

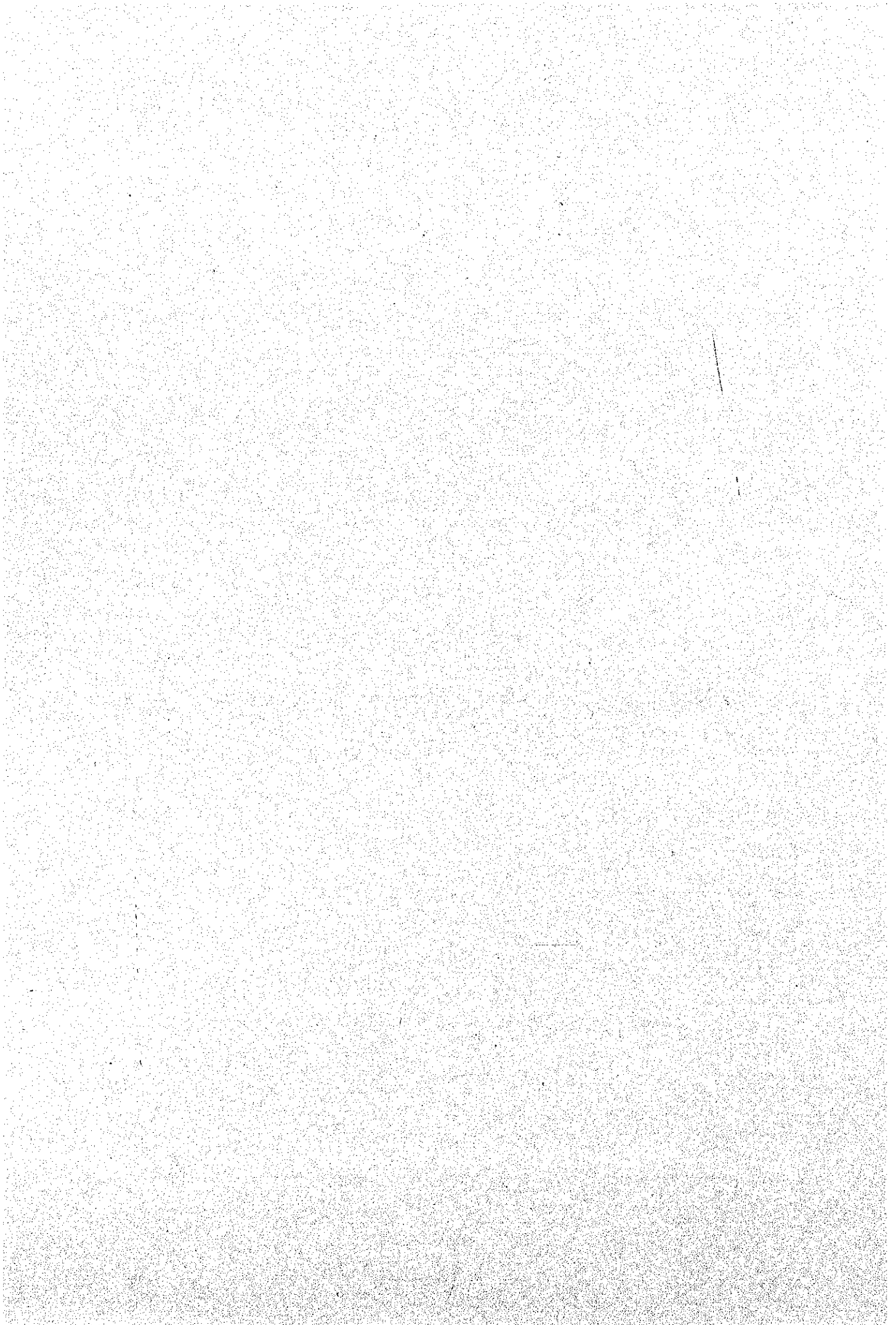
JAPAN INTERNATIONAL  
COOPERATION AGENCY  
MINISTRY OF LANDS, AGRICULTURE  
AND WATER DEVELOPMENT  
THE REPUBLIC OF ZIMBABWE

**BASIC DESIGN STUDY REPORT  
ON  
THE NYAKOMBA  
IRRIGATION DEVELOPMENT  
PROJECT  
IN  
THE REPUBLIC OF ZIMBABWE**

**FEBRUARY 1995**

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## PREFACE

In response to a request from the Government of the Republic of Zimbabwe, the Government of Japan decided to conduct a basic design study on the Nyakomba Irrigation Development Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Zimbabwe a study team headed by Mr. Mitsuhiro OTA, Director, General Affairs Division, Tsukuba International Agricultural Training Center, JICA and constituted by members of Taiyo Consultants Co., Ltd. and Sanyu Consultants Inc. from August 30 to September 28, 1994.

The team held discussions with the officials concerned of the Government of Zimbabwe, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Zimbabwe in order to discuss a draft report, and as this result, 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 countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zimbabwe for their close cooperation extended to the teams.

February 1995



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Kimio Fujita

President  
Japan International Cooperation Agency

## QUESTION

1. A company has a current ratio of 1.5 and a debt-to-equity ratio of 0.5. If the company's current assets are \$100,000, what is the value of its current liabilities?

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10. A company has a current ratio of 1.5 and a debt-to-equity ratio of 0.5. If the company's current assets are \$100,000, what is the value of its current liabilities?



February 1995

Mr. Kimio Fujita  
President  
Japan International Cooperation Agency  
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Nyakomba Irrigation Development Project in the Republic of Zimbabwe.

This study was conducted by Taiyo Consultants Co., Ltd. and Sanyu Consultants Inc., under a contract to JICA, during the period August 26, 1994 to February 24, 1995. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Zimbabwe and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs, and Ministry of Agriculture, Forestry and Fisheries. We would also like to express our gratitude to the officials concerned of the Department of Agricultural, Technical and Extension Services, the Department of Water Development and the Embassy of Japan in Zimbabwe for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

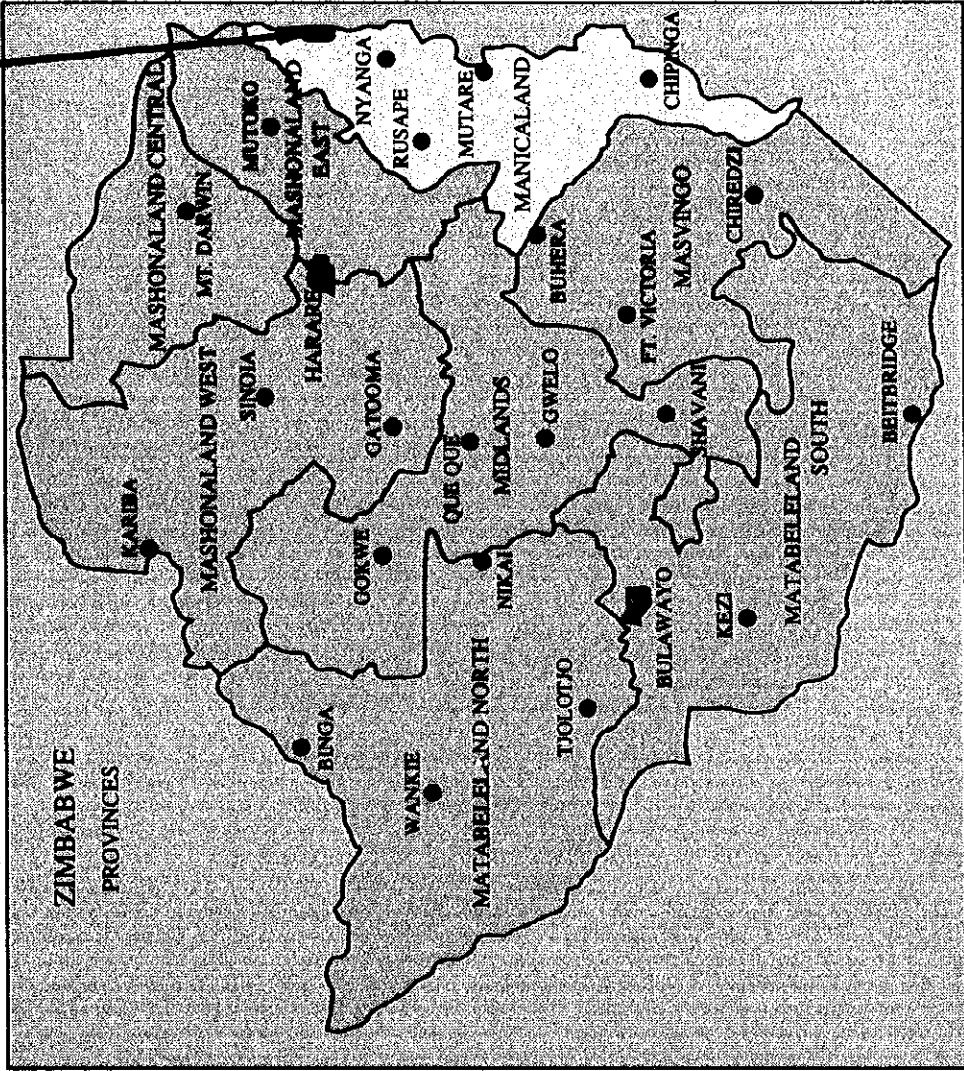
Very truly yours.

  
Ryosuke SAKANASHI

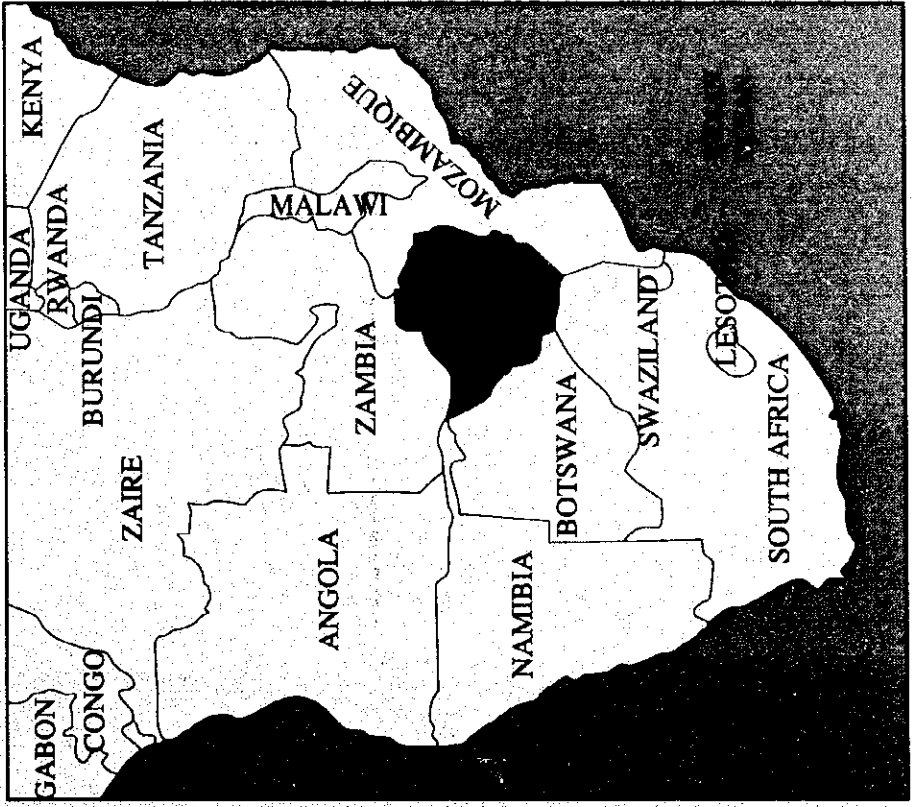
Project manager,  
Basic design study team on  
The Nyakomba Irrigation Development Project  
Taiyo Consultants Co., Ltd.



**PROJECT AREA**

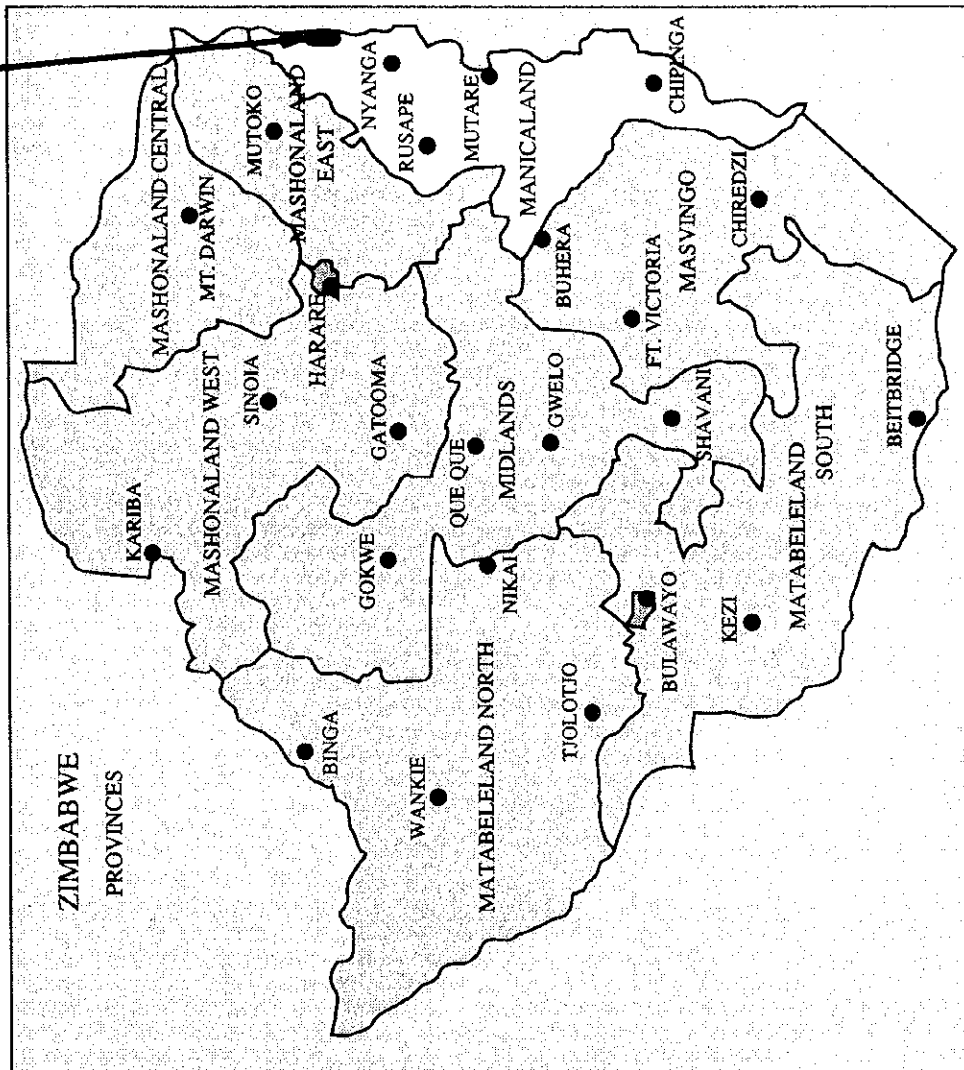


**COUNTRIES OF SOUTHERN AFRICA**

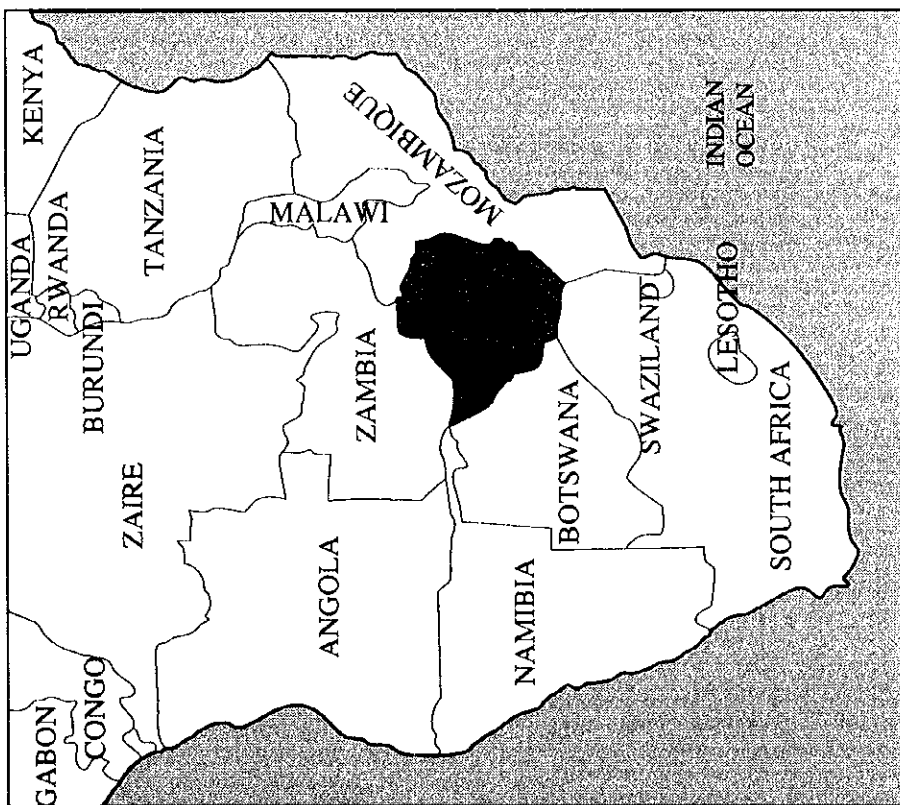


**LOCATION MAP**

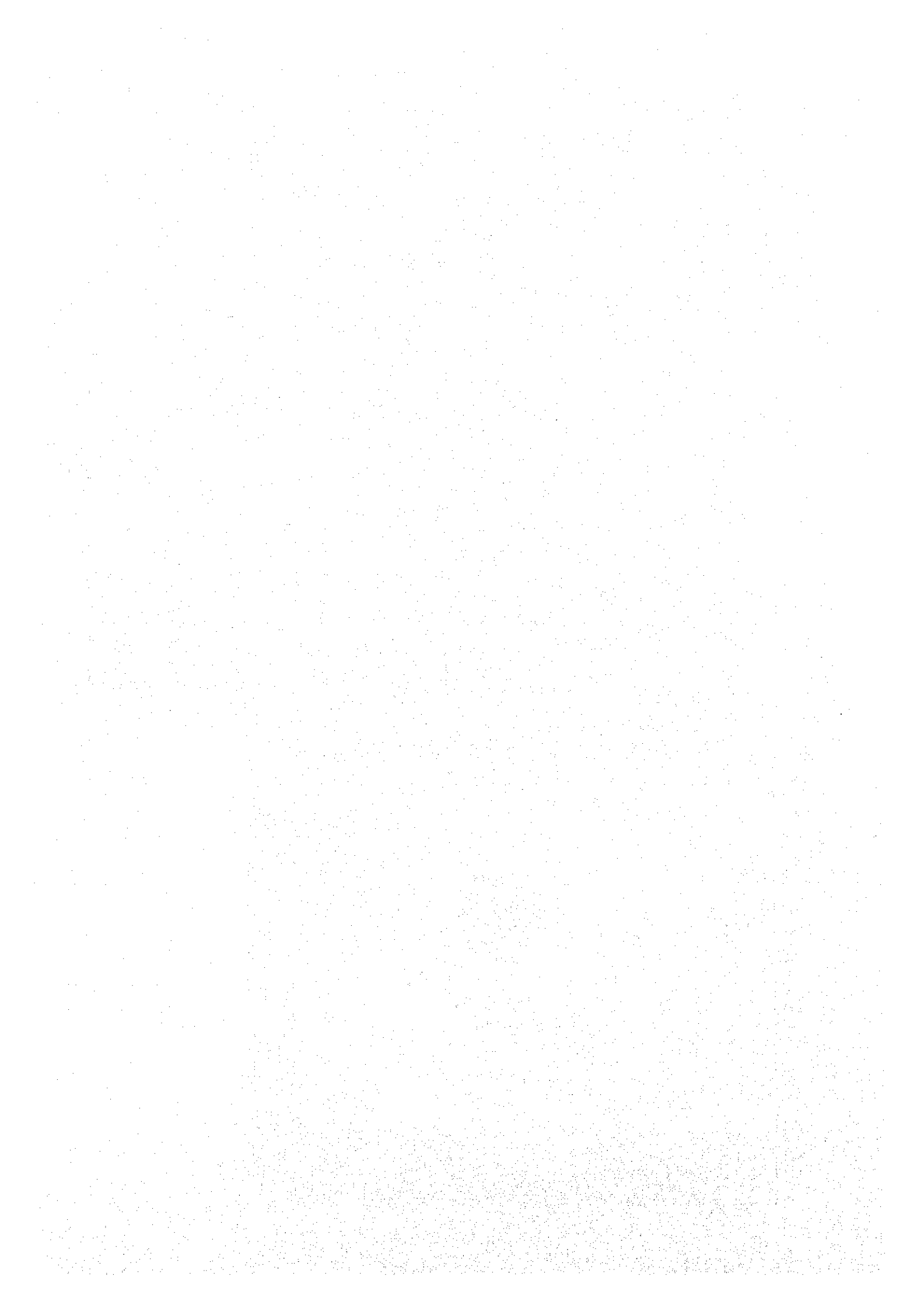
PROJECT AREA

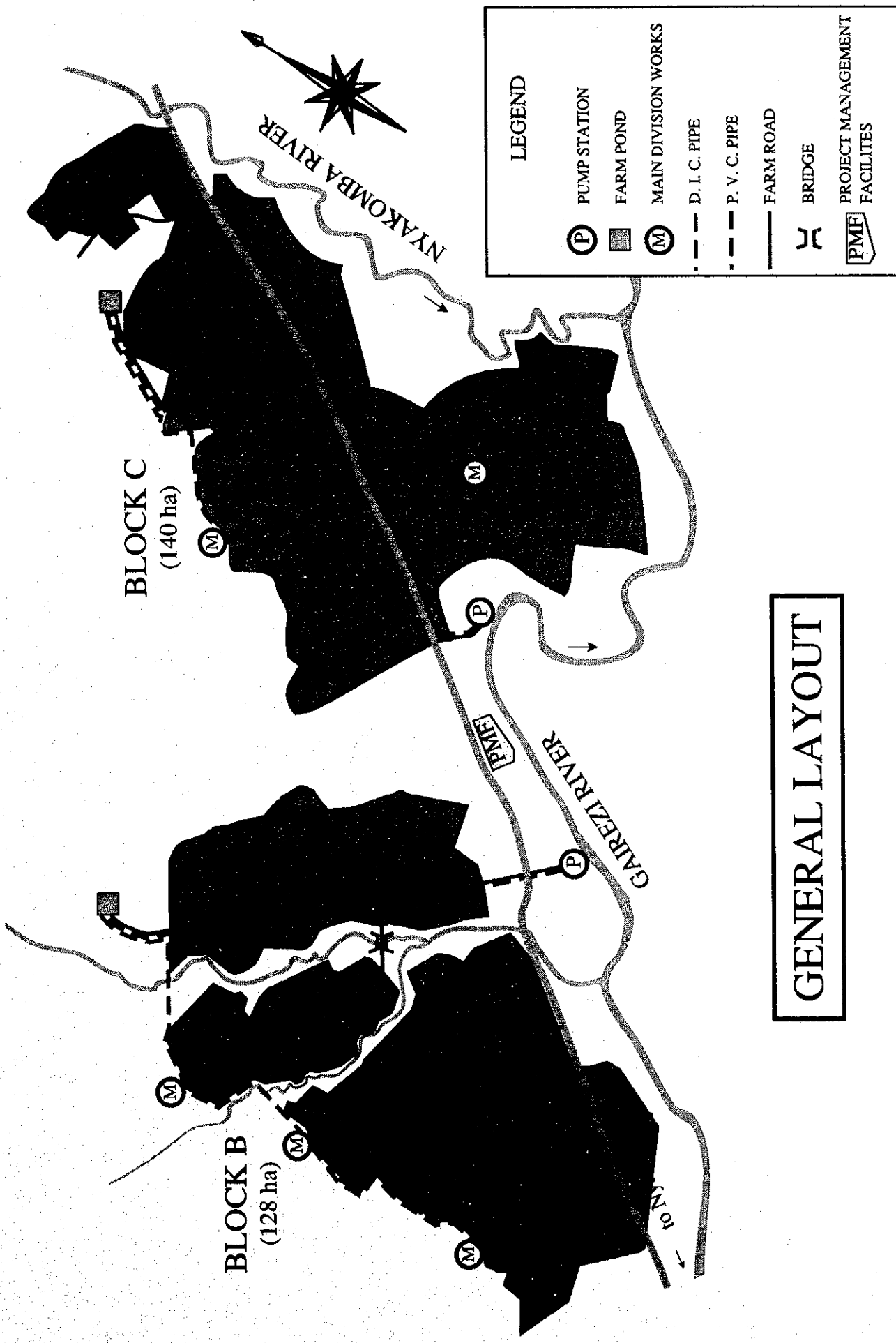


COUNTRIES OF SOUTHERN AFRICA



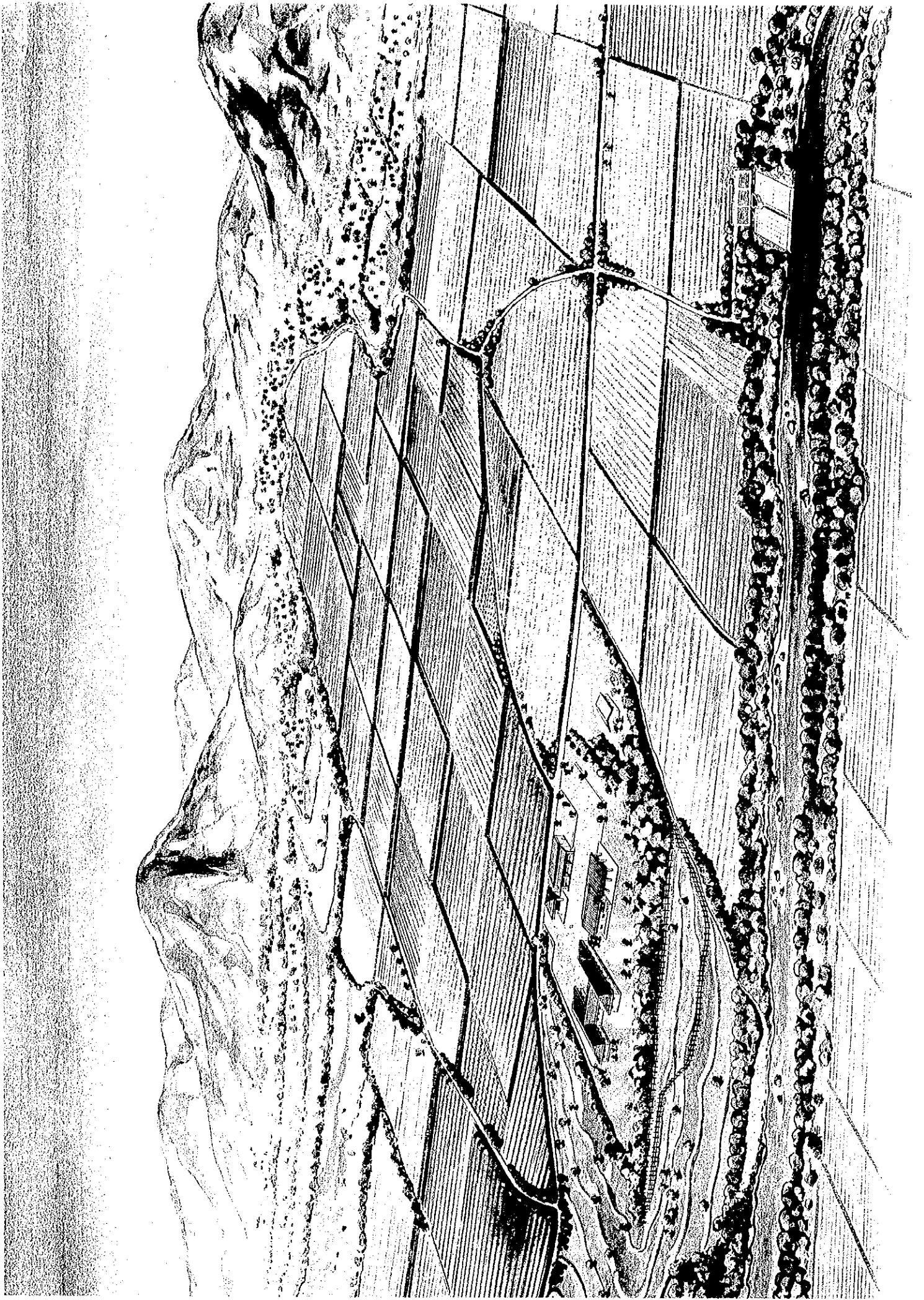
LOCATION MAP





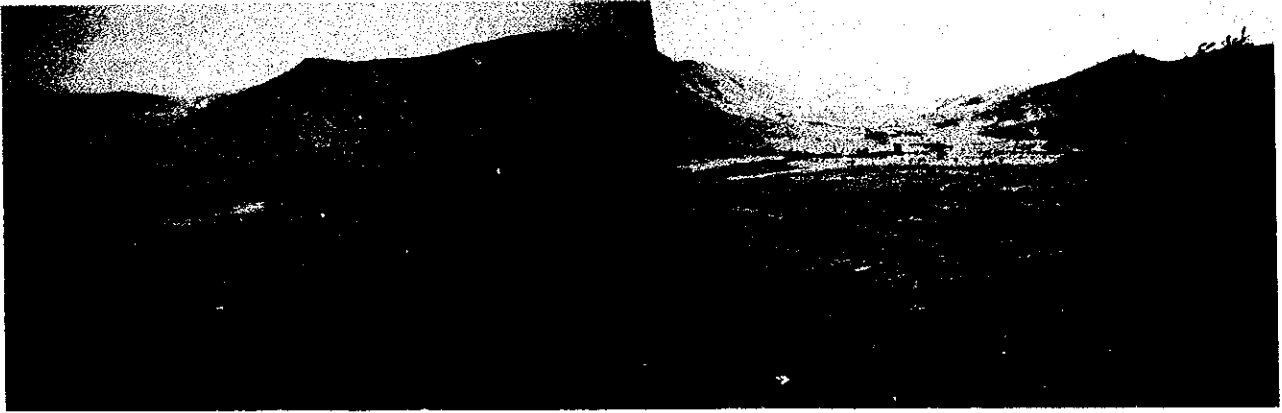
# GENERAL LAYOUT



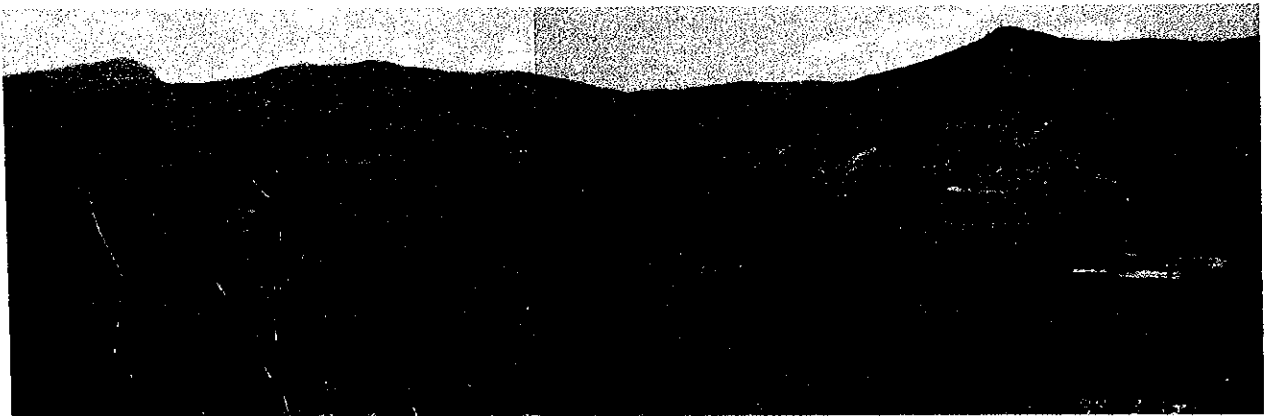








Panorama of Block B



Panorama of Block C



Proposed Site for Pump Station



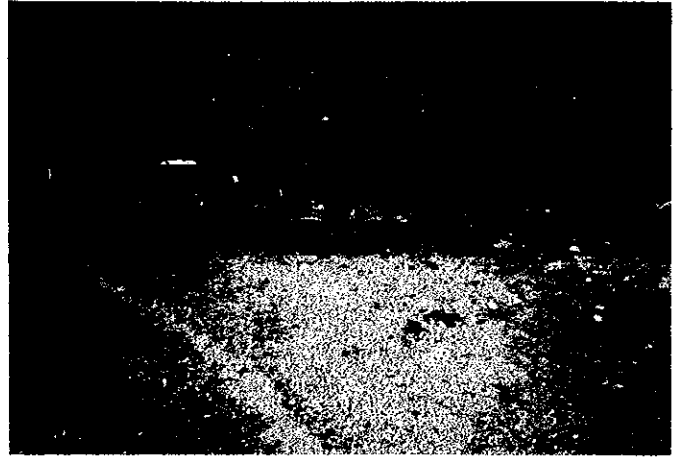
Proposed Site for Farm Pond

Block B



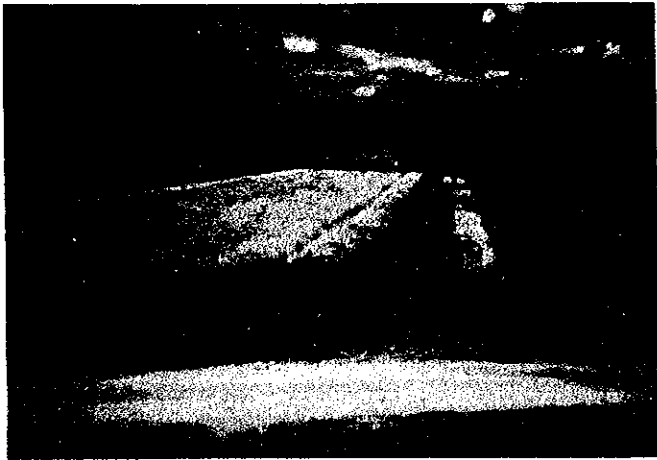


Proposed Site for Pump Station



Proposed Site for Farm Pond

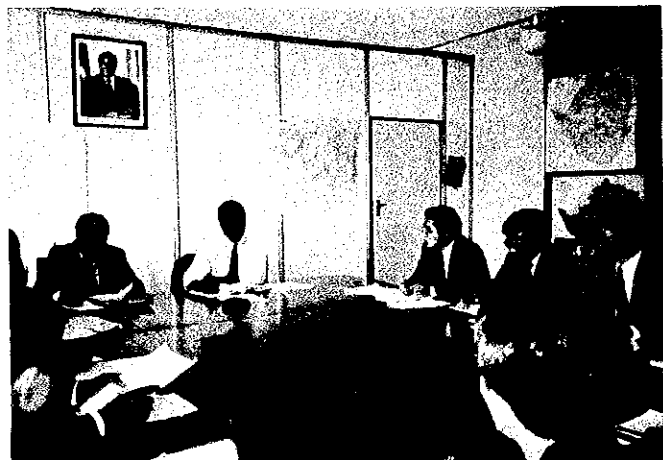
Block C



View of the Nyamaropa Irrigation Scheme



View of the Project for the Construction of Medium Size Dams in Masvingo Province



Meeting at MLAWD



Open Air Meeting for Explanation of the Project to the Farmers in the Communal Land



## **SUMMARY**

The Republic of Zimbabwe, located in the southern part of Africa, occupies 391,000 km<sup>2</sup>, with a population of 10,840,000 (as of 1993). Agriculture is the key industry of the country. The First National Development Plan (1986-1990) promoted agricultural development in the Communal Lands, where development has progressed considerably more slowly than in urban areas and on the Large Scale Commercial Farms (LSCF). In the current Second National Development Plan (1991-1995), based on the Structure Adjustment Program, top priority is given to development in the Communal Lands again, and the Ministry of Lands, Agriculture, and Water Development has been playing a key role in promoting the resettlement program to provide poor farmers and/or peasant farmers with land.

The Ministry of Lands, Agriculture, and Rural Resettlement has selected the Nyakomba Ward, which is one of the typical Communal Lands, located in the north-eastern part of the Manicaland Province, as one of the proposed sites of the program.

The Nyakomba Ward is located in a remote area which practices a single-crop agriculture in the rainy season utilizing rain as a water source at present. On the other hand, excellent crops are cultivated in the neighboring Nyamaropa Irrigation Scheme with the irrigation facilities, and the same development has been desired in the Nyakomba Ward.

Under these conditions, the Government of the Republic of Zimbabwe requested the Government of Japan to render assistance in formation of the Nyakomba Irrigation Development Project, and the Japan International Cooperation Agency (JICA) conducted a Feasibility Study on this Project from 1989 to 1990. Consequently, the feasibility of the Project for pumping irrigation was confirmed in the Study.

On the basis of this Study, the Government of Zimbabwe requested construction of irrigation facilities and appurtenant facilities in the Nyakomba Ward under Japan's Grant Aid Scheme.

In response to this request, the Government of Japan decided to conduct a basic design study on the Nyakomba Irrigation Development Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Zimbabwe a study team consisting of 7 members with a team leader from August 30 to September 28, 1994.

The team explained the Inception Report and held discussions with the officials concerned of the Government of Zimbabwe, and conducted field surveys at the study area and at other similar projects in Zimbabwe.

In the course of the discussions and field surveys, both parties confirmed the main items, i.e., contents of the Project, electrification, water right, technical cooperation, the executing agencies and budgetary measures. Consequently, the Minutes of Discussions regarding the aforementioned items were signed by the Permanent Secretary of the Ministry of Lands, Agriculture and Water Development and the leader of the study team on September 9, 1994.

Based on the field work results, further studies were conducted in Japan, and a draft report was prepared. Then, a mission was sent to Zimbabwe in order to explain and discuss the draft report from January 14 to January 23, 1995.

Consequently, the Minutes of Discussions regarding the acknowledgment of the draft report and some other relevant matters were signed by the Permanent Secretary of the Ministry of Lands, Agriculture and Water Development and the leader of the mission on January 18, 1995.

Finally, this report has been compiled to present the project background and the basic design for the project's facilities and equipment.

Concerning the Nyakomba Irrigation Project, it is certain that irrigation farming by means of irrigation pumps is indispensable. However, in consideration of insufficient local experience with irrigation systems utilizing pumps with such high pump heads and the huge proposed area, it is judged that development of the entire 680 ha of this Project is difficult.

Under these conditions, it is judged that limited implementation in a small area of one or two blocks, as the first step, is appropriate in this case. Consequently, Block B and Block C were selected as priority blocks, and field surveys were carried out on those two blocks. The pending problems were studied as well, and realization of electrification of the site and confirmation of water rights were clarified. As a result, the implementation of the Project is judged practicable.

The positive effects and practicability of the Project and the execution capacity of the parties concerned in Zimbabwe have been confirmed as appropriate from the outcome of the study made so far, and the positive effects of the Project conform to the system of Japan's Grant Aid. In consequence, concerning the implementation of the Project, it is judged to be appropriate to be done under Japan's Grant Aid. Accordingly, on the condition that the Grant Aid is provided, it was decided that the basic design would be carried out on Block B and Block C through a meeting among the Ministries concerned in Japan.

The facilities to be designed are one pump station, head races and one farm pond functioning as an outlet reservoir of the water from the pump station, at each block, i.e., Block B and Block C. In the farms, concrete irrigation canals, earth drainage canals and gravel paved farm roads are to be designed.

The Project Management Facilities, i.e., project management building, workshop/garage, agricultural warehouse and fuel station are to be designed as a base of AGRITEX and the farmers union in order to manage agricultural work.

Necessary equipment is planned for as well, in order to carry out smooth management of the facilities after the project facilities are transferred to the Government of Zimbabwe.

The Facilities and Equipment to be provided by the Project are as follows.

Irrigation Pump Station		Block B	Block C
Pumps	Bore Diameter:	ø 250 mm	ø 250 mm
	Type:	Horizontal, Double Suction	Horizontal, Double Suction
	Discharge:	6.14 m <sup>3</sup> /min	6.73 m <sup>3</sup> /min
	Unit:	3 units	3 units
	Total Head:	73.87 m	81.40 m
	Motor Power:	132 kw	150 kw

#### Irrigation Facilities, Drainage Canals and Farm Roads

		Block B	Block C
Head Races			
	DCI Pipe, PVC Pipe:	L = 3.7 km	L = 3.8 km
Farm Ponds	Capacity:	560 m <sup>3</sup>	620 m <sup>3</sup>
T-type Reinforced Concrete Retaining Wall			
Irrigation Canals			
	Reinforced Concrete:	L = 12.0 km	L = 15.0 km
Drainage Canals			
	Earth Canal:	L = 14.2 km	L = 16.3 km
Farm Roads (Gravel Pavement)			
	Trunk Farm Road:	L = 150 m	L = 160m
	Secondary Farm Road:	L = 3.9 km	L = 4.1 km

#### Project Management Facilities

Project Management Building:	603 m <sup>2</sup>
Workshop/Garage:	272 m <sup>2</sup>
Agricultural Warehouse:	162 m <sup>2</sup>
Fuel Station:	52 m <sup>2</sup>

#### Equipment

Agricultural Machines:		1 unit each
Tractor:	4WD, 75 HP	
Attachments:	Rotary Harrow, Disc Plow, Ridger, Trailer	
Field Maintenance Machine:		
Motor Grader:	B = 2.80 m	1 unit
Other Equipment:		
Pickup:	500 kg	1 unit
Truck:	6 ton	1 unit
Motorcycle:	90 cc	1 unit
Equipment for the Workshop		1 set



Agriculture in the Nyakomba Ward is single-crop agriculture in the rainy season utilizing rain as a water source at present. Therefore, drought easily affects yield, and there were two big droughts in 1991/92 and 1993/94. In particular 1991/92 year was a serious drought year throughout Zimbabwe, and no crops were harvested in Nyakomba then.

On the other hand, agriculture is carried out with irrigation facilities in the neighboring Nyamaropa Irrigation Scheme, so that area is not affected by drought

The cropping plan for the Project is decided in consideration of the crops recommended for the Nyakomba Ward and the Nyamaropa Irrigation Scheme by AGRITEX. Based on studies of replant failure and cropping seasons, a combination of maize + vegetables (potatoes and tomatoes) is selected. Tobacco continues to be a very profitable crop, but, as cultivation will be reduced in future, it is excluded from the plan.

After irrigation-based agriculture begins, a farmers union must be organized in accordance with the by-laws of AGRITEX to meet the anticipated need for project management involving all the farmers in order to establish efficient water use and stable agricultural management.

The farmers union will be organized under guidance of the Counselor of the ward and the officials of AGRITEX in charge of the ward.

The irrigation system of the Project is as follows. Irrigation water is drawn from the Gairezi River by pumps, then pumped through pipelines to farm ponds constructed at elevated sites within the project area. Then the water is delivered to main division works, before open concrete irrigation canals carry it from these main division works to the farms.

Concerning the selection of pumps, 3 units of double suction horizontal type pumps with a bore of 250 mm are selected in consideration of pump combination.

Electric motors are selected as prime movers, and required power will be 132 kw and 150 kw in Block B and Block C respectively.

Flywheels are applied in order to prevent the condition known as water hammer that may possibly occur at the time of power stoppages due to high pump heads.

Pipelines are installed from the pump station to the farm pond (high pressure section) and from the farm pond to the main division works and between the main division works (low pressure sections) at each block.

Diameters of pipelines are designed to be  $\phi$  300 ~  $\phi$  500 mm depending on the discharge. Ductile cast-iron pipes are applied for the high pressure sections and PVC pipes are applied for the low pressure sections, and the lengths are 3,694 m and 3,762 m for Block B and Block C respectively.

Air valves are installed at intervals of 400 to 500 m on the line, and on longitudinal protrusions; blow-off valves are provided on longitudinal depressions for operation and maintenance.

To guarantee a stable water supply, farm ponds serving the additional role of discharge chambers are constructed. The capacity of each farm pond is determined in accordance with the pump's allowed shut-down period. Subsequently, the volume of water pumped in 0.5 hour will be considered to be the capacity of the farm ponds. The capacity of each farm pond is 560 m<sup>3</sup> and 620 m<sup>3</sup> for Block B and Block C respectively. T-type reinforced concrete retaining walls are applied for the structure of the farm ponds.

Irrigation canals are constructed to distribute the water from the main division works with a disk valve to each farm in the project area. The irrigation canals are reinforced concrete trapezoidal sections, and their lengths are 12,035 m and 14,998 m for Block B and Block C respectively.

Along the irrigation canals, work is carried out at various points as necessary to provide such facilities as division works, drops, road cross siphons, canal cross siphons, canal cross culverts, entrance works, cut throat flumes and chutes.

Drainage canals are installed to drain rain water in the project area. The drainage canals are generally constructed along low-lying areas which are presently used as natural drainage. The ends of canals are connected to streams and to the Gairezi River. The drainage canals are trapezoidal-shaped earth canals, and their lengths are 14,163 m and 16,336 m for Block B and Block C respectively.

Along the drainage canals, work is carried out at various points as necessary to provide such facilities as confluent facilities, ground sills, road cross culverts, revetment works, canal cross culverts, entrance works and chutes.

Trunk farm roads designed for the use of big trucks link arterial district roads with the pump stations, and are used to deliver machinery. Farms are provided with secondary farm roads for use in farming activities and canal inspections. In principle, the secondary farm roads are constructed on relatively high land.

The farm roads are embanked, and the trunk farm roads are 5 m wide while the secondary farm roads are 3 m wide. Embankments are 40 cm high for the trunk farm roads while 30 cm high for the secondary farm roads, and the lengths of the trunk farm roads and secondary farm roads are 150 m and 3,915 m for Block B and 160 m and 4,096 m for Block C respectively.

Road bridges are constructed at intersections between the proposed roads and existing small rivers. The bridges are of box-culvert construction.

Hand-pumped wells are constructed beside the ponds, and wash stands are provided beside these wells.

The Project Management Facilities are constructed in the centre of Block B and Block C, as a base of AGRITEX and the farmers union in order to realize smooth operation & maintenance and efficient management of the Project.

The Project Management Facilities are composed of a project management building, a workshop/garage, an agricultural warehouse and a fuel station. The required sizes of the rooms in the facilities are calculated based on actual conditions with reference to common practices in Zimbabwe, and decided as follows.

Designation	Size	Remarks
Project Management Building:	603 m <sup>2</sup>	Management, Training
Workshop/Garage:	272 m <sup>2</sup>	Tractor, Motor Grader, etc.
Agricultural Warehouse:	162 m <sup>2</sup>	Materials, Yields
Fuel Station:	52 m <sup>2</sup>	
<hr/>		
Total	1,089 m <sup>2</sup>	

In the event that the Project is implemented under Japan's Grant Aid, the executing agencies are AGRITEX and DWD, both of which are under the Ministry of Lands Agriculture and Water Development. DWD is in charge of the pump house, the head races and the farm ponds. AGRITEX, on the other hand, is in charge of the facilities in the fields; the irrigation canals, drainage canals, and farm roads. It will also handle operation of the project management office.

Both government bodies have considerable experience with irrigation development projects, and have state offices in Mutare in Manicaland. AGRITEX also has a district office in Nyanga, the site of the project area. With the advice of consultants, these two state offices will actually manage and implement the Project.

Within the region, there are more than ten large contractors with the capacity to perform comprehensive construction work and with specialized technologies. These contractors possess the advanced construction technology needed to execute each stage of the Project. All of them have experience in construction projects conducted by DWD and AGRITEX, and own the machinery needed for this Project. Positive steps will be taken to involve these contractors in it.

Among the equipment to be procured, it has been decided that irrigation pump facilities are to be procured from Japan, since the pumps applied in this Project have high pump heads and careful systematic study is needed for prevention of water hammer.

The tractor and motor grader are to be procured from Japan, since it is not easy to procure them in Zimbabwe.

The pickup, truck and motorcycle are also to be procured from Japan, since those made in Japan are popular in Zimbabwe. The bicycles and equipment for the workshop are to be procured in Zimbabwe, since they are easy to procure there.

Equipment and materials for the construction are to be procured in Zimbabwe as much as possible, however ductile cast-iron pipes are to be procured from Japan, since they are not available locally.

The detailed design and execution management will be conducted by a Japanese consulting firm in accordance with an operation contract to be signed with the Ministry of Land Agriculture and Water Development after the Exchange of Notes (E/N) is signed. The operations contract will be prepared in accordance with the E/N, and will be issued after it has been approved by the Government of Japan.

The construction schedule is divided into two phases. In the first phase, Block C on which a first priority is put will be implemented, and the Project Management Facilities will be implemented in the first phase as well due to smooth management of the Project. The items of each phase are as follows.

<u>Phase</u>	<u>Items</u>
Phase I	Block C (A = 128 ha) Project Management Facilities
Phase II	Block B (A = 140 ha) Procurement of Equipment

The schedule from the E/N to commencement of the construction of each phase is for 5 months; about 3 months for the contract for consultant services, field survey in the detailed design stage and detailed design in Japan, and about 2 months for preparation of the tender documents, tendering & evaluation and contract for construction.

The construction period of this Project requires about one year for each phase, in consideration of natural conditions, site conditions, working conditions, construction methods, keeping down costs and so on.

This Project is one of development in the Communal Lands where top priority is given by the Government of Zimbabwe. The implementation of the Project is expected to realize the improvement of living standards in the Nyakomba Ward, which is one of the typical Communal Lands, by means of 1) increasing of incomes, 2) improvement of employment opportunities,

3) a stable food supply and 4) reduction of the labour burden of women and children by providing a constant water supply that is derived from the construction of the irrigation facilities. Moreover, its implementation is expected to have beneficial effects on the adjacent area.

Therefore, a huge benefit is expected by means of the implementation of the Project, and the Project will contribute to the improvement of BHN (Basic Human Needs) of the farmers in the proposed Communal Lands, so it is judged that the implementation of the Project under Japan's Grant Aid is appropriate.

Moreover, concerning the management and operation & maintenance, the responsible organization of Zimbabwe has sufficient personnel and budget, and there are expected to be no problems.

It is considered, however, that if the following points were to be improved and maintained, the Project will be carried out more smoothly and effectively.

#### Technical Cooperation

In order to achieve the target agricultural products and transfer the Japanese technology, it is considered effective to dispatch Japanese Experts and JOCV members.

#### Securing of Budget for the Project

Securing of the budget for the staffs of AGRITEX and DWD and for management and operation & maintenance costs during the implementation stage and the execution stage of the Project is necessary.

#### Establishment of Farmers Union

A farmers organization that can manage the Project properly shall be established.

## ABBREVIATIONS

AfDB	African Development Bank
AGRITEX	Department of Agricultural Technical and Extension Services
AEO	Agricultural Extension Officer
AES	Agricultural Extension Supervisor
AEW	Agricultural Extension Worker
AFC	Agricultural Finance Cooperation
CMB	Cotton Marketing Board
DWD	Department of Water Development
EC	Europe Community
GMB	Grain Marketing Board
IDA	International Development Association
IMC	Irrigation Management Committee
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standard
JOCV	Japan Overseas Cooperation Volunteers
LSCF	Large Scale Commercial Farm
MLAWD	Ministry of Lands, Agriculture and Water Development
NDP	Nyanga Development Projects
NPMO	Nyakomba Project Management Office
NVGA	Nyanga Vegetable Grower Association
SSCF	Small Scale Commercial Farm
TMR	Tobacco Marketing Board
ZESA	Zimbabwe Electricity Supply Authority
ZFU	Zimbabwe Farmers Union
S/W	Scope of Works
F/S	Feasibility Study
B/D	Basic Design
E/N	Exchange Note
GNP	Gross National Product
GDP	Gross Domestic Product

## MEASURES

mm	millimeter
cm	centimeter
m	meter
km	kilometer
cm <sup>2</sup> , sq. cm	square centimeter
m <sup>2</sup> , sq. m	square meter
km <sup>2</sup> , sq. km	square kilometer
ha	hectare
m <sup>3</sup> , cu. m	cubic meter
kg	kilogram
t, ton	metric ton
s, sec	second
min	minute
hr	hour
°C	degree centigrade
%	percentage
kw	kilowatt
MW	megawatt
HP	horse power
PS	0.9864HP, 0.7355KW
EL	Elevation
MSL	Mean Sea Level
Z\$	Zimbabwe dollar
US\$	American dollar
¥	Japanese yen

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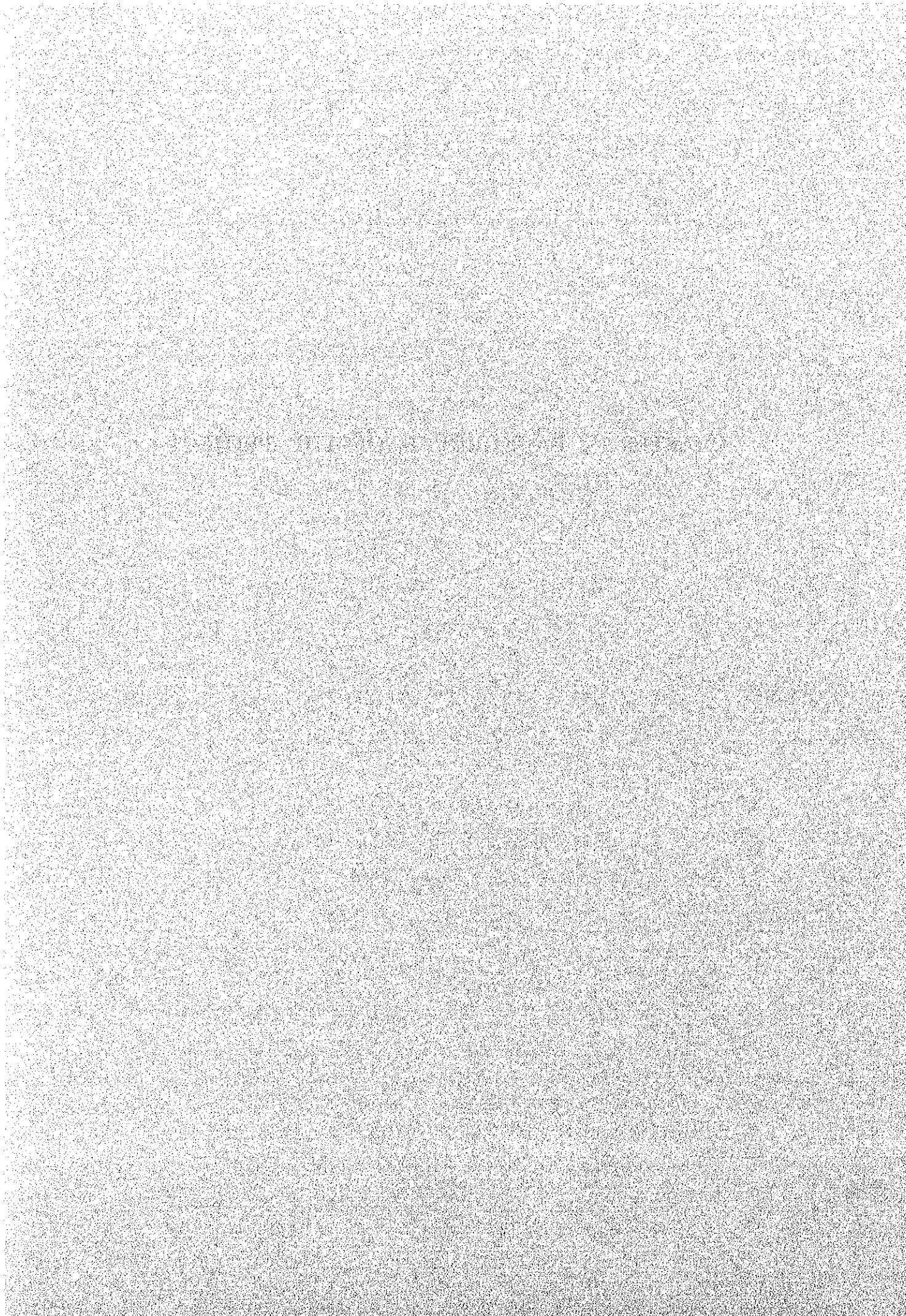
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## **CHAPTER 1 BACKGROUND OF THE PROJECT**



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### **1-1 Background of the Project**

The Republic of Zimbabwe, located in the southern part of Africa, occupies 391,000 km<sup>2</sup>, with a population of 10,840,000 (as of 1993). Agriculture is the key industry of the country. The First National Development Plan (1986-1990) aimed principally at "land reform and efficient land utilization", and promoted agricultural development in the Communal Lands, where development has progressed considerably more slowly than in urban areas and on the Large Scale Commercial Farms (LSCF). In the current Second National Development Plan (1991-1995), based on the Structure Adjustment Program, top priority is given to development in the Communal Lands again, and the Ministry of Lands, Agriculture, and Water Development has been playing a key role in promoting the resettlement program to provide poor farmers and/or peasant farmers with land.

The Nyakomba Ward in the north-eastern part of the Manicaland Province, located along the national border between Zimbabwe and Mozambique, is one of the typical Communal Lands. The Government of the republic of Zimbabwe requested a formation of the Nyakomba Irrigation Development Project to the Government of Japan, and the Japan International Cooperation Agency (JICA) conducted a Feasibility Study on this Project from 1989 to 1990. It was decided that the water resources for irrigation would come from the Gairezi River with pumping stations because of availability of sufficient water and its low cost, after a comparative study with the Nyakomba River Dam plan and a plan for the Weir system in the Gairezi River. Finally the feasibility of the Project with pumping irrigation was confirmed in the Study.

Under these conditions, the Government of Zimbabwe has requested Grant Aid to the Government of Japan for the construction of the irrigation facilities and their appurtenant facilities in this area.

### **1-2 Outline of the Request and Main Components**

#### **(1) Objective of Request**

The objective of the request is to implement the irrigation facilities for five (5) blocks for five (5) villages of the Nyakomba Ward in the Manicaland Province with the Grant Aid of Japan as the agricultural development plan in the Communal Lands.