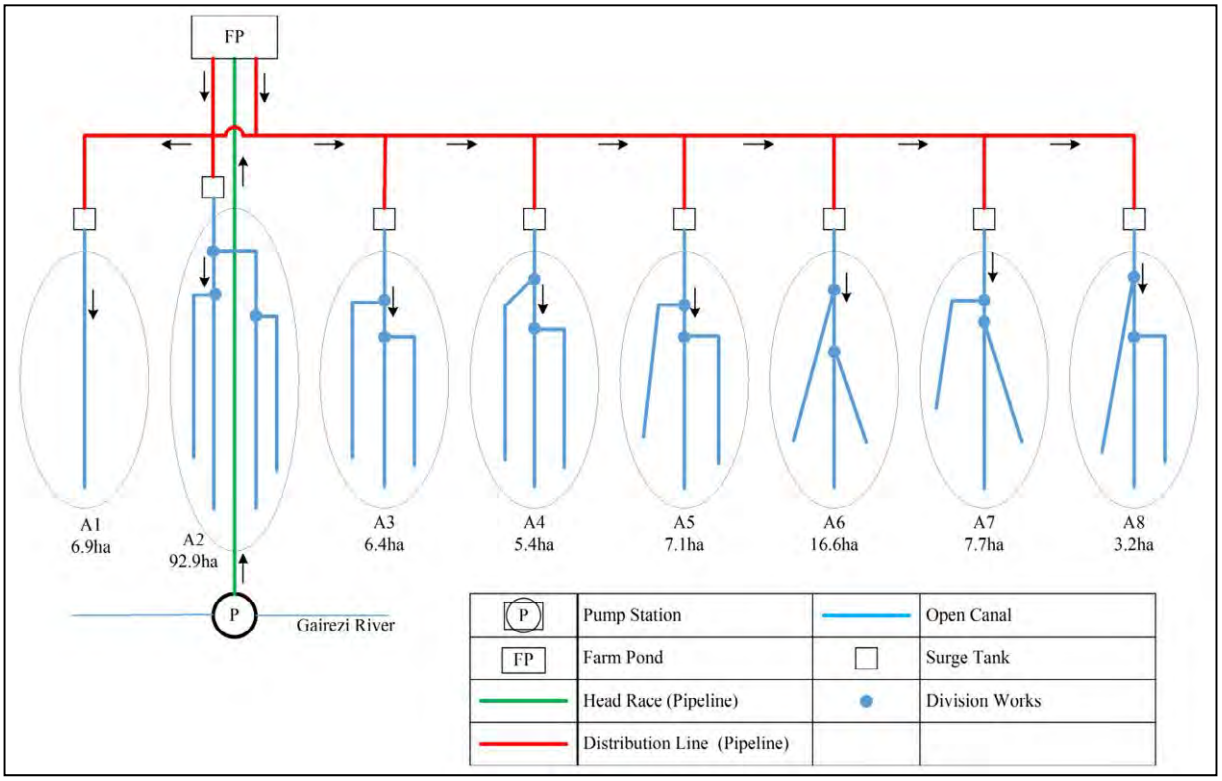


Figure 2.2.8 Diagram of Water Distribution

2) Head Race

Diameter of head race will be determined in accordance with table indicated below and diameter with 500mm will be introduced in Block A.

Table 2.2.28 Relationship between Velocity and Pipe Diameter in Pumping Irrigation

Pipe diameter (mm)	Average velocity (m/s)	Block A	
		Determined diameter	Velocity
450 ～ 800	1.2 ～ 1.8	500 mm	1.747 m/s

Source: Planning and Design Standard “Pipeline”, MAFF, Japan

The pressure pipes with diameter of 500mm and to be procured in Zimbabwe are three (3) types such as steel pipe (SP), ductile cast iron pipe (DCIP) and reinforced plastic pipe (FRP). The pipes to be stratified with pressure of 1 MPa (10kg/cm^2) are SP and DCIP only. From the aspect of economic efficiency, SP will be introduced. SP is produced in Zimbabwe and procured easily. Since SP can

be connected by not only welding but also the swivel joint ring, joint works of SP can be executed by local construction standard.

3) Distribution Line

Distribution line will be divided into two lines, one is distributed to A1 and another one is distributed to the area of A3 to A8. Design discharge of distribution line is the range of 0.008 to 0.125 m^3/s. Diameter of distribution line will be determined considering necessity head required from the elevation of the beneficiary area and to meet allowable minimum velocity. Considering above, pipe diameter with 150mm to 400mm will be determined. PVC will be introduced considering low pressure with 0.2 MPa (2.0 kg/cm^2), economic efficiency and workability.

4) Branch Canal

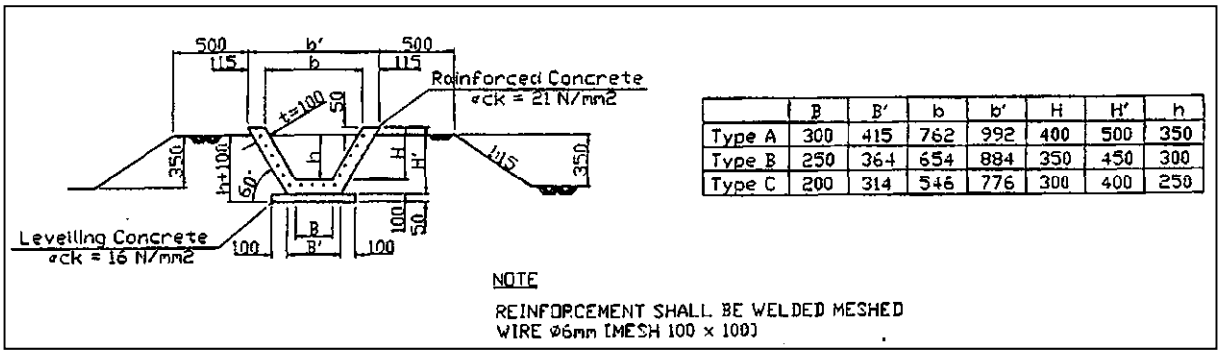
Branch canal (open canal) will be installed with the interval of 100m from the past experimental result of soil intake rate. In case of one side irrigation practices, interval of branch canal is 100m and in case of both sides irrigation practices, interval of branch canal is 200m.

Branch canal is classified with three (3) types in accordance with design discharge as shown in the table below.

Table 2.2.29 Design Discharge of Branch Canal

Type	Design discharge (m3/s)
Type A	0.090～0.135
Type B	0.055～0.089
Type C	0.000～0.054

Calculated by Manning formula with the bed slope with 1/250



	B	B'	b	b'	H	H'	h
Type A	300	415	762	992	400	500	350
Type B	250	364	654	884	350	450	300
Type C	200	314	546	776	300	400	250

Figure 2.2.9 Typical Cross Section of Branch Canal

Irrigation diagram is described in the Figure below and prepared based on the unit requirement of q= 2.346 (ℓ/s/ha) multiplying by beneficiary area.

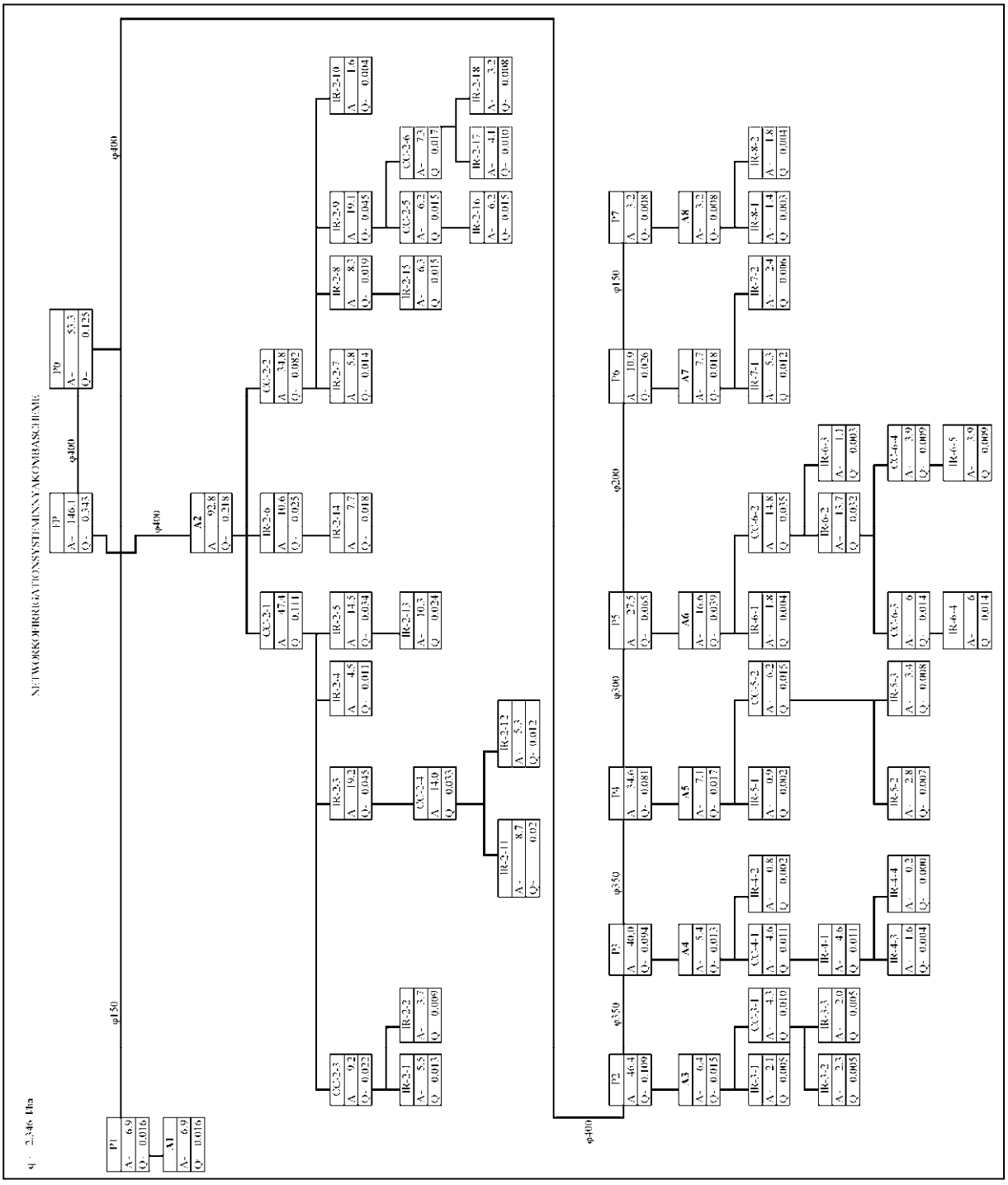


Figure 2.2.10 Irrigation Diagram

5) Road Crossing Works

Road crossing works will be installed at the junction between branch canal and road. Road crossing works are provided in the RC pipes with reinforced concrete and reinforced concrete boxes also will be installed at the end of both side of road crossing works for the connection between RC pipe and branch canal. RC pipe diameter is determined as 600 mm considering maintenance works and buried depth is 1.0m for main road crossing and 0.8m for farm road crossing.

6) Division Works

Division works will be installed at the diverging point of the branch canal. Division works provides reinforced concrete structure and provides steel sluice gate to be fabricated in Zimbabwe.

7) Drop

Since ground slope with 1/20 to 1/50 is steeper than design canal bed slope with 1/250, drop should be installed. Elevation difference of drop will set as 60cm uniformity and drop will be placed in accordance with ground elevation of the field.

(8) Drainage Plan

Drainage canal will be installed to remove extra rainfall and irrigation water. Drainage canal to be installed in mountain side of main road plan to drain to road side drainage canal and drainage canal to be installed in river side plan to drain to Gairezi river. Capacity of drainage canal will be determined to drain water during 4 hours for 4 hours continuous rainfall amount. Unit drainage discharge is determined as follows.

R_{24} = 113 mm/day (daily rainfall with return period of 10 years)
$R_4 = R_{24} / 24\ (24/t)^{1/3} = 113 \times (4/24)^{1/3} = 62.2$mm (4 hours continuous rainfall)
$q = R4 / (3600\times4) \times100 \times 100 = 62.2/ (3600\times4) \times10{,}000 = 43.2$ ℓ/s/ha (unit drainage discharge)
$q_m = f*q = 0.8 \times 43.2 = 34.6$ ℓ/s/ha (unit drainage discharge in mountainous area)
$q_f = f*q = 0.6 \times 43.2 = 25.9$ ℓ/s/ha (unit drainage discharge in up-land field)
Where, f: Run off ratio

Slope of drainage will be determined considering allowable maximum velocity with 0.90 m/s (clay loam). Since ground slope is steeper than design drainage canal slope, drop should be installed as same as branch canal for securing safety of the soil structure.

Figure 2.2.11 Drainage Diagram

(9) Farm Pond

The storage capacity of farm pond will be determined by the water amount with thirty minutes considering allowable time from pump stop to pump restart because a certain interval should be necessary for reducing a load of motor. Accordingly, the storage capacity of farm pond becomes 620 m^3.

$$V = 0.343\ (m^3/s) \times 60\ (s) \times 30\ (min) = 620\ m^3$$

The structure of farm pond is introduced retaining wall made by reinforced concrete with the effective water depth of 2 meters as same as existing one in Block B, C and D.

(10) Road Plan

1) Main Road

The Government of Zimbabwe requested the road improvement with 10 km of main road and 1 km of farm road as a scope of the improvement of the road. The requested scope of the main road is from Nyamalopa junction to Nyakomba center. From the results of the field survey, though erosion of road surface is recognized during rainy season, there are not serious and the road is maintained by local residents. In addition, maintenance of road surface can be continued by local technical standard. Therefore, improvement of road surface is not included in the scope of Grant aid. However, three culverts which are crossing road and stream are broken and these are can not be rehabilitated by the local resident. Therefore, three culverts will be included in the scope of the Grant aid of Japan and rehabilitated of the Project.

2) Farm Road

Farm road will be constructed to maintain the surge tank which is installed newly in Block A and to maintain the new pump station in Block D. The width and thickness of farm road are 5 meters and 20 cm respectively.

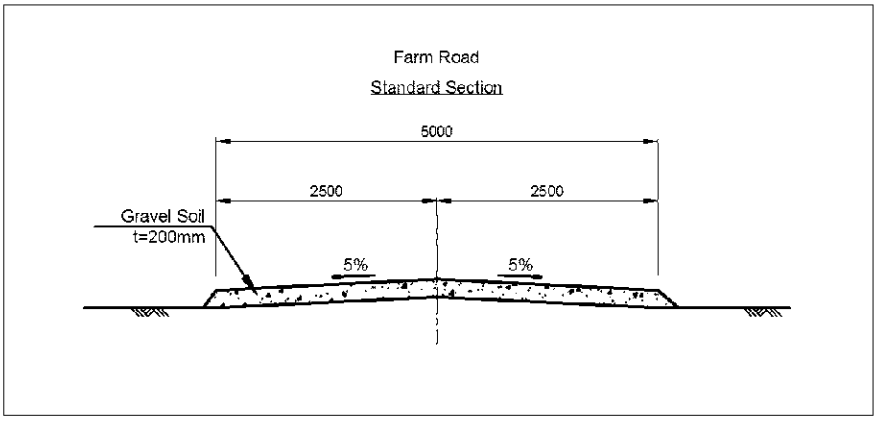


Figure 2.2.12 Typical Cross Section of Farm Road

(11) Bill of Quantity

Bill of quantity is as follows.

Table 2.2.30 Bill of Quantity

Structure	Unit	Quantity	Remarks
Pump station			
New construction of pump station	set	2	Block A and Block D
Repairing and/or replacement of pump equipment	set	2	Block B and Block C
Irrigation Facilities			
Head race	m	980	SPφ500, Block A
Head race	m	365	SPφ600, Block D
Farm pond	set	1	RC retaining wall structure with V=620m^3
Distribution pipeline	m	4,403	PVC, φ150 to φ400
Branch canal	m	10,568	Made by RC structure
Surge tank	nos	8	Made by RC structure
Appurtenant structures of branch canal			
Division works	nos	7	Made by RC structure
Drop	nos	620	RC structure
Road crossing	nos	5	RC structure
River crossing	nos	2	RC structure
Flow end treatment	nos	21	Gabion structure
Drainage			
Drainage canal	m	18,680	Earth canal
Drop	nos	506	RC structure
Flow end treatment	nos	31	Gabion structure
Flood protection works			
Retaining wall	m	156.6	Block B, RC structure
Retaining wall	m	152.4	Block C, RC structure
Access road	m	42.3	Block B
Access road	m	25.1	Block C
Road			
Rehabilitation of culvert in main road	nos	3	RC pipe with RC structure
Farm road	km	4.99	Gravel pavement, 11 lines

(12) Equipment

1) Equipment Requested

List of the equipment requested is as follows.

Table 2.2.31 List of Equipment Requested by GOZ

Equipment	nos	Specificatio
Dozer	1	D6
Grader	1	140K
Tractor	1	140Hp
Excavator	1	20ton
Low bed	1	
Front end loder	1	
Tipper	2	18m3
Trailer	1	
Lorry	1	7ton
Truck	1	1ton

Since the list of equipment requested included in the equipment which will be not used for the maintenance of the Nyakomba irrigation scheme directly, both sides discussed about this point. As a result of the discussion, the both sides agreed that types and numbers of equipment will be determined in accordance with the necessity of the operation and maintenance required in Nyakomba irrigation scheme Block A, B, C and D, and will be selected among requested equipment.

2) Procurement of Equipment

Through the field survey, necessity of the equipment conducting land consolidation and leveling is confirmed. As shown in the figure below which describing satellite picture, after construction of irrigation facility in Block B, land consolidation and leveling for the smooth distribution of irrigation water to all the beneficiary area was executed by Zimbabwe side. On the other hand, it is difficult condition in Block A at the present to distribute irrigation water to all the area without land consolidation and leveling. In addition, it should be required to execute land consolidation for equal land distribution to beneficiary famers. Accordingly, the equipment used for the land consolidation and land leveling will be procured in the Project. The necessary equipments for land consolidation and land leveling will be selected tractor and blade as an attachment of tractor. Additionally, procurement of the tractor will enable to utilize existing tractor's attachment stored in the warehouse procured by the past Grand aid such as rotary harrow, disc plow, ridger, and trailer. Finally, two set of tractor with attachments will be procured.

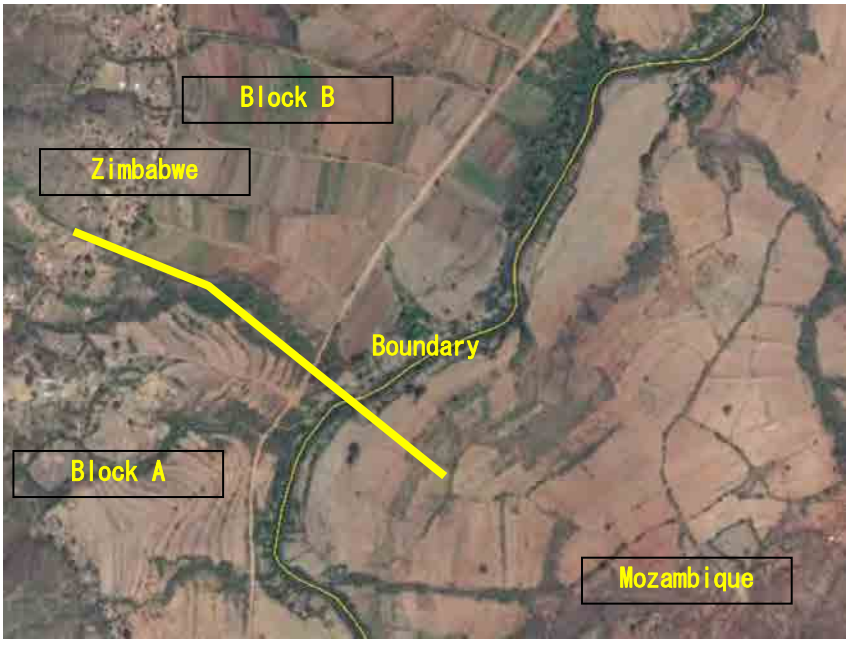


Figure 2.2.13 Condition of Farmland Consolidation in Block A (Not Improved) and B (Improved)

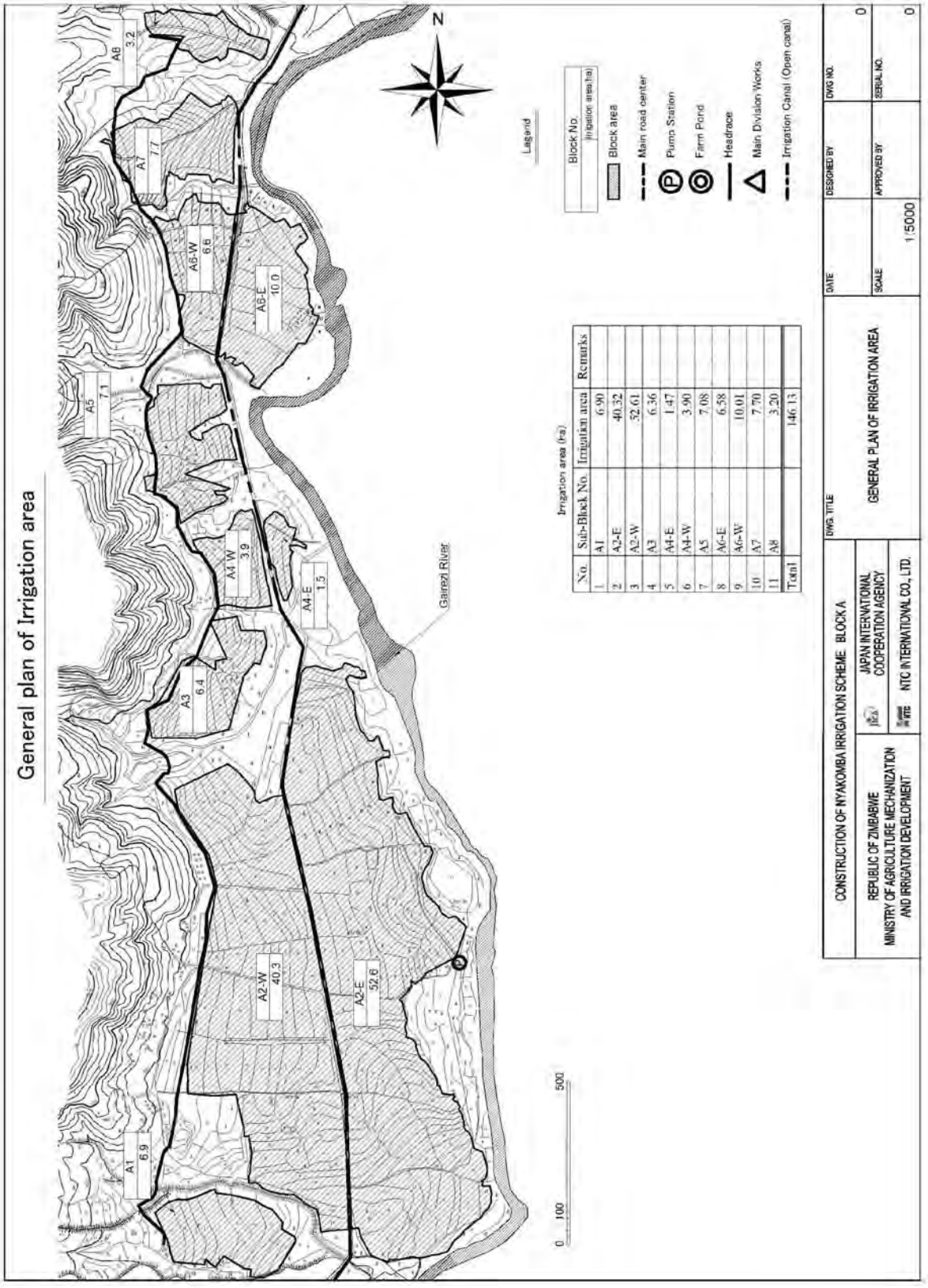
After construction of Block A, ZINWA should manage four pump stations under the only one supervisor of ZINWA under the far distance with 10 km. For smooth operation and management for four pump stations, one motorbike will be supplied.

2.2.3 Outline Design Drawings

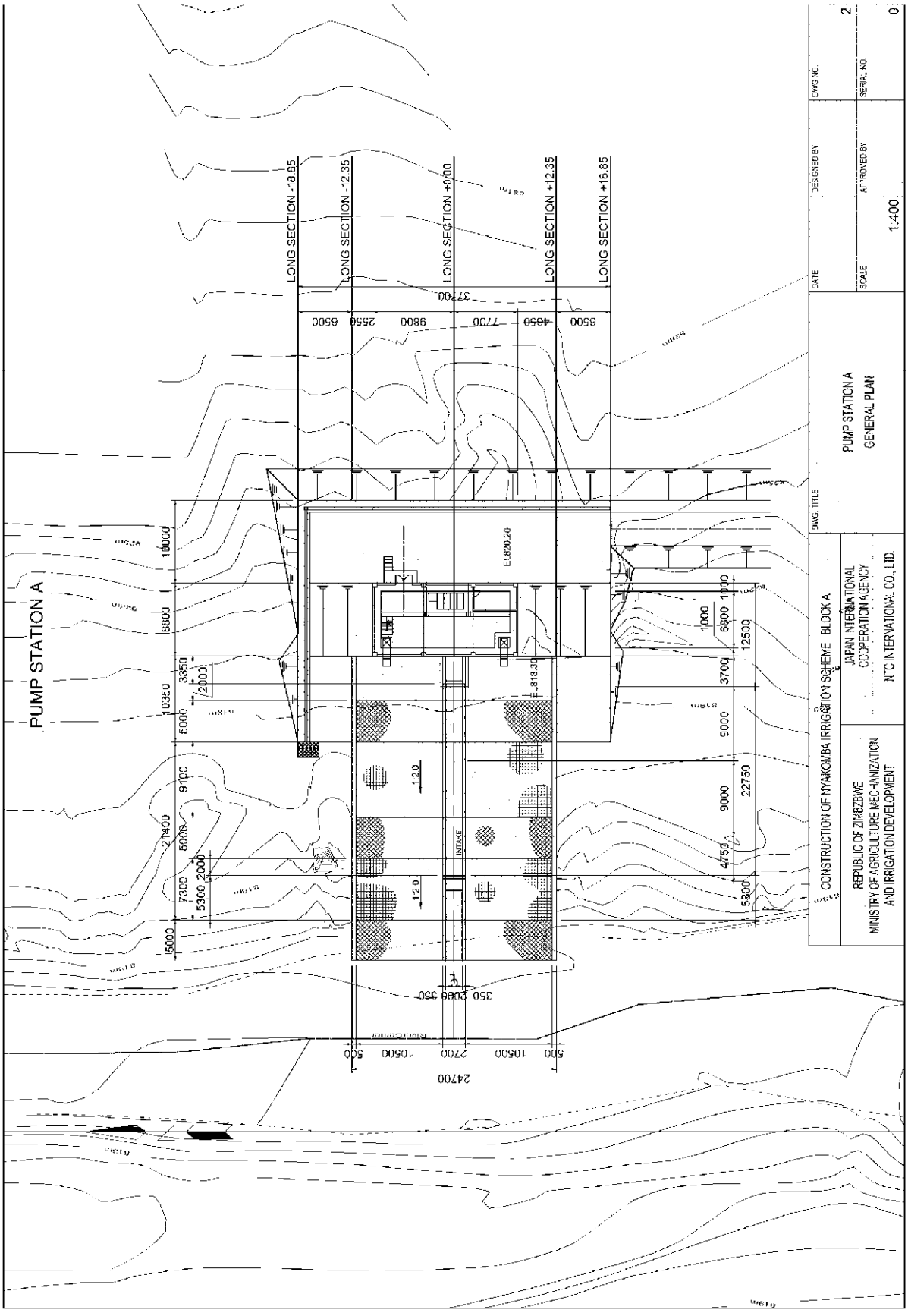
Outline design drawings are as follows.

Table 2.2.32 List of Drawings

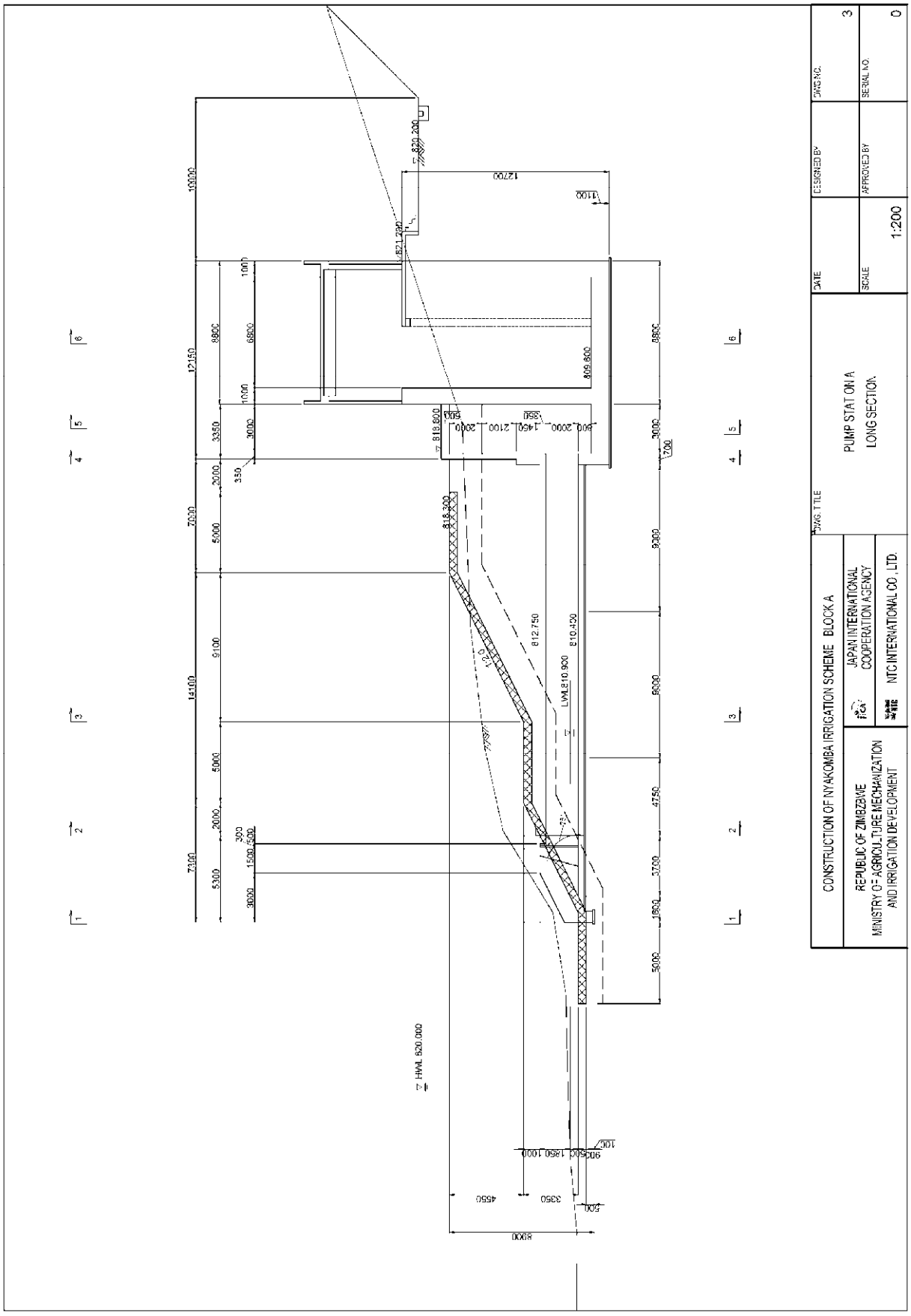
Title of Drawings	Nos	Page
General Plan of Irrigation Area	1	2-33
General Plan of Pump Station in Block A	1	2-34
Long Section of Pump Station in Block A	1	2-35
Section of Pump Station in Block A	1	2-36
Plan of Pump Station in Block A	1	2-37
Plan and Profile of Farm Pond in Block A	1	2-38
Plan and Profile of Head Race in Block A	2	2-39
Layout of Irrigation System	3	2-40
General Layout of Road Network	1	2-44
Culvert on Main Road	1	2-45
Standard Cross Section of Irrigation Canal	1	2-46
Standard Cross Section of Drainage Canal	1	2-47
Plan and Profile of Retaining Wall in Block B	1	2-48
Plan and Profile of Retaining Wall in Block C	1	2-49
General Plan of Pump Station in Pump Station D	1	2-50



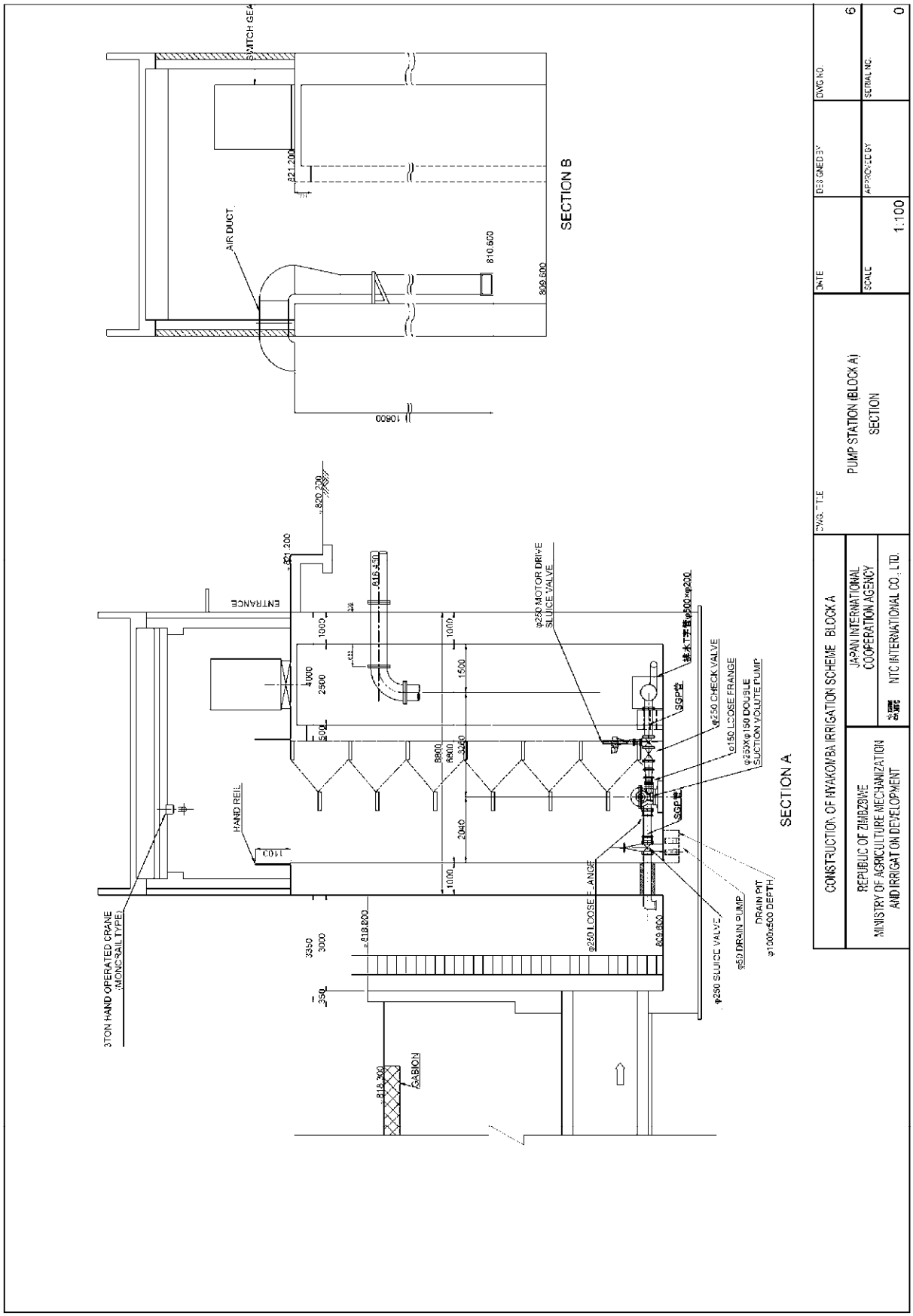
General Plan of Irrigation Area



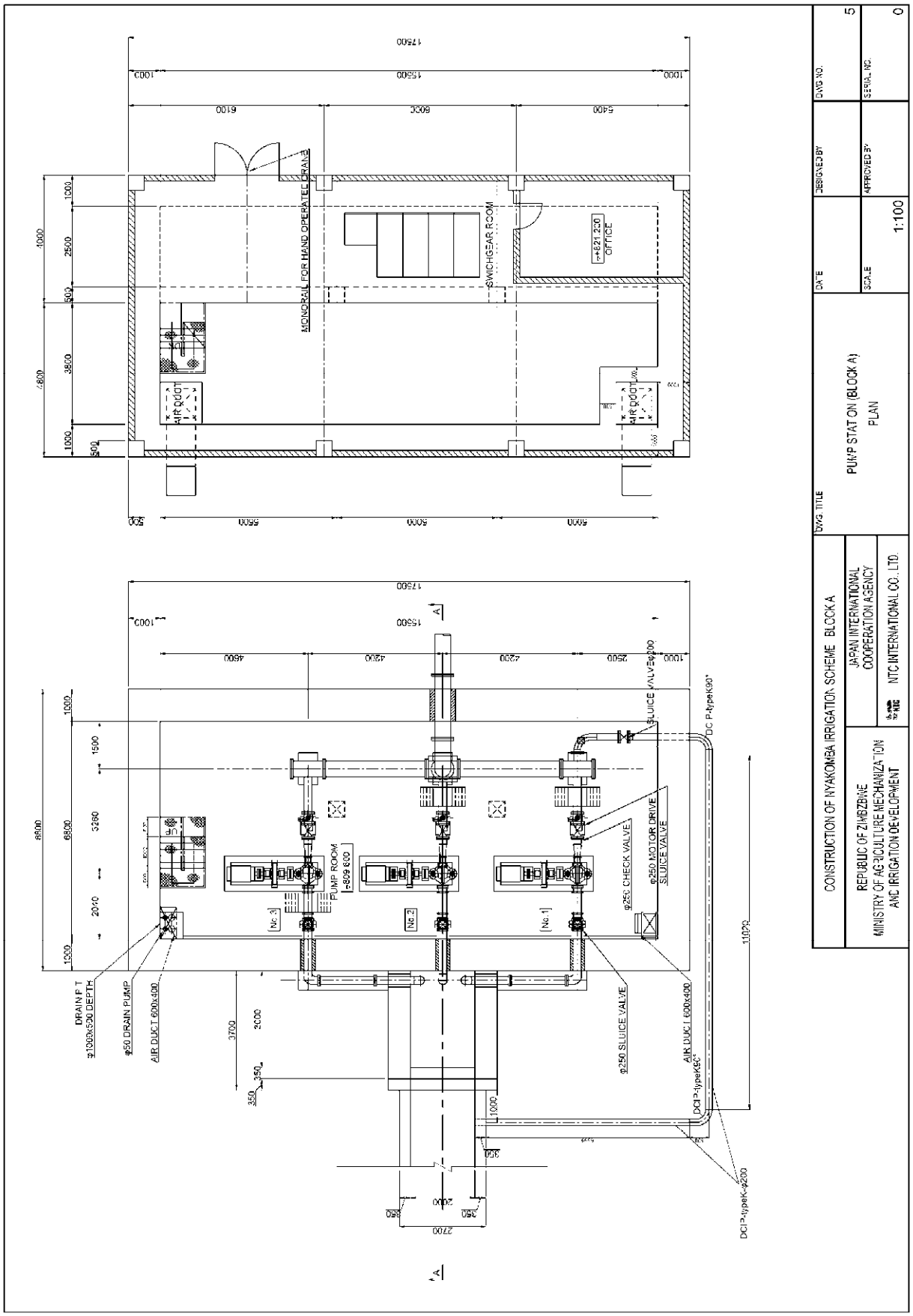
General Plan of Pump Station in Block A



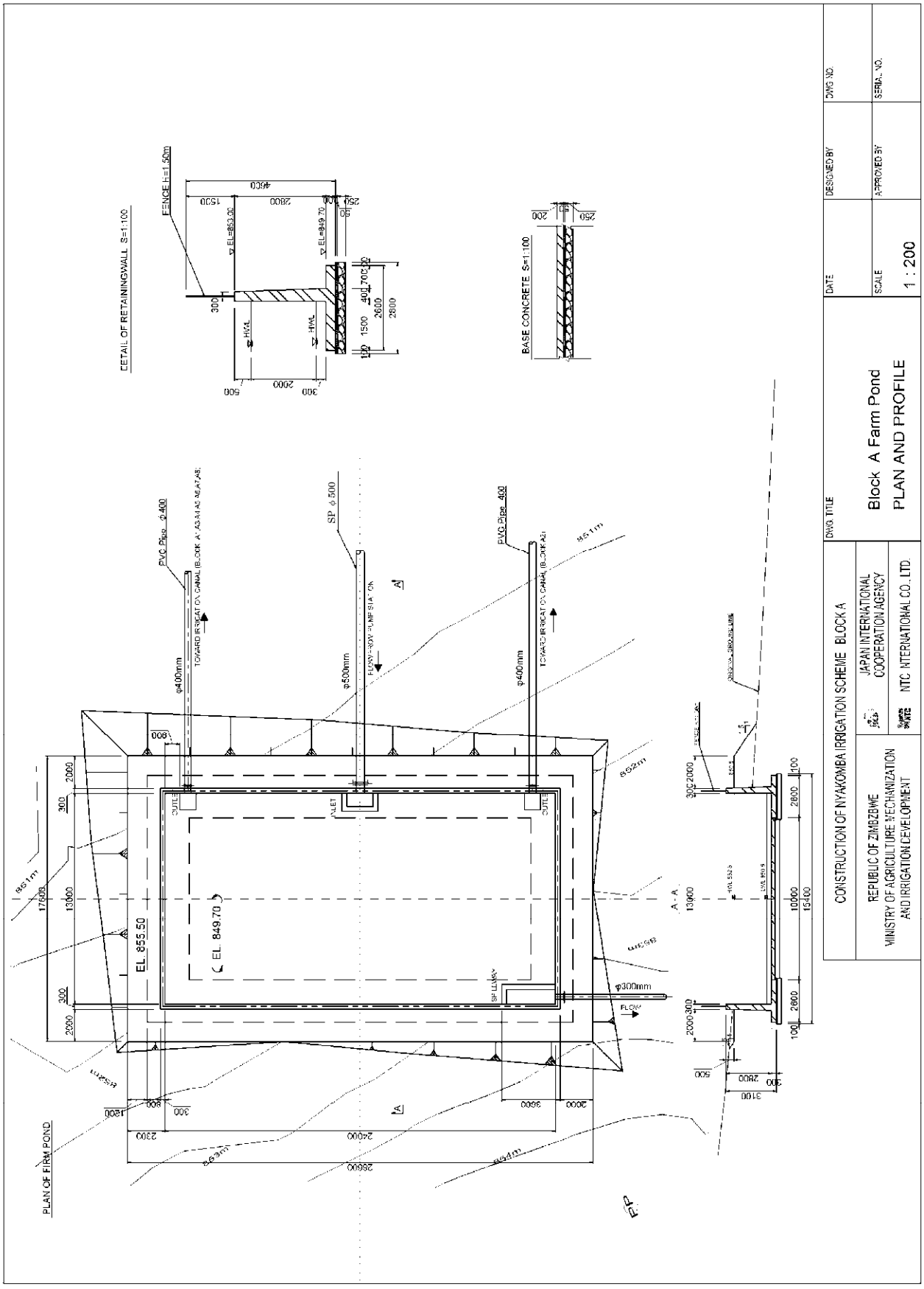
Long Section of Pump Station in Block A



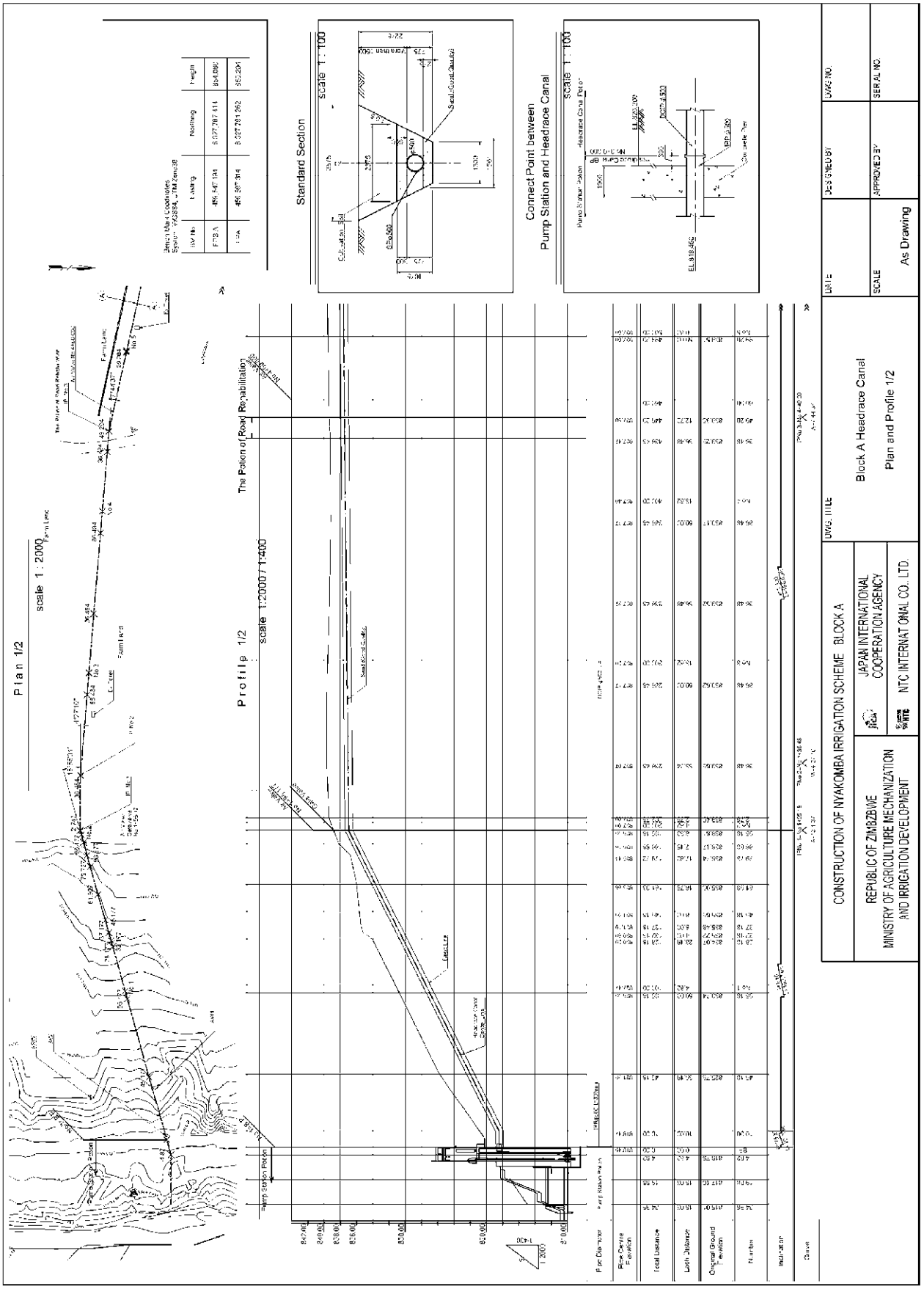
Section of Pump Station in Block A



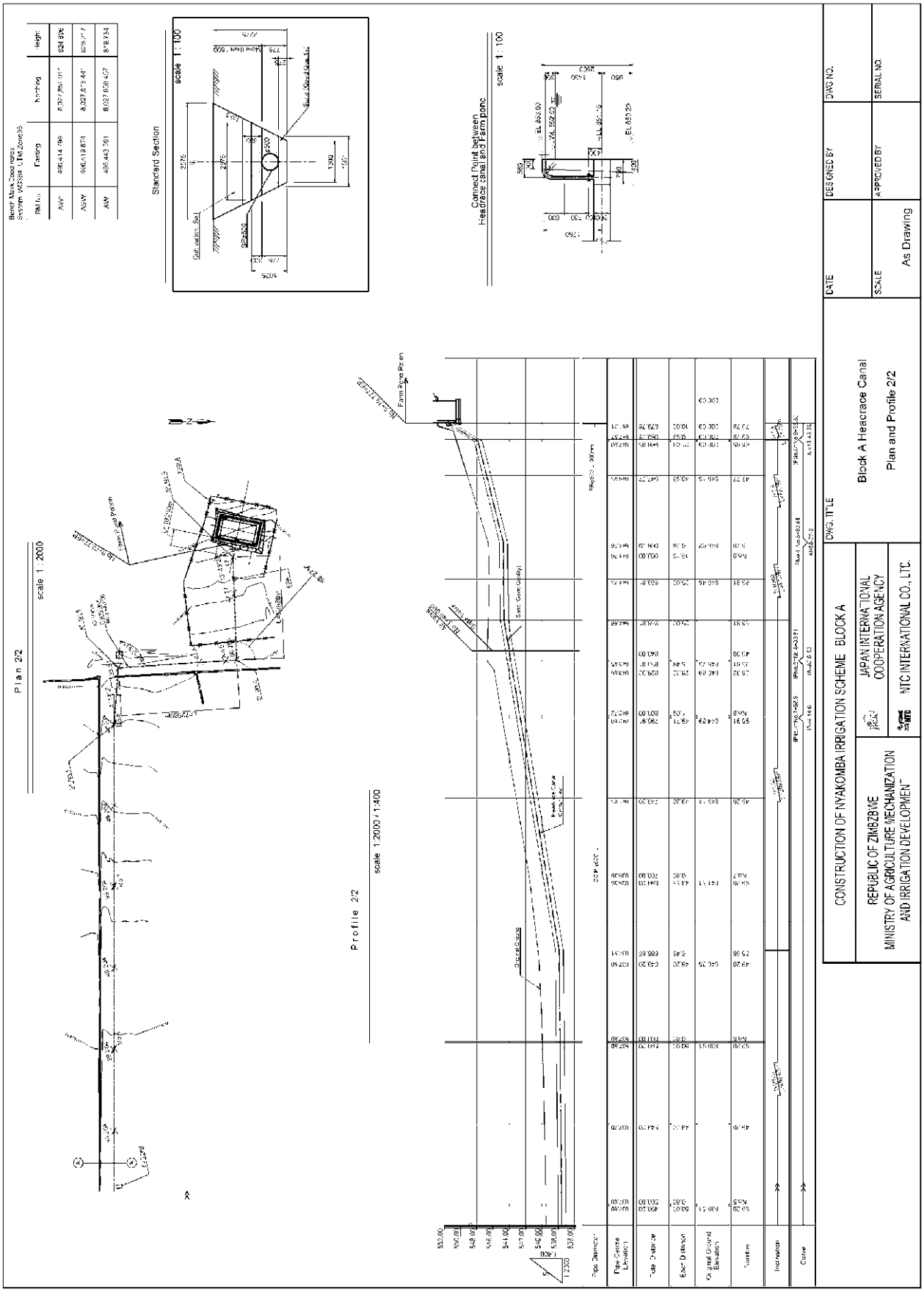
Plan of Pump Station in Block A



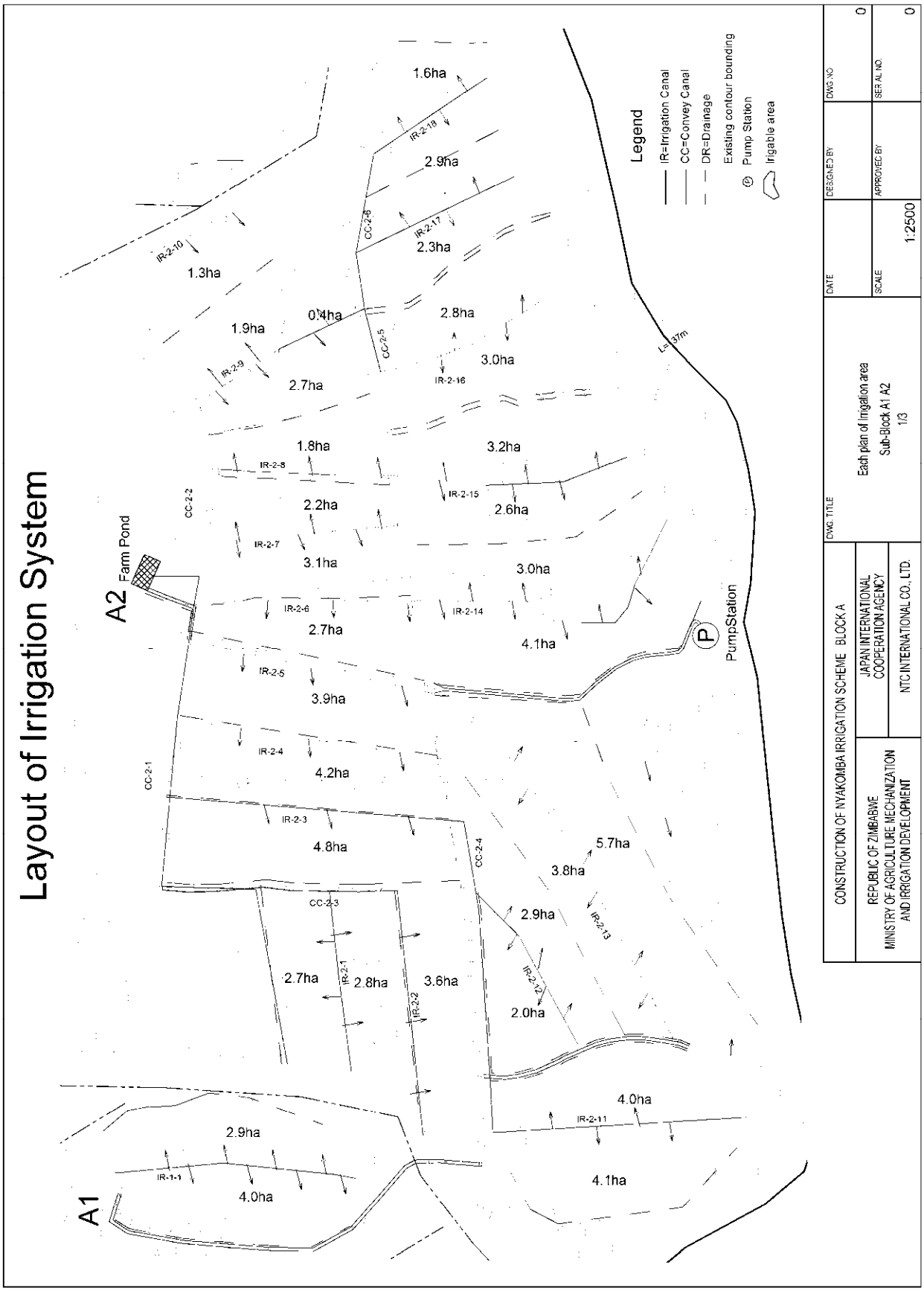
Plan and Profile of Farm Pond in Block A



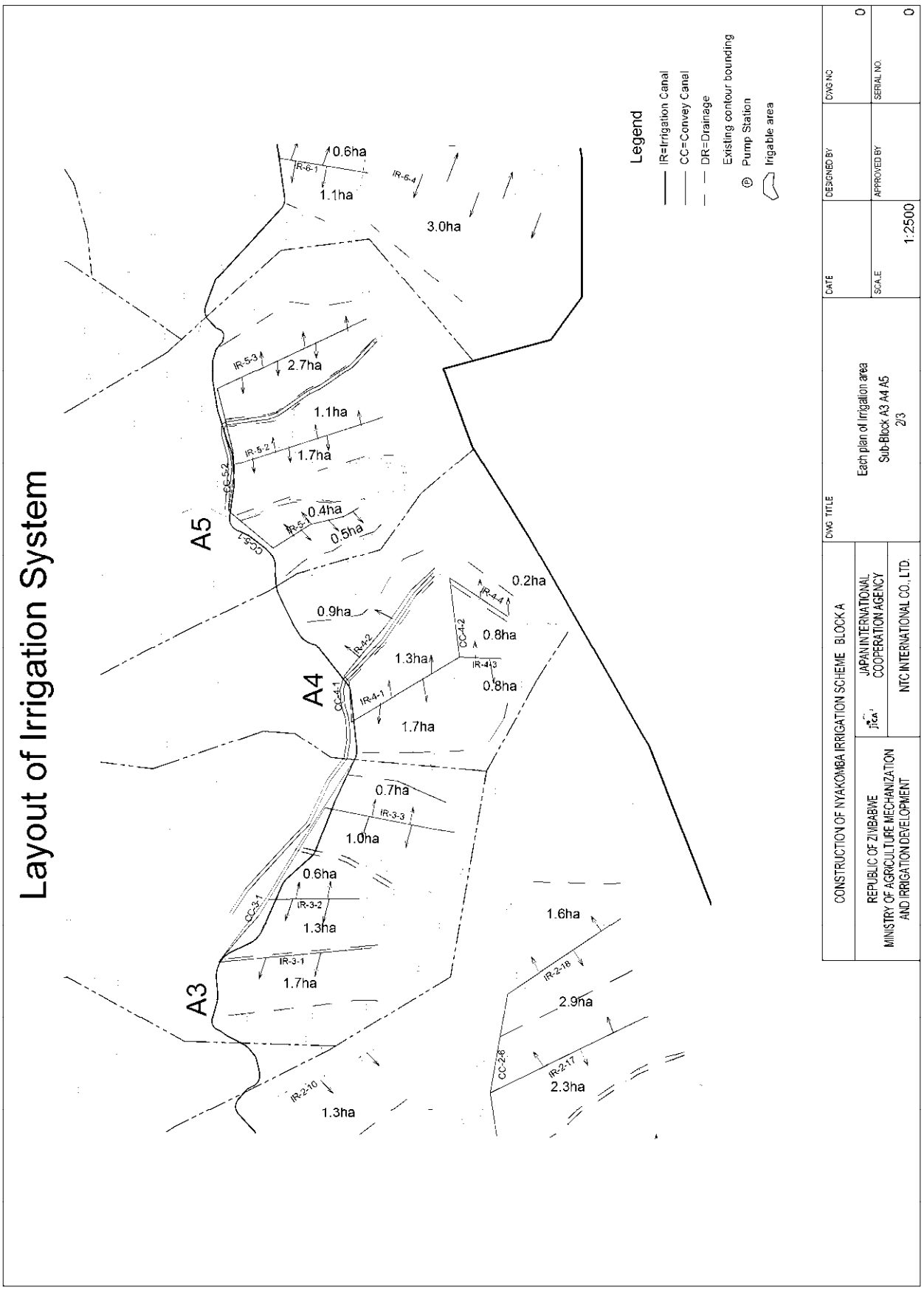
Plan and Profile of Head Race in Block A (1/2)



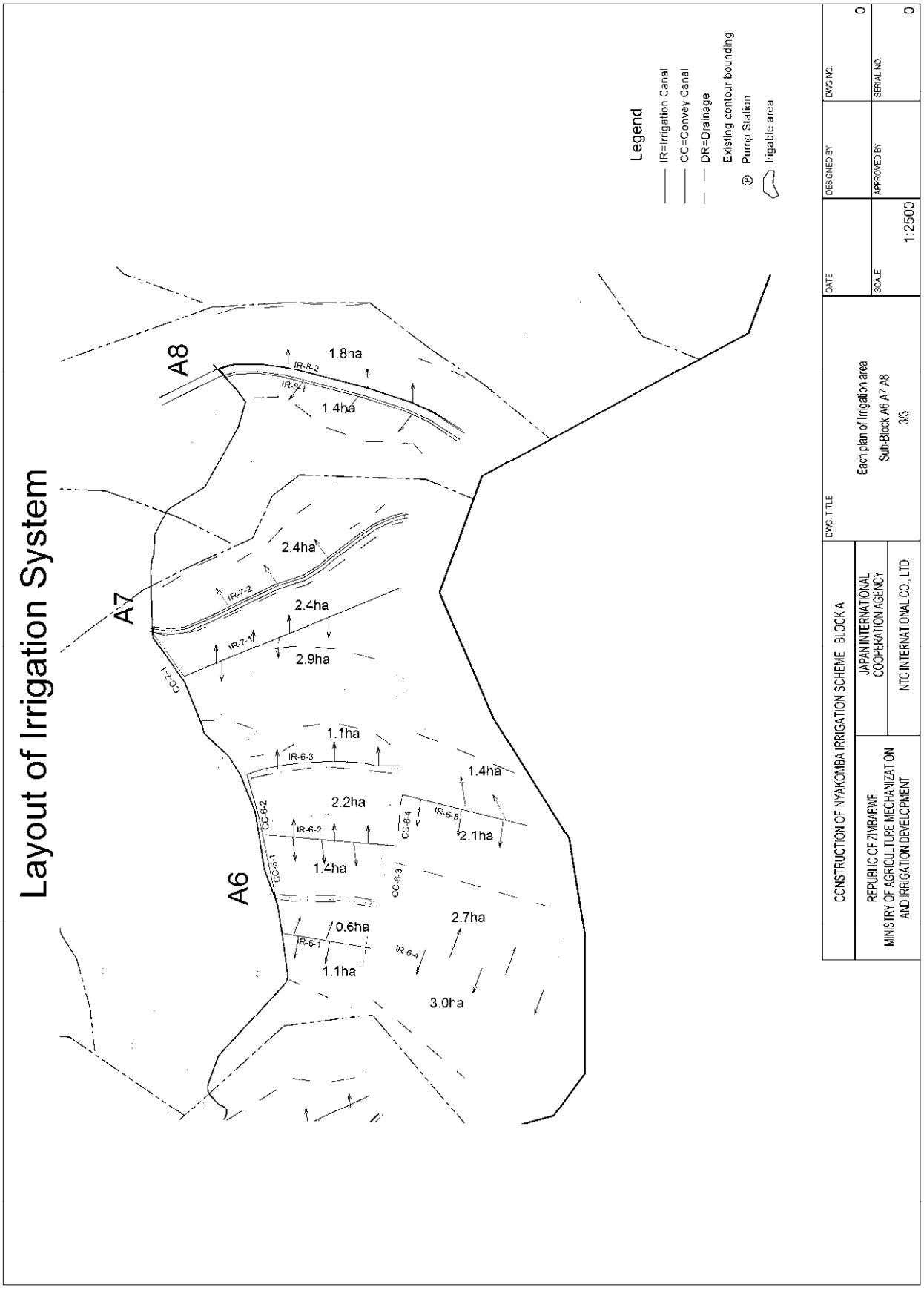
Plan and Profile of Head Race in Block A (2/2)



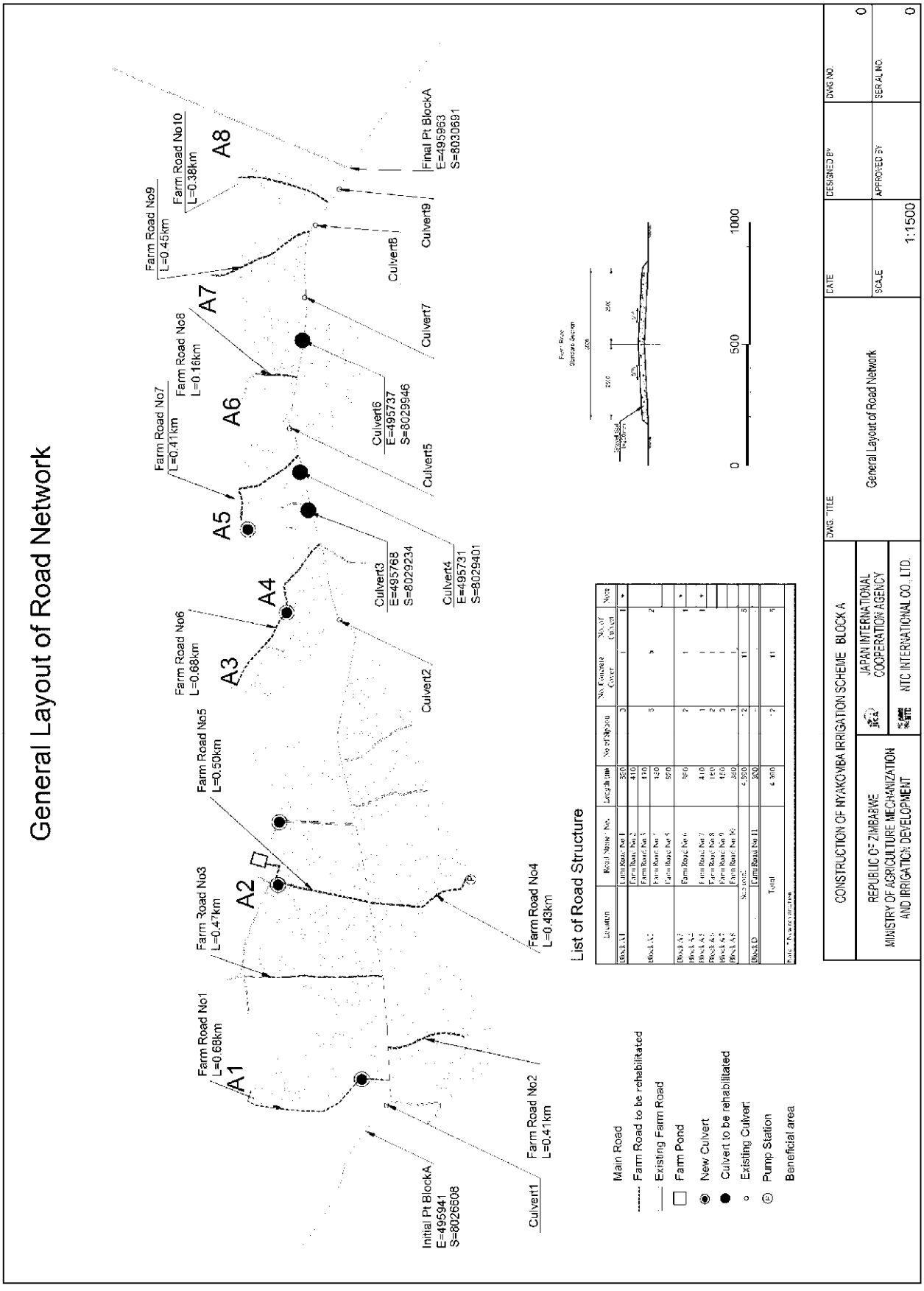
Layout of Irrigation System in Block A (1/3)



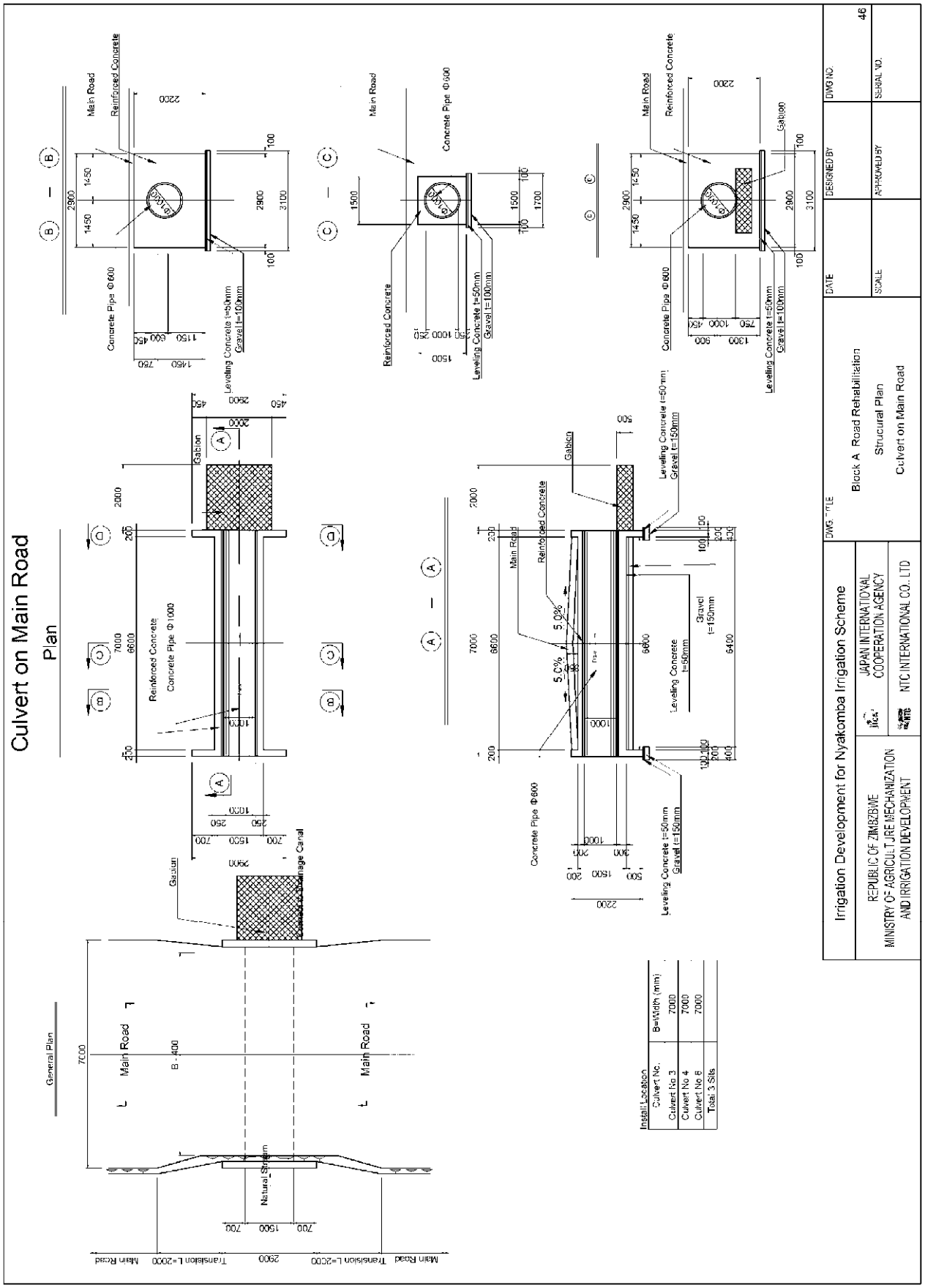
Layout of Irrigation System in Block A (2/3)



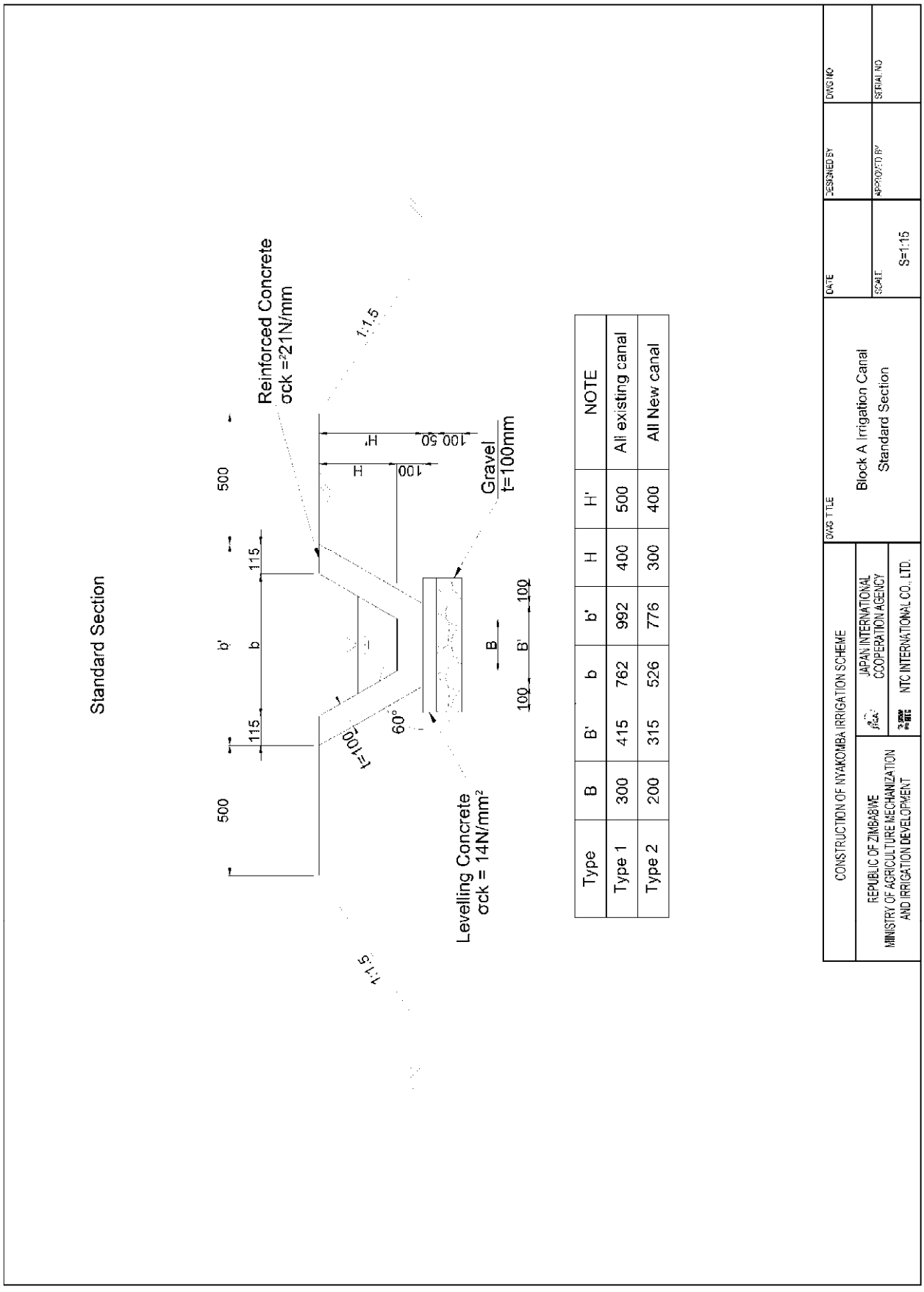
Layout of Irrigation System in Block A (3/3)



General Layout of Road Network

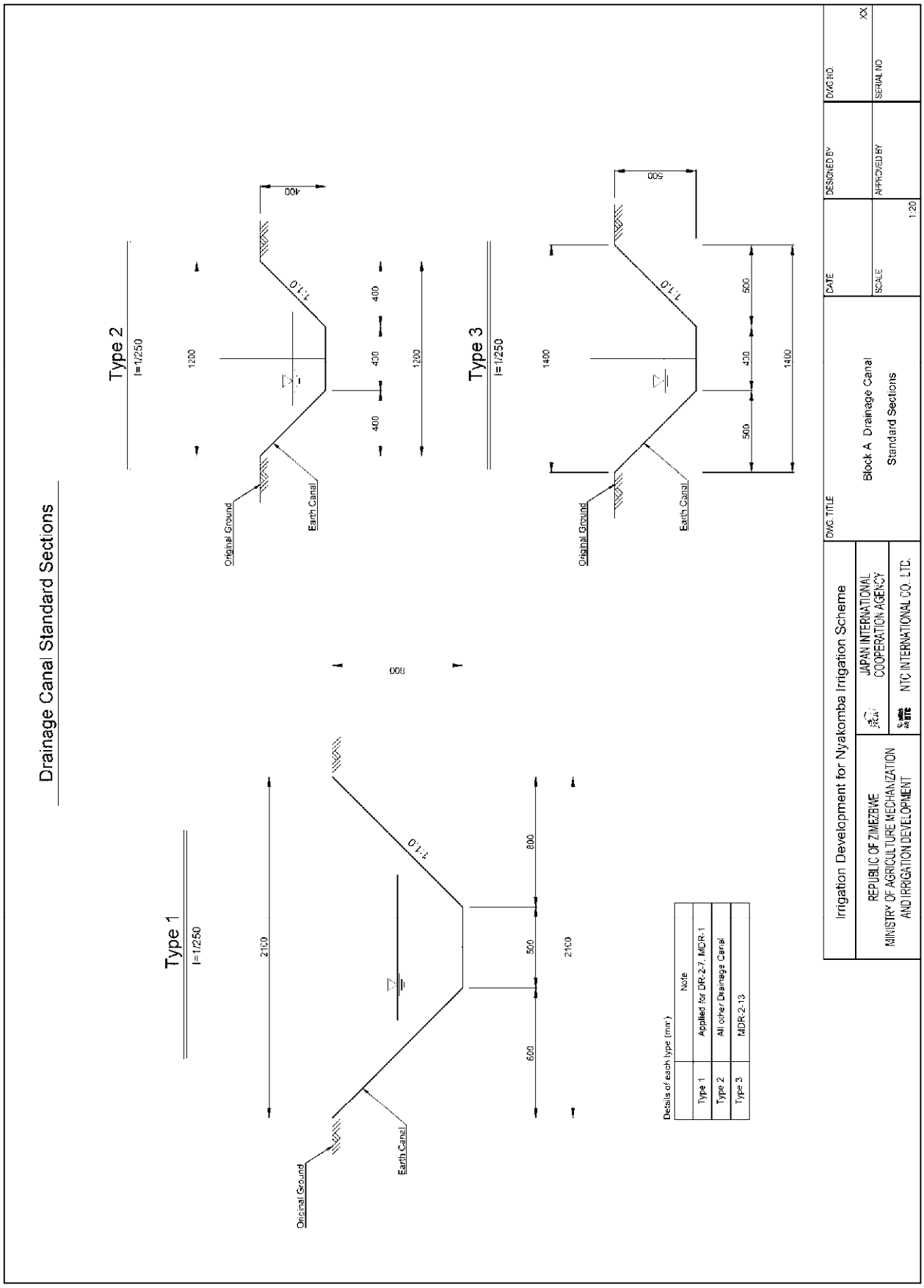


Culvert on Main Road

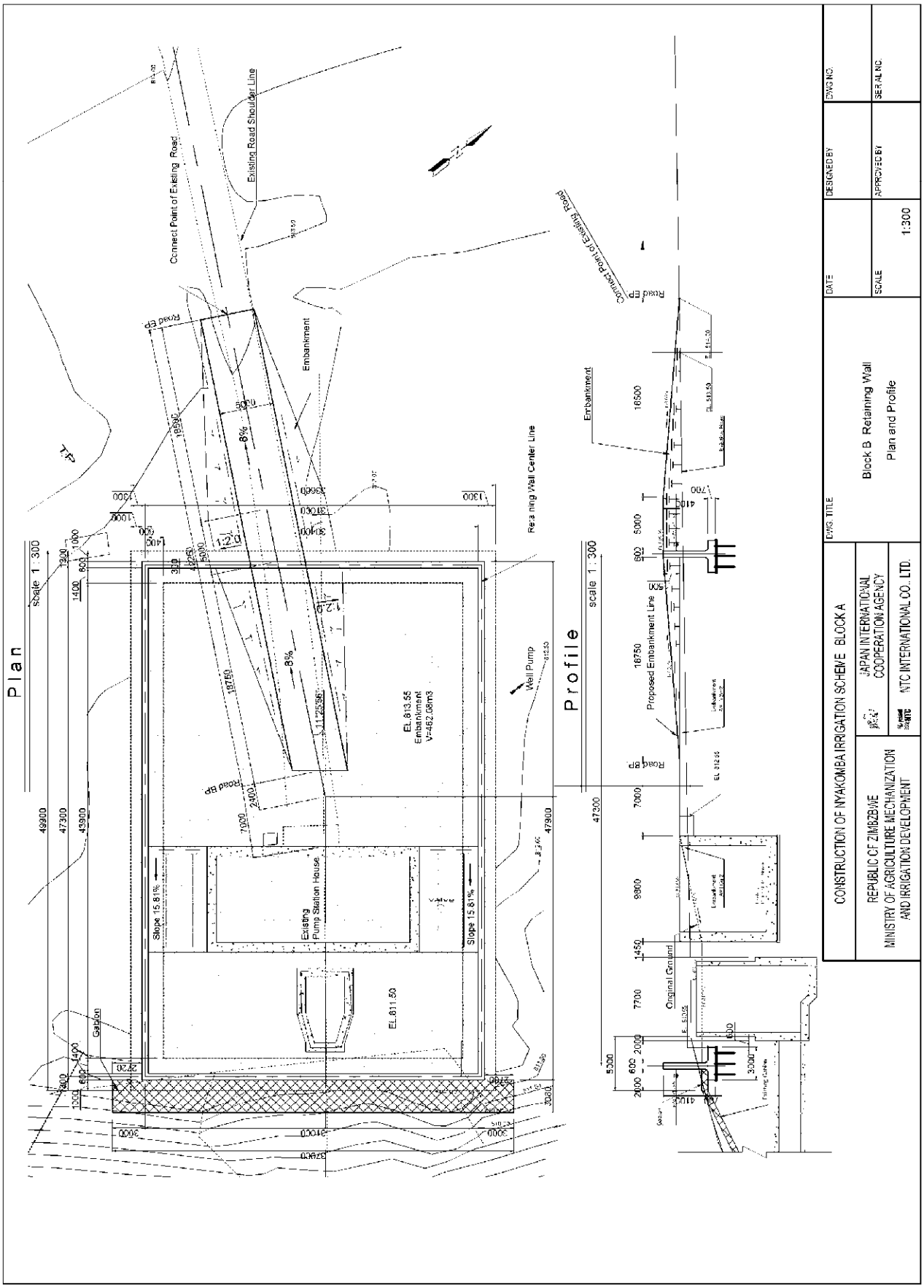


Type	B	B'	b	b'	H	H'	NOTE
Type 1	300	415	762	992	400	500	All existing canal
Type 2	200	315	526	776	300	400	All New canal

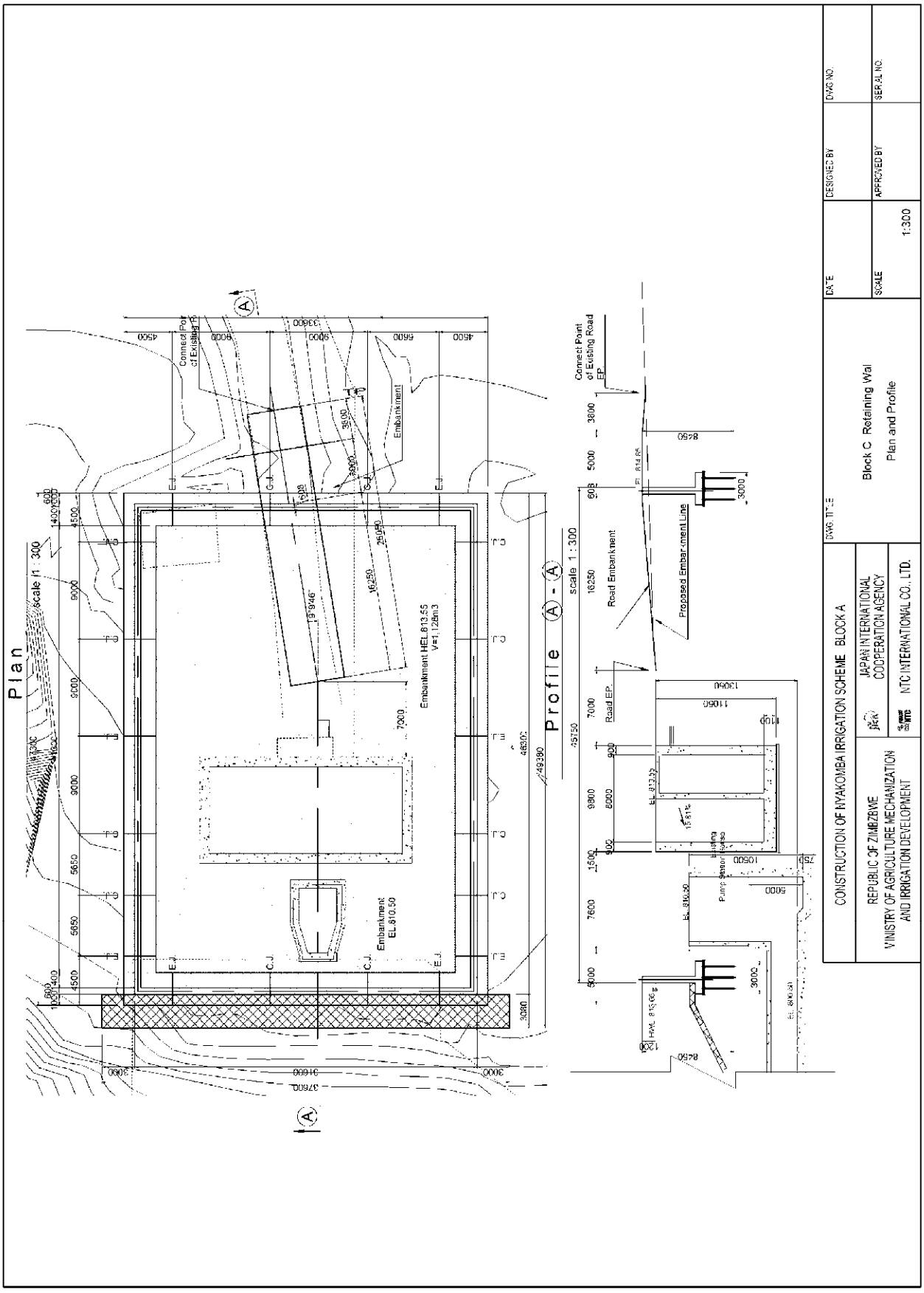
Standard Cross Section of Irrigation Canal



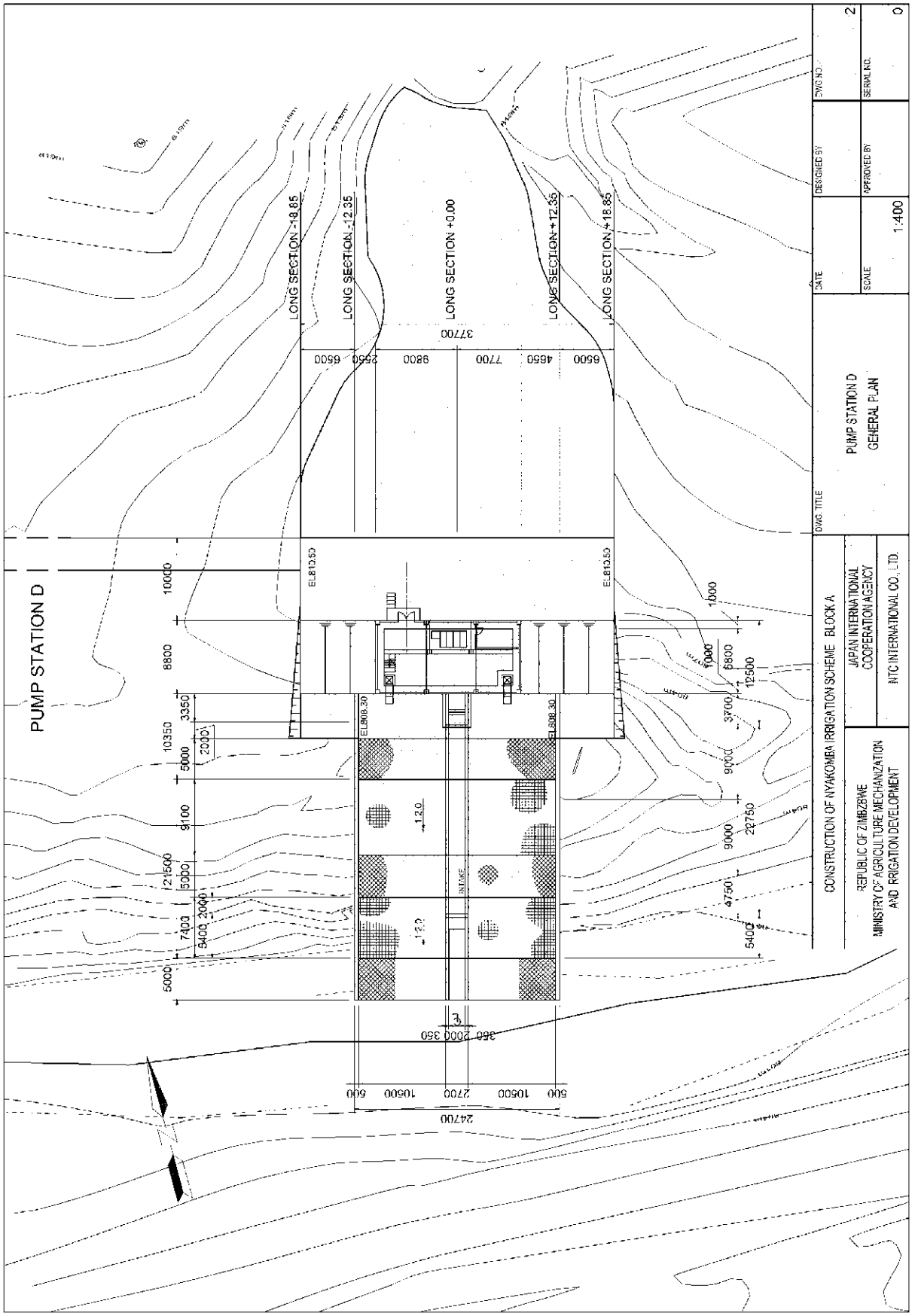
Standard Cross Section of Drainage Canal



Plan and Profile of Retaining Wall in Block B



Plan and Profile of Retaining Wall in Block C



General Plan of Pump Station in Block D

2.2.4 Implementation Plan

(1) Implementation Policy

1) Basic Issues

This cooperation project will be implemented within the framework of Japanese Grand Aid. After the completion of preliminary design, if Japanese government approves the project implementation, Exchange of Note (E/N) and Grand Agreement (G/A) will be concluded and finally, the project implementation phase will be started. The contract type of the project will be the lump sum service contract.

2) Concrete Materials for Construction Works

It is difficult to procure ready-mixed concrete at the site. Therefore, concrete will be made at the site by portable mixer. Materials for them are shown below.

Cement	:	Procured from Harare
Sand	:	Sand of river where 10 km away from the site will be procured
Aggregate for Concrete	:	Purchased from Harare or Mutare
Water	:	River water will be used

3) Construction Machineries

Local construction companies in Zimbabwe hold/own basically construction machineries, or they collaborate with other companies own heavy machineries. And, there are lease companies own truck cranes. It is possible to procure all of heavy machineries to be used for this Project in Zimbabwe.

Table 2.2.33 Procurement of the Construction Machinery

Construction Machinery	Supplier	
	Zimbabwe	Japan/Third Country
Backhoe	○	
Bulldozer	○	
Crane	○	
Dump Truck	○	
Trailer	○	
Concrete mixer truck	○	
Tamper	○	
Electric generator, Welding machine	○	

4) Material and Machineries for Pump Facilities

At the sites of Block B, C, and D that Pump Station had been completed, and all of pumps, motors and electric wires are procured from Japan. Since this project includes the rehabilitation of these equipments, materials for rehabilitation will also be procured from Japan to secure same quality as

past Grant aid. As pump facilities will be procured from Japan at the new pump station to secure quality of pump facilities, and operators of ZIMWA could operate and maintain them easily because same type of pump facilities will be procured. Materials of plumbers and valves in the pump station will be procured from Japan to prevent from delay caused by the margin of error, and to secure the timing to make correspondence pump installation and procurement of plumbers and valves.

5) Other Materials

This Project includes in the road construction. Its materials such as sand and gravels are supplied from 16 km far from the site.

Table 2.2.34 Procurement of the Construction Materials

Items of construction materials	Supplier			Remarks
	Zimbabwe	Japan	Third Country	
Pump		○		
Motor		○		
Plumbing inside the pump station (SGP: Carbon Steel Pipes for Ordinary Piping)		○		
Valves inside the pump station		○		
Wiring materials for motor / Switch panels		○		
Steel Pipe	○			
Concrete Pipe	○			
Cement	○			
Reinforcing bar	○			Made in South Africa
Backfill Material	○			Available at the site
Sealing strip	○			
Sand for gravel pavement	○			
Gasoline	○			

6) Temporary Road for Construction

Existing road will be improved for temporary road for construction to carry materials and to traffic heavy machineries for the construction of pump station, farm pond and surge tank. Since portable concrete mixer will be used for the construction of branch irrigation canal, temporary road for construction is not necessary.

7) Procurement Plan (Tractor and Motorbike)

Two tractors with the attachments of two set blade and one motorbike that supervisor of ZINWA uses for the maintenance all the blocks of pump facilities, which will be procured from Harare.

(2) Implementation Condition

Climate at the Project site is clearly categorized into two seasons. Dry season begins at the beginning of April and continues until the end of October. Rainy season begins at the beginning of November and continues until the end of March and cropping pattern depend on the climate. Farmers in Block A is cultivating only in the rainy season. The crop which is harvested at the site is paprika, and its timing is in the end of April. Paprika area is account for 5% of the project site. Other crops are finished to be harvested in March. Therefore, temporary road for construction and setting of temporary yard will be commenced during dry season after the construction contract. Substructure works of the pump station needs to be finished during the dry season preventing from flood of Gairezi river.

(3) Scope of Work

The responsibility sharing of scope of work between Japan and Zimbabwe is shown in the following table.

Table 2.2.35 Responsibility Sharing of Scope of Work

Responsibility by Japan	Responsibility by Zimbabwe
1) Construction of pump station: 1 set 2) Construction of farm pond: 1 set 3) Construction of irrigation canals: 1 set 4) Construction of appurtenant structure of irritation system such as drop, division works and others: 1 set 5) Construct ruction of drainage canal: 1 set 6) Culvert rehabilitation on main road: 1 set 7) Construction of farm road: 1 set 8) Procurement of two tractors 9) Procurement of one motorbike	1) To secure the land for proposed construction site 2) Provision of rented land required for the construction works without any compensation 3) Preparation of EMP and submission EMP to EMA 4) Extension of electric power line and installation/relocation of transformer. 5) Refund of VAT 6) Procedure of tax exempt 7) O&M for irrigation facilities after handing over

(4) Consultant Supervision

1) Framework of Project Implementation Structure

This Project should pass the Cabinet decision of Japan, and the Project will be implemented after the Exchange of Notes (E/N) between the governments of both the countries and the Grand Agreement (G/A) conclusion between JICA and Zimbabwe government.

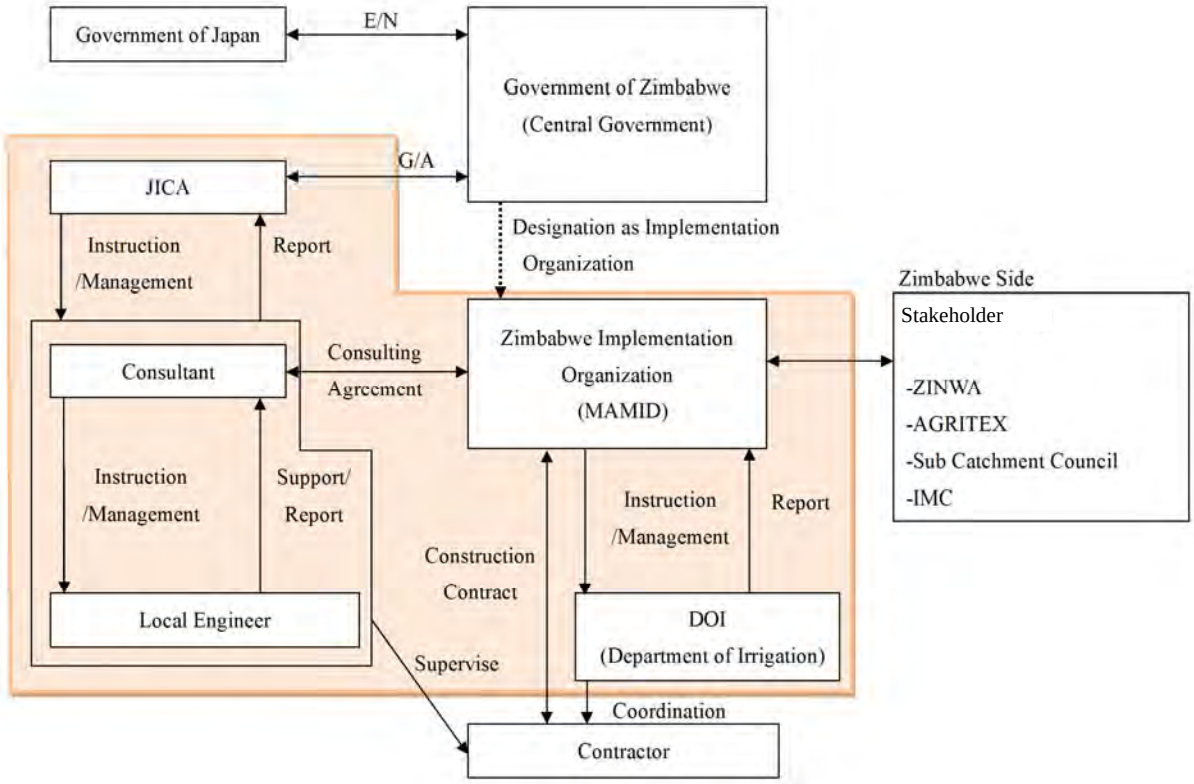


Figure 2.2.14 Framework of Project Implementation Structure

2) Consulting Service

Activities

After conclusion of G/A, consultant agreement between the Japanese consultant company recommended by JICA and MAMID will be concluded. The consultant company should performed detailed design, preparation of tender document, tender procedure and supervision of construction works.

On the construction management stage, consultant resident engineer in Zimbabwe should go to the site and has a responsible for the overall management of the construction works. Besides, local engineers will be employed by the consultant to support to resident engineer and work as interpreter.

The rule of consulting services of Japanese and local engineer for the Project is as follows.

【Stage of Detailed Design (D/D)】

- ✧ Conducting detail survey about existing condition of the target site, and revise the outline design
- ✧ Reconfirmation of basic condition, careful examination of specification, design drawing, and quantity calculation and inspection of all design
- ✧ Preparation of tender document
- ✧ Preparation of detailed drawing ,specifications and bill of quantities

【Tendering Stage】

- ✧ Approval of tender document by responsible organization (MAMID)
- ✧ Technical support to responsible organization concerning the procedure of tendering tendering such as P/Q, preparation of tender, tender execution, tender evaluation, negotiation with tenderer and conclusion of construction contract and others.
- ✧ Report the tender results to MAMID and JICA

【Stage of Construction Supervision】

- ✧ The Consultant should conduct management of construction schedule, quality control and safety management for the construction works and report to Zimbabwe side and JICA periodically.
- ✧ Payment procedure to contractor.
- ✧ Final inspection under the cooperation with MAMID
- ✧ Defect inspection one year after completion of the Project under the cooperation with MAMID

Manning Schedule

【Stage of Detailed Design Stage (D/D)】

The Japanese consultant is composed six persons namely team leader, facility design 1, facility design 2, pump facility, construction plan and estimation.

【Preparation of Tender Document】

Tender documents will be prepared by 4 experts namely team leader, facility design 1, pump facility, tender document. An expert in charge of tender document will go to the recipient country and explain the contents of the tender document. Finally, approval by Zimbabwe side will be obtained.

【Execution of Tendering】

The tender will be executed in Japan. Two experts namely team leader and facility design 1 will cope with the execution of tendering.

【Stage of Construction Supervision】

The consultant resident engineer with local engineer employed by the consultant basically will go to the construction site and supervise the contractor. Once a month, the resident engineer will go to Harare to explain the progress of the construction works to MAMID and JICA Zimbabwe office. The local engineer will support the work for the resident engineer and communicate with local resident for smooth implementation. Allocation of Japanese consultant experts is described in the table below.

Table 2.2.36 Allocation of Japanese Consultant Experts

Experts			The number of Experts	Role
Stage of detailed design and preparation of tender document				
	Japanese	Team leader and others	7	Through the detailed design, design drawing, cost estimation, tender document will be prepared.
Tendering Stage				
	Japanese	Team leader and others	2	Explanation of tender document to MAMID and approval of tender document Technical support for MAMID, owner of the Project such as tender execution, tender evaluation and contract negotiation and others
S Stage of Supervision				
	Japanese	Resident engineer and others	2	Supervisor 1: Resident engineer will stay in Zimbabwe until completion of the Project and will execute supervision, final inspection and defect inspection. Supervisor 2: Support to resident engineer at the beginning and final stage of the construction works.
	Local engineer	The local engineer /interpretive	1	The local engineer stay in the site and support to the Japanese resident engineer

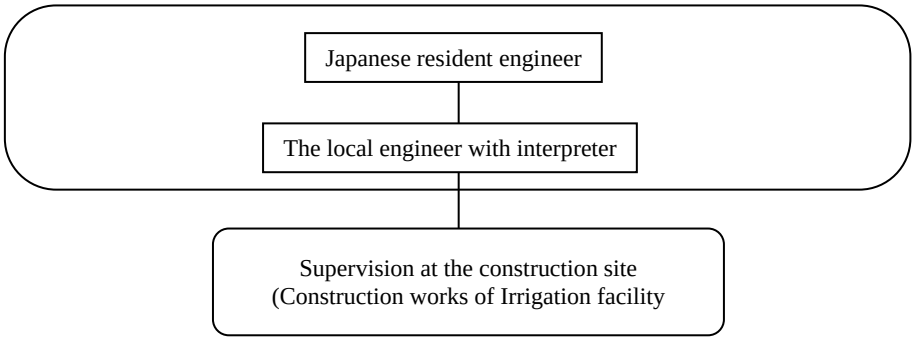


Figure 2.2.15 Organization Chart of Supervision Works of the Consultant

Final Inspection and Defect Inspection

Final inspection and defect inspection will be executed by the consultant under the cooperation with MAMID. These will be executed using the checking sheets, and the results will be reported to JICA.

(5) Quality Control Plan

Quality control such as confirmation of performance, bar arrangement inspection will be performed to confirm the construction photos with measurement taken by the local engineer. Quality certification of reinforcement bar fabrication will be confirmed of mill sheet and examination of tensile strength. Other material will be checked by the catalog. Control of work amount, control of finished work quality and quality control of main structures are shown in the following table.

Table 2.2.37 Items to be controlled in Supervision

Items	Type of Works	Description	Method of management
Control of finished work quality	Canal works	Control of canal bed elevation	Checking the elevation of canal bed elevation every 50 m point
		Concrete work	Confirmation and record by photos with measurement
	Pump station and other structures	Concrete works	Confirmation and record by photos with measurement which can check the thickness of concrete
	Road works	Embankment	Confirmation and record by photos with measurement which can check the width and thickness of gravel.
Quality Control	General	Concrete works	Confirmation of result of trial mixing test and the certification
	Canal W works	Concrete works	Slump test and density strength test by specimen every concrete placing day or every 150m3 bucket.
	Pipeline works	Refilling	Checking the refilling sand and confirmation of density strength at every 50m with height±20mm, width± 65mm and 95% compaction
	Pump station and farm pond	Concrete works	Slump test and density strength test by specimen every concrete placing day or every 150m3
	Pump station and farm pond	Refilling	Refilling by a fixed ruler of 30cm. Confirmation of material and thickness by eyesight.
	Road Works	Gravel Pavement	Confirmation of bearing soil capacity by 3 DCP (measuring device) every 1000 m2.
Progress Management	Canal Works	Establishment mark on the board of Concrete Canal	Confirmation by photos with blackboard written the date and station number.

(6) Procurement Plan

All the materials and equipments related to the pump station will be procured from Japan. The other material and equipment such as sand, gravel, valves for PVC pipe, steel pipe and other plumbing are possible to be procured in Zimbabwe.

(7) Operational Guidance Plan

An instruction for operational guidance will be supervised by the engineer from Japan at the newly-established Block A and Block D Pump Stations.

(8) Soft Component (Technical Assistance) Plan

Following three contents will be conducted under soft component of the Project.

1) Technical guidance for maintenance of irrigation facilities (Output 1)
2) Training on maintenance and fixing of pump facilities (Output 2)
3) Promotion of contract farming (Output 3)

1) Objective and Outcome of Soft Component

Contents of Soft Component	Objective	Outcome
Output 1: Technical guidance for maintenance of irrigation facilities	Irrigation facilities beyond farm pond will be maintained properly by IMC members.	IMC member of Block A, B, C and D will obtain the skill and knowledge for fixing small irrigation facilities beyond farm pond.
Output 2: Training on maintenance and fixing of pump facilities	Proper maintenance will be continued by staffs of ZINWA and pump facilities will be maintained appropriately.	The staffs of ZINWA which has a responsibility of the maintenance of the pump station and the staff of DOI can obtain the ability to identify the cause of trouble of pump equipment and to fix the pump equipment.
Output 3: Promotion of contract farming	Number of farmers of contract farming and number of crops to be introduced will be increase.	Number of contract farmers will increase XX farmers to XX framers. Number of crops of contract farming will be increase from XX crops to XX crops. (An indicator will be determined before commencement.)

2) Confirmation Method of Achievement of Outcomes

Contents of Soft Component	Outcome	Confirmation of Achievement
Output 1: Technical guidance for maintenance of irrigation facilities	IMC member of Block A, B, C and D will obtain the skill and knowledge for fixing small irrigation facilities beyond farm pond.	The questioner survey will be conducted for trainee to confirm the achievement of learning level after training..
Output 2: Training on maintenance and fixing of pump facilities	The staffs of ZINWA which has a responsibility of the maintenance of the pump station and the staff of DOI can obtain the ability to identify the cause of trouble of pump equipment and to fix the pump equipment.	The questioner survey will be conducted for trainee to confirm the achievement of learning level after training..
Output 3: Promotion of contract farming	Number of contract farmers will increase XX farmers to XX framers. Number of crops of contract farming will be increase from XX crops to XX crops. (An indicator will be determined before commencement.)	Discussion record between contract farming company and marketing committee will be prepared and to confirm the progress.

3) Activities

Output 1: Technical guidance for maintenance of irrigation facilities

Outcome	Consultant		Activities by Zimbabwe side	
	Input	Activities	DOI	IMC
IMC member of Block A, B, C and D will obtain the skill and knowledge for fixing small irrigation facilities beyond farm pond.	- Japanese experts: 5.0 M/M - Provision of construction materials: cement, reinforced bar, shovel, coarse aggregate, sand and others	- Repairing of irrigation canal with 180 m - Embankment along with existing canal with 3,400 m - Side wall raising of existing canal with 10 m - Construction of division works with 5 places - Construction of drop with 54 places - Technical guidance for the construction / repairing of irrigation facilities mentioned above	- Participation in the training of staff of DOI of Project office - Coordination with IMC and confirmation of training results	- Participation in the training in Block A - Acquisition of the knowledge and skill for the maintenance and fixing of the irrigation canal

Output 2: Training on maintenance and fixing of pump facilities

Outcome	Consultant		Activities by Zimbabwe side
	Input	Activities	Governmental staff
The staffs of ZINWA which has a responsibility of the maintenance of the pump station and the staff of DOI can obtain the ability to identify the cause of trouble of pump equipment and to fix the pump equipment.	- Japanese experts: 0.5.0 M/M - Execution of training in Japan - Provision of trainer, place of training and training materials	- Staff of ZINWA and DOI will invite to Japan for receiving training executed by Japanese experts.	- Two staffs from ZINWA participate in the training in Japan - Two staffs from DOI participate in the training in Japan - Trainee will acquire the knowledge and skill for operation and maintenance properly regarding general mechanics, pump, auxiliary equipment, motor, electrical equipment and others,

Output 3: Promotion of contract farming

Outcome	Consultant		Consultant	
	Input	Input	MAMID	MC
Number of contract farmers will increase XX farmers to XX framers. Number of crops of contract farming will be increase from XX crops to XX crops. (An indicator will be determined before commencement.)	- Japanese expert: 0.27 M/M - Provision of the places for introducing among Nyakomba MC and contract farming company MC: Marketing Committee	- Japanese expert will introduce the new contract farming company to AGRITEX extension officer and MC.	- DOI should list up new contract farming company. - AGRITEX should coordinate MC and contract farming company	- To increase the number of farmer conducting contract farming - To increase the number of the crops under the contract farming

4) Schedule

Soft Component Implementation Schedule

Year	2017												2018		
Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Output 1: Technical guidance for maintenance of irrigation facilities						■	■	■	■	■					
Output 2: Training on maintenance and fixing of pump facilities							□								
Output 3: Promotion of contract farming											■				

Note: ■ : Execution in Zimbabwe □ : Execution in Japan ▒: Rainy season

5) Submission of Soft Component

1) Output 1: Technical guidance for maintenance of irrigation facilities
Maintenance and fixing manual for small irrigation facility

2) Output 2: Training on maintenance and fixing of pump facilities
Training report after training

3) Output 3: Promotion of contract farming
Lists of contract farming companies and contract crops

6) Responsibility of Zimbabwe side

1) Output 1: Technical guidance for maintenance of irrigation facilities
DOI should allocate one project staff of DOI to participate in soft component.

2) Output 2: Training on maintenance and fixing of pump facilities
ZINWA and DOI should allocate the engineers who participate in the training in Japan.

3) Output 3: Promotion of contract farming
DOI should prepare the list of the contract company which interested in the Nyakomba irrigation scheme and introduce the list to Marketing Committee.

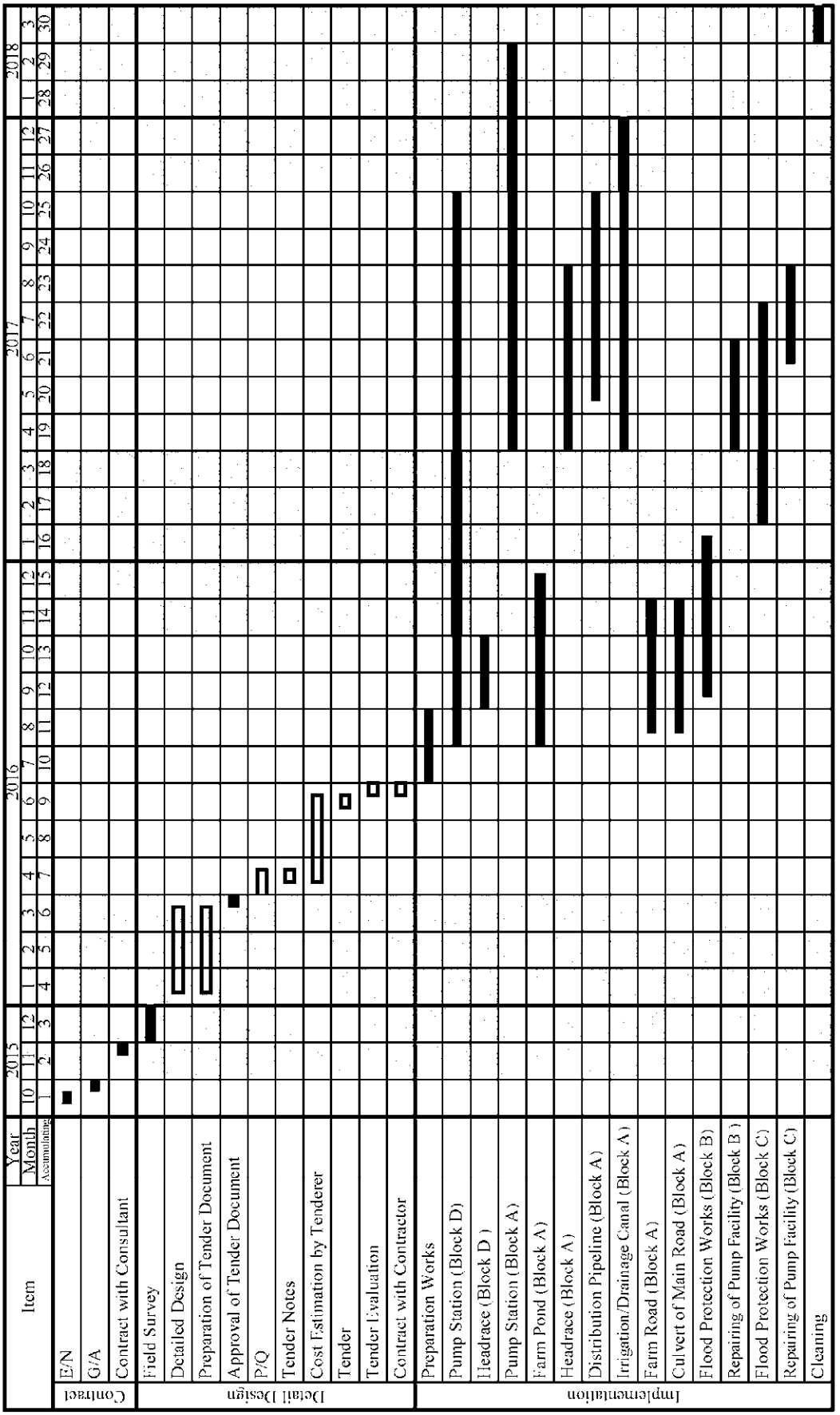
(9) Implementation Schedule

Climate at the Project site is clearly categorized into two seasons namely dry and rainy season. Two pump stations will be constructed in the Project. These basements of pump stations shall be constructed during dry season to prevent flood water. Since one basement of pump station require one dry season, construction period is needed two dry seasons.

In case Exchange Note (E/N) of the Project will be concluded at October, 2015, the contract signing with Contractor is assumed at the middle of June, 2016. Since two dry seasons are necessary for construction of pump stations, construction period is required three fiscal years.

- Detailed design and supervision: From December, 2015 to March, 2018
- Construction period: From July, 2016 to March, 2018

Implementation schedule of the Project is attached in next figure.


Item
Year
Month
Accumulation
2015
2016
2017
2018
Contract
Detail Design
Implementation
E/N
G/A
Contract with Consultant
Field Survey
Detailed Design
Preparation of Tender Document
Approval of Tender Document
P/Q
Tender Notes
Cost Estimation by Tenderer
Tender
Tender Evaluation
Contract with Contractor
Preparation Works
Pump Station (Block D)
Headrace (Block D)
Pump Station (Block A)
Farm Pond (Block A)
Headrace (Block A)
Distribution Pipeline (Block A)
Irrigation/Drainage Canal (Block A)
Farm Road (Block A)
Culvert of Main Road (Block A)
Flood Protection Works (Block B)
Repairing of Pump Facility (Block B)
Flood Protection Works (Block C)
Repairing of Pump Facility (Block C)
Cleaning
: Rain Season
: Work in Zimbabwe
: Work in Japan

2.3 Obligation of Recipient Country

Obligations of GOZ for smooth implementation of the Project are as follow.

Table 2.3.1 Obligation of GOZ

Responsibility	Obligation of GOZ
Securing land for major facilities	Securing land for the proposed irrigation facilities Securing land for the Pumping Stations is agreed by public meeting Securing land for Farm Ponds and Surge Tanks is agreed in writing GOZ shall acquire the necessary land smoothly
Land reclamination and land leveling	The benefitted area of 146 ha in Block A is divided euqualy to 228 benefisheries which is agreed by the related agencies and all beneficiaries in writing. GOZ is responsible to readjust the land plot and to distribute equally, and land levelling which will be carried out by the tractor and blade supplied by the Project
Submission of EMP to EMA and approval of environmental certificate	According to the Environmental Management Act of Zinbabwe, the irrigation scheme requires EIA. However, acording to the letter from EMA dated Dec. 9, 2014, the full scale EIA is not requied and only submission of EMP (Environmental Management Plan) and the approval is required. DOI is thus required to prepare EMP and submit it to EMA for the approval.
Water Intake Permit	DOI has already received a provisional new water intake permit for Block A from MAZOE Catchment Council with an upper limit of 1.96 million m3 for beneficial area of 140 ha. MEWC is required to communitate with the related agency of Mozambique to prevent from the dispute about water use coninuteously because the river for pump intake is the international river.
Agreement for O&M and Property of Irrigation Facilities	The demarcation of roles and responsibility for O&M and property of irrigation facilities such as pump is not clearly and definitely demarcated for Nyakomba Irrigation Scheme. The collection of water fee and O&M cost, therefore, does not executed smoothly and fairly. The principal stakeholders (IMC, ZINWA & DOI) are required, on the basis of the Water Act in Zimbabwe, to conclude an agreement for O&M and the property in order to continue proper O&M.
Budget Allocation for Securing Budget for Electric Sources	Since new pump stations are proposed to be newly constructed for Block A and D, extension of cable from the grid to the transformer site near the pump station and installation of transformer is required at Block A and D. While at Block B & C, because of the insufficient capacity of the existing transformer (which will be removed), new transformer will be installed (1000 kVA for each station). Cost necessary for these work will be borne by GOZ.
Assistance to Refund VAT for Procurement of Construction Material	MAMID is requested to promote procedure for refunding of VAT through writing letter to the related agencies (MFED).
Assistance to Exempt Import Tax	GOZ is requested to assist import tax exemption by submission of letter from MAMID to ZIMRA which is required Import Tax Exemption.

2.4 Project Operation Plan

(1) Sharing of Responsibility and Roles for Irrigation Facilities

Based on the results of the meeting on Feb. 2, 2015 by 4 prncipal stakeholders (ZINWA, DOI, AGRITEX and Sub Catchment Council) and Water Act in Zimnabwe, O&M and the property of the irrigation facilities can be tabulated below.

Table 2.4.1 Sharing of Responsibility and Roles for Irrigation Facilities

Facilities	Property	Responsible Body for O&M	Remarks
Pump station	ZINWA	ZINWA	Support of DOI should be required
Head Race	ZINWA	ZINWA	Ditto
Farm Pond	ZINWA	ZINWA	Ditto
Irrigated Farm Land	Communal land	IMC	Ditto
Distribution Pipeline	MAMID	IMC	Ditto
Irrigation Canal (open channel)	MAMID	IMC	Ditto
Canal Appurtenant Structure	MAMID	IMC	Ditto
Drainage Canal	MAMID	IMC	Ditto

- The property of main irrigation facilities up to farm pond (pump station, head race and farm pond) belongs to ZINWA. ZINWA should have responsibility for overall O&M of main irrigation facilities,
- The property of pumps and related equipment belongs to ZINWA. ZINWA should have responsibility for overall O&M of pump and related equipment,
- ZINWA collect water charge, electric charge and O&M cost from IMC. Water charge is collected in accordance with law, electric charge is collected by actual basis and O&M cost is determined by the agreement of ZINWA, DOI & IMC.
- DOI is responsible for technical support to beneficiaries,
- IMC is responsible for O&M of facilities of downstream from the farm pond,
- In case where the repair work exceeds capacity of IMC, DOI offer the technical and/or financial support, and
- Water charge is collected depending on the pumped water volume. Calculation method of pumped water volume is determined by the agreement of ZINWA, DOI and IMC.

(2) Plan of Operation and Maintenance

Operation and maintenance of the irrigation facilities are carried out as enumerated below.

Table 2.4.2 Operation and Maintenance of Irrigation Facilities and Chargeable Agencies

Facilities	Roles	Responsible body	Frequency
Pump station	Operation of pump station	ZINWA	Daily
	Record of operation	ZINWA	Daily
	Daily inspection	ZINWA	Before pump start
	Periodical inspection（overhaul）	ZINWA	Annually
Head Race	Ocular inspection	ZINWA	Monthly
Farm Pond	Ocular inspection	ZINWA	Monthly
Irrigation Canal	Gate operation	IMC	Daily
	Ocular inspection	IMC	Monthly
	Canal maintenance and fixing	IMC	Annually

2.5 Estimated Project Cost

2.5.1 Initial Cost Estimation

(1) Costs Borne by GOZ

Table 2.5.1 Costs Borne by GOZ

Costs	Estimated Amount
Refunding for VAT	381,000 US$
Land reclamation and leveling with 146ha	27,000 US$
Block A: Cable extension and installation of transformer	65,000 US$
Block B: Installation of transformer	42,000 US$
Block C: Installation of transformer	42,000 US$
Block D: Cable extension and installation of transformer	24,000 US$
Commissions for B/A and A/P	28,000 US$
Total	609,000 US$

(2) Condition of Cost Estimate

1) Estimation as of : February 2015
2) Exchange rate : 1 US$ = 119.06 JPY
3) Schedule : Period of design and construction is shown in the Implementation Schedule
4) Others : The Project cost is estimated in accordance with the procedure of the Grant Aid of GOJ. Application of amount and rate of contingency will be determined by the Ministry of Foreign Affairs.

2.5.2 Operation and Maintenance Cost

(1) Operation, Maintenance Cost

O&M cost for pump irrigation consist of i) canal maintenance cost, ii) water charge, iii) electric charge, iv) pump O&M cost as detailed in ANNEX 14. Total O&M cost is 515 US$ per farmer/year in average i.e., 43 US$/month as shown below.

Table 2.5.2 O&M Cost

Block	A	B	C	D	Total
Beneficial area (ha) (1)	146	128	115	191	580
Number of farmer (nos) (2)	228	128	165	239	760
Canal maintenance cost (3)	4,818 US$	4,224 US$	3,795 US$	6,303 US$	19,140 US$
Water charge /year (4)	11,415 US$	10,329 US$	9,543 US$	14,904 US$	46,190 US$
Electric charge/year (5)	32,525 US$	60,690 US$	64,054 US$	60,656 US$	217,925 US$
Pump O&M cost /year (6)	21,339 US$	31,999 US$	31,951 US$	22,937 US$	108,226 US$
Total O&M cost /year (7) = (3) + (4) + (5) + (6)	70,097 US$	107,242 US$	109,343 US$	104,800 US$	391,481 US$
Total O&M cost /ha/year (8) = (7) / (1)	480 US$	838 US$	951 US$	549 US$	675 US$
Total O&M/ cost /farmer / year	307 US$	838 US$	663 US$	438 US$	515 US$

(9) = (7) / (2)					

(2) Affordability

Agriculture gross annual income per farmers in Nyakomba become estimated at 7,768 US$ in average, if irrigation agriculture is conducted in all the area. While, the total O&M of irrigation facilities which consists of canal maintenance cost, water charge, electric charge and pump O&M cost become 515 US$ per annum/farmer. Thus, the proportion of annual total O&M is estimated at 6.6 % ranging from 4.4 to 9.1%.

Accordingly, it is judged that farmers have sufficient payment capacity to implement continuous pump irrigation.

Table 2.5.3 Proportion of O&M Cost in the Agriculture Income

Block	A	B	C	D	Total
Benefitted farmer (nos) (1)	228	128	165	239	760
Gross Agriculture Income （US$/Block） (2)	1,573,374US$	1,313,790US$	1,165,584US$	1,859,839US$	5,903,885US$
Gross Agriculture Income/farmer (US$/farmer) (3) = (2) / (1)	6,900 US$	10,264 US$	7,064 US$	7,782 US$	7,768 US$
O&M Cost /farmer (US$/farmer) (4): from (9) of above Table	307 US$	838 US$	663 US$	438 US$	515 US$
Agriculture Income/farmer (US$/farmer) (5)=(3)-(4)	6,592 US$	9,436 US$	6,401 US$	7,344 US$	7,253 US$
O&M cost / Gross Agric. Income (%) (6) = (4) / (3)	4.4 %	8.2 %	9.1 %	5.6 %	6.6 %

Chapter 3 Project Evaluation

Chapter 3 Project Evaluation

3.1 Preconditions

Preconditions required for the commencement of the Project can be itemized hereunder:

(1) Appropriate O&M of Irrigation Facilities Based on the Agreement

The property, operation, maintenance and management of the primary irrigation facilities such as pump station, head race distribution pipeline and farm pond belong to ZINWA according to the Water Act of Zimbabwe, while the property of facilities installed in the downstream of farm ponds belongs to MAMID, and the operation, maintenance and management of these facilities belong to IMC, and these structure for O&M are expected to be organized.

The present financial source of ZINWA is only water charge collected from farmers which are insufficient to cope with the cost for sufficient maintenance and management. Therefore, it is required for ZINWA, DOI and IMC to conclude agreement for property, operation, maintenance and management of the irrigation facilities through demarcation of mandatory of related organization.

(2) Approval of Environmental Certificate

At the commencement of the Project, DOI has to submit Environmental Management Plan to EMA and has to receive the Environmental Certificate in accordance with environmental act of Zimbabwe.

(3) Securing Electric Source of Pump

Government of Zimbabwe shall finance and complete following transformer setting at the side of each pumping stations:

Block A: Installation of transformer with a capacity of 1000 kVA and extension of cable for necessary connection,

Block B & C: Installation of two transformers with each capacity of 1000 kVA for Block B and C, respectively, and extension of cable for connection. The existing transformer with insufficient capacity shall be removed, and

Block D: Installation of transformer and extension of cable.

(4) Land Reclamation and Leveling for Equal Land Distribution

The benefitted area with 146 ha in Block A is expected to be distributed equally to 228 beneficiaries and is confirmed by all related agencies and all beneficiaries by agreement. The equal distribution of new farm plot and land leveling to enable surface irrigation in all benefitted area shall be implemented

under the responsibility of the GOZ.

(5) Tax Exemption

Prompt process of tax exemption and refundment is required by DOI and related agencies for Value Added Tax, Import Tax, etc.

3.2 Necessity Input by Recipient Country

(1) Linkage between DOI and and Related Organizations and Allocation of C/P

The Project is implemented mainly by DOI as the executing organization, however, the linkages among MAMID and with stakeholders of those other than MAMID are required. DOI is, therefore, requested to allocate C/P and implement the Project considering linkage with various organizations as those mentioned below.

Table 3.2.1 Organizations Related to the Project

Responsibility borne by GOZ	Stakeholders
Water intake permit	DOI, MAMID Department of Mechanization, MAMID ZINWA MAZOE Catchment Council IMC
Securing electric source of Pump Station	DOI, MAMID MEPD ZESA
Fair distribution of land	DOI, MAMID MLGPWNI Manicaland Province Office Nyanga District Council IMC
O&M of irrigation facilities	DOI, MAMID Department of Mechanization, MAMID AGRITEX、MAMID ZINWA IMC
Entitlement of Environmental Certificate	DOI, MAMID Department of Mechanization, MAMID MEWC MHCC EMA
Securing budget	DOI, MAMID Department of Mechanization, MAMID AGRITEX、MAMID MOFED

(2) GOZ's Assistance to Soft Component

Following 3 outputs are planned for soft components of the Project:

Output 1: Technical guidance for maintenance of irrigation facilities

Output 2: Training on maintenance and fixing of pump facilities

Output 3: Promotion of contract farming

Other than the above O&M strengthening of the irrigation facilities, the purpose of the soft components includes promotion of market oriented contract farming under application of irrigation water. In order to achieve these outputs, GOZ has to implement following:

- Active participation of DOI staff of Nyakomba Project office during implementation of training course (Output 1)
- Assignment of trainee from staffs of ZINWA and MAMID (Output 2), and
- Preparation of a list of contact farming company which are under practice of contract farming and are interested in Nyakomba area, and agricultural extension officer negotiate with contract farming companies. With the marketing committee, the extension officers promote farmers for contract farming (Output 3).

(3) GOZ's Assistance to Nyakomba Irrigation Scheme

One irrigation staff and four AGRITEX staffs are deployed in the Project Office located in Block B for Nyakomba Irrigation Scheme. Continuous deployment of these staffs to continue assistance to farmers is required.

3.3 Important Assumption

Important assumptions for implementation of the Project are enumerated below.

(1) Extreme Economic Confusion

Due to weak governance and failure in economic policy, the inflation, unemployment, poverty, etc. were still continued, and national economy was extremely confused by economic crisis related to presidential election in 2008 and hyper inflation caused by excessive issuance of bank notes. Therefore, no further failure in economic policy and economic sanction, which will occur, which become important assumption for the Project implementation.

(2) Natural Disaster

The Project area was hit by hurricane and heavy rainfall in 2006, and Gairezi River, which is the water source of the proposed irrigation pumps, hit the area and flooded and damaged the irrigation facilities heavily. Accordingly, natural disaster such as the floods exceeding in 2006 will not occur, which become important assumption for the Project implementation

3.4 Project Evaluation

3.4.1 Relevance

The Project is judged possessing relevance to be implemented under grant aid program of Japan due

to the reasons mentioned below.

(1) Relation with Development Plans in Zimbabwe

Zimbabwe Agenda (Zim Asset) ranked with the super goal of national plan toward sustainable socio-economy aims at development of agriculture sector through displaying food security and poverty reduction in order to achieve stable growth of agriculture in the area. Simultaneously, Zimbabwe National Irrigation Master Plan, July 2012 describes that i) there are potential area for irrigation development with an area of 2.24 million ha and ii) irrigation facilities will be developed in these area within 50 years. Nyakomba irrigation scheme is

- Developed on the basis of idea of Zim Asset,
- Belongs to short term development plan for cooperate agriculture sector in national irrigation master plan, and
- Included in the project list for 127 thousand ha to be developed within 5 years.

Thus, the Project implementation is in line with Zim Asset , National Irrigation Master Plan, etc.

(2) Reducing Inequality and Disaster Restoration

In comparison of farm income of Block A and developed three blocks namely Block B, C and D, the income of Block A is only one third of the income because of the non-existence of irrigation facilities in Block A. The objective of the irrigation development in Block A is to promptly correct the income disparity. While, in the developed three blocks, the irrigation areas are obliged to be reduced by flood damages. Resumption of the entire area is possible by the implementation of flood measures including relocation of pump station, repair work of pump facilities at the site, renewal of electric appliances, etc. Recovery to the previous irrigated agriculture is possible through correction of the regional disparity by construction of the irrigation facilities in Block A and restoration from damages.

3.4.2 Effectiveness

The prospected quantitative and qualitative effectiveness after implementation of the Project is as follow and judged possessing relevance.

(1) Quantitative Effectiveness

The quantitative effectiveness expected by the implementation of the Project is as follow.

Table 3.4.1 Target Indicator

Indicator	Present Value Year of 2014	Target Value Year of 2021 3 years after completion
Irrigation area (ha)	261	580
Cultivating area (ha)	764	1,045
Crop production in the top 3 crops		
Green maize (ton)	485	1,727
Sugar bean (ton)	333	534
Onion (ton)	648	2,160

Irrigation area, cultivating area and crop production are total of Block A to D.
Present value is based on the data collected from Project Office, Nyakomba, AGRITEX.

(2) Qualitative Effectiveness

The qualitative effectiveness expected by the Project is as follow:

- Agricultural production will increase and stabilize food supply in Nyakomba area
- Profitable crops will be introduced by introducing irrigation agriculture.

Annex

Annex

Annex 1: Member List of the Study Team

Explanation of Inception Report and Filed Site Survey from November 19, 2014 to February 8, 2015

Name	Position	Affiliation	Survey Period
Dr. NAGAYO Narihide	Team leader	Senior advisor, JICA	From 26/11/2014 to 03/12/2014
Mr. NOGUCHI Takuma	Coordinator	Rural Development Department, JICA	From 23/11/2014 to 03/12/2014
Mr. NISHI Mototaka	Consultant leader/ Irrigation facility design	NTC International Co., Ltd.	From 19/11/2014 to 14/01/2015
Mr. ISHIHARA Hiroei	O&M for irrigation scheme		From 06/01/2015 to 09/02/2015
Mr. TAKAGI Shigeru	Farm management / Famers' economy		From 01/12/2014 to 28/12/2014
Mr. NAKAMURA Kenji	Environmental social consideration / Procurement		From 19/11/2014 to 14/01/2015
Dr. Shemsu Kemal ANDETA	Procurement/ Cost estimation/ Construction planning		From 06/01/2015 to 09/02/2015
Mr. NIIJIMA Keiichi	Pump facility	NTC International Co., Ltd. (Cooperative company)	From 05/01/2015 to 13/01/2015
Mr. SAWADA Hidetomo	Electric facility		From 05/01/2015 to 13/01/2015

Discussion of Draft Final Report (As of July, 2015)

Name	Position	Affiliation	Survey Period
Mr. MORITAKI Ryosuke	Leader	Senior Advisor to the Director General, Rural Development Department, JICA	From 05/07/2015 to 10/07/2015
Mr. NOGUCHI Takuma	Coordinator	Rural Development Department, JICA	
Mr. NISHI Mototaka	Consultant leader/ Irrigation facility design	NTC International Co., Ltd.	From 02/07/2015 to 10/07/2015
Mr. ISHIHARA Hiroei	O&M for irrigation scheme		

Annex 2: Survey Schedule

Explanation of Inception Report and Filed Site Survey from November 19, 2014 to February 8, 2015

Date	Activities
19/11/2014 (W)	Leave Japan (Mr. Nishi and Mr. Nakamura)
20 (T)	Arrive at Harare
21 (F)	Meeting with JICA expert and JICA Zimbabwe office
22 (S)	Data compiling
23 (S)	Ditto
24 (M)	Call to MAMID, Discussion with DOI Arrived at Harare (Mr. Noguchi) and internal meeting
25 (T)	Minutes discussion with DOI and AGRITEX
26 (W)	Minutes discussion with DOI, Meeting with ZINWA Arrived at Harare (Dr. Nagayo)
27 (T)	Courtesy call to Minister of MAMID, Meeting with JICA, Preparation of entrusted work for topographic survey Move to Nyanga
28 (F)	Site survey, holding a workshop with beneficiary farmer
29 (S)	Site survey
30 (S)	Move from Nyanga to Harare
01/12/2014 (M)	Minutes discussion with DOI , Meeting with MOFED and EMA Arrive at Harare (Mr. Takagi)
02 (T)	Signing of Minutes of Discussion, Report to JICA and EOJ
03 (W)	Meeting with AGRITEX and Department of Mechanization
04 (T)	Contract with topographic survey company
05 (F)	Move to Mutare, Call to Manicaland Provincial Office and Nyanga Rural District Council
06 (S)	Data compiling
07 (S)	ditto
08 (M)	Meeting with topographic survey company, DOI and AGRITEX, Field survey
09 (T)	Field survey
10 (W)	ditto
11 (T)	ditto
12 (F)	ditto
13 (S)	ditto
14 (S)	Data compiling
15 (M)	Field survey
16 (T)	ditto
17 (W)	ditto
18 (T)	ditto
19 (F)	ditto
20 (S)	ditto
21 (S)	Data compiling
22 (M)	Field survey
23 (T)	ditto
24 (W)	ditto
25 (T)	Move from Nyanga to Harare
26 (F)	Meeting with DOI
27 (S)	Data compiling
28 (S)	Data compiling, Leave Harare (Mr. Takagi)
29 (M)	Meeting with DOI, Arrive at Japan (Mr. Takagi)
30 (T)	Meeting with DOI
31 (W)	Move to Masvingo
1/1/2015 (T)	Visit to Masvingo Irrigation Scheme, Move to Harare
2 (F)	Data compiling
3 (S)	ditto
4 (S)	ditto

Date	Activities
5（M）	Meeting with DOI and JICA, Arrived at Harare (Mr. Niijima and Mr. Sawada)
6（T）	Meeting with MAMID, DOI and JICA Arrived at Harare (Mr. Ishihara and Dr. Shemsu), Internal meeting
7（W）	Meeting with MAMID, DOI and JICA, Move to Nyanga
8（T）	Field survey, Pump function survey
9（F）	ditto
10（S）	ditto
11（S）	ditto
12（M）	Move to Harare, Leave Harare (Mr. Niijima and Mr. Sawada)
13（T）	Meeting with JICA and DOI Leave Harare (Mr. Nishi and Mr. Nakamura)
14（W）	Field survey, Institution survey and Quotation survey at Nyanga and Harare
15（T）	ditto
16（F）	ditto
17（S）	ditto
18（S）	Data compiling
19（M）	Meeting with EMA, DA and ZESA
20（T）	Field survey, Institution survey and Quotation survey
21（W）	ditto
22（T）	ditto
23（F）	ditto
24（S）	ditto
25（S）	Data compiling
26（M）	Field survey, Institution survey and Quotation survey
27（T）	ditto
28（W）	Meeting with EMA
29（T）	Meeting with ZESA
30（F）	Field survey, Institution survey and Quotation survey
31（S）	ditto
1/2/2015（S）	Data compiling
2（M）	Field survey, Institution survey and Quotation survey
3（T）	ditto
4（W）	ditto
5（T）	Call to contract farming company
6（F）	Report to JICA and DOI, Meeting with topographic survey company
7（S）	Report to JICA and DOI, Meeting with topographic survey company
8（S）	Leave Harare (Mr. Ishihara and Dr. Shemsu)
9（M）	Arrive at Japan (Mr. Ishihara and Dr. Shemsu)

Explanation of Draft Final Report from July 2 to July 10, 2015

Date	Activities
2/7/2015 (T)	Leave Japan (Mr. Nishi and Mr. Ishihara) and arrive at Harare
3 (F)	Meeting with JICA expert and explanation draft final report to MAMID
4 (S)	Examination of Minutes
5 (S)	Ditto
6 (M)	Minutes discussion with DOI, Leave Japan (Mr. Moritaki and Mr. Noguchi)
7 (T)	Minutes discussion with DOI and meeting with ZINWA Arrived at Harare (Mr. Moritaki and Mr. Noguchi) and internal meeting

Date	Activities
8/7/2015 (W)	Minutes discussion with DOI and finalization of Mantes of Meeting
9 (T)	Signing of Minutes of Discussion, Leave Harare (Mr. Noguchi, Mr. Nishi and Mr. Ishihara)
10 (F)	Arrive at Japan (Mr. Noguchi, Mr. Nishi and Mr. Ishihara), Leave Harare (Mr. Moritaki)
11 (S)	Arrive at Japan (Mr. Moritaki)

Note:
AGRITEX: Department of Agricultural Technical and Extension Services
DOI: Department of Irrigation
EMA: Environmental Management Agency
EOJ: Embassy of Japan
MAMID: Ministry of Agriculture, Mechanization, and Irrigation Development
MOFED: Ministry of Finance and Economic Development
ZINWA: Zimbabwe National Water Authority
ZESA: Zimbabwe Electricity Supply Authority

Annex 3: List of Parties Concerned in the Recipient Country

Embassy of Japan		
	HIRAISHI Yoshinobu	Ambassador Extraordinary and Plenipotentiary
	TSUNAKAKe David	Deputy Chief of Mission, Counsellor
	TSUZUKI Yoshitake	Counsellor
JICA Zimbabwe Office		
	MIZUNO Yuko	Resident Representative
	HIDAKA Yayoi	Administrative Officer
	James Nyahunde	Program Officer
	Beatrix Munonyara	Senior Administrative / Procurement Officer
Ministry of Finance and Economic Development, Headquarters		
	Margireta Makuwaza	Director, International Cooperation Department
	Brighton Shayanewako	Deputy Director, International Cooperation Department (In charge of Aid Cooperation)
	Stanley Zharare	Deputy Director, International Finance Department
	Sharon Timbe	Economist, International Cooperation Department
	Douglas Muzemba	Principal Economist, Revenue & Tax department
	Mr. AZUMA Kenjiro	ODA Advisor, JICA
Ministry of Agriculture, Mechanization and Irrigation Development		
	Joseph M. Made	Minister
	Reston J. Muzamhido	Principal Director of Mechanization and Irrigation Development
Department of Irrigation, Headquarters		
	C. Zawe	Director
	Shephard Kadaira	Deputy Director
	Chitsungo Bezzel	Deputy Director
	Ngwenya Maxwell	Engineer, Development Division
	Shorayi Edmund	Engineer, O&M division
	Johnson K. Hakata	Chief Accountant
	Vutete Elvis	Chief Engineer
	Muhambi Mutsa	Agronomist
	Tanyaradwa Mawoyo	Engineer
	Victor Charegwa	Engineer
	MORITAKI Ryosuke	Advisor, JICA
Department of Irrigation, Manicaland Provincial Office		
	Tafadwa Oliver Makore	Development Supervisor (Water Management Technician), in charge of Nyakomba
	Femayi Richard	Development Supervisor (Water Management Technician), in charge of Nyamalopa
Department of Mechanization, Headquaters		
	Rabson Gumbo	Director
	Martin Munyati	Acting Director
Department of AGRITEX, Headquaters		
	Wellington Chaonwa	Acting Chief, Agribusiness and Marketing, Department
	Shamiso Chikobru	Principal Agricultural Extension Specialist
Department of AGRITEX, Nyanga Office		
	Manyuke Eshumeli	AGRITEX Officer

Sithole Edmore	Supervisor of Extension Officers in charge of Nyakomba
Brian Daure	Extension Officer in charge of Block A
Makombe Tsitsi	Extension Officer in charge of Block B
	Extension Officer in charge of Block C
	Extension Officer in charge of Block D

ZINWA, Mazowe Catchment Office

F.G. Manzira	Catchment Manager, Mazowe Catchment
Paradzai Chiwandandelovu	Water Belief, in charge of Nyakomba and Nyamalopa

ZESA, Nyanga Department

Samkange	Customer's Officer
Mclloyd Chipinduro	Distribution Electrician

EMA: Environmental Management Agency, HQs

Petronella Shoko	Director, Environmental Protection

EMA Manicaland Provincial Office

Chitotombe Kingstone	Provincial Environmental Manager

EMA Nyanga Office

Daniel Manzou	District Environmental Manager
Charity Mudiwa	Environmental Officer

Minister of Local Government, Public Works and National Housing, Manicaland Provincial office

F.S. Mbetsa	Provincial Administrator

Minister of Local Government, Public Works and National Housing, Nyanga office

Bozai Irene	Acting District Administrator

Nyanga Rural District Council

Zenda K.S	Natural Resource Officer

Annex 4: Minutes of Discussion

Explanation of Inception Report

ZIMBABWE

MINUTES OF DISCUSSIONS
ON
PREPARATORY SURVEY ON
THE PROJECT FOR IRRIGATION DEVELOPMENT FOR
NYAKOMBA IRRIGATION SCHEME BLOCK A

The Government of Japan decided to conduct a Preparatory Survey on the Project for Irrigation Development for Nyakomba Irrigation Scheme Block A (hereinafter referred to as "the Project") and entrusted the Survey to the Japan International Cooperation Agency (hereinafter referred to as "JICA") in reference to the request from the Government of the Republic of Zimbabwe to the Government of Japan, dated August 9, 2012.

JICA has sent Zimbabwe the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Dr. NAGAYO Narihide, the Senior Advisor, JICA, and is scheduled to stay in Zimbabwe from November 23, 2014 to December 3, 2014.

The Team held discussions with the officials concerned of the Zimbabwe side and conducted the field survey.

In the series of discussions and the field survey, both sides confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Harare,
December 2, 2014

Dr. NAGAYO Narihide

Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. Reston Justin MUZAMHINDO

Acting Permanent Secretary
Ministry of Agriculture, Mechanization
and Irrigation Development

ATTACHMENT

1. Inception Report

The Team explained the objective of the Project and procedure of the Survey to be conducted in accordance with the Inception Report. After a series of discussions, the Team and Zimbabwe side (hereinafter referred to as "the both sides") agreed on the contents of the Inception Report in principle.

2. Objectives of the Project

The objective of the Project is to improve agricultural productivity and to increase farmers' income through construction of irrigation facilities in Block A. In addition, the Project will stabilize and improve agricultural productivity in Block B, C and D through the protection structure against flood in an effort to reduce the impact of flush flood which have become common occurrences over past 10 years.

3. Project Site

3.1 The benefited area of block A was 115ha composed of A1 and A2 at the time of request to Government of Japan (GOJ) based on the result of the previous basic study in 1999. However, expansion farmlands in block A were confirmed through the field study of the Team. Therefore, the benefited area of Project Site will be considered to include the expanded farmland named A3, A4 and A5 as shown in Annex-1.

3.2 Pump Station of Block B, C and D are also included in the Project site.

4. Project Title

As both sides agreed to include pump station of Block B,C and D to the Project site, it is agreed to change the project title to "Irrigation Development for Nyakomba Irrigation Scheme".

5. Responsible and Implementing Organization

5.1 The responsible organization of the Project is the Ministry of Agriculture, Mechanization and Irrigation Development (MAMID). The organization chart of responsible organization is shown in Annex-2.

5.2 The implementing organization of the Project is the Department of Irrigation. The organization chart of implementing organization is shown in Annex-3.

5.3 The list of stakeholders of the Project is attached in Annex-4.

6. Requested Equipment

The both sides discussed and agreed that types and numbers of equipment will be determined in accordance with the necessity of the operation and maintenance required in Nyakomba irrigation scheme Block A, B, C and D, and will be selected among requested equipment.

7. Contents of the Project

The contents of the Project are composed of the following four (4) items mainly.

7.1 Construction of irrigation facilities in Block A including pump facilities, pipeline, irrigation canal, farm pond, farm road, drainage canal and others,

7.2 Restorations of existing irrigation facilities in Block B, C and D including replacement and/or repairing of pump, flood protection structure by civil works and others necessity works,

7.3 Procurement of equipment needed for the operation and maintenance required in Nyakomba irrigation scheme Block A, B, C and D, and

7.4 Execution of soft component.

8. Environmental and Social Consideration

Zimbabwe side agreed to take necessary procedure for environmental and social considerations for the implementation of the Project. Based on discussion, Department of Irrigation, MAMID will submit report on detail implementation progress of the Project to Environmental Management Agency (EMA) by December 3, 2014. EMA will make a decision on whether Environmental Impact Assessment (EIA) or Environmental Management Plan (EMP) is required by December 15, 2014.

9. Land Distribution

Beneficiaries in Block A and other related organizations agreed equitable distribution of farmland at Block A. Department of Irrigation, MAMID will facilitate Irrigation Management Committee (IMC) to take action to compile the list of the beneficiaries of Block A with an agreement for equitable distribution, and submit to the Team by the end of January, 2015.

10. Water Permit

It is agreed that the Department of Irrigation, MAMID will apply for the water permit to Mazowe catchment council. The copy of application form and response from the council will be shared to the Team by the end of December, 2014.

11. Extension of Power Line

Zimbabwe side agreed that extension of power line to neighboring site of pump stations will be executed under the responsibility of Department of Irrigation, MAMID.

12. Initial Input

Budget and distribution plan for Initial input for farming in Block A such as seed, fertilizer, etc., will be prepared by Department of Irrigation, MAMID.

13. Roles and Responsibilities on Operation, Maintenance and Property of the Pump Stations

It is agreed that the Department of Irrigation, MAMID will take action to coordinate and define the roles and responsibilities on operation, maintenance and property of the pump and pump station among Department of Irrigation, Zimbabwe National Water Authority (ZINWA), and IMC by the end of January, 2015.

14. Japan's Grant Aid Scheme

14.1 Zimbabwe side understood the Japan's Grant Aid Scheme explained by the Team, as described in Annex-5.

14.2 The Team explained major undertakings to be taken by each government as described in Annex-6, for smooth implementation of the Project, as a condition for the Japan's Grant Aid to be implemented.

15. Schedule of the Preparatory Survey

15.1 The Team will proceed to further surveys in Zimbabwe until beginning of the February, 2015.

15.2 JICA will prepare the Draft Final Report in English and dispatch a mission team in order to explain its contents in July, 2015.

16. Other Relevant Issues

16.1 Supports for the Team

Zimbabwe side expressed the support for the Team and promised to take necessary measures for subsequent surveys.

16.2 Coordination between the Team and stakeholders

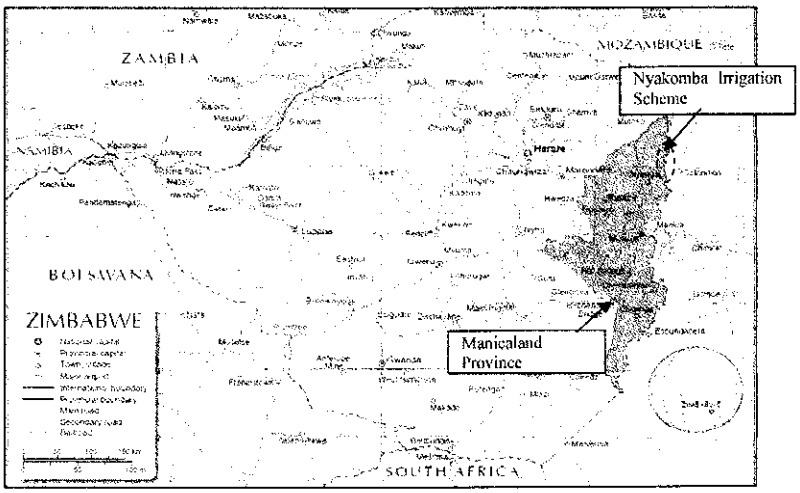
Zimbabwe side agreed to organize meeting between the Team and stakeholders namely IMC, other Ministries related to River management and others as required.

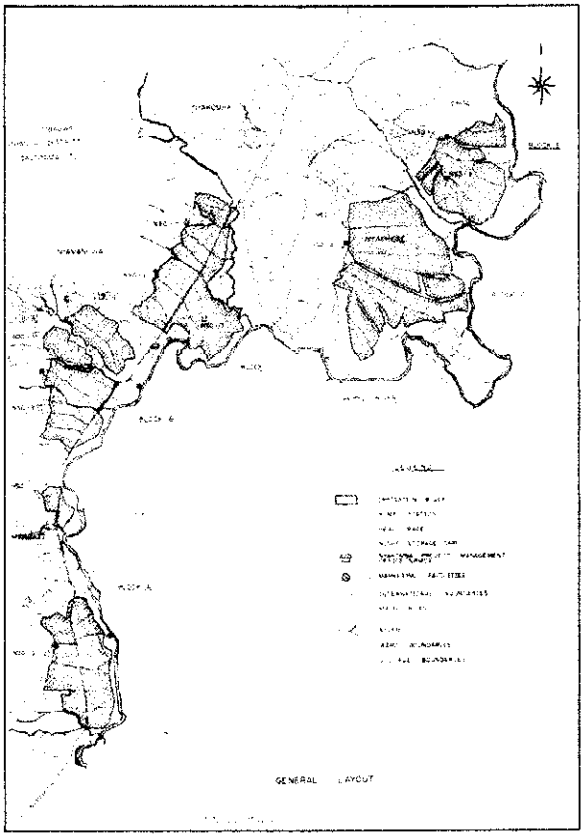
16.3 Approval of the Project
The both sides confirmed that the approval of the Project would depend on the decision by the GOJ.

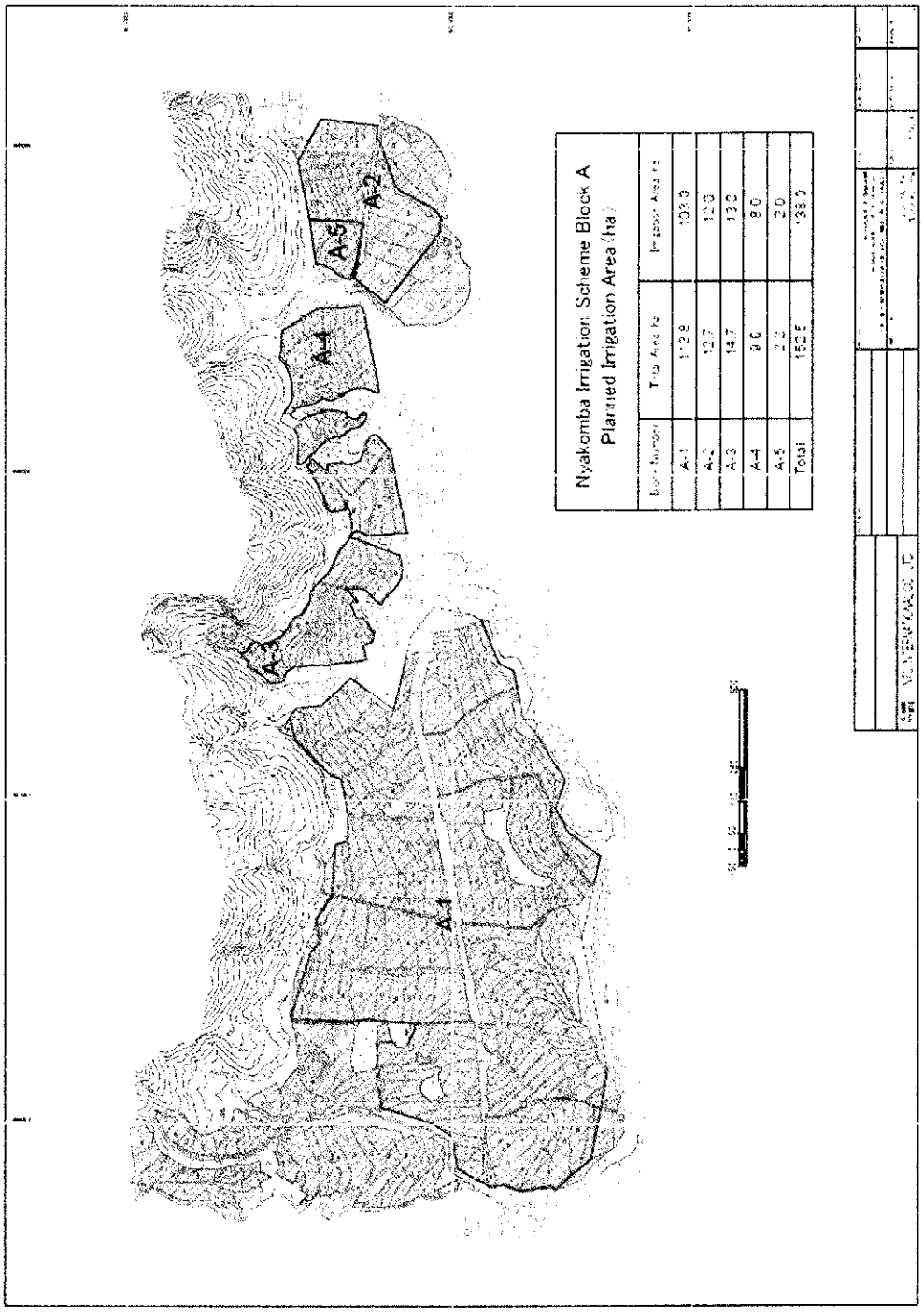
Annex-1: Map of the Project Site
Annex-2: Organization Chart of Responsible Organization
Annex-3: Organization Chart of Implementing Organization
Annex-4: List of Stakeholders of the Project
Annex-5: Japan's Grant Aid Scheme
Annex-6: Major Undertakings to be taken by Each Government

Annex-1

Map of the Project Site







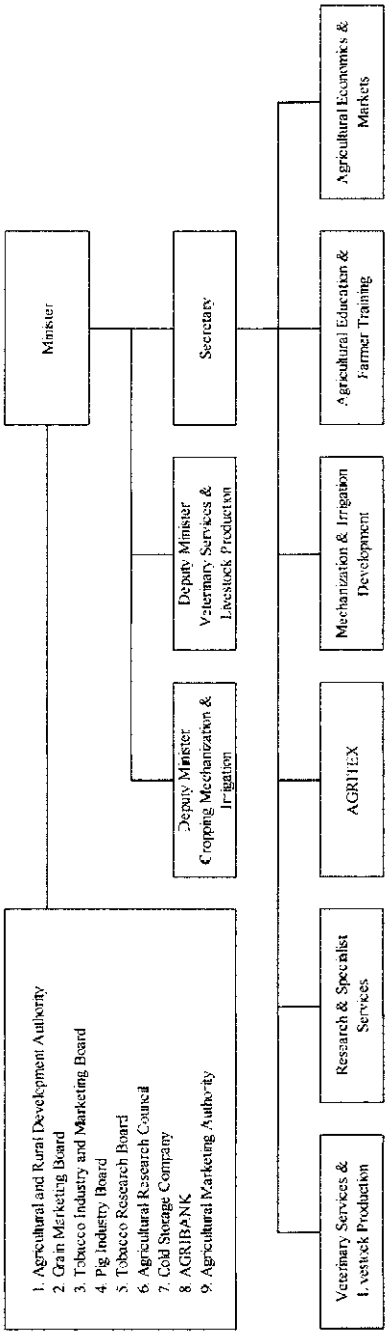
Nyakomba Irrigation Scheme Block A
Planned Irrigation Area (ha)

Block Number	Irrig. Area (ha)	Irrigation Area (ha)
A-1	119.9	103.9
A-2	12.7	12.0
A-3	14.7	13.0
A-4	9.0	9.0
A-5	2.0	2.0
Total	158.2	138.9

Annex-2

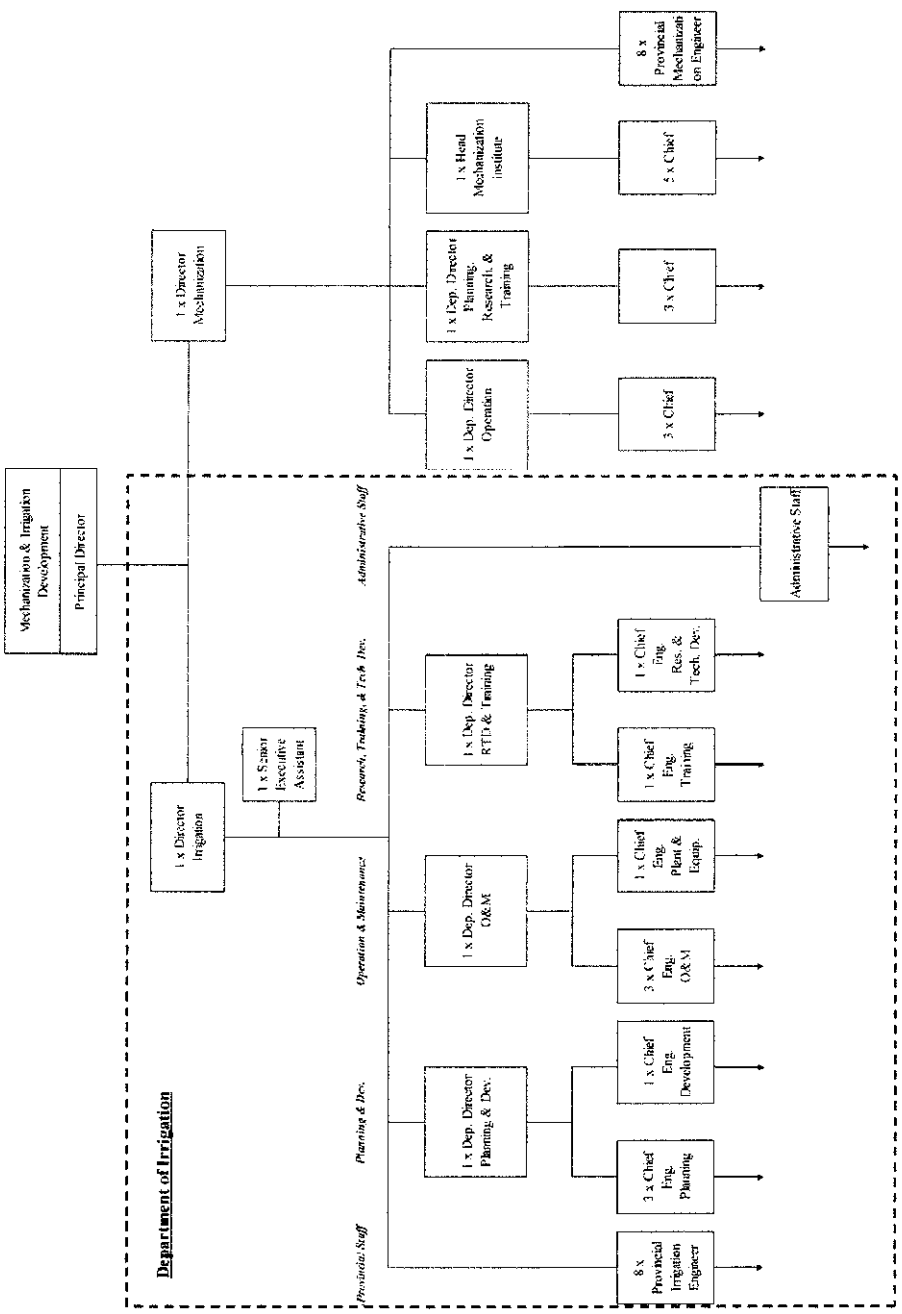
Organization Chart of Responsible Organization

Ministry of Agriculture Mechanization and Irrigation Development



Annex-3

Organization Chart of Implementing Organization



Annex-4

List of Stakeholders of the Project

Matters of Water Permit
- Department of Irrigation, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Department of Mechanization, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Zimbabwe National Water Authority (ZINWA)
- MAZOWE Catchment Council
- Irrigation Management Committee (IMC)

Matters of Electric Power Line Extension
- Department of Irrigation, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Ministry of Energy and Power Development (MEPD)
- Zimbabwe Electric Supply Authority (ZESA)

Matters of Land Distribution
- Department of Irrigation, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Ministry of Local Government, Public Works and National Housing
- Manicaland Provincial Office
- Nyanga Rural District Council
- Irrigation Management Committee (IMC)

Matters of O&M for Irrigation Facilities
- Department of Irrigation, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Department of Mechanization, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Department of Agriculture and Extension Services (AGRITEX), MAMID
- Zimbabwe National Water Authority (ZINWA)
- Irrigation Management Committee (IMC)

Matters of Environmental and Social Consideration
- Department of Irrigation, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Department of Mechanization, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Ministry of Environment, Water and Climate (MEWC)
- Ministry of Health and Child Care (MHCC)
- Environmental Management Agency (EMA)

Matters of Budget Allocation for the Project
- Department of Irrigation, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Department of Mechanization, Ministry of Agriculture Mechanization and Irrigation Development (MAMID)
- Department of Agriculture and Extension Services (AGRITEX)(MAMID)
- Ministry of Finance

Annex-5

JAPAN'S GRANT AID SCHEME

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of Official Development Assistance (ODA) operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on the law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

The Japanese Grant Aid is conducted as follows-

- Preparatory Survey (hereinafter referred to as "the Survey")
  - The Survey conducted by JICA
- Appraisal &Approval
  -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Determination of Implementation
  -The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  -Agreement concluded between JICA and a recipient country
- Implementation
  - Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide a basic document necessary for the appraisal of the Project by JICA and the GOJ. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed on by both parties concerning the basic concept of

the Project.

- Preparation of a basic design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Overall Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

The report on the Survey is reviewed by JICA, and after the appropriateness of the Project is confirmed, JICA recommends the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be signed between the GOJ and the Government of the recipient country to make a plead for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

The consultant firm(s) used for the Survey will be recommended by JICA to the recipient country to also work on the Project's implementation after the E/N and the G/A, in order to maintain technical consistency.

(3) Eligible Source Country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services from a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese Yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

(5) Major Undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex-6.

(6) "Proper Use"

The Government of the recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

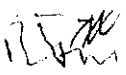
(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese Yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions to the Bank.



(10) Environmental and Social Considerations

A recipient country must ensure the environmental and social considerations for the Project and must follow the environmental regulation of the recipient country and JICA guidelines for environmental and social considerations.

End.

Annex-6

Major Undertakings to be taken by Each Government

NO	Items	To be covered by the Grant	To be covered by Recipient side
1	To secure land necessary for the implementation of the Project To distribute land to beneficiaries in proper manner		●
2	To construct following facilities		
	1) The roads	●	
3	To provide facilities for distribution of electricity, water supply and other incidental facilities necessary for the implementation of the Projects		
	1) Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Communication System	●	●
	3) Project Equipment	●	
4	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
5	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	●
6	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services (in case of tax exemption is applicable) be exempted / (in case refunding is applicable) be borne by the Authority without using the Grant		●
7	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
8	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract		●
9	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		●
10	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and installation of the equipment		●
11	To give due environmental and social consideration in the implementation of the Project		●

(B/A: Banking Arrangement, A/P: Authorization to pay)

13

Explanation of Draft Final Report

Minutes of Discussions
The Preparatory Survey on the Project for
Irrigation Development for Nyakomba Irrigation Scheme
(Explanation on Draft Preparatory Survey Report)

On the basis of the discussions and the results of field survey in Republic of Zimbabwe (hereinafter referred to as "Zimbabwe") in the period from November 2014 to February 2015, and the subsequent technical examination in Japan, the Japan International Cooperation Agency (hereinafter referred to as "JICA") prepared a draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") on the Project for Irrigation Development for Nyakomba Irrigation Scheme (hereinafter referred to as "the Project").

In order to explain the Draft Report and to consult with the concerned officials of the Government of Zimbabwe on its contents, JICA sent to Zimbabwe the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of the Draft Report, headed by Mr. MORITAKI Ryosuke, the Senior Advisor to the Director General and is scheduled to stay in the country from July 7 to July 10, 2015.

As a result of the discussions, both sides confirmed the main items described in the attached sheets.

Harare
July 9, 2015

Mr. MORITAKI Ryosuke
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. R.J. Chitsiko
Permanent Secretary
Ministry of Agriculture, Mechanization and Irrigation Development
Republic of Zimbabwe

C.C. Permanent Secretary, Ministry of Finance and Economy Development

1

ATTACHMENT

1. Objective of the Project

The objective of the Project is that i) Necessary irrigation facilities will be constructed in Block A, ii) Irrigated agriculture in Block A will become possible and iii) Flood disaster prevention will be executed in Block B, C and D through the construction of irrigation facilities and flood protection facilities, thereby contributing to increase in agriculture production in Nyakomba area.

2. Title of the Preparatory Survey

Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Irrigation Development for Nyakomba Irrigation Scheme.

3. Project Site

Both sides confirmed that the site of the Project, which is shown in Annex 1.

4. Line Agency and Executing Agency

Both sides confirmed the line agency and executing agency as follows.

4-1 The line agency is Ministry of Agriculture, Mechanization and Irrigation Development (hereinafter referred to as "MAMID"), which would be the agency to supervise the executing agency.

4-2. The executing agency is Department of Irrigation (hereinafter referred to as "DOI"). The executing agency shall coordinate with all the relevant agencies to ensure smooth implementation of the Project and ensure that the undertakings are taken by relevant agencies properly and on time.

5. Contents of the Draft Report

After the explanation of the contents of the Draft Report by the Team, the Zimbabwe side agreed in principle to its contents.

6. Cost Estimation

6.1 Both sides confirmed that the Project cost estimation described in the Annex 2 was provisional and would be examined further by the Government of Japan for its final approval.

6.2 The Team explained to the Zimbabwe side that the Project cost estimation described in Annex 2 does not include the contingency, however, the final Project cost may include the contingency described in E/N that would be appraised by GOJ. The contingency would cover the additional cost against natural disaster, unexpected national condition that might be beyond the control of the implementer and etc.

4.3 Zimbabwe side was informed that the Project cost shall not exceed the upper limit of the amount agreed on E/N and G/A.

7. Confidentiality of the Cost Estimation and Specifications

Both sides confirmed that the Project cost estimation and technical specifications in the Draft Report should never be duplicated or disclosed to any third parties until all the contracts of the Project are concluded.

8. Japanese Grant Scheme

The Zimbabwe side understands the Japanese Grant Scheme and its procedures as described in Annex 3 and Annex 4, and necessary measures to be taken by the Government of Zimbabwe.

9. Project Implementation Schedule

The Team explained to the Zimbabwe side that the expected implementation schedule is as attached in Annex 5.

10. Expected Outcomes and Indicators

Both sides agreed that key indicators for expected outcomes are as follows. The Zimbabwe side has responsibility to monitor the progress of the indicators and achieve the target in year 2021.

[Quantitative Effect]

Target Indicator

Indices	Present value in 2014	Target value in 2021
Irrigated Area (ha)	261	580
Cropping Area (ha)	764	1,045
Farm Income (US$/farmer)	3,200	5,400

Irrigated area and cropping area are total of Block A to D.
Farm income is average of Block A to D
Present value is based on the data collected from Project Office, Nyakomba AGRITEX.

[Qualitative Effect]

- Food supply become stable by increase in agriculture production in Nyakomba area,
- Agriculture income will increase due to cultivating high benefit crop through irrigated agriculture, and
- Market oriented agriculture will be executed through promotion of contract farming and will become the model area as sample for the surrounding of Nyakomba area.

11. Technical assistance ("Soft Component" of the Project)

Considering the sustainable operation and maintenance of the provided facility, following technical assistance is planned to be provided under the Project. The Zimbabwe side confirmed that it will assign necessary number of competent and appropriate C/Ps as described in the Draft Report and in Annex 6.

12. Environmental and Social Considerations

12.1 Zimbabwe side agreed that necessary procedure for environmental certificate in accordance with environmental law will be completed until end of August, 2015. DOI

should prepare Environmental Management Plan and submit to Environmental Management Agency (EMA).

12.2 Both sides agreed the contents of Environmental Checklist as shown in Annex 7.

12.3 Zimbabwe side agreed that Monitoring for Environmental and Social Consideration should be conducted by the Contractor, MAMID and ZINWA in accordance with the Monitoring Plan for the Project as shown in the Draft Report. DOI should submit the results of the monitoring to JICA by filling with the Monitoring Form attached in Annex 8, during the construction stage and operation stage.

12.4 Zimbabwe side agreed that JICA will disclose the results of the monitoring (Monitoring Form) conducted by the Contractor and MAMID and ZINWA on JICA's website.

13. Undertakings Taken by Both Sides

Both sides confirmed to undertakings described in Annex 9. The Zimbabwe side assured to take the necessary measures and coordination including allocations of the necessary budget which are preconditions of implementation of the Project.

14. Monitoring during the Implementation

The Project will be monitored every month by the executing agency and using the Project Monitoring Report (PMR) described in Annex 10.

15. Ex-Post Evaluation

JICA will conduct ex-post evaluation three (3) years after the project completion with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability) of the Project. Result of the evaluation will be publicized. The Zimbabwe side is required to provide necessary support for them.

16. Schedule of the Study

JICA will complete the Final Report of the Preparatory Survey and will submit it to Zimbabwe side by the end of October, 2015.

17. Obligation of the Recipient Country

It was assured that Zimbabwe side take necessary measures to fulfill those obligations, including major ones listed below, and a summery table is attached in Annex 11.

1) Securing land for facilities
2) Equal land distribution
3) Environmental certificate
4) Commissions for B/A and A/P
5) O&M agreement
6) Securing power for pump station
7) Refund of VAT
8) Assistance to Exempt Import Tax

18. Cost of Operation and Maintenance of Irrigation Facilities

The Team explained the necessary operation and maintenance cost of irrigation facilities composed of i) canal maintenance cost, ii) water charge, iii) electric charge, iv) pump O&M cost as detailed in Annex 12. Zimbabwe side agreed that necessary operation and maintenance cost should be borne by Zimbabwe side.

19. Role and Responsibility on Operation, Maintenance and Property of the Facility

19.1 The Zimbabwe side agreed that role and responsibility on operation, maintenance and property of the irrigation facility is prepared in accordance with the water act of Zimbabwe and are confirmed as shown in Annex 13.

19.2 The Zimbabwe side agreed to coordinate and organizing a meeting among three (3) stakeholders namely ZINWA, DOI and IMC. The meeting should finalize the role and responsibility on operation, maintenance and property of the irrigation facility among the stakeholders and should be concluded in the Agreement with fully explanation and understandings of the Agreement by the beneficiary farmers.

19.3 The Zimbabwe side agreed that in accordance with 19.1 and 19.2 above, an official handing over of the facilities together with the responsibility for the operation and maintenance of the pump station, head race and farm pond to ZINWA shall be conducted after completion of the Project.

19.4 Role and responsibility on operation, maintenance and property of the irrigation facility will be executed and continued based on the Agreement among those parties.

19.5 Zimbabwe side should take the responsibility and prepare operation and maintenance cost described in the Draft Final Report including i) electricity charge, ii) water charge, iii) pump maintenance cost and iv) canal and road maintenance cost.

20. Land Distribution and Land Consolidation/Leveling

20.1 Zimbabwe side agreed that equal land distribution in Block A should be executed based on the agreement as attached in Annex 14 dated on December 19, 2014 among stakeholders.

20.2 Zimbabwe side agreed that land consolidation with equal land distribution, and land leveling for the smooth distribution of irrigation water to all the beneficiary area in Block A should be implemented by Zimbabwe side.

21. Water Permit

21.1 The team confirmed that the procedure of water permit has been completed by the efforts of DOI because the letter concerning water permit was issued by related authority as attached in Annex 15.

21.2 Regarding water permit on Trans-boundary River, the letter submitted by the Ministry of Environment, Water and Climate in Zimbabwe to concerned authority in Mozambique notifying the about amount of water extracted from the River as 1,400 liters per second as attached in Annex 16, shall be expected to address the issue of agreement on the water use of Trans-boundary River. The team expects the Zimbabwe side should continue the communication with the Mozambique side so that dispute among the countries would not

be brought as an issue.

22. Main Road

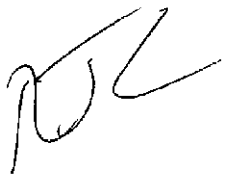
22.1 The Zimbabwe side requested the improvement of main road with 10 km to GOJ. Through the field survey, however, it was confirmed that main road could be improved by the technical standard in Zimbabwe. Additionally, supplement of the pavement materials and usual maintenance are conducted by the local resident. Therefore, Zimbabwe side agreed that improvement of the pavement for main road will be not included in the Grant Aid.

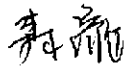
22.2 Through the field survey, it was confirmed that three (3) culverts were damaged. Since rehabilitation of these culverts by the Zimbabwe side is seemed to be difficult, rehabilitation of three (3) culverts will be rehabilitated by the Grand Aid.

23. Other Relevant Issue

Zimbabwe side will make comments on Draft Final Report until end of August.

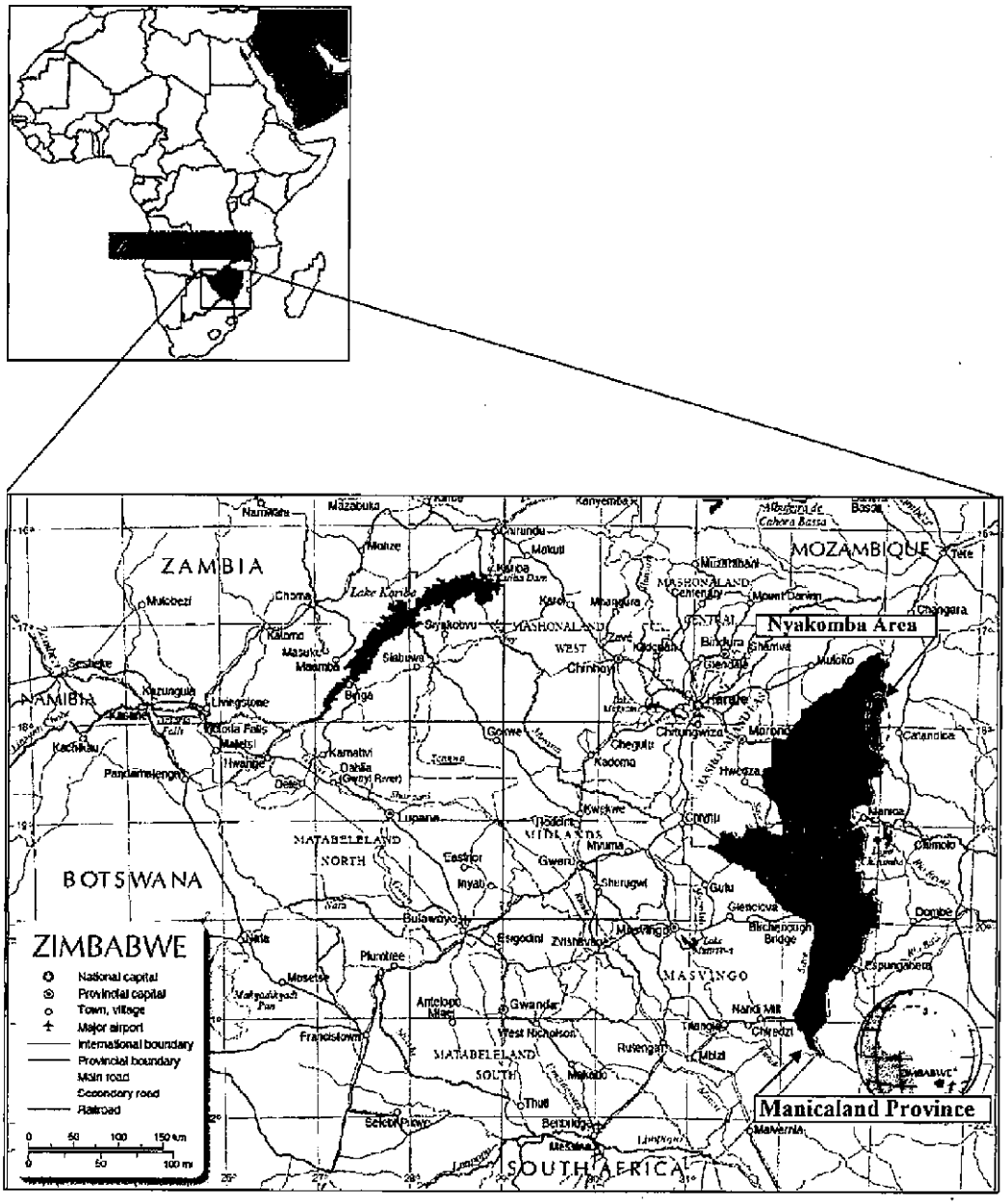
Annex 1: Project Site
Annex-2: Project Cost Estimation
Annex-3: Flow Chart of Japanese Grant Procedures
Annex 4: Financial Flow of Grant Aid
Annex 5: Project Implementation Schedule
Annex 6: Necessity Input for Soft Component by Zimbabwe Side
Annex 7: Environmental Checklist
Annex 8: Monitoring Form
Annex 9: Major Undertaking to be Taken by Each Government
Annex 10: Project Monitoring Report
Annex 11: Obligation of the Recipient Country
Annex 12: Operation and Maintenance Cost borne by Zimbabwe Side
Annex 13: Responsibilities Sharing for Irrigation Facilities
Annex 14: Agreement of Land Equally Land Distribution
Annex 15: Provisional Water Permit
Annex 16: Notification to Mozambique about Water Intake





Annex 1

Project Site



7

Annex 2

Project Cost Estimation

< Confidential>

1. Project Cost to be borne by Japan's Grant Aid

Items	Cost (Million JPY)
1. Construction works including in procurement of equipment	1,517
2. Soft component	19
3. Consulting service fee including in design, tendering and supervision, etc.	135
4. Total	1,671

2. Project Cost to be borne by Zimbabwe side

Items	Cost (US$)
1. Refund for VAT	381,000
2. Land consolidation and land leveling	27,000
3. Securing of power for pump station	173,000
4. Commissions for B/A and A/P	28,000
5. Total	609,000

3. Estimation Condition

1) Exchange rate: 1 US$ = 119.06 JPY

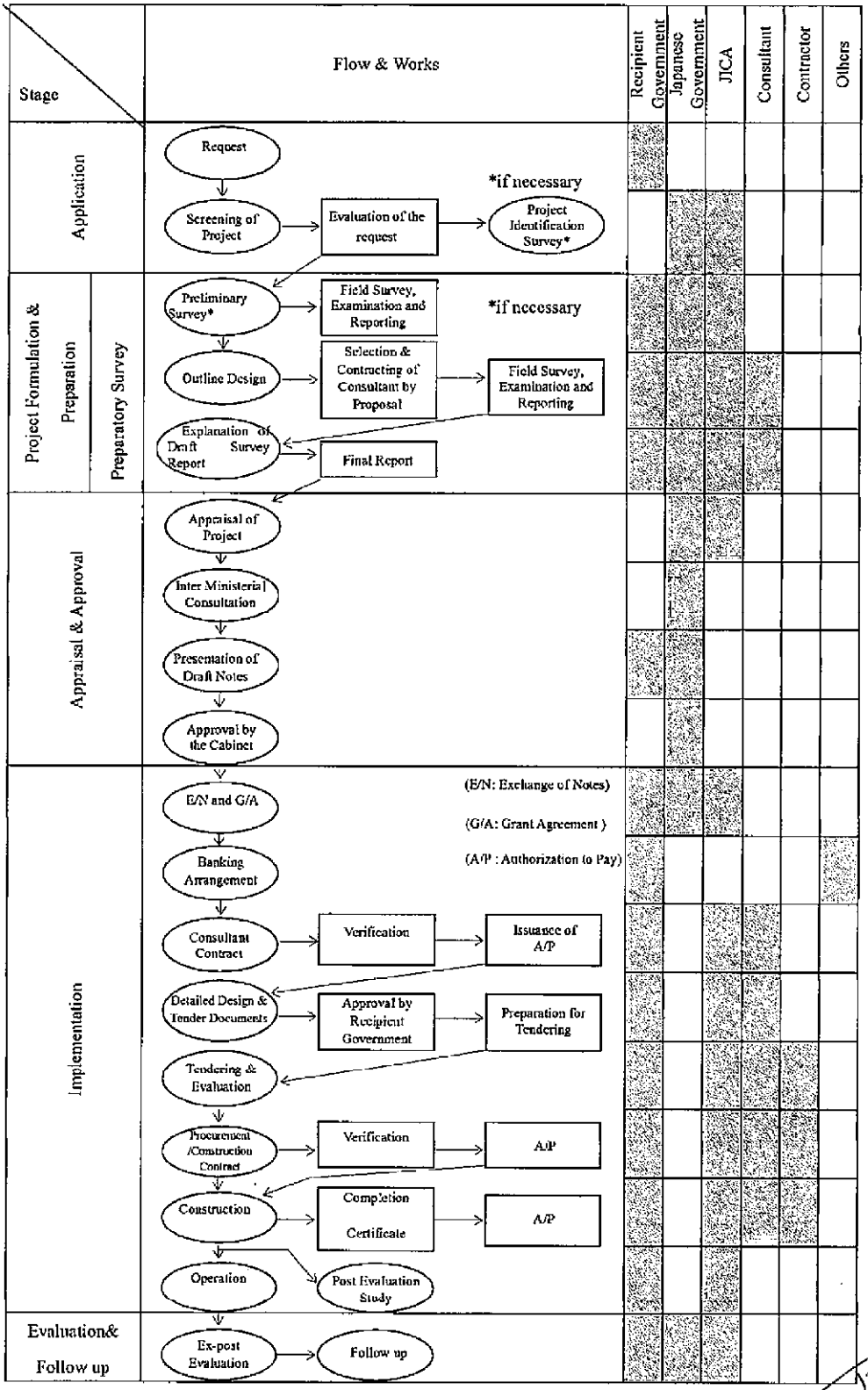
2) Cost estimation: The above Project cost was estimated in accordance with the guideline of Japan's Grant Aid.

3) Implementation period: The project intends to be required approximately 30 month after E/N conclusion for the detailed design, tender and construction works as shown in the implementation schedule in the Draft Report

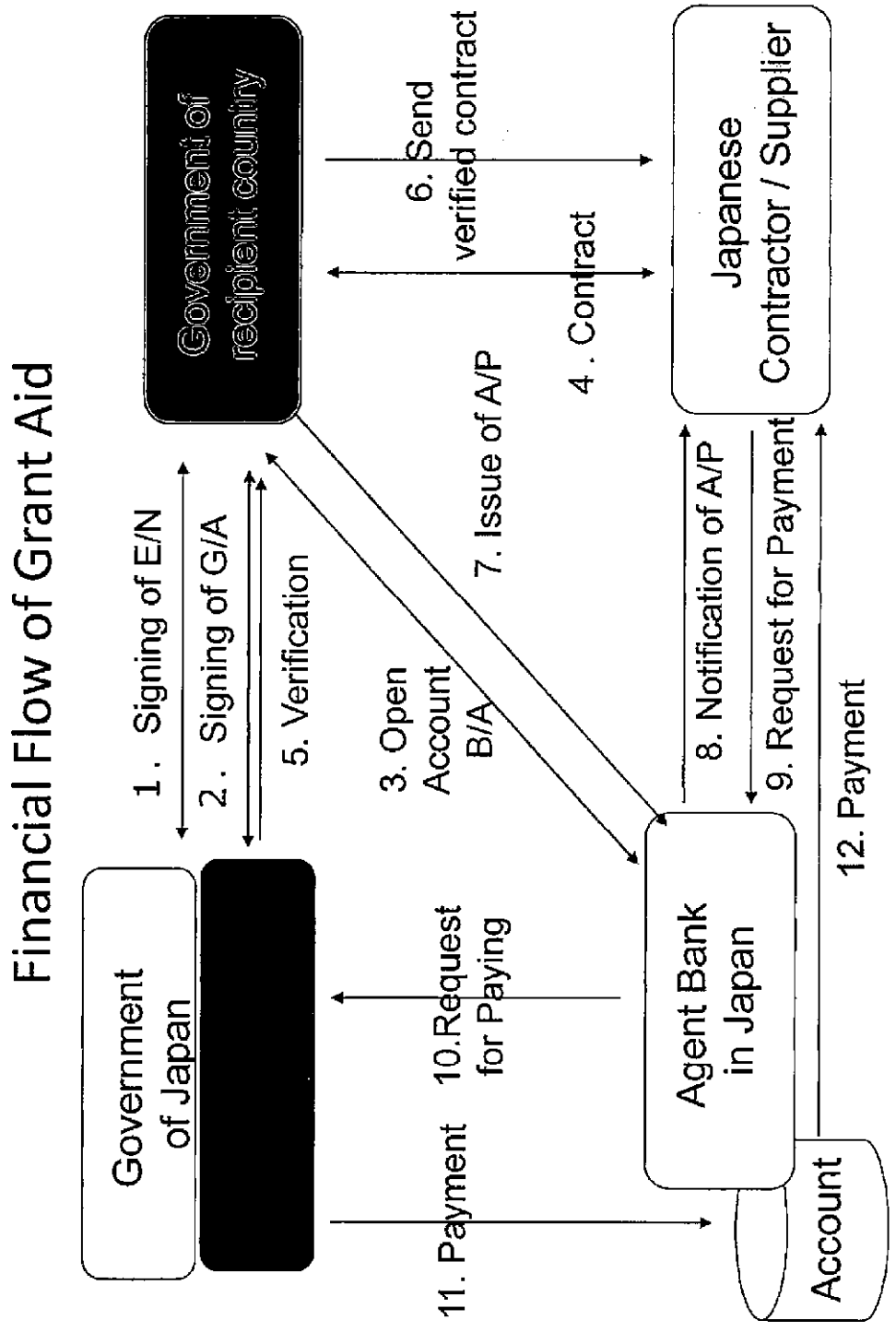
8

Annex 3

FLOW CHART OF JAPANESE GRANT PROCEDURES



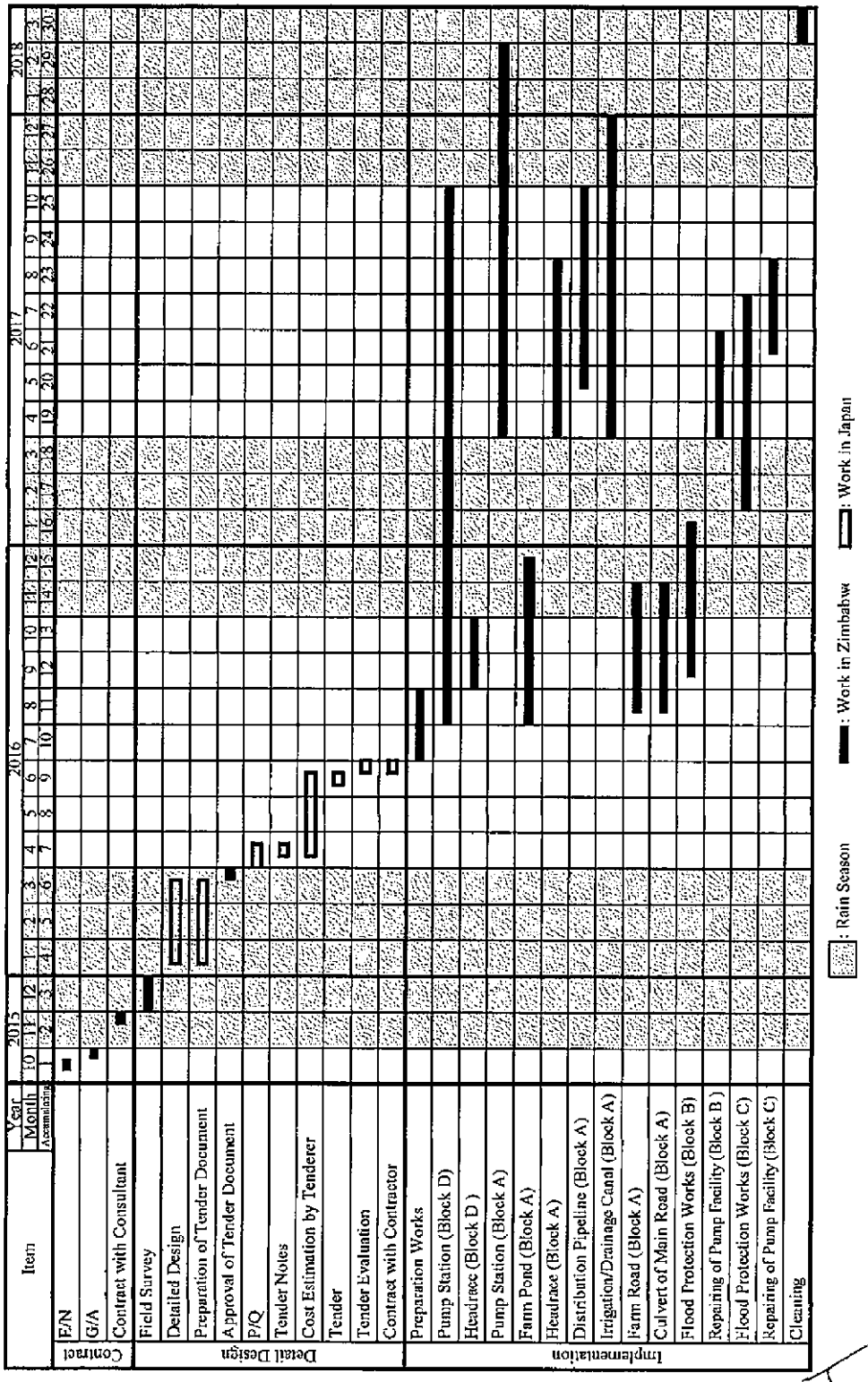
Annex 4


Financial Flow of Grant Aid
Government of recipient country
Japanese Contractor / Supplier
Government of Japan
Agent Bank in Japan
Account
1. Signing of E/N
2. Signing of G/A
3. Open Account B/A
4. Contract
5. Verification
6. Send verified contract
7. Issue of A/P
8. Notification of A/P
9. Request for Payment
10.Request for Paying
11. Payment
12. Payment

10

Annex 5

Project Implementation Schedule



Annex 6

Necessity Input for Soft Component by Zimbabwe Side

The soft component of the Project include in following three (3) outputs.

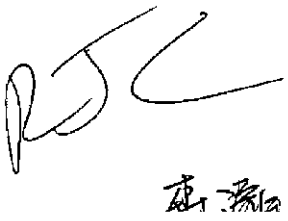
Output 1: Technical guidance for maintenance of irrigation facilities

Output 2: Training on maintenance and fixing of pump facilities

Output 3: Promotion of contract farming

For smooth implementation of soft component, necessity inputs by Zimbabwe are as follows.

- DOI should assign the staff of DOI of Nyakomba Project office during implementation of training for coordinating and facilitating with farmers (Output 1),
- Zimbabwe side should select the trainee from the staffs of ZINWA and MAMID and dispatch them to Japan under the cooperation with the Consultant. Trainees will be selected from engineers, that are two mechanical engineer and two electrical engineer who are mandated the responsibility for the operation and maintenance of Nyakomba Irrigation Scheme (Output 2), and
- DOI and AMA shall prepare and submit a list of the company which are under practice of contract farming and are interested in Nyakomba area and AGRITEX will contact and negotiate with contract farming companies. A list of company will be selected through the discussion with the Consultant during detailed design stage. The extension officers promote contract farming together with marketing committee and farmers (Output 3).

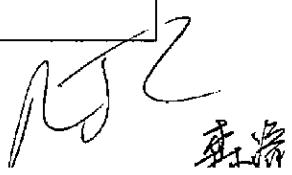


Annex 7

Environmental Checklist

Category / Item	Check Item	Check	Reason / Mitigation Measure
1. Permit and Explanation			
(1) EIA and environmental permit	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Yes (b) Yes (c) Yes (d) N/A	(a) Based on the discussion with EMA, the DOI submitted Prospectus and Terms of Reference to EMA. Then, the DOI is requested to submit EMP which is under finalization process up to date. (b) (c) Implementation of the project is approved by EMA with conditions of submitting EMP to EMA. (d) Provisional water permit was obtained from ZINWA. Official one will be obtained at completion of the construction.
(2) Explanation to local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders been reflected to the project design?	(a) Yes (b) Yes	(a) DOI held several meetings with local stakeholders, and project concept was accepted by them. (b) Strong requests of maintenance of pumps were particularly raised by participants of the stakeholder meetings. Besides, land distribution plan was made with considerations of comments from the local stakeholders.
(3) Examination of alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Yes	(a) Alternatives were examined with multiple criteria not only environmental and social issues, but economic development, construction cost, etc.
2. Pollution Control			
(1) Water quality	(a) Are considerations given to water pollution of river water and groundwater by effluent or leachates from agricultural lands? Are adequate use/disposal standards for fertilizers, agrochemicals, and livestock wastes established? Is a framework established to increase awareness of the standards among farmers? (b) Is a monitoring framework established for water pollution of rivers and groundwater?	(a) Yes (b) Yes	(a) Extension officers of AGRITEX are going to train farmers in particular IMC of Block A newly established in order them to apply chemicals and fertilizers with appropriate manner based on the standards recommended by AGRITEX. (b) It is planned to establish monitoring structure during the construction and operation stage by DOI and contractor respectively. Details of monitoring structure are described in the main report.
(2) Solid Wastes	(a) Are wastes properly treated and	(a) Yes	(a) The waste soil shall be reused as filling

Category / Item	Check Item	Check	Reason / Mitigation Measure
	disposed of in accordance with the country's regulations?		or backfilling as much as possible. Remaining will be disposed at the site where already confirmed by environmental officer of EMA Nyanga office
(3) Soil contamination	(a) Are there possible impacts in irrigated lands, such as salinization of soils will result? (b) Are adequate measures taken to prevent soil contamination of irrigated lands by agrochemicals, heavy metals and other hazardous substances? (c) Are any agrochemicals management plans prepared? Are any usages or any implementation structures organized for proper use of the plans?	(a) Yes (b) Yes (c) Yes	(a) (b) Occurrence rate of salinization soils by this project will not be high because such impacts are not found up to date in Block B, C, and D developed 15 years ago, and EC of water in Gairezi River measured shown low conductivity. (c) Agrochemicals management plans are prepared by AGRITEX, and direction to and monitoring of grass-route level are carried out by Extension Officers in Nyakomba.
(4) Noise and vibration	(a) Do construction sites generate noise and vibration affecting to the residents? (b) Is there a possibility of noise or vibration problem in the new irrigation system?	(a) No (b) No	(a) Some impacts are expected by construction machines, but Impact is limited because the construction sites which may cause major noise and vibrations are isolated from the residential area. (b) There is no work to cause neither noise nor vibration at operation stage. Farmers living in Block B, C, and D witnessed that distance between the irrigation facilities are well isolated from their houses so that they have never been uncomforted. Moreover, new pump stations to be constructed is 200m and 500m away from the nearest residences respectively, thus negative impact is not expected.
(5) Subsidence	(a) Is there a possibility of subsidence caused by extraction of groundwater?	(a) No	(a) No groundwater extraction is planned in the Project.
(6) Odor	(a) Are there any odor sources? Is there a possible odor problems affecting the inhabitants?	(a) No	(a) This project will not generate any odor. Also, inhabitants of Block B, C, and D witnessed no odor so far.
3. Natural environment			
(1) Protected area	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) No	(a) There is no protected area in and around the project area.
(2) Ecosystem	(a) Does the project area encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral	(a) No (b) No	(a) (b) It is confirmed by EMA that the project area doesn't encompass those area.



Category / Item	Check Item	Check	Reason / Mitigation Measure
	reefs, mangroves, or tidal flats)? (b) Does the project area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) Is there a possibility that the project will result in the loss of breeding and feeding grounds for valuable wildlife? (d) Is there any degradation of ecosystem by overgrazing such as desertification and adverse impact on growth environment of wild life? (e) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(c) No (d) No (e) N/A	(c) Breeding sites and feeding grounds of rare species are not lost by the project. Even if it's partially lost, alternative sites are available enough. (d) Grazing land is strictly controlled by bylaws of IMC, hence overgrazing will not be appeared. (e) In the aforesaid contexts, significant impacts on ecosystem are not expected in this project.
(3) Hydrometeor	(a) Is there possible impact on the hydrometeor of the Gairezi River?	(a) No	(a) No impact is expected since intake volume is small enough comparing with the one of Gairezi River.
(4) Topography and geology	(a) Do the project affect topographic or geological features of the project area?	(a) No	(a) No significant impact is expected on topographic and geological conditions, because large-scaled excavation nor blasting are not expected.
4. Social environment			
(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is expected, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly,	(a) No (b) (c) (d) (e) (f) (g) (h) (i) (j)	(a) There is no work to cause involuntary resettlement because bylaw of IMC restricts construction of houses in the irrigation scheme (irrigation land), so that nobody lives in the irrigation area. (b) (c) (d) (e) (f) (g) (h) (i) (j)

Category / Item	Check Item	Check	Reason / Mitigation Measure
	people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
(2) Living and livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the allotment will result in inequitable distribution or usurpation of land and available resources? (c) Is there a possibility that the allotments will result in inequitable distribution or usurpation of Water Permit and available resources? (d) Is there a possibility that the water use by the project will adversely affect downstream fisheries and water use? (e) Is there a possibility that water-borne or water-related diseases will be introduced? Is adequate consideration given to public health education, if necessary?	(a) Yes (b) Yes (c) Yes (d) No (e) No	(a) Though minor impacts such as traffic accident, infectious diseases, public infrastructure, etc are expected, mitigation measures to minimize those impacts are prepared and described in the EMP. (b) Water Permit will not be issued for individuals, but for a group of irrigation scheme. Also, water resources will properly be managed by WMC of IMC. Thus, inequitable distribution of benefits is not expected. (c) Beneficiaries were agreed with equal land distribution in the past grant aid scheme, same manner is expected in this project as well. (d) Adverse impacts by previous constructions in Block B, C, and D were not reported by community. Suspended matters from construction site of pump station in Block A will go down to the bottom of Gairezi River naturally before reach to the Block B during the running. (e) Malaria is common diseases even without project. Health workers of Ministry of Health Nyanga department is conducting routine patrol
(3) Cultural heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) No	(a) Religious graves and mountains for praying good rainfall are located away from the project area. Thus, no impact on cultural heritage is expected.
(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are	(a) No	(a) Although significant negative impact is not expected, RC retaining walls constructed on all sides of the stations in

Category / Item	Check Item	Check	Reason / Mitigation Measure
	necessary measures taken?		Block B and C against the flood may make a cold impression.
(5) Ethnic minorities and indigenous people	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) (b) There are no ethnic minority groups in the project area, because the area is called as Communal land in where current inhabitants have been forced to resettle in 1970s and 80s.
(6) Working condition	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country? (b) Are tangible safety considerations in place for individuals involved in the project? (c) Are intangible measures being planned and implemented for individuals involved in the project? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Yes (b) Yes (c) Yes (d) Yes	(a) Construction plan is developed in line with Zimbabwean labor law. (b) Tangible safety considerations such as establishment of road signs, barricade, employment of flagmen, etc. and regular maintenance of equipment shall be taken. (c) Day-to-day safety briefing will nurture workers. Contractors will also be obligated to hold briefing about infectious diseases such as HIV/AIDS. (d) It was confirmed in the field survey that no trouble happened between the last contractor and inhabitants in Block B, C, and D. Though serious troubles between the inhabitants and security guards to be recruited from community are not expected, traditional leaders will take necessary complaint and grievance management as necessary.
5. Others			
(1) Impact during construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment, are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Yes (b) Yes (c) Yes	(a) Following measures are considered: sprinkling water, limitation of working hours, prohibit of idling of equipment, usage of disposal sites approved by EMA (b) (c) Adverse impacts on natural and social environment is not significant, and those will be mitigated / reduced / prevented by measures described in Section 2 pollution to Section 4 Social environment in this table.

Category / Item	Check Item	Check	Reason / Mitigation Measure
(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Yes (b) Yes (c) Yes (d) Yes	(a) Monitoring based on the EMP shall be conducted in the construction phase and operation phase by Contractor and DOI respectively. (b) Items may affect minor or significant adverse impacts, i.e. rated as A-, B-, or C-, and positive impacts, i.e. rated as A+, B+, or C+, are selected as monitoring items. (c) Though monitoring system exists already, one (1) additional motorbike shall be donated by this project in order to reduce workloads of operation, maintenance and monitoring of irrigation facilities. (d) Monthly monitoring by Contractor shall centrally be controlled by the Project Management Group (PMG).

Annex 8

Monitoring Form

Monitoring Form - Construction Stage (every month)

Month & Year: _____

Reporter: _____

Date: _____

Item (rate)	Reporter	Monitoring Report	Judgment by PMG*
Air pollution	Contractor	Visual observation of dust at the construction sites: (□ No air pollution / □ Probable air pollution => describe below) Note: Attach the records of the daily visual observation.	☐ A ☐ B ☐ C
Water pollution	Contractor	Turbidity of river water tested by transparency meter in the construction sites of pump station and box culverts: (□ No water pollution / □ Probable water pollution => describe below) SS Measured:_____ mg / L* (SAZ: less than 25.0/-0.1mg / L) *Turbidity of the river water can be converted from the water transparency	☐ A ☐ B ☐ C
Waste	Contractor	Volume of disordered waste at the construction sites: (□ No waste problem / □ Probable waste problem => describe below)	☐ A ☐ B ☐ C
		Evidence of community's approval for the place and way of waste disposal (□ Yes, there is an evidence of approval / □ No evidence => describe below)	☐ A ☐ B ☐ C
Noise and vibrations	Contractor	Noise and vibration at the construction sites measured by noise tester and vibration tester: (□ Noise or vibration problems are insignificant and less than the level set by the Standards Association of Zimbabwe / □ Noise and/or vibration are beyond the said standards=> describe below) Noise: Measured Avg._____dB, Max _____ dB, Min. _____dB (SAZ: less than _____dB) Vibration: Measured Avg._____ Hz, Max _____ Hz, Min. _____ Hz (SAZ: less than _____Hz) Note: Attach the records of the daily measurement.	☐ A ☐ B ☐ C
Ecological system	Contractor	Record of illegal hunting and/or logging: (□ No illegal means / □ Illegal means found => describe below)	☐ A ☐ B ☐ C

19

Item (rate)	Reporter	Monitoring Report	Judgment by PMG*
Water usage	District Agr.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Existing social infrastructures & services	Contractor	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
HIV/AIDS infection	Contractor	Record of briefing to the workers: (□ Briefing provided / □ No briefing provided => describe below)	☐ A ☐ B ☐ C
		Record of briefing to the grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Accidents	Contractor	Record of accidents: (□ No accident / □ Accidents occurred => describe below)	☐ A ☐ B ☐ C
Water right for the new water usage	MAMID/ ZINWA	Provisional Water right permit letter issued by ZINWA: (□ Water right is permitted / □ Not permitted yet => describe below) Note: Official version of the permit will be issued just after or about completion of the construction.	☐ A ☐ B ☐ C
		Water use permit letter issued by organizations concerned in Mozambique: (□ Water use is permitted / □ Not permitted yet => describe below)	☐ A ☐ B ☐ C

Remarks: Judgment by Project Management Group (PMG): "A" = Confirmed as no problem; "B" = To be re-examined; "C" = To be solved

Note:

- The reporters (Contractor, Ministry of Agriculture and Mechanization Development: MAMID, and Zimbabwe National Water Authority: ZINWA) shall fill the monitoring form every month, and submit it to the Project Management Group (PMG).
- The PMG will evaluate the report with support of the related agencies. If there are items to be re-examined, the PMG shall inform the reporters to make detailed survey on the items. In case of any serious problems occurred, the PMG shall take countermeasure to solve the problems in cooperation with related agencies.

- **Monitoring Form - Operation Stage (every year)**

Duration: _____

Reporter: _____

Date: _____

Item (rate)	Reporter	Monitoring Report	Judgment by PMG*
Soil pollution	Extension Staff, assigned in Nyakomba irrigation scheme, Dept. of AGRITEX	Record of the way of fertilization and spraying of the pesticide etc in the irrigation scheme (□ As per recommendation of MAMID / □ Higher/Lower than the one recommended by MAMID => describe below) Measured Data_____ Baseline Data (as of):_____	☐ A ☐ B ☐ C
Noise and vibrations	Water belief/ Operator of pump, Mazowe Catchment office, ZINWA	Record of abnormal noise and/or vibration (□ No abnormal noise nor vibration / □ Found abnormal noise and/or vibration=> describe below) Measured Data_____ Baseline Data (as of):_____	☐ A ☐ B ☐ C
Ethnic minority, indigenous people	Traditional Leaders, Extension Staff, assigned in Nyakomba irrigation scheme, Dept. of AGRITEX	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Land use & utilization of local resources	Traditional Leaders, Extension Staff, assigned in Nyakomba irrigation scheme, Dept. of AGRITEX, EMA Nyanga District Office	Record of improper land use especially in the dry land: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Social institutions	Irrigation Management Committee, Extension Staff, assigned in Nyakomba irrigation scheme, Dept. of AGRITEX DOI, Manicaland Provincial office, ZINWA Mazowe catchment office	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
		Availability of By-law of IMC in Block A (□ Available / □ Not Available => describe below)	☐ A ☐ B ☐ C
		Selection criteria and process of IMC committee member (□ Fair enough / □ Not fair => describe below)	☐ A ☐ B ☐ C

Item (rate)	Reporter	Monitoring Report	Judgment by PMG*
		Gap between contribution amounts for the payment of water/electricity fee recorded by casher of IMC, and record of invoice/ cash/bank transaction issued by ZINWA and ZESA respectively (□ Not significant / □ Significant => describe below)	☐ A ☐ B ☐ C
Scenery	IMC, Block B, and C ZINWA Mazowe catchment office	Painting on the retaining wall around the pump stations in Block B, and C (□ Painted well / □ Not painted yet => describe below)	☐ A ☐ B ☐ C
Work environment	IMC especially Maintenance Committee (MC) and Water Management Committee (WMC)	Record of accidents happened during the operation and/or maintenance works: (□ No accident / □ Accident happened => describe below)	☐ A ☐ B ☐ C
Water right for the new water usage	MAMID, ZINWA	Water right permit letter issued by ZINWA: (□ Water right is permitted / □ Not permitted yet => describe below) Note: This is not provisional version.	☐ A ☐ B ☐ C

Remarks: Judgment by Project Management Group (PMG): "A" = Confirmed as no problem; "B" = To be re-examined; "C" = To be solved

Note:

- The reporters (Department of Irrigation, AGRITEX, ZINWA, ZESA, IMC, Traditional leaders) shall report the monitoring result to the Department of Irrigation, MAMID. Then, DOI shall combine the data collected and fill the monitoring form every month, and submit it to the Project Management Group (PMG).
- The PMG will evaluate the report with support of the related agencies. If there are items to be re-examined, the PMG shall inform the reporters to make detailed survey on the items. In case of any serious problems occurred, the PMG shall take countermeasure to solve the problems in cooperation with related agencies.

Annex 9

Major Undertakings to be Taken by Each Government

NO	Items	To be covered by the Grant	To be covered by Recipient side
1	To secure land necessary for the implementation of the Project To distribute land to beneficiaries in proper manner		●
2	To construct following facilities		
	1) The irrigation facilities	●	
	2) The flood protection facilities	●	
	3) The farm road	●	
3	To provide facilities for distribution of electricity, water supply and other incidental facilities necessary for the implementation of the Projects		
	1) Electricity		
	a. The distributing power line to the site and installation of transformer		●
	b. The internal wiring within the site	●	
	c. The main circuit breaker	●	
	2) Communication System	●	●
	3) Project Equipment	●	●
4	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
5	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
6	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services (in case of tax exemption is applicable) be exempted / (in case refunding is applicable) be borne by the Authority without using the Grant		●
7	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
8	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract		●
9	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		●
10	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and installation of the equipment		●
11	To give due environmental and social consideration in the implementation of the Project		●

(B/A: Banking Arrangement, A/P: Authorization to pay)

Annex 10

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX
20XX, Month

Organization Information

Authority (Signer of the G/A)	Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Executing Agency	Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____
Line Ministry	Person in Charge _____ (Division) _____ Contacts Address: _____ Phone/FAX: _____ Email: _____

Outline of Grant Agreement:

Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____
Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:

1: Project Description

1-1 Project Objective

1-2 Necessity and Priority of the Project

- Consistency with development policy, sector plan, national/regional development plans and demand of target group and the recipient country.

1-3 Effectiveness and the indicators

- Effectiveness by the Project

2: Project Implementation

2-1 Project Scope

Table 2-1-1a: Comparison of Original and Actual Location

Location	**Original:** *(M/D)* **Attachment(s):Map**	**Actual:** *(PMRand PCR)* **Attachment(s):Map**

Table 2-1-1b: Comparison of Original and Actual Scope

Items	Original	Actual
(M/D) 'Soft component' shall be included in 'Items'.	*(M/D)*	*(PMR and PCR)* Please state not only the most updated schedule but also other past revisions chronologically. All change of design shall be recorded regardless of its degree.

2-1-2 Reason(s) for the modification if there have been any.

(PMR and PCR)

2-2 Implementation Schedule

2-2-1 Implementation Schedule

Table 2-2-1: Comparison of Original and Actual Schedule

Items	Original		Actual
	DOD	G/A	
[M/D] 'Soft component' shall be stated in the column of 'Items'. Project Completion Date*	*(M/D)*		*(PMR,PCR)* As of (Date of Revision) Please state not only the most updated schedule but also other past revisions chronologically.

*Project Completion was defined as _____ at the time of G/A.

2-2-2 Reasons for any changes of the schedule, and their effects on the project.

(PMR and PCR)

2-3 Undertakings by each Government

2-3-1 Major Undertakings

See Attachment 2.

2-3-2 Activities

See Attachment 3.

2-3-3 Report on RD

See Attachment 4.

2-4 Project Cost

2-4-1 Project Cost

Table 2-3-1 Comparison of Original and Actual Cost by the Government of Japan
(Confidential until the Tender)

Items			Cost (Million Yen)	
	Original	Actual	Original	Actual
Construction Facilities (or Equipment)	'Soft component' shall be included in 'Items'.			Please state not only the most updated schedule but also other past revisions chronologically.
Consulting Services	- Detailed design -Procurement Management -Construction Supervision			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

Table 2-3-2 Comparison of Original and Actual Cost by the Government of XX

Items			Cost (Million USD)	
	Original	Actual	Original	Actual
	'Soft component' shall be included in 'Items'.			Please state not only the most updated schedule but also other past revisions chronologically.
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = (local currency)

2-4-2 Reason(s) for the wide gap between the original and actual, if there have been any, the remedies you have taken, and their results.

(PMR, PCR)

2-5 Organizations for Implementation

2-5-1 Executing Agency:

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original: *(M/D)*

Actual, if changed: *(PMR and PCR)*

2-6 Environmental and Social Impacts

Report based on the agreed environmental checklist and monitoring form (See Attachment 4)

3: Operation and Maintenance (O&M)

3-1 O&M and Management

- Organization chart of O&M
- Operational and maintenance system (structure and the number ,qualification and skill of staff or other conditions necessary to maintain the outputs and benefits of the project soundly, such as manuals, facilities and equipment for maintenance, and spare part stocks etc)

Original: *(M/D)*
Actual: *(PCR)*

3-2 **O&M Cost and Budget**
- The actual annual O&M cost for the duration of the project up to today, as well as the annual O&M budget.

Original: *(M/D)*

4: Precautions (Risk Management)

- Risks and issues, if any, which may affect the project implementation, outcome, sustainability and planned countermeasures to be adapted are below.

Original Issues and Countermeasure(s): *(M/D)*	
Potential Project Risks	Assessment
1.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
2.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
3.	Probability: H/M/L
(Description of Risk)	Impact: H/M/L
	Analysis of Probability and Impact:

	Mitigation Measures:
	Action during the Implementation:
	Contingency Plan (if applicable):
Actual issues and Countermeasure(s)	
(PMR and PCR)	

5: Evaluation at Project Completion

5-1 Overall evaluation
Please describe your evaluation on the overall outcome of the Project.

(PCR)

5-2 Lessons Learnt and Recommendations
Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

(PCR)

Attachment
1. Project Location Map
2. Undertakings to be taken by each Government
3. Monthly Report
4. Report on RD
5. Monitoring report on environmental and social considerations
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (Completion Report Only)

Annex 11

Obligation of the Recipient Country

Items	Obligation	Schedule	Responsibility Organization	Expenses (US$)	Budget Preparation
1) Securing land for facilities	Zimbabwe side should acquire the necessary land smoothly.	Before beginning of construction works	- MAMID - MLGPWNH - Nyanga Rural District Council	None	None
2) Equal land distribution	Zimbabwe side is responsible to land reclamation, leveling and distribution equally in Block A.	Immediately after completion of construction works	- DOI	27,000	DOI
3) Environmental certificate	DOI is required to prepare EMP and submit it to EMA for the approval.	Before E/N	- DOI	None	None
4) Commissions for B/A and A/P	MAMID should open an account in the name of GOZ in the Bank in Japan. GOZ should bear an advising commission of an Authorization to Pay and payment commissions to the Bank	Immediately after G/A, B/A should be conducted. In accordance with payment schedule of Consultant and Contractor, payment commissions will be paid by GOZ.	- MAMID	28,000	DOI
5) O&M agreement	1. The stakeholders are required on the basis of the Water Act in Zimbabwe to conclude an agreement for O&M and the property in order to continue proper O&M. 2. Pump station, head race and farm pond should be handed over to ZINWA officially.	1. Before beginning of construction works 2. Immediately after completion of construction works	1. DOI, IMC and ZINWA 2. MAMID and ZINWA	None	None
6) Securing power for pump station	1. Cable extension and installation of transformer for Block A 2. Installation of transformer for Block B 3. Installation of transformer for Block C 4. Cable extension and installation of transformer for Block D	During construction stage	- DOI	1. 65,000 2. 42,000 3. 42,000 4. 24,000	DOI
7) Refund of VAT	MAMID is requested to promote procedure for refunding of VAT through writing letter to MFED and is requested to prepare the budget for refund of VAT.	March, 2018	- MAMID - MFED - ZIMRA	381,000	DOI
8) Assistance to Exempt Import Tax	DOI is requested to assist import tax exemption by submission of letter to ZIMRA which is required import tax exemption.	During construction stage	- DOI - MAMID - ZIMRA	None	None

Annex 12

Operation and Maintenance Cost borne by Zimbabwe Side

O&M cost for pump irrigation consist of i) canal maintenance cost, ii) water charge, iii) electric charge, iv) pump O&M cost as detailed in ANNEX 14 in the Draft Final Report. Total O&M cost is 515 US$ per farmer/year in average i.e., 43 US$/month as shown below.

Block	A	B	C	D	Total
Beneficial area (ha) (1)	146	128	115	191	580
Number of farmer (nos) (2)	228	128	165	239	760
Canal maintenance cost (3)	4,818 US$	4,224 US$	3,795 US$	6,303 US$	19,140 US$
Water charge /year (4)	11,415 US$	10,329 US$	9,543 US$	14,904 US$	46,190 US$
Electric charge/year (5)	32,525 US$	60,690 US$	64,054 US$	60,656 US$	217,925 US$
Pump O&M cost /year (6)	21,339 US$	31,999 US$	31,951 US$	22,937 US$	108,226 US$
Total O&M cost /year (7) = (3) + (4) + (5) + (6)	70,097 US$	107,242 US$	109,343 US$	104,800 US$	391,481 US$
Total O&M cost /ha/year (8) = (7) / (1)	480 US$	838 US$	951 US$	549 US$	675 US$
Total O&M/ cost /farmer / year (9) = (7) / (2)	307 US$	838 US$	663 US$	438 US$	515 US$

Annex 13

Responsibilities Sharing for Irrigation Facilities

Facility	Property	Responsible Body for O&M	Remarks
Pump station	ZINWA	ZINWA	Support of DOI should be required
Head race	ZINWA	ZINWA	Ditto
Farm Pond	ZINWA	ZINWA	Ditto
Farm land	Communal	IMC	Ditto
Distribution pipeline	MAMID	IMC	Ditto
Branch canal (open canal)	MAMID	IMC	Ditto
Canal appurtenant facility	MAMID	IMC	Ditto
Drainage canal	MAMID	IMC	Ditto

Annex 14

Agreement of Land Equally Land Distribution

EQUAL LAND DISTRIBUTION AGREEMENT FOR NYAKOMBA IRRIGATION SCHEME BLOCK A.

ON THIS DATE 19 DECEMBER 2014, WE AS BLOCK A FARMERS AGREED TO SHARE THE LAND EQUALLY AMONG THE BLOCK A BENEFICIARIES AFTER THE COMPLETION OF THE BLOCK CONSTRUCTION.

THE LIST OF THE BENEFICIARIES IS ATTACHED.

VILLAGE HEAD NAME MEINRAD DANDADZI SIGNATURE Dandadzi

IRRIGATION MANAGEMENT COMMITTEE CHAIRPERSON

NAME PAUL DANDADZI SIGNATURE Paul

DISTRICT HEAD IRRIGATION DEPARTMENT.

NAME KAERE21 GEORGE SIGNATURE

DISTRICT HEAD AGRITEX

NAME PHILIPA RUSAMBWA SIGNATURE

IRRIGATION MANAGEMENT COMMITTEE CHAIRPERSON.

NAME PAUL DANDADZI SIGNATURE Paul

MINISTRY OF LOCAL GOVERNMENT, PUBLIC WORKS AND NATIONAL HOUSING.

NAME BOOZA1 IRENE SIGNATURE.

NYANGA RURAL DISTRICT COUNCIL.

NAME ZENDA KENNETH SIMBI SIGNATURE.

MINISTRY OF LANDS.

NAME MUREKACHIRO BERNARD SIGNATURE. Bernard

DISTRICT ADMINISTRATOR.

NAME BOOZA1 IRENE SIGNATURE.

PROVINCIAL ADMINISTRATOR.

NAME CHIRINGA COSMAS SIGNATURE.

Annex 15

Provisional Water Permit

添付資料7

Mazowe Catchment
3rd Floor Old Mutual House
Speke Ave / S Nujoma
P O Box CY 715, Causeway,
Harare
Tel: 700953/ 761465/6/ 2919224
Fax: 707850
Email: mazowe@ziwa.co.zw

29 December 2014

Ministry of Agriculture, Mechanization and Irrigation Development
Department of Irrigation
Kaguvi Building
Harare.

ATTN: S. KADAIRA

RE: PROVISIONAL IRRIGATION WATER ALLOCATION FOR NYAKOMBA IRRIGATION SCHEME BLOCK A (MAP No 1732D4 & 1733C3, GAIREZI RIVER GRID REFERENCE 965 283)

The above subject matter refers,

This letter serves to confirm that Nyakomba irrigation Scheme has applied for a permit to abstract water from Gairezi River to irrigate 140ha 1,960ML/Annum.

Having considered their proposed cropping calendar and the available water for irrigation, the application request was provisionally granted pending issuance of the final certificate in terms of the Water Act (Chapter 20:24).

Zimbabwe National Water Authority
(ZINWA)
MAZOWE CATCHMENT
29 DEC 2014
CATCHMENT MANAGER
P.O. BOX CY 715, CAUSEWAY
TELEPHONE:761465/71

F.G. MANZIRA
CATCHMENT MANAGER, MAZOWE.

cc: KAIREZI SUBCATCHMENT COUNCIL.

Head Office
8th floor Old Mutual Centre
3rd Street / Jason Moyo Avenue
P O Box CY 617
Causeway, Harare
Tel: 04 797 610-3/ 04 797 604-6
Fax: 04.796980 / 797602

Sanyati Catchment
P O Box 554
Gweru
Tel: 054 222511-4
Fax: 054 220168

Runde Catchment
P O Box 250
Masvingo
Tel: 039 263690/262950-2
Fax: 039 263972

Save Catchment
P O Box 210
Mutoko
Tel: 020 60926
Fax: 020 62848

Gwayi Catchment
P O Box 566
Bulawayo
Tel: 09-69361-3/67628
Fax: 09-77109

Mzingwane Catchment
P O Box 2008
Bulawayo
Tel: 09 885191/2/6-8
Fax: 09 882865

Manyame Catc
P O Box CY 7
Causeway
Harare
Tel: 738784
Fax: 73878

Annex 16

Notification to Mozambique about Water Intake

All correspondences should be addressed

"THE SECRETARY"

Tel: +263 4 700596-8

Ministry of Environment,
Water and Climate.
P.O Box CY 7767
Causeway,
HARARE

ZIMBABWE

MIN. OF ENVIRONMENT, WATER & CLIMATE
12 JUN 2015
11th Floor, Kaguvi Building
Tel: 04 701631-3 / 701641-5
REGISTRY

11 June 2015

The National Director
National Directorate of Water Maputo
Maputo
Republic of Mozambique

Attention: Ms Suzana Saranga.

REF: NOTIFICATION ON THE REHABILTATION AND EXPANSION OF NYAKOMBA IRRIGATION SCHEME.

The above – mentioned matter refers.

The Government of Zimbabwe with assistance from the Japanese Government is planning to rehabilitate blocks B, C and D of the Nyakomba Irrigation Scheme which were affected by the 2005 floods and proceed with the completion of blocks A and E which were initially started in 2002. The Nyakomba irrigation Scheme is a planned measure which started in 1997. The proposed expansion of Nyakomba Irrigation Scheme Blocks A and E and the existing Blocks B, C, D are situated in the Saunyama Communal Area of Nyanga District in Manicaland Province. Water for irrigation will be abstracted from the Gaerezi River which flows into Mozambique.

When all the blocks are operational the irrigation scheme will abstract about one thousand four hundred (1 400) litres per second from the Gaerezi River. This water is enough to irrigate about seven hundred (700) hectares of irrigable land with eight hundred and sixty (860) beneficiaries.

We therefore want to notify you of the intention by the Government of Zimbabwe to rehabilitate and expand the irrigation scheme which was started in 1997 with assistance from the Japanese Government.

T. Mutazu (Mr).
Director Water Resources Planning and Management

Cc: Prof. Z. Phiri - The Executive Secretary Zambezi Watercourse Commission

35

Annex 5: Soft Component Plan

Republic of Zimbabwe
Project for Irrigation Development for Nyakomba Irrigation Scheme
Soft Component Plan

May, 2015

NTC International Co., Ltd.

Contents

1. Background of Softcomponent

This softcomponent is composed of following three (3) outcomes.

（1） Guidance of maintenance of irrigation facilities

（2） Guidance of maintenance and repairing of pump facilities

（3） Promotion of contract farming

Outcomes 1: Guidance of maintenance of irrigation facilities

In Block A, newly development area, a part of irrigation canals have been constructed by the farmers' participation under self-supporting effort by the Government of Zimbabwe with the length of 3,660m as shown in the Figure below.

Figure Existing Irrigation Canal in Block A

However, since these existing canals constructed by the Zimbabwe side were only small portions not covering all the area of Block A, length of existing canal shall be extended to be supplied irrigation water in all the area of Block A. In addition, crack of concrete, insufficient canal cross section and defect of drop are found in the existing canals. Therefore, improvement of existing canals shall be required. Two alternatives are there, one is removal of existing canal and new construction and another is repairing of existing canals. Comparing these, repairing will be recommended because of accumulation of repairing skill in IMC through the technical transfer and reduction of the construction cost. Accordingly, improvement of existing canals will be implemented by the softcomponent for the purpose of guidance of maintenance of irrigation facilities.

In the softcomponent, repairing of canal crack, construction of drop and reinforcement of canal embankment will be implemented under the participation of farmers. Through these activities, the skill for maintenance of irrigation facilities will be acquired by IMC.

Since the existing canals in Block B, C and D which were constructed by past Grant Aid Project includes the portion to be repaired, IMC in Block B, C and D should participate in the softcomponent in order to acquire the skill for maintenance and repairing of canals through the practices. After complete of softcomponent, irrigation canal will be maintained properly by IMC and farmers in Block B, C and D respectively based on the skill acquired by participation of softcomponent.

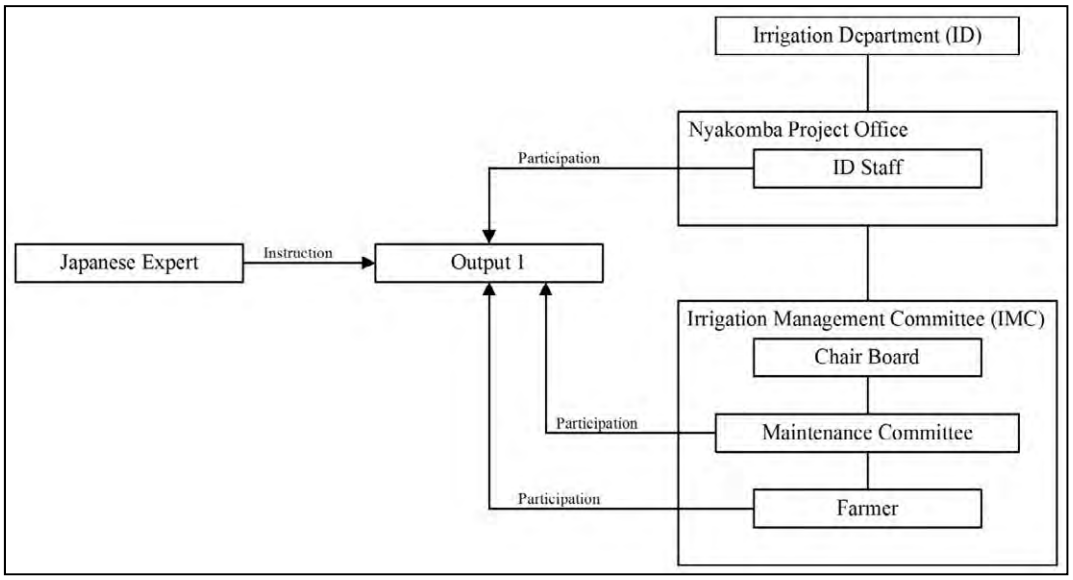


Figure Implementation Structure for Outcome 1

Outcome 2: Guidance of maintenance and repairing of pump facilities

As big flood occurred in 2006 and flood water intruded into basement of pump station, pump facilities have been affected big damages for a long time. After flood, at least one pump among three pumps recovered and functioned owing to big effort by the Government of Zimbabwe. However, staff of ZINWA which has responsible organization for operation and maintenance of pump station did not provide pump manuals, drawing and necessary document in the sites and since skill and knowledge of ZINWA staff about pump mechanics and pump electrics were not enough, recovery works for pump mechanics and electrics were insufficient.

If mechanical engineer and electrical engineer in ZINWA and/or DOI had enough knowledge concerning repairing pumps, earlier restoration and a wide range of restoration of pump station by Zimbabwe side might be realized. In addition, the knowledge of ZINWA for continuous maintenance for pump facilities such as parts replacement was not provided. In order to cope with these problems, to acquire the skill for repairing of pump facilities and to acquire the skill for proper maintenance of pump facilities, guidance of maintenance and repairing of pump facilities will be performed in the softcomponent.

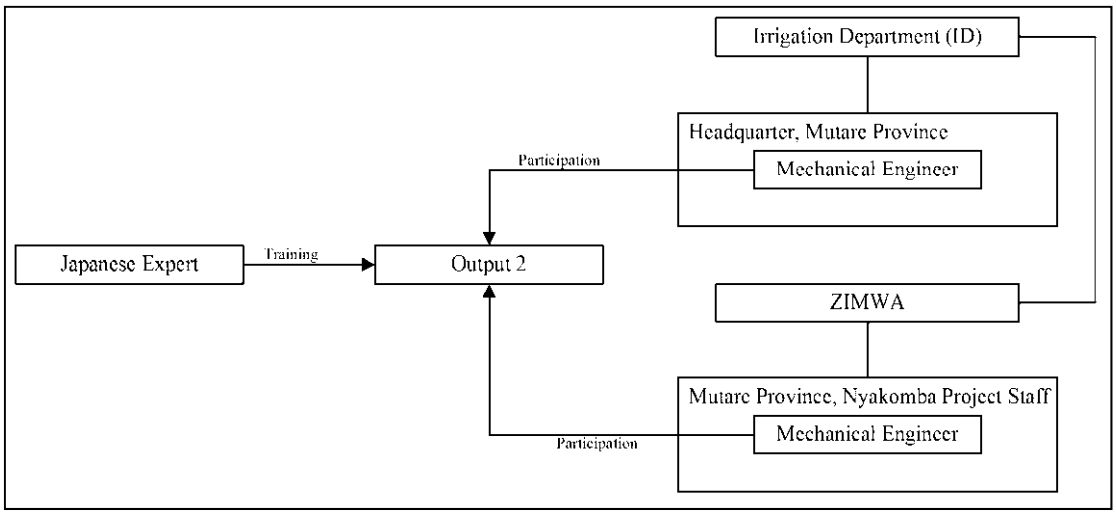


Figure Implement Structure for Outcome 2

Outcome 3: Promotion of contact farming

The contract farming is promoting as the national agricultural policy in Zimbabwe and the contract farming such as chili, tobacco and paprika is conducting in Nyakomba area. Since initial inputs such as seeds and fertilizer were provided by contract companies, providing initial input might bring about big

opportunities for farmers trying irrigation agriculture who are anxious about the ensuring the expenses for initial input and expansion of irrigation agriculture will be expected.

In Nyakomba area, extension officers of AGRITEX are functioning as a mediator between contract companies and beneficiary farmers and simultaneously extension officer are conducting farming guidance to farmers directly. Therefore, in case numbers of contract farmers will increase, outcomes of contract farming will be expected to contribute promoting expansion of irrigation agriculture. Accordingly, softcomponent will be conducted to increase the number of contract farmer in Nyakomba area and to introduce new contract farming company to marketing board and extension officer. Finally, beneficiary farmers are aiming to profitable agriculture with the increase of number of contact famers and contract crops.

The expansion of contract farming will bring about introducing profitable crops and affordability the operation and maintenance cost for pump irrigation which will be normally more expensive comparing with gravity irrigation. The contract farming will facilitate to introduce new irrigation agriculture because of not paying the initial input cost, which will enhance the utilization rate of irrigation facility during early stage.

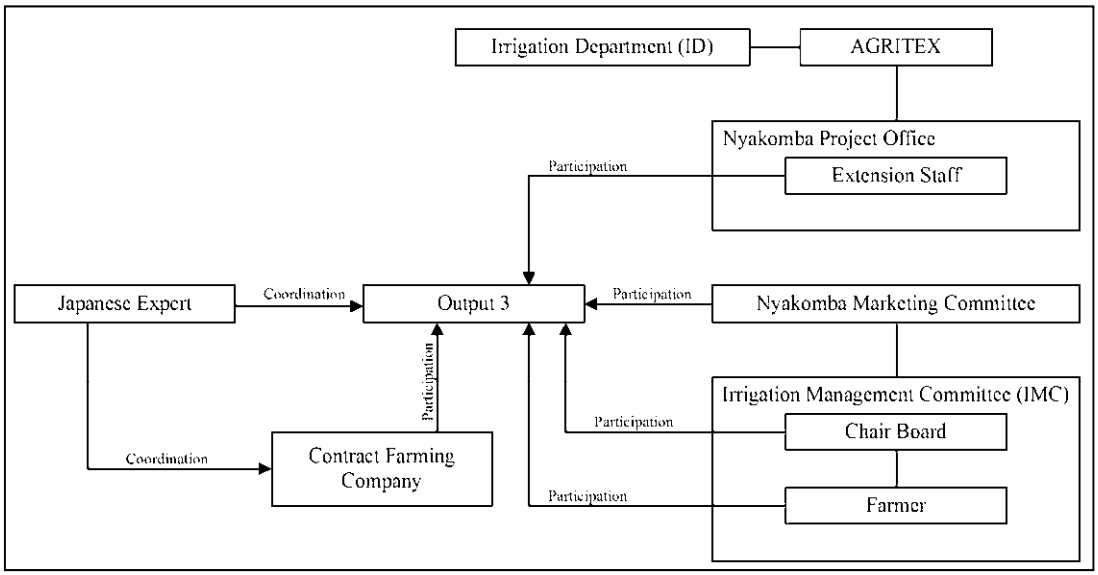


Figure Implementation Structure for Outcome 3

2. Objective and Outcome of Softcomponent

Objective and outcome of softcomponent are as follows.

Softcomponent	Objective	Outcome
Outcome 1 Guidance of maintenance of irrigation facilities	Proper maintenance of irrigation facilities beyond farmpond by IMC in Block A to D will be continued.	IMC member in Block A to D acquire the skill and knowledge for repairing of irrigation canals beyond farm pond.
Outcome 2 Guidance of maintenance and repairing of pump facilities	Proper operation and maintenance of pump facility by staff of ZINWA and DOI will be continued.	Staffs of ZINWA which is responsible body of O/M for pump station and engineers of DOI acquire the skill and knowledge for periodical maintenance of pump facilities and repairing and identifying failure cause of pump facilities.
Outcome 3 Promotion of contract farming	Number of contract farmers and number of contract crops will increase.	Number of contract farmers will increase XX families to XX families. Number of contract crops will increase from XX to XX. (Indicator will be set before commence of softcomponent.)

3. Confirmation Method for Achievement of Outcome

Softcomponent	Outcome	Confirmation method for achievement of outcome
Outcome 1	IMC member in Block A to D acquire	Learning level for repairing of irrigation canals

Guidance of maintenance of irrigation facilities	the skill and knowledge for repairing of irrigation canals beyond farm pond.	will be confirmed through questionnaire survey after training.
Outcome 2 Guidance of maintenance and repairing of pump facilities	Staffs of ZINWA which is responsible body of O/M for pump station and engineers of DOI acquire the skill and knowledge for periodical maintenance of pump facilities and repairing and identifying failure cause of pump facilities.	Learning level will be measured through practical tests. Learning level for maintenance skill and repairing skill for pump facilities will be confirmed through questionnaire survey after training.
Outcome 3 Promotion of contract farming	Number of contract farmers will increase XX families to XX families. Number of contract crops will increase from XX to XX. (Indicator will be set before commence of softcomponent.)	The contents of discussion between contract company and marketing committee will be recorded. From the records of discussion, progress degree will be confirmed.

4. Activity of Softcomponent (Input)

Outcome 1: Guidance of maintenance of irrigation facilities

Outcome	Consultant		Activities by Zimbabwe side	
	Input	Activities	DOI	IMC
IMC member in Block A to D acquire the skill and knowledge for repairing of irrigation canals beyond farm pond.	- Japanese: 5.0 M/M - Construction materials: Provision of cement, reinforcement bar, coarse aggregate, fine aggregate, shovel, etc.	- Repairing work of canal (180m) - Embankment of canal (3,400m) - Canal side wall rasing (10m) - Construction of division works (5 places) - Construction of drop (54 places) - Guidance for repairing and construction the structure mentioned above	- Staff of DOI: 95 man-day - Coordination to IMC and confirmation of training outcome	- IMC and Farmers: 5 month×30days / 1.30×10 persons = 1,150 man-day - Practice of repairing work of existing canal in Block A

Outcome 2: Guidance of maintenance and repairing of pump facilities

Outcome	Consultant		Activities by Zimbabwe side
	Input	Activities	Government staff
Staffs of ZINWA which is responsible body of O/M for pump station and engineers of DOI acquire the skill and knowledge for periodical maintenance of pump facilities and repairing and identifying failure cause of pump facilities.	- Japanese: 0.5 M/M - Execution of training, - Provision of trainer, training place, training materials	- Staff of ZINWA and DOI will be dispatched to Japan and training will be executed in Japan by Japanese trainer	- ZINWA staff: 2 persons - DOI staff : 2 persons - Trainee will acquire the skill and knowledge for mechanics and electrics of pump facilities to maintain and operate pump facility properly

Training Schedule (Tentative)

Date		Contents of training		Place
		Morning	Afternoon	
1	S		Leave Harare	
2	S	Moving	Arriver at Japan	
3	M	Orientation	Lecture on pump (explanation of O/M manuals for pump facility)	Pump manufacturer
4	T	Lecture on pump facilities - Body of pump	Lecture on pump facilities - Valve, vacuum pump, etc.	Pump manufacturer
5	W	Lecture on pump facilities - Auxiliary equipment	Lecture on pump facilities - Auxiliary equipment	Pump manufacturer
6	T	Training in factory	Same as left	Pump manufacturer

		- Practice for maintenance activities		
7	F	Lecture on electric equipment	Same as left	Electric manufacturer
8	S	Holiday		
9	S	Holiday	Moving	
10	M	Practice in motor factory	Same as left	Electric manufacturer
11	T	Moving	Practice in valve factory	Valve manufacturer
12	W	Practice in valve factory	Moving	Valve manufacturer
13	T	Study tour in irrigation scheme	Same as left	Site of irrigation scheme
14	F	Wrap up discussion	Same as left	Pump manufacturer
15	S	Leave Japan	Arrive at Harare	

Since the training includes various contents, Zimbabwe engineer inviting to Japan is more economical comparing with Japanese trainer dispatching to Zimbabwe. Simultaneously, from the aspect of ensuring the quality of training, the training will be executed in Japan. During the period of training, one Japanese consultant should attend and participate in the training and actually 0.5 man-month of work period of Japanese consultant should be required.

Outcome 3: Promotion of contract farming

Outcome	Consultant		Activity of Zimbabwe side	
	Input	Activities	Governmental staff	Marketing committee
Number of contract farmers will increase XX families to XX families. Number of contract crops will increase from XX to XX. (Indicator will be set before commence of softcomponent.)	- Japanese: 0.27 M/M	- Introduce new contract farming company to marketing committee and extension officer	- Extension officer: Mediating between contract farming company and meriting committee - DOI: Listing new contract farming company	- Increase contract farmers - To promote an agreement with the new contract farming company and to increase the contract farming crops

Calculation of working period

Since one Japanese consultant implementing outcome 1 together with outcome 3, shortening for arrangement with Zimbabwe side and preparation time, work efficiency and reduction of the cost for the air flight will be ensured.

Work item	Duration
Listing new proposed contract farming company	1 day
Interview survey with proposed contract farming company	2 days
Introducing new contract farming company to extension worker and marketing committee	3 days
Monitoring	2 days
Total	8 days

As duration of eight (8) days of working time is proposed as mentioned table above, 0.27 man-month of work period of Japanese consultant should be required.

5. Procurement of Implementation Resources for Softcomponent

Outcome 1: Guidance of maintenance of irrigation facilities

The existing canals in Block A were constructed by farmers' participation under the instruction of DOI.

Therefore, the local resource of Zimbabwe will be utilized in the softcomponent with the ownership of DOI and the participation of IMC farmers under the guidance of Japanese consultant engineer to acquire the skill for maintenance and repairing of canals

Outcome 2: Guidance of maintenance and repairing of pump facilities

Since it is difficult to utilize the local resource of Zimbabwe, the training for maintenance and repairing of pump facility will be executed in Japan to utilize Japanese engineer of pump manufacturer.

Outcome 3: Promotion of contract farming

AGRITEX extension officer will coordinate to existing contract farming companies. DOI should list up proposed contract farming company. Negotiation to new contract farming company will be carried out by the extension officer. This softcomponent will be implemented utilizing local resources based on the involvement of the extension officer.

6. Implementaion Schedule

Outcome 1: Guidance of maintenance of irrigation facilities

This softcomponent will be implemented from June to October, 2017 during dry season on the later of the Project.

Outcome 2: Guidance of maintenance and repairing of pump facilities

This softcomponent will be implemented after installation of one plane of pump faculty before installation of another pump facility. Period of training will be planed 15 days in total including in 10 days for training, 2 days for domestic traveling and 3 days for international traveling.

Outcome 3: Promotion of contract farming

This softcomponent will be implement on the later of the Project.

Implementation schedule of softcomponent is as follows.

Implementaion Schedule of Softcomponent

Year	2017												2018		
Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1) Guidance of maintenance of irrigation facilities						■	■	■	■	■					
2) Guidance of maintenance and repairing of pump facilities							□								
3) Promotion of contract farming											■				

Note: ■ : Execution in Zimbabwe, □: : Execution in Japan, □ : Rainy season

7. Submission of the Result

Overall

- Softcomponent completion report

Outcome 1: Guidance of maintenance of irrigation facilities

- Manual of maintenance and repairing for small scaled irrigation facilities

Outcome 2: Guidance of maintenance and repairing of pump facilities
- Training report

Outcome 3: Promotion of contract farming
- List of contract farming company before and after softcomponent, list of contract farming crops and list of contract farming famers

8. Cost of Softcomponent

The cost for softcomponent is estimated as 18.8 million JPY.

Items	Quantity	Unit Price (1,000 JPY)	Amount (1,000 JPY)
(1) Guidance of maintenance of irrigation facilities			
1. Direct consultant expenses			3,340
1) Irrigation facility / Farming agriculture (4 class)	5.00 M/M	668	(3,340)
2. Direct expenses			7,189
Traversing cost, perdiem and accommodation	1 set		(2,268)
Expenses of vehicle	1 set		(103)
Local employee cost	1 set		(698)
Construction materials	1 set		(4,120)
3. Indirect cost			4,275
Overhead (90%)	1 set		(3,006)
Technical expenses (20%)	1 set		(1,269)
Sub-total			**14,804**
(2) Guidance of maintenance and repairing of pump facilities			
1. Direct consultant expenses			334
1) Pump facility (3 class)	0.50 M/M	820	(334)
2. Direct expenses			2,492
Traversing cost, perdiem and accommodation	1 set		(2,360)
Lecturer fee	1 set		(132)
3. Indirect cost			428
Overhead (90%)	1 set		(301)
Technical expenses (20%)	1 set		(127)
Sub-total			**3,254**
(3) Promotion of contract farming			
1. Direct consultant expenses			180
1) Irrigation facility / Farming agriculture (4 class)	0.27 M/M	668	(180)
2. Direct expenses			284
Traversing cost, perdiem and accommodation	1 set		(109)
Expenses of vehicle	1 set		(132)
Local employee cost	1 set		(43)
3. Indirect cost			230
Overhead (90%)	1 set		(162)
Technical expenses (20%)	1 set		(68)
Sub-total			**694**
(4) Total			**18,752**

9. Obligation of Recipient Country

（1）Guidance of maintenance of irrigation facilities
- DOI should assign the staff of DOI to participate in implementation of training. The staff of DOI should arrange trainee from IMC to participate in training and schedule.

（2）Guidance of maintenance and repairing of pump facilities
- DOI should select the trainee from the actual person engage in the pump operation and

maintenance work.

（3）Promotion of contract farming

- DOI should prepare the list of all contract farming companies and proposed contract farming companies which are interested in Nyakomba irrigation scheme. Negotiation to contract farming companies will be performed by the extension officer. The extension officer tougher with marketing committee should promote contract farming to beneficiary farmers.

10. Implementation Plan

Outcome 1: Guidance of maintenance of irrigation facilities

（1）Work in Zimbabwe

- Implementation period for repairing canal, construction of drop and diversion work will be required 5 months.

Outcome 2: Guidance of maintenance and repairing of pump facilities

（1）Work in Japan

- As shown in Training Schedule (Tentative) in page of Annex 5-5, total days of training will be 15 days and training days in Japan will be 10 days.
- Work in Japan (10 days, 0.5 M/M)

Outcome 3: Promotion of contract farming

（1）Work in Zimbabwe

- Working days requires 8 days, 0.27 M/M as shown in the table in the page of Annex 5-6.

Annex 6: Letter Issued by EMA Regarding Environmental and Social Conditions

ENVIRONMENTAL MANAGEMENT AGENCY

All communications should be addressed to "The Director General"
Makombe Complex, Block I,
Harare Street / Herbert Chitepo Avenue,
P.O. Box CY 385, Causeway, Harare, Zimbabwe
Telephone (04) 705671/3 /705861/3 Fax 783123

E-mail: ema@ema.co.zw,

REF: 23/1/50
XR 17/1/13
09 December 2014

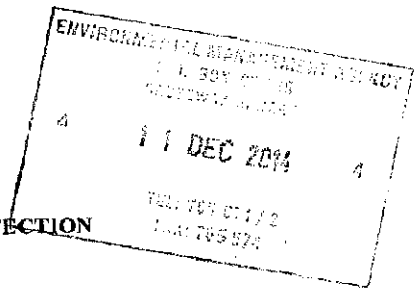
The Director
Japan International Cooperation Agency (JICA)

ATTENTION: Dr. N Nagayo

REF: NYAKOMBA IRRIGATION DEVELOPMENT SCHEME

We acknowledge receipt of your submission dated 26 November 2014. In order to fulfill the Environmental requirements submit an Environmental Management Plan (EMP) for the proposed project for our consideration. The Environmental Management Plan should be structured in the format given below.

1. An executive summary
2. A table of contents
3. List of acronyms
4. Introduction / project background
5. Full project description including maps
6. Stakeholder consultation
7. Legal Framework
8. Environmental baseline analysis
9. EMP
10. EMP implementation plan and the associated cost
11. Decommissioning plan
12. List of beneficiaries



Thank you

P. SHOKO
DIRECTOR ENVIRONMENTAL PROTECTION
FOR DIRECTOR GENERAL
Cc: PEM MANICALAND PROVINCE

RECEIVED BY: ..... **DATE:** .....

DESIGNATION: ..... **I.D NUMBER:** .....

CONTACT NUMBER: .....

Annex 7: Environmental Check List

Category / Item	Check Item	Check	Reason / Mitigation Measure
1. Permit and Explanation			
(1) EIA and environmental permit	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Yes (b) Yes (c) Yes (d) N/A	(a) Based on the discussion with NEMA, the DOI submitted Prospectus and Terms of Reference to NEMA. Then, the DOI is requested to submit EMP which is under finalization process up to date. (b) (c) Implementation of the project is approved by NEMA with conditions of submitting EMP to NEMA. (d) Provisional water permit was obtained from ZINWA. Official one will be obtained at completion of the construction.
(2) Explanation to local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders been reflected to the project design?	(a) Yes (b) Yes	(a) DOI held several meetings with local stakeholders, and project concept was accepted by them. (b) Strong requests of maintenance of pumps were particularly raised by participants of the stakeholder meetings. Besides, land distribution plan was made with considerations of comments from the local stakeholders.
(3) Examination of alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Yes	(a) Alternatives were examined with multiple criteria not only environmental and social issues, but economic development, construction cost, etc.
2. Pollution Control			
(1) Water quality	(a) Are considerations given to water pollution of river water and groundwater by effluent or leachates from agricultural lands? Are adequate use/disposal standards for fertilizers, agrochemicals, and livestock wastes established? Is a framework established to increase awareness of the standards among farmers? (b) Is a monitoring framework established for water pollution of rivers	(a) Yes (b) Yes	(a) Extension officers of AGRITEX are going to train farmers in particular IMC of Block A newly established in order them to apply chemicals and fertilizers with appropriate manner based on the standards recommended by AGRITEX. (b) It is planned to establish monitoring structure during the construction and operation stage by DOI and contractor respectively. Details of monitoring structure are

Category / Item	Check Item	Check	Reason / Mitigation Measure
	and groundwater?		described in the main report.
(2) Solid Wastes	(a) Are wastes properly treated and disposed of in accordance with the country's regulations?	(a) Yes	(a) The waste soil shall be reused as filling or backfilling as much as possible. Remaining will be disposed at the site where already confirmed by environmental officer of NEMA Nyanga office
(3) Soil contamination	(a) Are there possible impacts in irrigated lands, such as salinization of soils will result? (b) Are adequate measures taken to prevent soil contamination of irrigated lands by agrochemicals, heavy metals and other hazardous substances? (c) Are any agrochemicals management plans prepared? Are any usages or any implementation structures organized for proper use of the plans?	(a) Yes (b) Yes (c) Yes	(a) (b) Occurrence rate of salinization soils by this project will not be high because such impacts are not found up to date in Block B, C, and D developed 15 years ago, and EC of water in Gairezi River measured shown low conductivity. (c) Agrochemicals management plans are prepared by AGRITEX, and direction to and monitoring of grass-route level are carried out by Extension Officers in Nyakomba.
(4) Noise and vibration	(a) Do construction sites generate noise and vibration affecting to the residents? (b) Is there a possibility of noise or vibration problem in the new irrigation system?	(a) No (b) No	(a) Some impacts are expected by construction machines, but Impact is limited because the construction sites which may cause major noise and vibrations are isolated from the residential area. (b) There is no work to cause neither noise nor vibration at operation stage. Farmers living in Block B, C, and D witnessed that distance between the irrigation facilities are well isolated from their houses so that they have never been uncomforted. Moreover, new pump stations to be constructed is 200m and 500m away from the nearest residences respectively, thus negative impact is not expected.
(5) Subsidence	(a) Is there a possibility of subsidence caused by extraction of groundwater?	(a) No	(a) No groundwater extraction is planned in the Project.
(6) Odor	(a) Are there any odor sources? Is there a possible odor problems affecting the inhabitants?	(a) No	(a) This project will not generate any odor. Also, inhabitants of Block B, C, and D witnessed no odor so far.
3. Natural environment			
(1) Protected area	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a	(a) No	(a) There is no protected area in and around the project area.

Category / Item	Check Item	Check	Reason / Mitigation Measure
	possibility that the project will affect the protected areas?		
(2) Ecosystem	(a) Does the project area encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) Is there a possibility that the project will result in the loss of breeding and feeding grounds for valuable wildlife? (d) Is there any degradation of ecosystem by overgrazing such as desertification and adverse impact on growth environment of wild life? (e) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	(a) No (b) No (c) No (d) No (e) N/A	(a) (b) It is confirmed by NEMA that the project area doesn't encompass those area. (c) Breeding sites and feeding grounds of rare species are not lost by the project. Even if it's partially lost, alternative sites are available enough. (d) Grazing land is strictly controlled by bylaws of IMC, hence overgrazing will not be appeared. (e) In the aforesaid contexts, significant impacts on ecosystem are not expected in this project.
(3) Hydrometeor	(a) Is there possible impact on the hydrometeor of the Gairezi River?	(a) No	(a) No impact is expected since intake volume is small enough comparing with the one of Gairezi River.
(4) Topography and geology	(a) Do the project affect topographic or geological features of the project area?	(a) No	(a) No significant impact is expected on topographic and geological conditions, because large-scaled excavation nor blasting are not expected.
4. Social environment			
(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is expected, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on	(a) No (b) (c) (d) (e) (f) (g) (h) (i) (j)	(a) There is no work to cause involuntary resettlement because bylaw of IMC restricts construction of houses in the irrigation scheme (irrigation land), so that nobody lives in the irrigation area. (b) (c) (d) (e) (f)

Category / Item	Check Item	Check	Reason / Mitigation Measure
	socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		(g) (h) (i) (j)
(2) Living and livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the allotment will result in inequitable distribution or usurpation of land and available resources? (c) Is there a possibility that the allotments will result in inequitable distribution or usurpation of Water Permit and available resources? (d) Is there a possibility that the water use by the project will adversely affect downstream fisheries and water use? (e) Is there a possibility that water-borne or water-related diseases will be introduced? Is adequate consideration given to public health education, if necessary?	(a) Yes (b) Yes (c) Yes (d) No (e) No	(a) Though minor impacts such as traffic accident, infectious diseases, public infrastructure, etc are expected, mitigation measures to minimize those impacts are prepared and described in the EMoP. (b) Water Permit will not be issued for individuals, but for a group of irrigation scheme. Also, water resources will properly be managed by WMC of IMC. Thus, inequitable distribution of benefits is not expected. (c) Beneficiaries were agreed with equal land distribution in the past grant aid scheme, same manner is expected in this project as well. (d) Adverse impacts by previous constructions in Block B, C, and D were not reported by community. Suspended matters from construction site of pump station in Block A will go down to the bottom of Gairezi River naturally before reach to the Block B during the running. (e) Malaria is common diseases even without project. Health workers of

Category / Item	Check Item	Check	Reason / Mitigation Measure
			Ministry of Health Nyanga department is conducting routine patrol
(3) Cultural heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) No	(a) Religious graves and mountains for praying good rainfall are located away from the project area. Thus, no impact on cultural heritage is expected.
(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) No	(a) Although significant negative impact is not expected, RC retaining walls constructed on all sides of the stations in Block B and C against the flood may make a cold impression.
(5) Ethnic minorities and indigenous people	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N/A (b) N/A	(a) (b) There are no ethnic minority groups in the project area, because the area is called as Communal land in where current inhabitants have been forced to resettle in 1970s and 80s.
(6) Working condition	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country? (b) Are tangible safety considerations in place for individuals involved in the project? (c) Are intangible measures being planned and implemented for individuals involved in the project? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) Yes (b) Yes (c) Yes (d) Yes	(a) Construction plan is developed in line with Zimbabwean labor law. (b) Tangible safety considerations such as establishment of road signs, barricade, employment of flagmen, etc. and regular maintenance of equipment shall be taken. (c) Day-to-day safety briefing will nurture workers. Contractors will also be obligated to hold briefing about infectious diseases such as HIV/AIDS. (d) It was confirmed in the field survey that no trouble happened between the last contractor and inhabitants in Block B, C, and D. Though serious troubles between the inhabitants and security guards to be recruited from community are not expected, traditional leaders will take necessary complaint and grievance management as necessary.
5. Others			

Category / Item	Check Item	Check	Reason / Mitigation Measure
(1) Impact during construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment, are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Yes (b) Yes (c) Yes	(a) Following measures are considered: sprinkling water, limitation of working hours, prohibit of idling of equipment, usage of disposal sites approved by NEMA (b) (c) Adverse impacts on natural and social environment is not significant, and those will be mitigated / reduced / prevented by measures described in Section 2 pollution to Section 4 Social environment in this table.
(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Yes (b) Yes (c) Yes (d) Yes	(a) Monitoring based on the EMoP shall be conducted in the construction phase and operation phase by Contractor and DOI respectively. (b) Items may affect minor or significant adverse impacts, i.e. rated as A-, B-, or C-, and positive impacts, i.e. rated as A+, B+, or C+, are selected as monitoring items. (c) Though monitoring system exists already, one (1) additional motorbike shall be donated by this project in order to reduce workloads of operation, maintenance and monitoring of irrigation facilities. (d) Monthly monitoring by Contractor shall centrally be controlled by the Project Management Group (PMG).

Annex 8: Monitoring Form

Monitoring Form

Monitoring Form - Construction Stage (every month)

Month & Year:_____
Reporter: _____
Date: _____

Item (rate)	Reporter	Monitoring Report	Judgment by PMG*
Air pollution	Contractor	Visual observation of dust at the construction sites: (□ No air pollution / □ Probable air pollution => describe below) Note: Attach the records of the daily visual observation.	☐ A ☐ B ☐ C
Water pollution	Contractor	Turbidity of river water tested by transparency meter in the construction sites of pump station and box culverts: (□ No water pollution / □ Probable water pollution => describe below) SS Measured:_____ mg / L * (SAZ: less than 25.0;/-0.1mg / L) *Turbidity of the river water can be converted from the water transparency	☐ A ☐ B ☐ C
Waste	Contractor	Volume of disordered waste at the construction sites: (□ No waste problem / □ Probable waste problem => describe below)	☐ A ☐ B ☐ C
		Evidence of community's approval for the place and way of waste disposal (□ Yes, there is an evidence of approval / □ No evidence => describe below)	☐ A ☐ B ☐ C
Noise and vibrations	Contractor	Noise and vibration at the construction sites measured by noise tester and vibration tester: (□ Noise or vibration problems are insignificant and less than the level set by the Standards Association of Zimbabwe / □ Noise and/or vibration are beyond the said standards=> describe below) Noise: Measured Avg._____ dB, Max _____ dB, Min. _____ dB (SAZ: less than _____dB) Vibration: Measured Avg._____ Hz, Max _____ Hz, Min. _____ Hz (SAZ: less than _____Hz) Note: Attach the records of the daily measurement.	☐ A ☐ B ☐ C
Ecological system	Contractor	Record of illegal hunting and/or logging: (□ No illegal means / □ Illegal means found => describe below)	☐ A ☐ B ☐ C

Item (rate)	Reporter	Monitoring Report	Judgment by PMG*
Water usage	District Agr.	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Existing social infrastructures & services	Contractor	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
HIV/AIDS infection	Contractor	Record of briefing to the workers: (□ Briefing provided / □ No briefing provided => describe below)	☐ A ☐ B ☐ C
		Record of briefing to the grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Accidents	Contractor	Record of accidents: (□ No accident / □ Accidents occurred => describe below)	☐ A ☐ B ☐ C
Water right for the new water usage	MAMID/ ZINWA	Provisional Water right permit letter issued by ZINWA: (□ Water right is permitted / □ Not permitted yet => describe below) Note: Official version of the permit will be issued just after or about completion of the construction.	☐ A ☐ B ☐ C
		Water use permit letter issued by organizations concerned in Mozambique: (□ Water use is permitted / □ Not permitted yet => describe below)	☐ A ☐ B ☐ C

Remarks: Judgment by Project Management Group (PMG): "A" = Confirmed as no problem; "B" = To be re-examined; "C" = To be solved

Note:

- The reporters (Contractor, Ministry of Agriculture and Mechanization Development: MAMID, and Zimbabwe National Water Authority: ZINWA) shall fill the monitoring form every month, and submit it to the Project Management Group (PMG).
- The PMG will evaluate the report with support of the related agencies. If there are items to be re-examined, the PMG shall inform the reporters to make detailed survey on the items. In case of any serious problems occurred, the PMG shall take countermeasure to solve the problems in cooperation with related agencies.

- Monitoring Form - Operation Stage (every year)

Duration: _____
Reporter: _____
Date: _____

Item (rate)	Reporter	Monitoring Report	Judgment by PMG*
Soil pollution	Extension Staff, assigned in Nyakomba irrigation scheme, Dept. of AGRITEX	Record of the way of fertilization and spraying of the pesticide etc in the irrigation scheme (□ As per recommendation of MAMID / □ Higher/Lower than the one recommended by MAMID => describe below) Measured Data_____ Baseline Data (as of):_____	☐ A ☐ B ☐ C
Noise and vibrations	Water belief/ Operator of pump, Mazowe Catchment office, ZINWA	Record of abnormal noise and/or vibration (□ No abnormal noise nor vibration / □ Found abnormal noise and/or vibration=> describe below) Measured Data_____ Baseline Data (as of):_____	☐ A ☐ B ☐ C
Ethnic minority, indigenous people	Traditional Leaders, Extension Staff, assigned in Nyakomba irrigation scheme, Dept. of AGRITEX	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Land use & utilization of local resources	Traditional Leaders, Extension Staff, assigned in Nyakomba irrigation scheme, Dept. of AGRITEX, EMA Nyanga District Office	Record of improper land use especially in the dry land: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
Social institutions	Irrigation Management Committee, Extension Staff, assigned in Nyakomba irrigation scheme, Dept. of AGRITEX DOI, Manicaland Provincial office, ZINWA Mazowe catchment office	Record of grievances: (□ No grievance / □ Grievances made => describe below)	☐ A ☐ B ☐ C
		Availability of By-law of IMC in Block A (□ Available / □ Not Available => describe below)	☐ A ☐ B ☐ C
		Selection criteria and process of IMC committee member (□ Fair enough / □ Not fair => describe below)	☐ A ☐ B ☐ C

Item (rate)	Reporter	Monitoring Report	Judgment by PMG*
		Gap between contribution amounts for the payment of water/electricity fee recorded by casher of IMC, and record of invoice/ cash/bank transaction issued by ZINWA and ZESA respectively (□ Not significant / □ Significant => describe below)	☐ A ☐ B ☐ C
Scenery	IMC, Block B, and C ZINWA Mazowe catchment office	Painting on the retaining wall around the pump stations in Block B, and C (□ Painted well / □ Not painted yet => describe below)	☐ A ☐ B ☐ C
Work environment	IMC especially Maintenance Committee (MC) and Water Management Committee (WMC)	Record of accidents happened during the operation and/or maintenance works: (□ No accident / □ Accident happened => describe below)	☐ A ☐ B ☐ C
Water right for the new water usage	MAMID, ZINWA	Water right permit letter issued by ZINWA: (□ Water right is permitted / □ Not permitted yet => describe below) Note: This is not provisional version.	☐ A ☐ B ☐ C

Remarks: Judgment by Project Management Group (PMG): "A" = Confirmed as no problem; "B" = To be re-examined; "C" = To be solved

Note:

- The reporters (Department of Irrigation, AGRITEX, ZINWA, ZESA, IMC, Traditional leaders) shall report the monitoring result to the Department of Irrigation, MAMID. Then, DOI shall combine the data collected and fill the monitoring form every month, and submit it to the Project Management Group (PMG).
- The PMG will evaluate the report with support of the related agencies. If there are items to be re-examined, the PMG shall inform the reporters to make detailed survey on the items. In case of any serious problems occurred, the PMG shall take countermeasure to solve the problems in cooperation with related agencies.

Annex 9: Agreement for Equal Land Distribution

EQUAL LAND DISTRIBUTION AGREEMENT FOR NYAKOMBA IRRIGATION SCHEME BLOCK A.

ON THIS DATE 19 DECEMBER 2014, WE AS BLOCK A FARMERS AGREED TO SHARE THE LAND EQUALLY AMONG THE BLOCK A BENEFICIARIES AFTER THE COMPLETION OF THE BLOCK CONSTRUCTION.

THE LIST OF THE BENEFICIARIES IS ATTACHED.

VILLAGE HEAD NAME MEINARD DANDADZI SIGNATURE Dandadzi

IRRIGATION MANAGEMENT COMMITTEE CHAIRPERSON

NAME PAUL DANDADZI SIGNATURE Paul

DISTRICT HEAD IRRIGATION DEPARTMENT.

NAME KAGEDZA TOBIAS SIGNATURE

DISTRICT HEAD AGRITEX

NAME PHILIPPA [illegible] SIGNATURE

IRRIGATION MANAGEMENT COMMITTEE CHAIRPERSON.

NAME PAUL DANDADZI SIGNATURE Paul

MINISTRY OF LOCAL GOVERNMENT, PUBLIC WORKS AND NATIONAL HOUSING.

NAME Boora IRENE SIGNATURE.

NYANGA RURAL DISTRICT COUNCIL.

NAME ZENIA [illegible] SIGNATURE.

MINISTRY OF LANDS.

NAME MUHAMMAD [illegible] SIGNATURE.

DISTRICT ADMINISTRATOR.

NAME Boora. IRENE SIGNATURE.

PROVINCIAL ADMINISTRATOR.

NAME CHIRENGA COSMAS SIGNATURE.

Name	ID Number	Sex	Signature
1 Meinrald Dandadzi	34 010255 A 34	M	Dandadzi
2 Thomas Dandadzi	34 052780 R 34	M	[illegible]
3 Jeremiah Dandadzi	34 069152 L 34	M	[illegible]
4 Henry Dandadzi	34 058555 R 34	M	Henry Dandadzi
5 Johnson Dandadzi	34 [illegible] M 34	M	[illegible]
6 Maengeni Dandadzi	34 022516 W 34	F	Maengeni
7 Lee Dandadzi	34 022011 L 34	M	[illegible]
8 Nicholas Dandadzi	34 054190 J 34	M	[illegible]
9 Daniel Dandadzi	34 [illegible]	M	Daniel
10 Luke Dandadzi	75 [illegible]	M	Luke
11 Agnes Kandadzi	34 024582 K 34	F	Agnes
12 Rosemary Kocokele	34 [illegible] 34	F	[illegible]
13 James Dandadzi	34 [illegible] 34	M	[illegible]
14 Paul Dandadzi	34 [illegible] T 34	M	Paul
15 David Dandadzi	34 [illegible] 34	M	[illegible]
16 Patricia Dandadzi	34 [illegible] L 34	M	[illegible]
17 Ronald Dandadzi	63 14662 M 34	M	[illegible]
18 Stanley Dandadzi	85 [illegible] S 34	M	[illegible]
19 Victor Dzimbiri	63 ~~05000~~ 173052 D 34	M	[illegible]
20 Canisius F Dzimhemia	34 080460 D 34	M	[illegible]
21 Simba Dzimhemia	63 114163 Q 34	M	[illegible]
22 Brighton Dzimhemia	34 036321 D 34	M	[illegible]
23 Sarah Dito	34 049735 D 34	F	Sarah Dito
24 Leonard Dzimhemia	34 103127 A 34	M	[illegible]
25 Andrew Bukuta	34 043655 L 34	M	Andrew
26 John C Bukuta	75 045685 H 34	M	[illegible]
27 Paul Bukuta	42 076581 Z 34	M	P Bukuta
28 Francisca Bukuta	75 083116 G 34	F	F Bukuta
29 Isaac Bukuta	34 048149 G 34	M	[illegible]
30 Betty Dandadzi	34 000255 D 34	F	Betty

	Name		I.D Number	Sex	Signature
31	Cotilda	Muchemwa	34.013912 A.34	F	[illegible]
32	Anselm	Madzia	34.066063 J.34	M	Anselm Madzia
33	Clever	Madzia	34 024192 J 34	M	C Madzia
34	Ieroy	Nzamwe	34.058744 P 34	M	Ieroy
35	Pardon	Nzamwe	34.094[illegible] 34	M	Pardon
36	Lazarus	Madzia	34 041894 S.34	M	[illegible]
37	Clowdo	Tazira	34.146333 G 34	M	[illegible]
38	Hatch	Madzia	34.056075 M 34	M	[illegible]
39	Felix	Madzia	34.[illegible] 34	M	[illegible]
40	[illegible]	Madzia	[illegible] 34	M	[illegible]
41	[illegible]	Mutambarambe	34.[illegible] 34	F	[illegible]
42	Miles	Mutambarambe	34.062999 J.34	M	[illegible]
43	Robert	Mutambarambe	34.091454 C.34	M	[illegible]
44	[illegible]	Mutambarambe	34.084332 L 34	M	[illegible]
45	Noah	Mutambarambe	34 065916 B 34	M	[illegible]
46	Clifford	Mutambarambe	34.068924 N 34	M	C [illegible]
47	Biggie	Mutambarambe	34 076911 V.34	M	[illegible]
48	Evance	Mutambarambe	34.048601 J 34	M	[illegible]
49	David K	Mutambarambe	34 012304 H 34	M	[illegible] L
50	Selina	Sandiramhue	34.009953 P.34	M	[illegible]
51	Ismael	Samuriwa	75 023437 T 34	M	[illegible]
52	Stanley	Marauka	63.454467 B 34	M	[illegible]
53	Angeline	Chibwa	34 024490 G 34	F	[illegible]
54	Eliah	Chisoma	34.~~[illegible]~~ 024 868 C.34	F	[illegible]
55	Felicia	Chisoma	34 014957 P.34	F	[illegible]
56	Luke C.	Chisoma	34.024490 G 34	M	[illegible]
57	Christopher	Chibwa	34 054715 J.34	M	C [illegible]
58	Jonathan	Chimbwa	34.075112 G 34	M	J Chimbwa
59	Samson	Rukweza	34.014815 J.34	M	S Rukweza
60	Stanford	Mutambarambe	75 300452 R.34	M	S Mutambarambe

	Name	ID Number	Sex	Signature
61	GODFREY DANGADZI	34-[illegible]-34	M	
62	KENNEDY DANGADZI	34-[illegible]-34	M	
63	JULIET DANGADZI	34-[illegible]-34	F	
64	JUSTICE DANGADZI	34-[illegible]-34	M	
65	CHAC BUKUTA	34-[illegible]-34	M	
66	MISHECK BUKUTA	34-[illegible]-34	M	
67	ABEL BUKUTA	34-[illegible]-34	M	
68	NELIAN BUKUTA	34-[illegible]-34	F	
69	JOSIAH BUKUTA	70-[illegible]-34	M	
70	MARTHA BUKUTA	75-[illegible]-34	F	
71	CHRISTOPHER TAZIWA	63-[illegible]-34	M	
72	LIZZIE TAZIWA	34-[illegible]-34	M	
73	ROSINA TAZIWA	34-[illegible]-34	F	
74	HERBERT K. TAZIWA	34-[illegible]-34	M	
75	CONSTANTINE MUCHINGURI	63-[illegible]-34	M	
76	[illegible] MUCHINGURI	63-[illegible]-34	M	
77	REASON MUCHINGURI	34-[illegible]-34	M	
78	JUNE MUCHINGURI	34-[illegible]-34	F	
79	GODFREY MUCHINGURI	34-[illegible]-34	M	
80	LAZARUS MUCHINGURI	34-[illegible]-34	M	
81	CANISIUS M. MUCHINGURI	34-[illegible]-34	M	
82	CANISIUS M. MUCHINGURI	34-[illegible]-34	M	
83	JOHANNES MADUZA	34-[illegible]-34	M	
84	HANNAH MADUZA	63-[illegible]-34	F	
85	JOSEPH MADUZA	34-[illegible]-34	M	
86	LAZARUS M. MADUZA	63-[illegible]-34	M	
87	EDWARD MADUZA	42-[illegible]-34	M	
88	MATTHEW MADUZA	63-[illegible]-34	M	
89	JAMES MADUZA	34-[illegible]-34	M	
90	SAMUEL TAZIWA	34-[illegible]-34	M	

	Name	I.D. Number	Sex	Signature
91	Edmore Bukuta	34-042462 X 34	M	Edmore
92	Edwin Bukuta	34 065[illegible] E 34	M	Edwin
93	Patrick Nzanire	34 [illegible] 34	M	Patrick
94	Augustine Chimongo	63-179998 E 34	M	Augustine
95	Doreen Mandibtseka	34-024135 F 34	F	Doreen
96	Lenns Mandibtseka	34 054[illegible] 34	M	[illegible]
97	Clemence Chimeke	34 022874 G 34	M	Clemence
98	Kadmund Bukuta	34-087156 N 34	M	Kadmund
99	Stanford Bukuta	34 042467 K 34	M	Stanford
100	Tendai C Dzimwema	34 062[illegible] M 34	M	[illegible]
101	Nyasha Dzimwema	34 [illegible] A 34	M	[illegible]
102	Jessie Dzimwema	34 024875 J 34	F	J Dzimwema
103	Douglas Nzanire	75 454042 M 34	M	Douglas
104	Winston Bukuta	34 084[illegible] T 34	M	Winston
105	Manfold Jim Dandadzi	34 110[illegible] 34	M	[illegible]
106	Fungai Mandibtseka	34 098[illegible] F 34	M	[illegible]
107	Tendai Bukuta	34 051[illegible] A 34	M	[illegible]
108	Farmel Mutandakamwe	34 059462 E 34	M	[illegible]
109	Lovemore Mutandakamwe	34-064682 L 34	M	[illegible]
110	David Mutandakamwe	75-621714 C 34	M	[illegible]
111	Tendai Mutandakamwe	34-065[illegible] 34	M	Tendai
112	Maxis Mutandakamwe	34 [illegible] G 34	M	Maxis
113	Trymore Mutandakamwe	34-072451 A 34	M	Trymore
114	Tatenda Mutandakamwe	42-259925 K 34	M	[illegible]
115	Nyasha Mutandakamwe	34-091465 F 34	M	[illegible]
116	Lameck K Mutandakamwe	34 [illegible] 34	M	Lameck K
117	Clifford Mugwagwa	43-141[illegible] K 43	M	[illegible]
118	Stella Chimuchenga	34-053115 H 34	F	Stella
119	Nesbert Mutandakamwe	34-052145 A 34	M	Nesbert
120	Moses Mutandakamwe	34-051619 D 34	M	Moses

Name	I D Number	Sex	Signature
121 Alice Dzihwema	34-025474 H 34	F	Alice
122 Lazarus Dzihwema	34 [illegible] L 34	M	[illegible]
123 Martin Dzihwema	34 [illegible] L 34	M	[illegible]
124 Aaron Dzihwema	34 [illegible] 34	M	[illegible]
125 Rachel Dzihwema	34 [illegible] 34	M	[illegible]
126 Kenneth Mhandutsera	34 [illegible] 34	F	[illegible]
127 Peter Dzihwema	34 [illegible] 34	M	[illegible]
128 Gideon Nzanike	50 [illegible] 34	M	[illegible]
129 Ambrose Tazwiwa	75 [illegible] 34	M	A Tazwiwa
130 Yeneukai Tazwiwa	34 [illegible] 34	F	V Tazwiwa
131 Casper Tazwiwa	34 [illegible] A 34	M	[illegible]
132 Patrick Tazwiwa	34 [illegible] T 34	M	[illegible]
133 Steven Mukonyita	62 124 277 W 34	M	[illegible]
134 Kithmore Mukonyita	63 122755 F 34	M	[illegible]
135 Maxwell Mukonyita	34 054974 A 34	M	[illegible]
136 Ignatius Tazwiwa	34 [illegible] 34	M	[illegible]
137 Casper Tazwiwa	34 058255 K 34	M	[illegible]
138 Anthony C Tazwiwa	34 [illegible] N 34	M	[illegible]
139 Godfrey Bunyita	42 173817 S 34	M	[illegible]
140 David Mukombarwei	34 [illegible] 34	M	[illegible]
141 Patrick Bunyita	34 [illegible] G 34	M	Patrick
142 Emmanuel Mukonyita	34 054774 A 34	M	[illegible]
143 Knighton Mukonyita	62 1413558 R 34	M	[illegible]
144 Herbert Tazwiwa	75 305279 L 34	M	[illegible]
145 Grace G Tazwiwa	75 [illegible] 34	M	[illegible]
146 Timothy Mabusa	34 [illegible] 34	M	[illegible]
147 Rosina M Mabaso	75 [illegible]	F	[illegible]
148 Daniel Mangoza	34 [illegible] L 34	M	[illegible]
149 Elijah Mandutsera	34 0405 [illegible] 34	M	[illegible]
150 Michael Bunyita	34 [illegible] 34	M	[illegible]

	Name	ID Number	Sex	Signature
151	Tawanda Fadanza	42 222127 G 42	M	[illegible]
152	Ranet Mukengani	34 013110 N 34	M	[illegible]
153	Washington Chisoma	34 [illegible] 34	M	[illegible]
154	Francis Mandanga	34 [illegible] 34	M	[illegible]
155	Costa Mutambarabwe	34 [illegible] 34	M	Costa
156	Tinashe Mutambarambwe	34 [illegible] 34	M	[illegible]
157	Lovemore Mutambarambwe	34 [illegible] 34	M	[illegible]
158	Cashiel Mutambarambwe	34 [illegible] 34	M	[illegible]
159	Angeline Maffuko	34 [illegible] 34	F	[illegible]
160	Mary Mandanga	34 [illegible] 34	F	Mary
161	Freedom Mutambarambwe	34 [illegible] 34	M	[illegible]
162	Julius Mandanga	34 034196 K 34	M	Julius
163	Maria Mugange	45 [illegible] 34	F	[illegible]
164	Clemence Mutambarambwe	34 094955 L 34	M	[illegible]
165	Lucky Mandanga	34 012714 K 34	M	[illegible]
166	[illegible] Mandanga	34 125025 [illegible] 34	M	[illegible]
167	Desmond Chinoll	34 101591 E A 34	M	[illegible]
168	Takemore Mutambarambwe	50 119630 [illegible] 34	M	[illegible]
169	Magret Kutsanza	34 095353 N 34	M	[illegible]
170	Christopher Mutambarambwe	75 269964 C 34	M	Christopher
171	Phillip K. Mutambarambwe	34 051246 [illegible] 34	M	Phillip
172	Peter Mutambarambwe	34 056214 [illegible] 34	M	Peter
173	Benson Chisoma	34 064388 H 34	M	B Chisoma
174	Rezai Mutsambira	34 043126 N 34	F	Mutsambira
175	Bernard Makanika	63 105543 R 34	M	[illegible]
176	Takesure Mutambarambwe	34 100853 T 34	M	[illegible]
177	Zivai Chimusha	34 062576 Z 34	M	[illegible]
178	Caleb Chimusha	34 022661 H 34	M	[illegible]
179	Melody Samunda	34 100922 T 34	M	[illegible]
180	Magret Samunda	34 051535 C 34	F	[illegible]

Name	I D Number	Sex	Signature
181 Francis Kuuta	34-080079 A 34	M	F [illegible]
182 Mungaraidzi Muchirewesi	75 314 516 Q 34	M	[illegible]
183 Kudakwashe Muchirewesi	75 188258 B 34	M	[illegible]
184 Collins Mhlanga	34 [illegible]	M	[illegible]
185 Kudzanai Chimusasa	[illegible] 34	M	[illegible]
186 Shadreck T Mapfura	34 [illegible] 34	M	[illegible]
187 Ambros C Banganga	63 1374222 S 34	M	A [illegible]
188 Dennis Taruza	34 112715 M 34	M	D [illegible]
189 Richard Mhlanga	34 [illegible] A 34	M	[illegible]
190 Edmore Dzamunda	34 110273 H 34	M	E Dzamunda
191 Lazarus Dzamunda	34 104657 F 34	M	[illegible]
192 Peter Clever Kuuta	75 [illegible]	M	[illegible]
193 Joseph Taruza	34 [illegible] 34	M	[illegible]
194 Simon Taruza	45 128019 F 34	M	[illegible]
195 [illegible] Taruza	34 095142 M 34	M	[illegible]
196 [illegible] Taruza	23 118271 L 23	M	[illegible]
197 Tafadzwa Fungwiza	34 012066 F 34	M	[illegible]
198 Munyaradzi Mira [illegible]	34 126521 L 34	M	[illegible]
199 Tonderai Mutandwa [illegible]	34 112140 M 34	M	[illegible]
200 Magret Chinguwo	34 053115 [illegible] 34	F	M [illegible]
201 [illegible] Mutambwa [illegible]	34 110056 E 34	M	[illegible]
202 Peter P Mutandwa [illegible]	34 [illegible] 34	M	[illegible]
203 Richard Mutandwa [illegible]	34 123027 B 34	M	[illegible]
204 [illegible] Samumba	34 [illegible] 34	M	[illegible]
205 Zivai [illegible] Mhlanga	63 1432543 L 34	M	[illegible]
206 Tonderai [illegible] Mutandwa [illegible]	34 042421 A 34	M	[illegible]
207 [illegible] Chiusa	34 [illegible] A 34	M	W [illegible]
208 Oscar Katerere	34 114504 H 34	M	O [illegible]
209 Tendai T Fungwiza	34 102685 M 34	M	[illegible]
210 Prudence Muchirewesi	75 375121 [illegible] 34	M	[illegible]

	Name	I.D Number	Sex	Signature
211	TATENDA MUCHAKWESI	34 484103 T	M	T [illegible]
212	~~COLLIN~~ ELIZABETH MANDIZGELA	34 [illegible] 34	F	[illegible]
213	PHILLIP MAKODZA	34 [illegible] 34	M	Phillip
214	CHRISTOPHER MAKODZA	34 [illegible] 34	M	[illegible]
215	RICHARD DZIMUCHA	34 [illegible] 34	M	[illegible]
216	ANNAKELETA BANGANI	34 [illegible] 34	F	[illegible]
217	[illegible]	34 [illegible] 34	M	[illegible]
218	CATHERINE MUTSAMBANDWI	34 045125 L 34	F	[illegible]
219	TENDEKAI DZIMUCHA	34 105263 A 34	M	[illegible]
220	SIMBARASHE BANGANI	34 [illegible] A 34	M	[illegible]
221	TAURAI BANGANI	34 [illegible] 34	M	[illegible]
222	RICHARD MAKODZA	34 [illegible] 34	M	[illegible]
223	TATENDA CHIMANDIWO	34 [illegible] 34	M	[illegible]
224	SIMBA CHIMANIKIRE	34 [illegible] 34	M	[illegible]
225	~~[illegible]~~	~~42 205522 [illegible] 34~~	M	[illegible]
225	MUSEKIWA SANGAMANE	34 [illegible] 34	M	[illegible]
226	DOMINIC DURUTA	34 [illegible] 34	M	[illegible]
227	PHILIP C DZIKAMA	34 1058991 F 34	M	P Dzikama
228	TONDERAI [illegible]	34 [illegible] 34	M	Tondera
~~229~~	~~CLEOPAS MAKODZA~~	~~34 [illegible] 34~~	~~M~~	

Annex 10: Agreement for Acquisition of Plot Land for Farm Pond

MAIN POND
(A2)

添付資料5

Minutes of the Block A meeting held at Nyakomba Irrigation scheme

Date : 30 January 2015

Time : 1000hrs – 1300hrs

Chairing : Mr Maereka

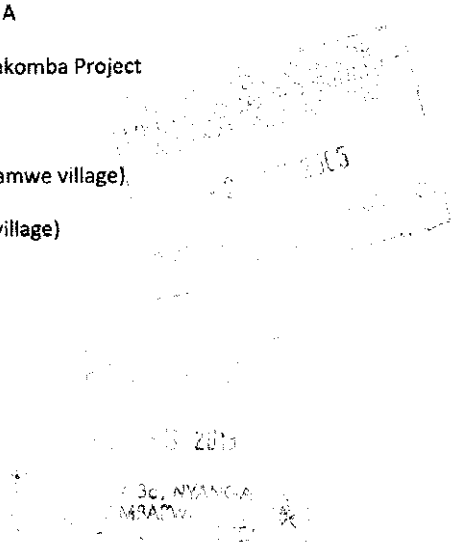
Agenda

Casual labour recruitment procedures

Compensation issues on fields affected by irrigation development

Present :

Ms I. Boozai	Acting District Administrator (Nyanga)
Mrs P. Rwambiwa	District Agricultural Extension Officer (Nyanga)
Mr B. Maereka	Irrigation Technician (Mutare)
Ms T. Makombe	Extension worker Nyakomba block B
Ms Chirangeni	Extension worker Nyakomba block C
Ms H. Nyamuzinga	Extension worker Nyakomba block D
Mr B. Daure	Extension worker block A
Mr O.T Makore	Irrigation technician Nyakomba Project
Mr R. Nyagwaya	Local councillor ward 11
Mr F. Mutandakamwe	village head (Mutandakamwe village)
Mr M. Dandadzi	Village head (Dandadzi village)
Mr P. Dandadzi	Chairperson – block A
Mr T. Mutandakamwe	Vice- chairperson
Mr M. Mutandakamwe	Secretary
Ms A. Ganje	Treasurer
Mr T. Dzihwema	Vice-secretary
Mr M. Mutandakamwe	Committee member
Mr H.B Taziwa	Committee member
Ms F. Mutandakamwe	Committee member



Ms A. Dhokotera	Farmer
Mr C. Muchirewesi	Farmer
Ms R. Mutandakamwe	Farmer

Mr Maereka asked Mr Makore to give a background of the matter that resulted in some of the community members raising complains on procedures of engaging casual labourers. He said the two women who raised the complaint were only doing on behalf of their husbands who were stopped from work because the procedures were not followed. Mr Makore explained that after the incident Mr Ishihara came to him with the matter and they both agreed that it was an issue that needed urgent attention before similar mistakes could be encountered. Then Mr Makore went to Dandadzi and Mutandakamwe villages to meet the two village heads whom he shared with the matter on the ground. The two village heads all agreed that it was necessary to call for a meeting inviting the irrigation management committee and the two women who raised the complaint. Mr Makore indicated that on that day of the meeting the two women apologised to the village heads and openly said they feared that they were going to lose irrigation plots since they are beneficiaries of block A irrigation project. It was in that meeting that the village heads, irrigation technician (Mr Makore) and Agritex Extension worker (Mr Daure) all pointed out that no one will lose their plots as long as they are on the list of beneficiaries.

The second issue that Mr Makore gave a background to is the compensation issue on the farmers who have their fields targeted for construction of structures. There is Mr Reason Muchirewesi who stay in Harare and his field was targeted for the construction of a farm pond. Mr Constantine Muchirewesi who is the uncle to Reason Muchirewesi said his son discussed all the issues with Mr Makore who said that compensation for Mr Reason Muchirewesi was already agreed on and his two brothers who had not initially benefitted be considered as beneficiaries and this was agreed by all the two village heads and other beneficiaries of block A irrigation project.

From Mr Makore's background report it indicated that there was no any political interference in casual labour selection and plot beneficiary selection in block A irrigation project.

After Mr Makore's background then Mr Maereka handed over the two issues to the district administrator so that she may respond to what had happened in the recruitment procedures and compensation on the fields affected by farm pond construction.

Firstly, the District Administrator welcomed the village heads the irrigation management committee, councillor and government employees from Agritex and Irrigation development. The District Administrator made it clear that the project is a result of bilateral relations between Zimbabwe government and Japanese government and it should not be taken for granted. These consultations involved availability of undisputed common land and water resource, and the farmers as well who would work on the developed irrigation land. The District Administrator pointed out that it is all of us at Nyakomba to implement what we agreed on during the consultations. Also she highlighted that this is a national project which President himself is aware of and is going to come for the commissioning like he did in the other blocks. Importantly, she said lets work together for the successful of Nyakomba Block A irrigation project.

On the issue of recruitment procedures, the District Administrator called on the two village heads in consultation with irrigation management committee chairperson to lead in the selection of casual labour recruitment. Any contractor who wishes to engage casual labour will first meet the two village heads who will then give the contractor the labour force required. She emphasised that once this is followed there will not be cases of complaints like we experienced in the recent recruitment. The District Administrator encouraged the village heads to fairly recruit casual labour on behalf of the contractor by not engaging the same people every time they are requested to provide labour. Also she mentioned that a balance in the selection must consider taking equal numbers from each village, thus Mutandakamwe and Dandadzi.

On the issue of compensation the District Administrator pointed out that all the two villages are beneficiaries of the project so for any construction activities there has to be land that we avail for such structures as the farm pond. There is no monetary or other material compensation to expect if the land close to one's homestead is targeted for construction purposes. The only compensation available is in the form of irrigation plots where the village heads will look at the size of land taken up for development and then compensate it with irrigation land this is done at a village meeting involving Agritex and Irrigation staff. Above all, the District Administrator made it clear that all communal land belongs to the state and in the event that there are misunderstandings the communal lands Act will be enforced to see the success of the project.

Some important remarks also came from the District Agricultural Extension Officer, who firstly appreciated the hardworking character, which Nyakomba farmers are known for over the years. She also emphasised that recruitment procedures must be followed because there is a lot to benefit from the project once commissioned. Mrs Rwambiwa also touched on the issue of the high expectations in terms of production from the Nyakomba project which she said will go a long way in reducing food shortages in the province and the country at large.

Mr Maereka then opened the floor for comments, first to speak was Tendai Dzihwema, who agreed to the balanced recruitment. Secondly, the local councillor added that the village heads also need to closely engage the Irrigation management committee during the recruitment. Again, Mrs Francisca Mutandakamwe was grateful with the suggested recruitment procedures and the compensation issues, she even encouraged the village heads to consider on the lighter duties if they happen to come from the contractors. Mr Mutandakamwe apologised on behalf of the other farmers for anything that was said by any farmer hinting segregation or conflict. He promised that everyone has a role to play in the development of block A irrigation project. Village head, Dandadzi also emphasised that the compensation issue of Mr Reason Muchirewesi has been discussed at a village meeting and the whole village agreed that his two brothers get irrigation plots as compensation to the land he allocated for construction of a farm pond.

Finally, Mr Maereka responded to the comments and considered that the village heads will also need to work together with Irrigation management committee in recruitment but the village heads will carry the mandate. He thanked everyone for committing their time to the meeting.

There was a closing prayer from Mrs A. Ganje

The meeting ended at 1305hrs

Map showing the plot of land to be used for the construction of the main farm pond

Detail of the main farm pond site

Name	ID N°"	Position	Signature
NYAMUZUWA HANNESS	75-340060 R06	AGW	
TINDIRIKA MALIET	50-067695750	AGW	
MOSES MUTANDAKAMWE	34-051619A-34	COMMITTE MEMBER	
Tendai e Dzinwema	34-062207M	Vice secretary	
FANUEL M. MUTANDAKAMWE	34-057462E34	VILLAGE HEAD	
MILES MUTANDAKAMWE	34-062779J34	SECRETARY.	
DANDADZI PAUL	34-062497R31-34	CHAIRPERSON	
MEINRAD DANDADZI	34-010285A-32	VILLAGE HEAD	
HERBERT B. TAZIWA	34051071 H34	C/MEMBER	
Constantine Muchisewesi	08-043994W34	FARMER	
TENDAI MUTANDAKAMWE	34065487C3-	VICECHAIRPERSON.	
Annett Dhokotera	34-081302S	FARMER	
RUMBIDZAI. MUTANDAKAMWE	34-097577N34	FARMER.	
FRINCISCA MUTANDAKAMWE	75-067822T-24	C/MEMBER.	
Agnes Ganje	50-096376 G50	Treasure	A. Ganje
Malcombe Tsitsi	34-055556784	A.E.W	Malcombe
Makore Tafadzwa D.	50-094036G50	IRRIGATION	Makore.
NDHLOVU RICHARD	63-447721N34	CLLR.	
DAUKE BRIAN	75.343947J-75	A.E.O	
GOORA IRENE	08-780143H44	Acting DA	
RWAMBWA PHILIPA	07-092914K27	D.A.E.O	
MAEREICA BRIAN	50-083000 S50	IRR. TECHNICIAN	

Annex 11: Agreement for Acquisition of Plot Land for Surge Tank

添付資料6

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR

CONSRUCTION OF FARM POND

IN

NYAKOMBA IRRIGATION SCHEME BLOCK A

Agreement made between

Department of Irrigation in the Ministry of Agriculture

And

Individual Farmers in Nyakomba Irrigation Scheme Block A

January 2015

Location map of the proposed farm pond sites

A1

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR NYAKOMBA IRRIGATION SCHEME BLOCK A

The Department of Irrigation under the Ministry of Agriculture, Mechanization and Irrigation Development has requested MrS MANDITSERA DOREEN who is the resident of DANDADZI and the owner of the land found in Nyanga District, Nyakomba Ward 11 DANDADZI Village for the acquisition of a plot of land to be used for the construction of farm pond for Nyakomba Irrigation Scheme Block A.

Accordingly, MrS MANDITSERA DOREEN agreed to provide the requested plot of land of total area **100m²** (as indicated in the attached map) as a contribution to the implementation of the project that benefits the communities of Block A.

Mrs MANDITSERA DOREEN also agreed that he will not request for any kind of compensation for the land and for cutting of trees and plants that are found around the plot during the implementation of the project from either the Department of Irrigation or any organization who want to develop the area.

Therefore, this agreement for the Acquisition of a plot of land for the construction of farm pond and its accessories is made in the 23rd day of the month of January 2015.

IN WITNESS WHERE OF, each of the parties hereto has caused this Agreement to be executed in duplicate as of the date above written by its duly authorized representative.

On behave of Land Owner

Signature: Doreen Date 30/01/2015

Name: Doreen manditsera

On behave of the Department of Irrigation

Signature: Makore Date 30/01/2015

Name: MAKORE TAFADZWA.O.

Witness

1. Village Head MEINRAD DANDADZI Dandadz
2. IMC Chairperson PAUL DANDADZI Paul Dandadzi
3.

Proposed location of farm pond inside Block A1

The detail location of pond A1

A 5

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR NYAKOMBA IRRIGATION SCHEME BLOCK A

The Department of Irrigation under the Ministry of Agriculture, Mechanization and Irrigation Development has requested Mr. TAZIWA ANDREW who is the resident of DANDADZI and the owner of the land found in Nyanga District, Nyakomba Ward 11 DANDADZI Village for the acquisition of a plot of land to be used for the construction of farm pond for Nyakomba Irrigation Scheme Block A.

Accordingly, Mr. TAZIWA ANDREW agreed to provide the requested plot of land of total area **100m²** (as indicated in the attached map) as a contribution to the implementation of the project that benefits the communities of Block A.

Mr. TAZIWA ANDREW also agreed that he will not request for any kind of compensation for the land and for cutting of trees and plants that are found around the plot during the implementation of the project from either the Department of Irrigation or any organization who want to develop the area.

Therefore, this agreement for the Acquisition of a plot of land for the construction of farm pond and its accessories is made in the 23rd day of the month of January 2015.

IN WITNESS WHERE OF, each of the parties hereto has caused this Agreement to be executed in duplicate as of the date above written by its duly authorized representative.

On behave of Land Owner

Signature: _____ Date 30 / 01 /2015

Name: TAZIWA ANDREW

On behave of the Department of Irrigation

Signature: Makore Date 30 / 01 /2015

Name: MAKORE TAFADZWA

Witness

1. Village Head MEINRAD DANDADZI
2. IMC Chairperson PAUL DANDADZI
3. _____

Proposed location of farm pond inside Block A3

The detail location of pond A3

A4

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR NYAKOMBA IRRIGATION SCHEME BLOCK A

The Department of Irrigation under the Ministry of Agriculture, Mechanization and Irrigation Development has requested Mr. MUBYUTA WITNESS who is the resident of BANDAAZI and the owner of the land found in Nyanga District, Nyakomba Ward 11 BANDAAZI Village for the acquisition of a plot of land to be used for the construction of farm pond for Nyakomba Irrigation Scheme Block A.

Accordingly, Mr. MUBYUTA WITNESS agreed to provide the requested plot of land of total area **100m²** (as indicated in the attached map) as a contribution to the implementation of the project that benefits the communities of Block A.

Mr. MUBYUTA WITNESS also agreed that he will not request for any kind of compensation for the land and for cutting of trees and plants that are found around the plot during the implementation of the project from either the Department of Irrigation or any organization who want to develop the area.

Therefore, this agreement for the Acquisition of a plot of land for the construction of farm pond and its accessories is made in the 23rd day of the month of January 2015.

IN WITNESS WHERE OF, each of the parties hereto has caused this Agreement to be executed in duplicate as of the date above written by its duly authorized representative.

On behave of Land Owner

Signature: Mubyuta Date 29 / 01 /2015

Name: WITNESS MUBYUTA

On behave of the Department of Irrigation

Signature: TMakore Date 29 / 01 /2015

Name: MAKORE TAFADZWA.O.

Witness

1. Village Head MEINARD DANDADZI Dandadzi
2. IMC Chairperson PAUL DANDADZI Paul Dandadzi
3. _____

Note: Mango trees shall not be demolished during the construction

Proposed location of farm pond inside Block A4

The detail location of pond A4

AS-1

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR NYAKOMBA IRRIGATION SCHEME BLOCK A

The Department of Irrigation under the Ministry of Agriculture, Mechanization and Irrigation Development has requested Mr. MUTANDAKAMWE MOSES who is the resident of MUTANDAKAMWE and the owner of the land found in Nyanga District, Nyakomba Ward 11 MUTANDAKAMWE Village for the acquisition of a plot of land to be used for the construction of farm pond for Nyakomba Irrigation Scheme Block A.

Accordingly, Mr. MUTANDAKAMWE MOSES agreed to provide the requested plot of land of total area **100m²** (as indicated in the attached map) as a contribution to the implementation of the project that benefits the communities of Block A.

Mr. MUTANDAKAMWE MOSES also agreed that he will not request for any kind of compensation for the land and for cutting of trees and plants that are found around the plot during the implementation of the project from either the Department of Irrigation or any organization who want to develop the area.

Therefore, this agreement for the Acquisition of a plot of land for the construction of farm pond and its accessories is made in the 23rd day of the month of January 2015.

IN WITNESS WHERE OF, each of the parties hereto has caused this Agreement to be executed in duplicate as of the date above written by its duly authorized representative.

On behave of Land Owner

Signature: _____ Date 30 / 01 /2015

Name: MOSES MUTANDAKAMWE

On behave of the Department of Irrigation

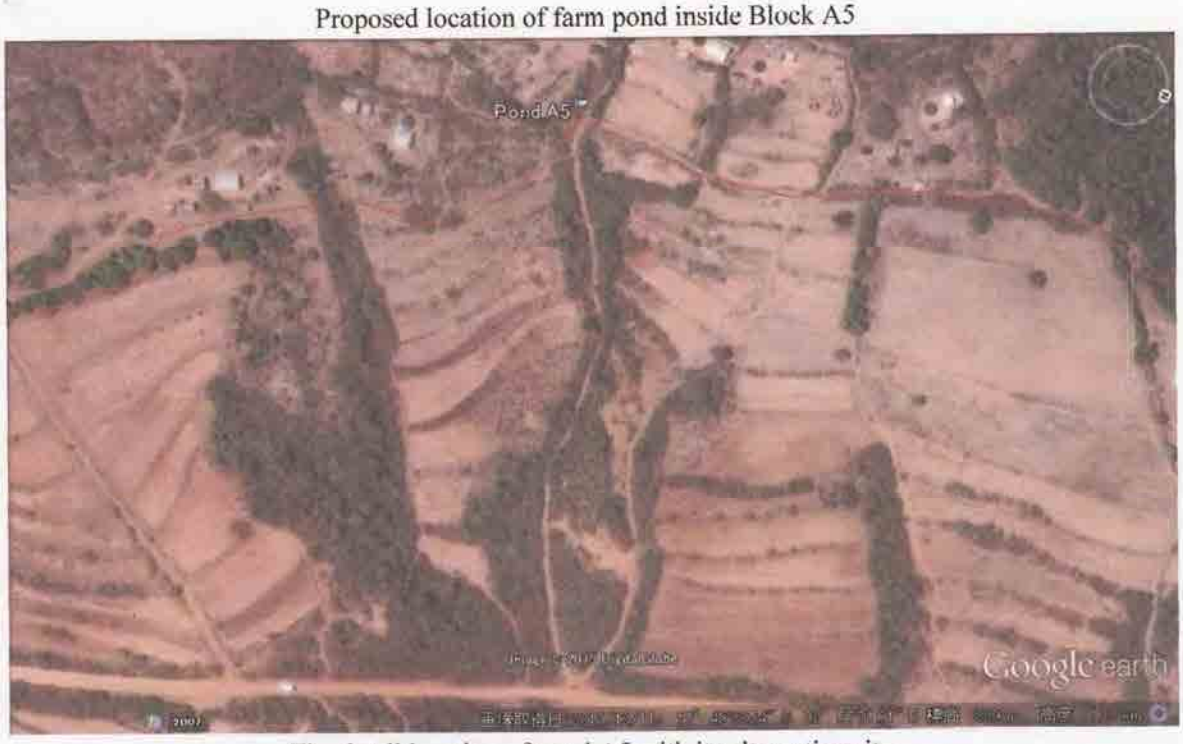
Signature: _____ Date 30 / 01 /2015

Name: MAKORE TAPADZWA.O.

Witness

1. Village Head — FANUEL M MUTANDAKAMWE
2. IMC Chairperson — PAUL DAMBADZI
3. _____

Proposed location of farm pond inside Block A5



The detail location of pond A5 with its alternative site

A 5 - 2

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR NYAKOMBA IRRIGATION SCHEME BLOCK A

The Department of Irrigation under the Ministry of Agriculture, Mechanization and Irrigation Development has requested Mr. MUTANDAKAMWE PASSMORE who is the resident of MUTANDAKAMWE and the owner of the land found in Nyanga District, Nyakomba Ward 11 MUTANDAKAMWE Village for the acquisition of a plot of land to be used for the construction of farm pond for Nyakomba Irrigation Scheme Block A.

Accordingly, Mr. MUTANDAKAMWE PASSMORE agreed to provide the requested plot of land of total area **100m²** (as indicated in the attached map) as a contribution to the implementation of the project that benefits the communities of Block A.

Mr. MUTANDAKAMWE PASSMORE also agreed that he will not request for any kind of compensation for the land and for cutting of trees and plants that are found around the plot during the implementation of the project from either the Department of Irrigation or any organization who want to develop the area.

Therefore, this agreement for the Acquisition of a plot of land for the construction of farm pond and its accessories is made in the 23rd day of the month of January 2015.

IN WITNESS WHERE OF, each of the parties hereto has caused this Agreement to be executed in duplicate as of the date above written by its duly authorized representative.

On behalf of Land Owner

Signature: PM Date 30 / 01 /2015

Name: PASSMORE MUTANDAKAMWE

On behalf of the Department of Irrigation

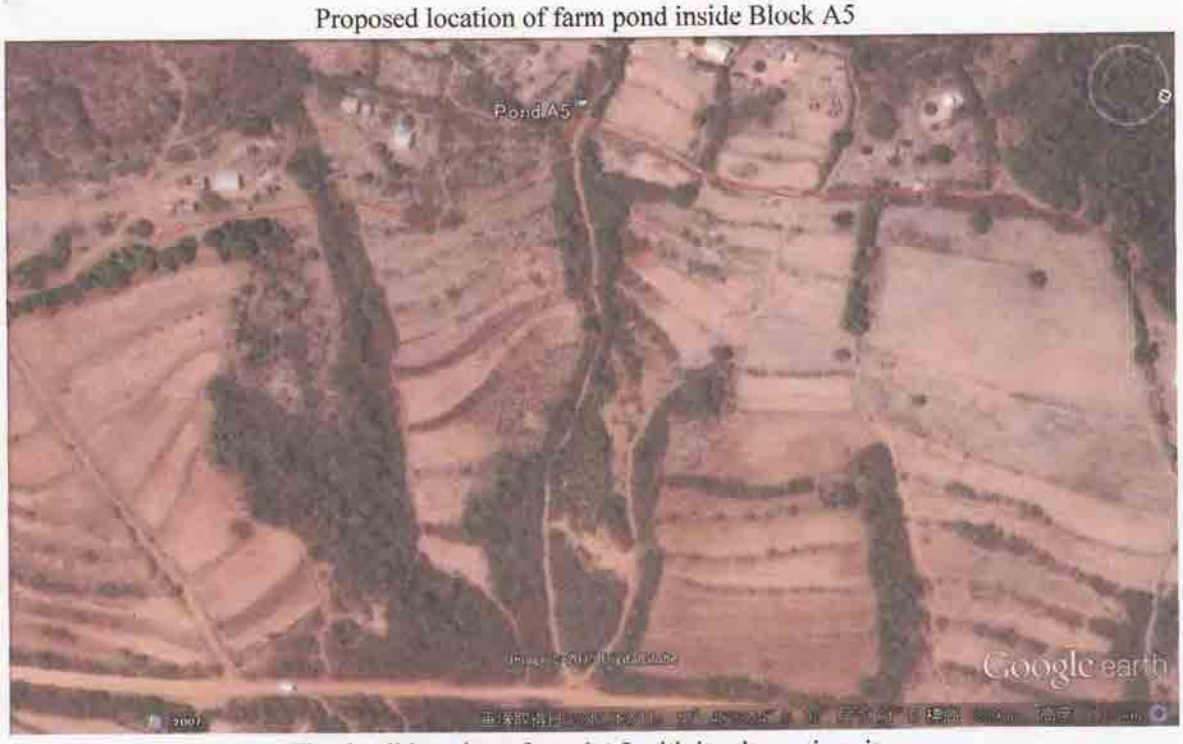
Signature: Makore Date 30 / 01 /2015

Name: MAKORE TAFADZWA.O

Witness

1. Village Head — FARMER MUTANDAKAMWE
2. IMC Chairperson — PAUL DANDADZI
3. _____

Proposed location of farm pond inside Block A5



The detail location of pond A5 with its alternative site

A 6

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR NYAKOMBA IRRIGATION SCHEME BLOCK A

The Department of Irrigation under the Ministry of Agriculture, Mechanization and Irrigation Development has requested Mr. MUTANDAKAMWE LOVEMORE.M. who is the resident of MUTANDAKAMWE and the owner of the land found in Nyanga District, Nyakomba Ward 11 MUTANDAKAMWE Village for the acquisition of a plot of land to be used for the construction of farm pond for Nyakomba Irrigation Scheme Block A.

Accordingly, Mr. MUTANDAKAMWE LOVEMORE.M agreed to provide the requested plot of land of total area **100m²** (as indicated in the attached map) as a contribution to the implementation of the project that benefits the communities of Block A.

Mr. MUTANDAKAMWE LOVEMORE. M. also agreed that he will not request for any kind of compensation for the land and for cutting of trees and plants that are found around the plot during the implementation of the project from either the Department of Irrigation or any organization who want to develop the area.

Therefore, this agreement for the Acquisition of a plot of land for the construction of farm pond and its accessories is made in the 23rd day of the month of January 2015.

IN WITNESS WHERE OF, each of the parties hereto has caused this Agreement to be executed in duplicate as of the date above written by its duly authorized representative.

On behave of Land Owner

Signature: _____ Date 29/01/2015

Name: LOVEMORE M MUTANDAKAMWE

On behave of the Department of Irrigation

Signature: _____ Date 29/01/2015

Name: MAKORE TAFADZWA.O

Witness

1. Village Head — FANUEL MUTANDAKAMWE _____
2. IMC Chairperson — PAUL PANDAZA _____
3. _____

Proposed location of farm pond inside Block A6

The detail location of pond A6

A 7

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR NYAKOMBA IRRIGATION SCHEME BLOCK A

The Department of Irrigation under the Ministry of Agriculture, Mechanization and Irrigation Development has requested Mrs CHISOMA ELLAH CHILISWA ENGELINA who is the resident of MUTANDA KAMWE and the owner of the land found in Nyanga District, Nyakomba Ward 11 MUTANDA KAMWE Village for the acquisition of a plot of land to be used for the construction of farm pond for Nyakomba Irrigation Scheme Block A.

Accordingly, Mrs CHISOMA ELLAH CHILISWA ENGELINA agreed to provide the requested plot of land of total area **100m²** (as indicated in the attached map) as a contribution to the implementation of the project that benefits the communities of Block A.

Mrs CHISOMA ELLAH CHILISWA ENGELINA also agreed that he will not request for any kind of compensation for the land and for cutting of trees and plants that are found around the plot during the implementation of the project from either the Department of Irrigation or any organization who want to develop the area.

Therefore, this agreement for the Acquisition of a plot of land for the construction of farm pond and its accessories is made in the 23rd day of the month of January 2015.

IN WITNESS WHERE OF, each of the parties hereto has caused this Agreement to be executed in duplicate as of the date above written by its duly authorized representative.

On behave of Land Owner

Signature: Ellah Engelina Date 29 / 01 /2015

Name: Ellah Chisoma Engelina Chilisiwa

On behave of the Department of Irrigation

Signature: Makore Date 29 / 01 /2015

Name: MAKORE TAFADZWA.O.

Witness

1. Village Head — Samuel Mutandakamwe
2. IMC Chairperson — Paul Zimudzi
3. _____

Proposed location of farm pond inside Block A7

The detail location of pond A7 (just at the boundary of two compound)

A 8

AGREEMENT FOR THE ACQUISITION OF PLOT OF LAND

FOR NYAKOMBA IRRIGATION SCHEME BLOCK A

The Department of Irrigation under the Ministry of Agriculture, Mechanization and Irrigation Development has requested Ms. MUCHIREWESI LETTICIA who is the resident of DANDAZI Short Line and the owner of the land found in Nyanga District, Nyakomba Ward 11 Dandazi Short Line Village for the acquisition of a plot of land to be used for the construction of farm pond for Nyakomba Irrigation Scheme Block A.

Accordingly, Ms Muchirewesi Letticia agreed to provide the requested plot of land of total area **100m²** (as indicated in the attached map) as a contribution to the implementation of the project that benefits the communities of Block A.

Ms Muchirewesi Letticia also agreed that he will not request for any kind of compensation for the land and for cutting of trees and plants that are found around the plot during the implementation of the project from either the Department of Irrigation or any organization who want to develop the area.

Therefore, this agreement for the Acquisition of a plot of land for the construction of farm pond and its accessories is made in the 23rd day of the month of January 2015.

IN WITNESS WHERE OF, each of the parties hereto has caused this Agreement to be executed in duplicate as of the date above written by its duly authorized representative.

On behalf of Land Owner

Signature: Muchirewesi Letticia Date 29 / 01 /2015

Name: Muchirewesi Letticia

On behalf of the Department of Irrigation

Signature: Makore Date 29 / 01 /2015

Name: MAKORE TAPADZWA .O.

Witness

1. Village Head MEINRAD DANDAZI Dandazi
2. IMC Chairperson _____
3. _____

Proposed location of farm pond inside Block A8

The detail location of pond A8

Annex 12: Provisional Water Permit

添付資料7

Mazowe Catchment
3rd Floor, Old Mutual House
Speke Ave. / S Nujoma
P. O. Box CY 715, Causeway
Harare
Tel: 700953/ 761465/6/ 2918224
Fax: 707850
Email: mazowe@zinwa.co.zw

29 December 2014

Ministry of Agriculture, Mechanization and Irrigation Development
Department of Irrigation
Kaguvi Building
Harare.

ATTN: S. KADAIRA

RE: PROVISIONAL IRRIGATION WATER ALLOCATION FOR NYAKOMBA IRRIGATION SCHEME BLOCK A (MAP No 1732D4 & 1733C3, GAIREZI RIVER GRID REFERENCE 965 283)

The above subject matter refers,

This letter serves to confirm that Nyakomba irrigation Scheme has applied for a permit to abstract water from Gairezi River to irrigate 140ha 1,960ML/Annum.

Having considered their proposed cropping calendar and the available water for irrigation, the application request was provisionally granted pending issuance of the final certificate in terms of the Water Act (Chapter 20:24).

Zimbabwe National Water Authority
(ZINWA)
MAZOWE CATCHMENT
29 DEC 2014
CATCHMENT MANAGER
P.O. BOX CY 715, CAUSEWAY
TELEPHONE 761465/73

F.G. MANZIRA
CATCHMENT MANAGER, MAZOWE.

cc: KAIREZI SUBCATCHMENT COUNCIL.

Head Office
8th floor Old Mutual Centre
3rd Street / Jason Moyo Avenue
P O Box CY 617
Causeway, Harare
Tel: 04 797 610-3/ 04 797 604-6
Fax: 04 796980 / 797602

Sanyati Catchment
P O Box 554
Gweru
Tel: 054 222511-4
Fax: 054 220168

Runde Catchment
P O Box 250
Masvingo
Tel: 039 263690/262950-2
Fax: 039 263972

Save Catchment
P O Box 210
Mutare
Tel: 020 60926
Fax: 020 62848

Gwayi Catchment
P O Box 566
Bulawayo
Tel: 09 69361-3/67628
Fax: 09 77109

Mzingwane Catchment
P O Box 2008
Bulawayo
Tel: 09 885191/2/6-8
Fax: 09 882865

Manyame Catcl
P O Box CY 7
Causeway
Harare
Tel: 738784
Fax: 73878

Annex 13: Notification to Mozambique Regarding Water Intake

All correspondences should be addressed

"THE SECRETARY"

Tel: +263 4 700596-8

Ministry of Environment,
Water and Climate.
P.O Box CY 7767
Causeway,
HARARE

ZIMBABWE

11 June 2015

The National Director
National Directorate of Water Maputo
Maputo
Republic of Mozambique

Attention: Ms Suzana Saranga.

REF: NOTIFICATION ON THE REHABILTATION AND EXPANSION OF NYAKOMBA IRRIGATION SCHEME.

The above - mentioned matter refers.

The Government of Zimbabwe with assistance from the Japanese Government is planning to rehabilitate blocks B, C and D of the Nyakomba Irrigation Scheme which were affected by the 2005 floods and proceed with the completion of blocks A and E which were initially started in 2002. The Nyakomba irrigation Scheme is a planned measure which started in 1997. The proposed expansion of Nyakomba Irrigation Scheme Blocks A and E and the existing Blocks B, C, D are situated in the Saunyama Communal Area of Nyanga District in Manicaland Province. Water for irrigation will be abstracted from the Gaerezi River which flows into Mozambique.

When all the blocks are operational the irrigation scheme will abstract about one thousand four hundred (1 400) litres per second from the Gaerezi River. This water is enough to irrigate about seven hundred (700) hectares of irrigable land with eight hundred and sixty (860) beneficiaries.

We therefore want to notify you of the intention by the Government of Zimbabwe to rehabilitate and expand the irrigation scheme which was started in 1997 with assistance from the Japanese Government.

T. Mutazu (Mr).
Director Water Resources Planning and Management

Cc: Prof. Z. Phiri - The Executive Secretary Zambezi Watercourse Commission

Annex 14: Recommendation for Demarcation of Cost for O&M

1. Background

According to water policy of the country, ZINWA (Zimbabwe National Water Authority), is responsible for the management and control of water resource of the country. Any developer who wants to extract water from a river or a reservoir must have water use permit. This water permits replaced the water rights which were provided for in terms of the Water Act of 1976. Water permits and agreements give their holders a right to use raw water from either a river or a dam. Water permits are issued to people intending to use water from rivers while those wishing to draw water from ZINWA managed dams/reservoir enter into an agreement with the Authority allowing them enjoy rights to the water and gets priority in the time of drought (scarcity of water). Holders of water permits and agreements are required to pay for water use.
This indicates that there are two ways of water use system in the country such as: 1) Agreement Water and 2) Payment Water (water permit).
In Agreement Water system for any irrigation development project ZINWA is responsible to bring water to the field from its source (river or dam) through pumping or conveyance canal and the irrigation developer (farmers) shall pay the amount required for the service given. Otherwise, the developer gets water permit and take the responsibility of conveying water to the field from its source and pay for the water tariff under Payment Water system
The situation in Nyakomba is a little complicated. On the one hand the beneficiaries consider ZINWA to be responsible for operation and maintenance of the pump house and farm pond but pays only the water tariff. On the other hand, the farmers are paying the electricity bill for the operation of the pump directly to ZETDC (Zimbabwe Electricity Transmission and Distribution Company). The situation in Nyakomba seems that they have water permit because the beneficiaries are paying ZINWA only the water tariff set by the government; however, the beneficiaries consider the responsibility of the pump house up to pond belongs to ZINWA. In water permit the holder is paying for the water he is taking, however, if ZINWA is responsible for the pump house up to the farm pond (as understood by the beneficiaries) the system has to be made under Agreement Water System which means ZINWA shall cover all the cost of bringing water up to the farm pond and the beneficiaries has to pay the amount needed for the service (that includes cost of electricity, operation maintenance and water tariff).
According to the information collected from ZINWA the amount of money collected as water fee from the Nyakomba scheme, since the commencement of the project, has been very little to cover the cost of maintenance of the pump, especially when the damage is caused by complete flooding of the pump house (as happened in March 2006). In addition, all the farmers (registered beneficiaries) are not paying or engaging in the irrigation schemes according to the plan. This situation has resulted in:

- Stoppage of irrigation activity for a number of years specially at Block D until the pump is rehabilitated with the help of DOI (department of Irrigation, MAMID)
- Long term loss of income to the communities
- Lack of interest from the beneficiary side to pay the water fee
- Mistrust between the beneficiaries and ZINWA
- Lack of interest for ZINWA to take responsibility of the project (pump house) as the amount of money collected from the beneficiary is so little that it sometimes doesn't cover the cost of salary for operator of the pump.

Therefore, there is a need to formulate a working operation and maintenance guideline for smooth implementation of Nyakomba Irrigation Scheme.

2. Assumptions

Considering the above situation the following assumption is taken in the preparation of this operation and maintenance proposal.

1) General assumption

i) The beneficiaries must agree to the set up of Agreement Water system (Beneficiaries must sign agreement for ZINWA to bring water to the farm pond as they consider ZINWA to take the responsibility of the pump house up to farm pond).
ii) ZINWA shall take responsible for the provision of water from its source to the farm pond (Agreement Water).
iii) As agreed in the meeting with the beneficiaries of the project on February 02, 2015, ZINWA shall take the full responsibility of the pump, the pump house up to the farm pond.
iv) The beneficiary of the project shall be willing to pay the cost that requires bringing water from the river up to the farm pond which includes water fee, electricity bill, operation and maintenance fee.
v) The charge shall be composed of the exact amount of water needed for the crop during the growth period (water charge), the exact electricity consumption (electricity charge) and operation and maintenance of the scheme (pump and canal maintenance cost) on a monthly basis.
vi) The beneficiaries shall take the responsibility of maintaining the irrigation structure beyond farm pond. The cost for this activity should be collected as part of the contribution for the activities of Irrigation Management Committee (IMC).
vii) All registered beneficiaries shall engage in the production of irrigation crop on the entire irrigable area throughout the year. The size of irrigable area and registered beneficiaries are shown below

Table: Irrigation Size and Number of Beneficiaries per Block

Block	Irrigable area (ha)	Registered Beneficiary (No)	Hectare per Family
Block A	146	228	0.64
Block B	128	128	1.00
Block C	115	165	0.70
Block D	191	239	0.80
Total	580	760	0.76

2) Specific assumption

i) The meteorological data collected from the surrounding Station shall be used as a basis for the calculation of irrigation water requirement of the crop
ii) Irrigation period is generally considered from March up to October (including supplementary irrigation for Tabasco Chili and Paprika)
iii) Considering the poor experience of irrigated agriculture in the area, the topography of the area and type of irrigation system (surface irrigation) to be adopted, an irrigation efficiency of 60% is considered in the calculation of water requirement.
iv) The irrigation water requirement is taken as equals to the crop water need discarding the amount of precipitations that rains during the growth period.
v) The cost for routine maintenance of the pump is prepared for 30 years life span of the pump and the cost share to be covered by the beneficiaries are calculated for every 10 years period
vi) The pump shall be operated for 8 hours a day during the irrigation season and the electricity bill is determined according to the three different rate used in the country such as peak time, standard and off-peak period which has different rate per kWh.

3. Calculation of Operation and Maintenance Cost

1) Distribution system maintenance Cost (Canal Maintenance Cost)

Maintenance cost of irrigation system is considered nonrecurring costs that are required to maintain the long term viability of the infrastructures. As agreed during the meeting with IMC) Irrigation Management Committee) member in February 02, 2015, the beneficiaries shall take the responsibility of maintaining the irrigation structure beyond farm pond.
The Maintenance Committee shall be responsible for the mobilization of the beneficiaries and maintaining of the facilities. Operation cost of the scheme covers but not limited to canal lining repair; gate maintenance; weed mowing along the canal; vandal damage; maintenance of drainage canals, cleaning of irrigation structures.

The beneficiary shall contribute their labor for routine maintenance acidity such as grass mowing, removal of sediment from of irrigation structures such as siphon, drops, division box and maintaining of drainage canals.
In addition, a certain fixed monetary contribution shall be made for administrative purpose and for the purchase of some important construction materials such as cement. The cost for this activity should be collected as part of the contribution for the activities of IMC. The list of irrigation facility maintenance and their frequency is presented in the table below.

Table: Typical List of Lined Irrigation Facility Maintenance Schedule

Items	Frequency of repair	Description	Quantity
Canal line repair	Once a year	Crack repair every 25 m per span in one year	14.7 km long
Siphon cleaning	Twice a year	Silt cleaning after rain storm	12 siphon
Weed mowing	Once a year	Grass along the canal	14.7 km
Culvert, drop structure, distribution structure repair	Once a year	Cracks repair size of 2 structure per year	5 culvert, 1100 drop, 20 distribution structure
Gate structure repair	Infrequent	Assume one gate per year	33 gates
Drainage canal repair	Twice a year	After rainy season	19.0 km
Farm Road	Twice a year	After rain	5.0 km

The costs of maintenance for irrigation facilities is estimated as follow

Items	Estimated annual cost	Remark
Canal line repair	590,352 × (0.025/14.7) = 1,004 US$	Cost for purchasing cement and other material shall be covered by the beneficiaries
Siphon cleaning	Nil	To be done by the beneficiaries
Weed mowing	Nil	To be done by the beneficiaries
Culvert, drop structure, distribution structure repair	980,823 × (2/1,125) = 1,744 US$	Cost for purchasing cement and other material shall be covered by the beneficiaries
Gate structure repair	712 × 1 = 712 US$	Purchased by beneficiaries
Drainage canal repair	Nil	To be done by the beneficiaries
Farm Road repair	Nil	To be done by the beneficiaries
Administration Cost	Assume 0.5$ per family per month = 0.5×12×228 = 1,368 US$	Purchase of note book, pen and other expense
Total Cost	4,828 US$	

The calculation for canal repair is made with the assumption that 25 m of canal length will be rehabilitated every year and cost is calculated by (0.025 km/total span) x total cost of canal. It is also similar for the other items where cost is needed.
From the above estimation the total cost of irrigation facilities maintenance that shall be covered by the beneficiaries is 4,828 US$ per year per month per 146 ha (Block A) which is about 33 US$ per hectare per year or 21 US$ per family.

2) Water charge

To determine the water charge (water fee) the amount of water used by each farmer or hectare is calculated. Using the metrological data of the area and applying Penman-Monteith Method (FAO) the monthly reference evapo-transpiration (ETo) of the area is calculated as shown below.

Table: Reference Evapo-transpiration per Month

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ETo (mm)	4.7	4.9	4.8	4.4	3.5	2.8	2.8	3.7	4.9	5.5	5.4	4.6

The actual amount of Irrigation Water Requirement (Crop Water Requirement) shall be determined from the reference evapo-transpiration (ET_0) calculated above. Considering the crop coefficient (Kc) and cropping intensity (crop ratio = CR) for the proposed irrigated crops in the area the crop evapo-transpiration (ETc) for a certain growth period is calculated as:

$$ETc_i = Kc_i \; x \; ET_{0i} \; x \; CR$$

Where ETc_i = crop evapo-transpiration for specific crop and growth period, *i* month
ET_{0i} = reference evapo-transpiration for specific growth period, *i* month,
Kc_i = crop coefficient for specific growth period, *i* month, used data from FAO
CR = crop ratio determined according to proposed area to be covered by each crop

The irrigation water requirement can be calculated by summing up all the crop evapo-transpiration for a given growth period as follow

$$IWRi = \sum_{i=1}^{n} (ET_{ci})$$

Where IWR_i = Irrigation Water Requirement for specific growth period (month), i
n = growth period (month)

The calculation result is presented in the following table

Table: Daily Crop Evapo-transpiration for Different Growth Period and Crops

Crop	C/R	Month	March	April	May	June	July	August	September	October
		ETo(mm/day)	4.8	4.4	3.5	2.8	2.8	3.7	4.9	5.5
Onion	14	KC		1.05	1.05	1.05	1.05	1.05	0.75	
		ETonion		0.64	0.51	0.41	0.41	0.54	0.51	
Potato	11	KC	1.15	1.15	1.15	1.15	1.15	0.75		
		ETpotato	0.60	0.55	0.44	0.35	0.35	0.30		
Sugar beans	31	KC					0.4	1.15	1.15	0.55
		ETbean					0.34	1.31	1.73	0.93
Green maize	31	KC					0.4	1.15	1.15	0.55
		ETmaize					0.34	1.31	1.73	0.93
Cabbage	7	KC			1.05	1.05	1.05	0.95		
		ETcabbage			0.25	0.20	0.20	0.24		
Tomato	7	KC			1	1	1	0.8		
		ETtomato			0.24	0.19	0.19	0.21		
White maize	67	KC	0.55		Maize, Chili and Paprika are irrigated in March as Supplementary irrigation					
		ETmaize	1.75							
Tabasco Chili	13	KC	0.75	0.75						
		ETchili	0.46	0.42						
Paprika	21	KC	0.90	0.75						
		ETpaprika	0.90	0.69						
Total		ETcrop	3.71	2.30	1.45	1.16	1.84	3.90	4.00	1.86

With this average monthly irrigation water requirement (crop evapo-transpiration) and using 60% irrigation efficiency of the project the total amount of water needed for each month including the water fee per month for the 146 ha of land at 6.56 US$/Mℓ charge rate is indicated in the following table:
(Where; 6.56 US$ comes from 1.06 US$/Mℓ of water levy, 4.50 US$/Mℓ of water tariff and 1.0 US$/Mℓ of catchment fee)

Table: Monthly Water Requirement and Water Fee for Block A

Item	unit	Jan	Feb	Mar	Apr.	May.	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Irrigation Water requirement													
IWR = ETcrop	(mm/day)			3.71	2.30	1.45	1.16	1.84	3.90	4.00	1.86		
Irrigation Efficiency				0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6		
Water Requirement per ha	(m^3/ha/day)	Off-season		61.9	38.37	24.08	19.27	30.73	65.02	66.14	30.95	Off-season	
Total irrigation Area	ha			146	146	146	146	146	146	146	146		
Total IWR per day	m^3/day			9,037.4	5,602.0	3,515.7	2,813.4	4,486.6	9,492.9	9,656.4	4,518.7		
Water requirement for household Consumption													
Consumption per family (20lt/day/person*5family)	m^3/day	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Number of families	Number	228	228	228	228	228	228	228	228	228	228	228	228
Daily consumption for the family of Block A	m^3/day	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8	22.8
Total water requirement													
Irrigation + consumption	m^3/day	22.8	22.8	9,060.2	5,624.8	3538.5	2,836.2	4509.4	9515.7	9,679	4541.5	22.8	22.8
Number of days per month	Day	31	28	31	30	31	30	31	31	30	31	30	31
Monthly water consumption	m^3/month	707	638	280,866	168,744	109,694	85,086	139,791	294,987	290,376	140,787	684	707
Water fee at $6.56 per Ml	$/1.000$m^3$	4.6	4.2	1,842.5	1,107.0	719.6	558.2	917.0	1,935.1	1,904.9	923.6	4.5	4.6
Total Cost including VAT	**$**	5.3	4.8	2,118.9	1,273.0	827.5	641.9	1,054.6	2,225.4	2,190.6	1,062.1	5.2	5.3

The irrigation period is between March and October where the pump is operated 8hr per day. During the other months the pump will be operated only for 1 hr a day to supply water for house hold purpose.

Note: water requirement during off-season is considered as water for household consumption (1 hr pumping per day). By law water for household consumption (primary purpose less than 5,000m3) is free of charge if extracted by the consumer from river, however, in this case since water is conveyed by pumping it will require operation and maintenance cost.

3) Electricity consumption

In the determination of electricity consumption the required power consumption of the motor can be calculated from the relationship between the pump shaft power, discharge rate, pumping head, pump efficiency as follow:
Mo=So/ηm; where Mo is power consumption of the motor, So is pump shaft power and ηm is the efficiency of electric motor which is 90%. So can be determined by the following formula
So=（0.163*γ*Q*H)/ ηp

Where

Q: pump Discharge rate which is 6.86 m3/min
H: Pumping head = 51 m
ηp: Efficiency of the pump = 77%
γ: Water density = 1
Which gives: So=（0.163*γ*Q*H)/ηp = 74.06 kW
Therefore, the Power Consumption of the motor will be calculated as
Mo=So/ηm = 82.29 kW

However actual electric consumption of the pump motor for each block is given as follow

Block Name	Discharge Capacity	Power consumption
Block A	6.86 m3/min	90 kW
Block B	6.14 m3/min	132 kW
Block C	6.82 m3/min	132 kW
Block D	9.48 m3/min	132 kW

From the above figures the electricity consumption can be calculated by multiplying the power consumption of the motor by the number of hour the pump operate. The summary of power consumption and the monthly cost of electricity bill is calculated and shown below. Normally the number of hour the pump operates shall be considered 8 hour per day. This hour is subdivided in to peak, standard and off-peak consumption rate in order to consider the difference bill rate of electricity in the time of use.

Table: Monthly Electricity Charge for Block A

	Description		Unit	Jan*	Feb*	Mar	Apr.	May.	Jun	Jul	Aug	Sep	Oct	Nov*	Dec*
Condition	Pump operation hour per day		hr	1	1	8	8	8	8	8	8	8	8	1	1
	Power consumption	90 kW	kW	90	90	90	90	90	90	90	90	90	90	90	90
	Number of motor in operation		No	1	1	3	2	2	1	1	3	3	2	1	1
Sunday/Holiday	Time breakdown	Operation hour	Unit price / Days	5	4	4	7	6	4	4	6	4	4	4	7
	Peak:17:00-20:00	0 hr	$0.13/Kwh												
	Standard:7:00-17:00 and 20:00-22:00	8 hr	$0.07/Kwh	31	25	555	603	605	174	276	875	593	403	50	88
	off-peak 0-7:00 and 22:00-0:00	0 hr	$0.04/Kwh												
Normal Day	Time breakdown	Operation hour	Unit price / Days	22	20	23	19	21	22	23	21	22	23	22	20
	Peak:7:00-12:00 & 17:00-21:00	4 hr	$0.13/Kwh		234	1,112	1,141	1,474	666	1107	1066	1136	1614		234
	Standard:12:00-17:00 and 21:00-22:00	4 hr	$0.07/Kwh	138	126	998	1024	1323	598	993	957	1020	1449	138	126
	off-peak 0-7:00 and 22:00-0:00	0 hr	$0.04/Kwh												
Saturday	Time breakdown	Operation hour	Unit price / Days	4	4	4	4	4	4	4	4	4	4	4	4
	Peak:7:00-11:00 & 17:00-20:00	3 hr	$0.13/Kwh			193	240	281	121	192	203	206	281		
	Standard:11:00-17:00 and 20:00-22:00	5 hr	$0.07/Kwh	25	42	347	215	252	109	173	364	371	252	25	25
	off-peak 0-7:00 and 22:00-0:00	0 hr	$0.04/Kwh												
Electricity Bill	Sub-Total Electricity Bill		USD	195	427	3,206	3,224	3,935	1,667	2,743	3,467	3,328	3,999	214	473
	VAT	15%	USD	29	64	481	483	590	250	411	520	499	600	32	71
	Rural Electrification Levy)	6%	USD	12	25	192	193	236	100	164	208	199	240	13	28
	Total bill per month		USD	236	517	3,880	3,901	4,761	2,018	3,318	4,195	4,026	4,839	259	572

Note: *The number of hour the pump is operated during off-season is only one hour per day to pump water for household consumption

Operation hour is sub-divided as follow (source ZETDC)

Day	Hour	Time of Use
Sunday and Holiday	7:00 ~ 17:00	Standard
Normal Day	7:00 ~ 12:00	Peak
	12:00 ~ 17:00	Standard
Saturday	7:00 ~ 11:00	Peak
	11:00 ~ 17:00	Standard

4) Pump Maintenance Cost

The following spare parts are considered needed for the operation and maintenance of the pump house in the course of its life span (The life span of the pump is considered as 25 years)

Table: Spare Parts Needed for the Maintenance of the Pump Station

No	names of parts	Life span	Every year	Every two years	Every 5 years
1	Impeller	10 years			○
2	Casing liner	5 years			○
3	Casing wearing ring	5 years			○
4	Impeller ring	5 years			○
5	Shaft	10 years			○
6	Sleeve	5 years			○
7	Socket coupling	5 years			○
8	Antifriction bearing	5 years			○
9	Sliding bearing	5 years			○
10	Submerged bearing (rubber)	5 years			○
11	Submerged bearing (ceramic)	10 years			○
12	Hard Metal sleeve	10 years			○
13	O-ring	until damaged		○	○
14	Sheet gasket	until damaged		○	○
15	Mechanical seal	2 years		○	○
16	Gland packing	1 year	○	○	○
17	Felt ring	2 years		○	○
18	Oil seal	2 years		○	○
19	Lubricant (Oil, Grease)	1 year	○	○	○
20	Rubber for coupling bolt	2 years	○	○	○
21	Throat bushing	2 years	○	○	○
22	V-belt	2 years	○	○	○

Accordingly the cost needed for the period of 10 years from the installation of the pump is calculated as shown below. The calculation also include labor and operator cost.

Assumption

- One operator at each pump station plus one supervisor for the entire 4 sites
- Two technician from Harare visiting the site once a year for 6 days
- Per diem = 25USD/day (lunch + dinner)
- Accommodation = 60USD/day (including breakfast)
- Number of days is calculated as two days travel (Harare to Nyakomba) plus (4 days for work at 4 pump house (one day per each pump house).
- Fuel is calculated using 300 km Harare Nyakomba one way plus 90 km Nyanga to Nyakomba.
- Rated at 8 km per liter

Table: Cost of Operation and Maintenance Needed for Block A

Item (spare parts)	Price	Unit	Year 1st		2nd		3rd		4th		5th		6th		7th		8th		9th		10th		Total after 10 year
			Labor	Spare part	Labor	Spare part	Labor	Spare part	Labor	Spare part	Labor	Spare part	Labor	Spare part	Labor	Spare part	Labor	Spare part	Labor	Spare part	Labor	Spare part	
impeller	8.544			-		-		-		-	○	-		-		-		-		-	●	8.544	8.544
casing liner	-			-		-		-		-		-		-		-		-		-		-	
casing wearing ring	1.243			-		-		-		-	●	1.243		-		-		-		-	●	1.243	1.243
impeller ring	-			-		-		-		-		-		-		-		-		-		-	
shaft	1.270			-		-		-		-	○	-		-		-		-		-	●	1.270	1.270
sleeve	2.969			-		-		-		-	●	2.969		-		-		-		-	●	2.969	5.939
socket coupling	-			-		-		-		-		-		-		-		-		-		-	
antifriction bearing	285			-		-		-		-	●	285		-		-		-		-	●	285	570
sliding bearing	-			-		-		-		-		-		-		-		-		-		-	
submerged bearing (rubber)	-			-		-		-		-		-		-		-		-		-		-	
submerged bearing (ceramic)	-			-		-		-		-		-		-		-		-		-		-	
Hard Metal sleeve	-			-		-		-		-		-		-		-		-		-		-	
O-ring	-			-		-		-		-		-		-		-		-		-		-	
Sheet gasketing	305			-	●	305		-	●	305	●	305	●	305		-	●	305		-	●	305	1.830
Mechanical seal	-			-		-		-		-		-		-		-		-		-		-	
Gland packing	508		●	508	●	508	●	508	●	508	●	508	●	508	●	508	●	508	●	508	●	508	5.080
felt ring	-			-		-		-		-		-		-		-		-		-		-	
oil seal	61			-	●	61		-	●	61	○	-	●	61		-	●	61		-	●	61	305
Lubricant (Oil, Grease)	296			-	●	296		-	●	296	○	-	●	296		-	●	296		-	●	296	1.480
Rubber for coupling bolt	742			-	●	742		-	●	742	○	-	●	742		-	●	742		-	●	742	3.710
Throat bushing	-			-		-		-		-		-		-		-		-		-		-	
V-belt	-			-		-		-		-		-		-		-		-		-		-	
Sub-total				508		1.912		508		1912		5.310		1912		508		1912		508		16.224	31.218
No of pump				3		3		3		3		3		3		3		3		3		3	3
Summary of the cost of operation and maintenance																							
Spare part fee US $				1.524		5.736		1.524		5.736		15.930		5.736		1.524		5.736		1.524		48.672	93.652
No. of day for field work		Day	6		6		6		6		6		6		6		6		6		6		
No. of people		Man	2		2		2		2		2		2		2		2		2		2		
Per diem (6day/year)	25	US$/MD	12	300	12	300	12	300	12	300	12	300	12	300	12	300	12	300	12	300	12	300	3.000
Accommodation US$	60	US$/MD	8	480	8	480	8	480	8	480	8	480	8	480	8	480	8	480	8	480	8	480	4.800
Transport (600+90*2*4) km÷8km/lit	1.4	US$/liter	210	283.5	210	283.5	210	283.5	210	283.5	210	283.5	210	283.5	210	283.5	210	283.5	210	283.5	210	283.5	4.935
Support (including silt clearing)	10	US$/MD	5	200	5	200	5	200	5	200	5	200	5	200	5	200	5	200	5	200	5	200	2.000
Salary of Operator	700	US$/MM	12	8.400	12	8.400	12	8.400	12	8.400	12	8.400	12	8.400	12	8.400	12	8.400	12	8.400	12	8.400	84.000
Salary of Supervisor(700/4*175)	175	US$/MM	12	2.100	12	2.100	12	2.100	12	2.100	12	2.100	12	2.100	12	2.100	12	2.100	12	2.100	12	2.100	21.100
Total $/year			**210**	**13,260**	**210**	**17,474**	**210**	**13,260**	**210**	**17,474**	**210**	**27,667**	**210**	**17,474**	**210**	**13,260**	**210**	**17,474**	**210**	**13,260**	**210**	**60,409**	**213,389**

●Part replacement
○Overhaul

According to the above calculation, the total cost of operation and maintenance for Block is estimated as 213,389 US$ per ten year. Similarly the total cost of operation and maintenance for Block B, Block C and Block D is calculated and the result is tabulated as below. This vale shall be distributed over the 10 year period and shall be used for the operation and maintenance of the scheme (pump house and pond). The summary of O & M cost per block is presented below:

Table: Pump O & M Cost per Block

Block	Cost for 10 year ($/10 year)	Cost per year ($/year)
Block A	213,389	21,339
Block B	319,994	31,999
Block C	319,511	31,951
Block D	229,370	22,937

5) Cost share by block

Using the above cost for water charge, electricity bill and the cost of operation and maintenance of the scheme the cost share that shall be covered by each beneficiary is summarized below

Block A

Table: Summary of O and M Cost for Nyakomba Irrigation Scheme (BLOCK A)

Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year Cost
Electricity charge	236	517	3,880	3,901	4,761	2,018	3,319	4,195	4,026	4,840	259	573	32,525
Water charge	5	5	2,119	1,273	828	642	1,055	2,225	2,191	1,062	5	5	11,415
Pump maintenance cost	1,778	1,778	1,778	1,778	1,778	1,778	1,778	1,778	1,778	1,779	1,779	1,779	21,339
Canal maintenance cost	401	401	401	401	401	401	402	402	402	402	402	402	4,818
Total													70,097
Per farmer (228 family)													307

Block B

Table: Summary of O and M Cost for Nyakomba Irrigation Scheme (BLOCK B)

Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year cost
Electricity charge	347	313	7,283	6,689	6,983	3,431	7,098	10,474	10,292	7,098	335	347	60,690
Water charge	3	31	1,888	1,145	755	592	955	1,981	1,950	961	34	35	10,329
Pump maintenance cost	2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	2,667	31,999
Canal maintenance cost	352	352	352	352	352	352	352	352	352	352	352	352	4,224
Total													107,242
Per farmer (128 family)													838

Block C

Table: Summary of O and M Cost for Nyakomba Irrigation Scheme (BLOCK C)

Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year cost
Electricity charge	347	313	10,647	6,689	6,983	3,431	7,098	10,474	10,292	7,098	335	347	64,054
Water charge	4	31	1,699	1,032	682	535	861	1,783	1,755	1,091	34	35	9,543
Pump maintenance cost	2,663	2,663	2,663	2,663	2,663	2,663	2,663	2,663	2,663	2,663	2,663	2,663	31,951
Canal maintenance cost	316	316	316	316	316	316	316	316	316	316	316	316	3,795
Total													109,343
Per farmer (165 family)													663

Block D

Table: Summary of O and M Cost for Nyakomba Irrigation Scheme (BLOCK D)

Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year cost
Electricity charge	610	556	1,858	7,217	7,557	3,726	7,714	11,336	11,179	7,714	598	590	60,656
Water charge	6	31	2,800	1,692	1,110	867	1,407	2,939	2,893	1,091	34	35	14,904
Pump maintenance cost	1,911	1,911	1,911	1,911	1,911	1,911	1,911	1,911	1,911	1,911	1,911	1,911	22,937
Canal maintenance cost	525	525	525	525	525	525	525	525	525	525	525	525	6,303
Total													104,800
Per farmer (239 family)													438

Total of Nyakomba Irrigation Scheme

Table: Summary of O and M Cost for Nyakomba Irrigation Scheme (Total)

Category	Block A	Block B	Block C	Block D	Total/year
Electricity charge	32,525	60,690	64,054	60,656	217,925
Water charge	11,415	10,329	9,543	14,904	46,191
Pump maintenance cost	21,339	31,999	31,951	22,937	108,226
Canal maintenance cost	4,818	4,224	3,795	6,303	19,140
Total	70,097	107,242	109,343	104,800	391,482
Per farmer	307	838	663	438	515

4. Affordability

The annual income of beneficiary of Nyakomba project is estimated using the available data collected from AGRITEX and proposed production plan. The assumption is that all the beneficiary will engaged in the production of the crop on the entire of irrigable land of Block A, B, C and Block D. Table below shows the basic information on market price, production cost, yield and profit from each crops produced in the area.

Table: Production Profit Gained from One Hectare (Source: AGRITEX)

No	Crop type	Water source	Expected Yield (a) t/ha	Selling price (b) $/t	Total cost (c)=(a)*(b) $/ha	Production Cost (d) $/ha	Profit (e) = c-(d) $/ha
1	White maize	Supplementary irrigation	8.5	390	3315	610	2,705
2	Tabasco Chili	Supplementary irrigation	14	570	7980	2387	5,593
3	Sugar beans	Irrigated	3	1,100	3300	675	2,625
4	Paprika	Supplementary irrigation	4	2,000	8000	1146	6,854
5	Green Maize	Irrigated	50,000 cobs	$/12 cobs *	4,167	755	3,412
6	Onion	Irrigated	27	667	18009	3270	14,739
7	Potato	Irrigated	22	667	14674	2825	11,849
8	Tomato	Irrigated	30	500	15000	1142	13,858

Note *: Since the green maize is used for grilled corn it is sold at 12 cobs per dollar

The total profit incurred by producing these crops from each blocks and annual income per beneficiaries is calculated in the following tables.

Table: Annual income from producing the proposed crops for Block A

Crop type	Annual planted area (ha) (f)	Profit ($/year/ha) (d)	Profit$/year (m) = (k)-(l)
White maize	80	2,705	216,400
Tabasco Chili	15	5,593	83,895
Sugar beans	45	2,625	118,125
Paprika	35	6,854	239,890
Green Maize	45	3,412	153,540
Onion	20	14,739	294,780
Potato	16	11,849	189,584
Tomato	20	13,858	277,160
Total profit from 146 hectare per year			1,573,374
No. of registered Beneficiary			228
Gross profit per farmer per year			6,900
Operation and maintenance cost per year per farmer per year			307
Net profit per farmer per year			6,593
Percentage paid for O&M from gross profit			4.4%

Table: Annual income from producing the proposed crops for Block B

Crop type	Annual planted area (ha) (f)	Profit ($/year/ha) (d)	Profit$/year (m) = (k)-(l)
White maize	70	2,705	189,350
Tabasco Chili	25	5,593	139,825
Sugar beans	39	2,625	102,375
Paprika	10	6,854	68,540
Green Maize	39	3,412	133,068
Onion	18	14,739	265,302
Potato	14	11,849	165,886
Tomato	18	13,858	249,444
Total profit from 128 hectare per year			1,313,790
No. of registered Beneficiary			128
Gross profit per farmer per year			10,264
Operation and maintenance cost per year per farmer per year			838
Net profit per farmer per year			9,426
Percentage paid for O&M from gross profit			8.2%

Table: Annual income from producing the proposed crops for Block C

Crop type	Annual planted area (ha) (f)	Profit ($/year/ha) (d)	Profit$/year (m) = (k)-(l)
White maize	60	2,705	162,300
Tabasco Chili	20	5,593	111,860
Sugar beans	35	2,625	91,875
Paprika	10	6,854	68,540
Green Maize	35	3,412	119,420
Onion	16	14,739	235,824
Potato	13	11,849	154,037
Tomato	16	13,858	221,728
Total profit from 115 hectare per year			1,165,584
No. of registered Beneficiary			165
Gross profit per farmer per year			7,064
Operation and maintenance cost per year per farmer per year			663
Net profit per farmer per year			6,401
Percentage paid for O&M from gross profit			9.4%

Table: Annual income from producing the proposed crops for Block D

Crop type	Annual planted area (ha) (f)	Profit ($/year/ha) (d)	Profit$/year (m) = (k)-(l)
White maize	120	2,705	324,600
Tabasco Chili	15	5,593	83,895
Sugar beans	59	2,625	154,875
Paprika	15	6,854	102,810
Green Maize	59	3,412	201,308
Onion	26	14,739	383,214
Potato	21	11,849	248,829
Tomato	26	13,858	360,308
Total profit from 191 hectare per year			1,859,839
No. of registered Beneficiary			239
Gross profit per farmer per year			7,782
Operation and maintenance cost per year per farmer per year			438
Net profit per farmer per year			7,344
Percentage paid for O&M from gross profit			5.6%

Table: Annual income from producing the proposed crops for Total

Crop type	Annual planted area (ha) (f)	Profit ($/year/ha) (d)	Profit$/year (m) = (k)-(l)
White maize	330	2,705	892,650
Tabasco Chili	75	5,593	419,475
Sugar beans	179	2,625	469,875
Paprika	70	6,854	479,780
Green Maize	179	3,412	610,748
Onion	79	14,739	1,164,381
Potato	64	11,849	758,336
Tomato	80	13,858	1,108,640
Total profit from 580 hectare per year			5,903,885
No. of registered Beneficiary			760
Gross profit per farmer per year			7,768
Operation and maintenance cost per year per farmer per year			515
Net profit per farmer per year			7,253
Percentage paid for O&M from gross profit			6.6%

As indicated above the annual profit gained from the production of these crops on average is more than 7,768 US$ per family. Note that this profit can only be achieved if all the farmers are producing these crops on the entire 580 ha of irrigable land.
Considering the above analysis the beneficiaries of each block can easily afford the cost of operation and maintenance of the project for the scheme to run smoothly, which is about 515 US$ per year per family (between 4.4 to 9.4 % of the gross profit per annum).

5. Conclusion and Recommendation

Provided that the beneficiaries engaged in the production of irrigated crops according to the proposed plan, they can afford to cover the cost for the operation and maintenance of the scheme provided ZINWA took responsibility to manage the scheme efficiently and transparently.
A clear bylaw has to be set that governs the operation of the scheme. Transparency on the activity of ZINWA is paramount for creating trust between the beneficiary and the staffs of ZINWA.
As a recommendation a yearly financial report has to be prepared and presented to the beneficiary and WUA must be involved in the process of approving the routine maintenance work and flow of fund necessary for the maintenance of the scheme.