

THE PRESIDENT OF THE UNITED STATES OF AMERICA
THE VICE PRESIDENT OF THE UNITED STATES OF AMERICA
THE SECRETARY OF THE UNITED STATES OF AMERICA

INTERNAL WATER SUPPLY PROGRAM

ION

COMMUNAL LANDS IN PARISH

ONE

MAINTENANCE AND REPAIRS PROGRAM

MAINTENANCE PROGRAM

WATER

MAINTENANCE

MAINTENANCE PROGRAM



THE REPUBLIC OF ZIMBAWE
THE MINISTRY OF WATER RESOURCES AND DEVELOPMENT

RURAL WATER SUPPLY PROGRAMME
IN
COMMUNAL LANDS IN PARTS
OF
MASVINGO AND MIDLANDS PROVINCES

MAIN REPORT
VOL. I

JICA LIBRARY



1029798[4]

AUGUST 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

S D S

83-079(1/2)

国際協力事業団	
受入 月日 84.08.27	534
登録No. 08151	618
	SDS



PREFACE

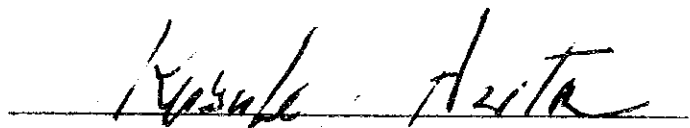
In response to the request of the Government of the Republic of Zimbabwe, the Japanese Government decided to conduct a study on the Rural Water Supply Programme in Communal Lands in parts of Masvingo and Midlands Provinces and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to the Republic of Zimbabwe a study team headed by Mr. Fujio Matsumoto from December 1982 to March 1983.

The team exchanged views with the officials concerned of the Government of Zimbabwe on the above Programme and conducted a field survey in the Communal Lands. After the team returned to Japan further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Water Supply Programme and contribute to the promotion of friendly relations between our two countries.

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

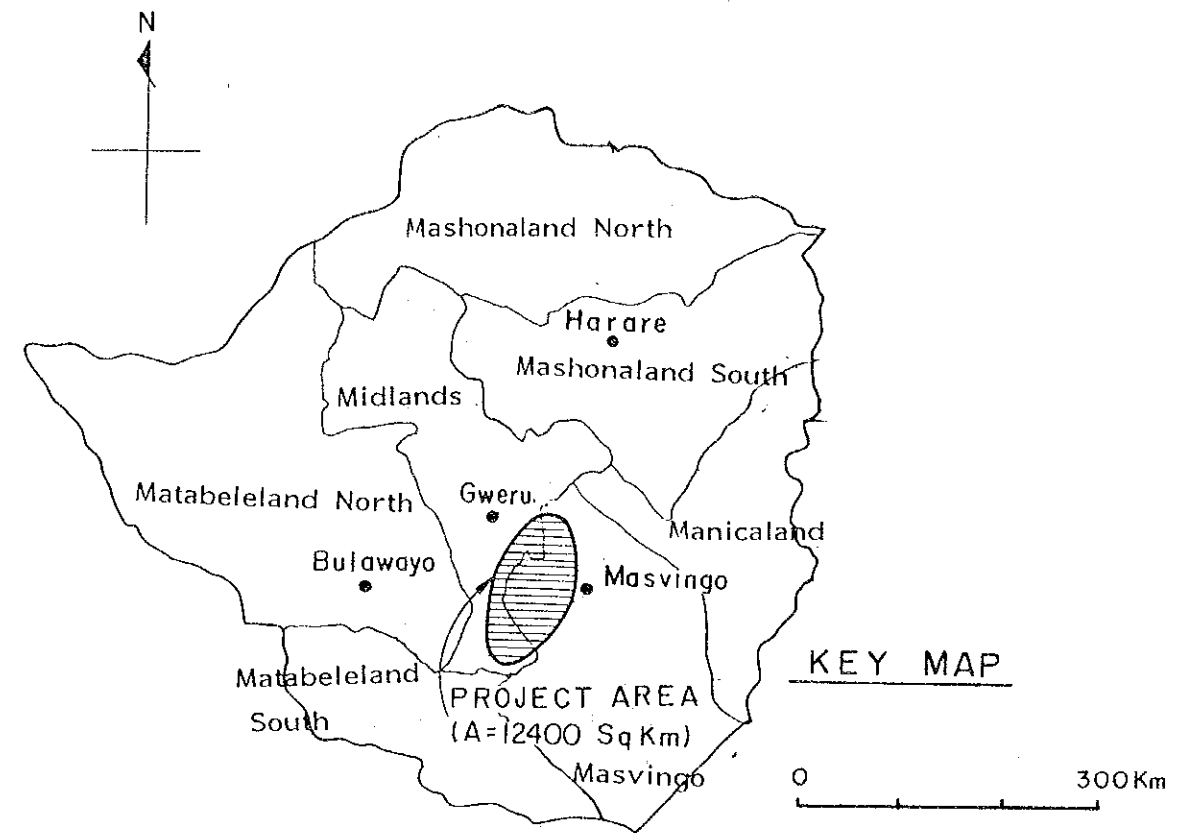
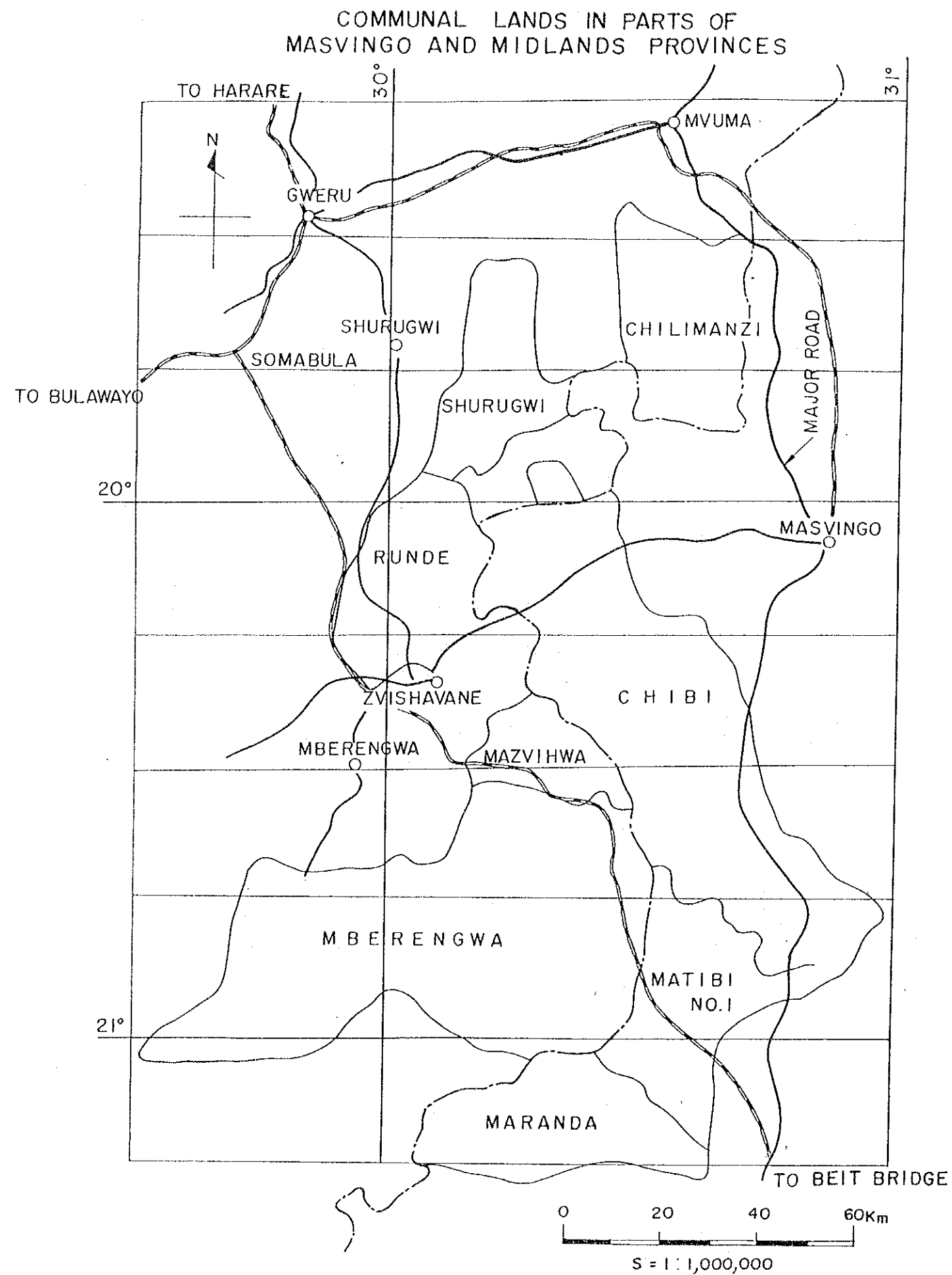
August 1983

A handwritten signature in dark ink, appearing to read 'Keisuke Arita', is written over a horizontal line.

Keisuke Arita

President

Japan International Cooperation Agency



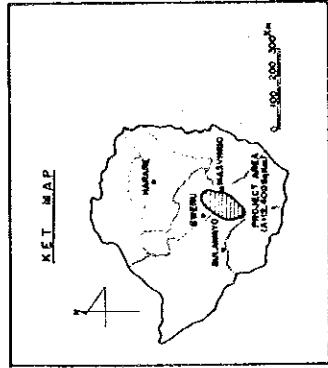
LIST OF COMMUNAL LANDS

MASVINGO PROVINCE

Nyaningwe D.C.	Chibi C.L.
Batanai D.C.	Matibi No.1 C.L.
	Maranda C.L.

MIDLANDS PROVINCE

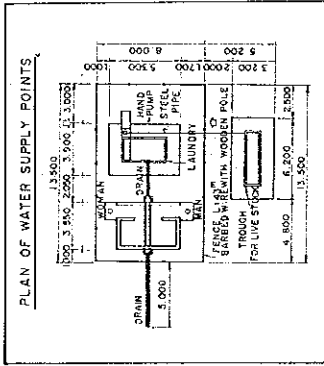
Shurugwi D.C.	Shurugwi C.L.
Zvishavane D.C.	Runde C.L.
	Mazvihwa C.L.
Takawira D.C.	Chilimanzi C.L.
Mberengwa D.C.	Mberengwa C.L.



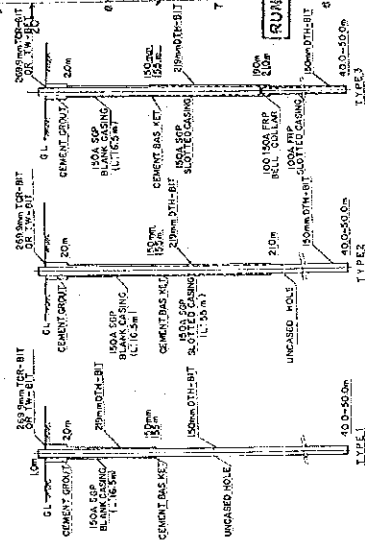
KEY MAP

DRILLING PROGRAMME

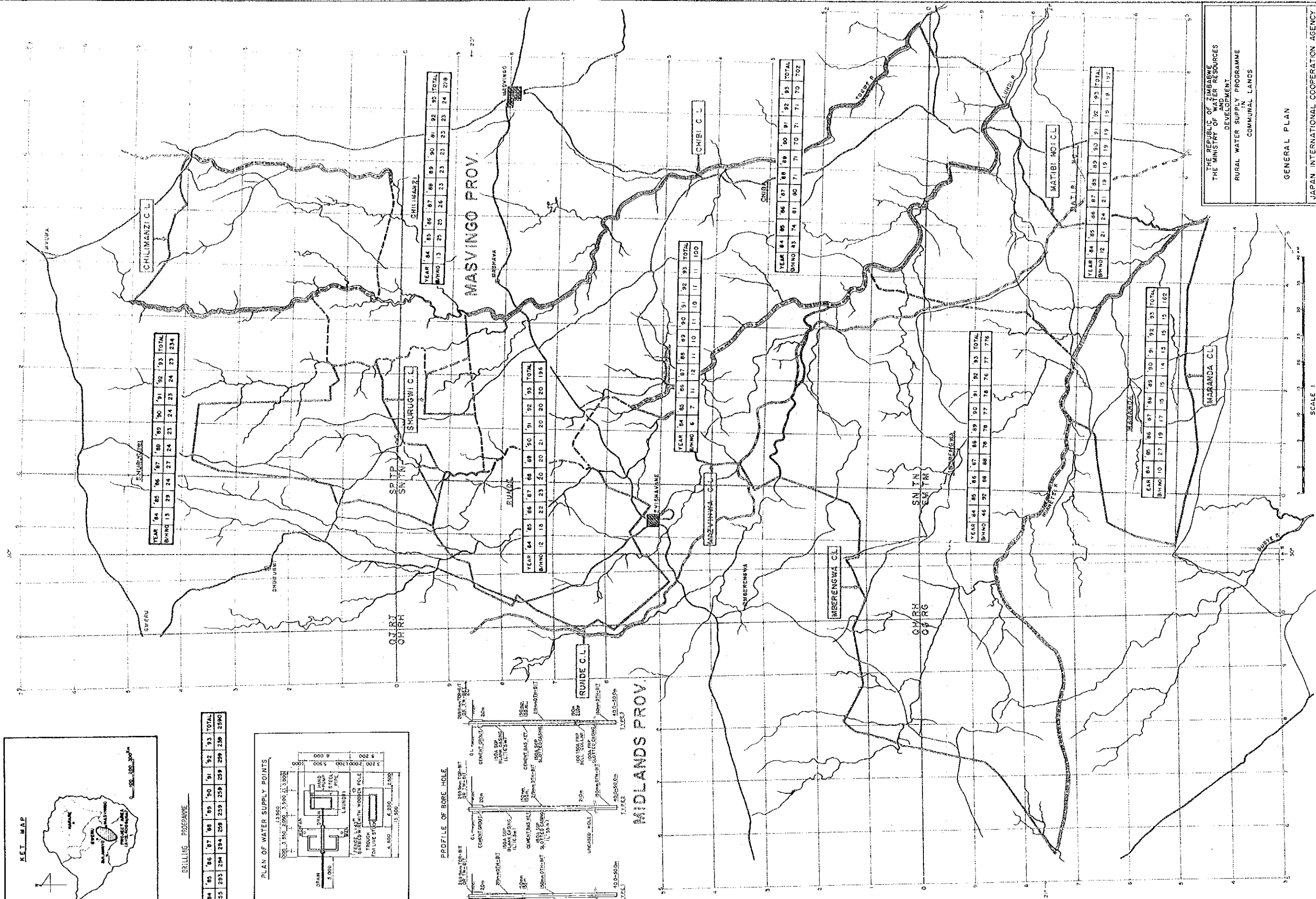
YEAR	'84	'85	'86	'87	'88	'89	'90	'91	'92	'93	TOTAL
BHNO	155	233	234	234	235	239	239	239	239	239	2390



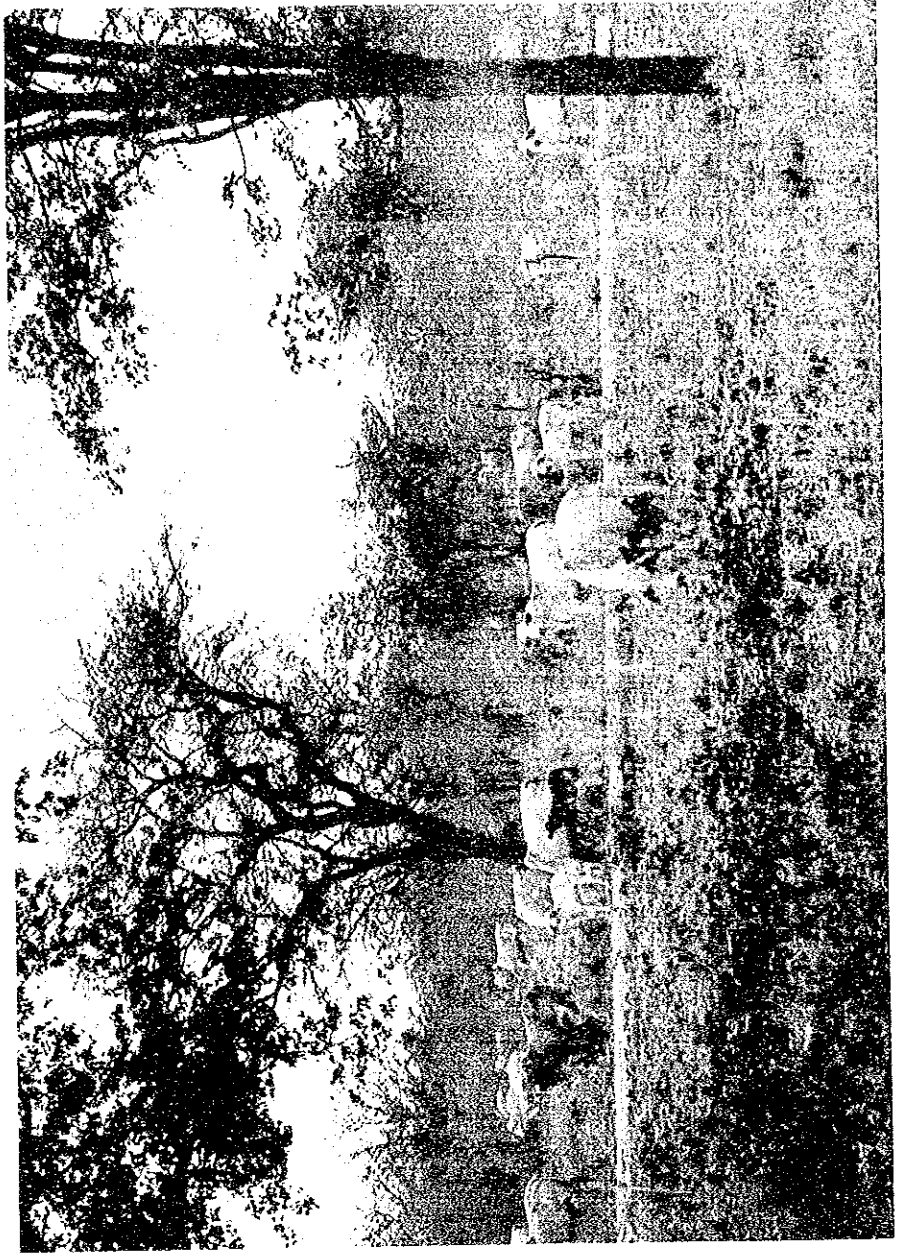
PROFILE OF BORE HOLE



MIDLANDS PROV.

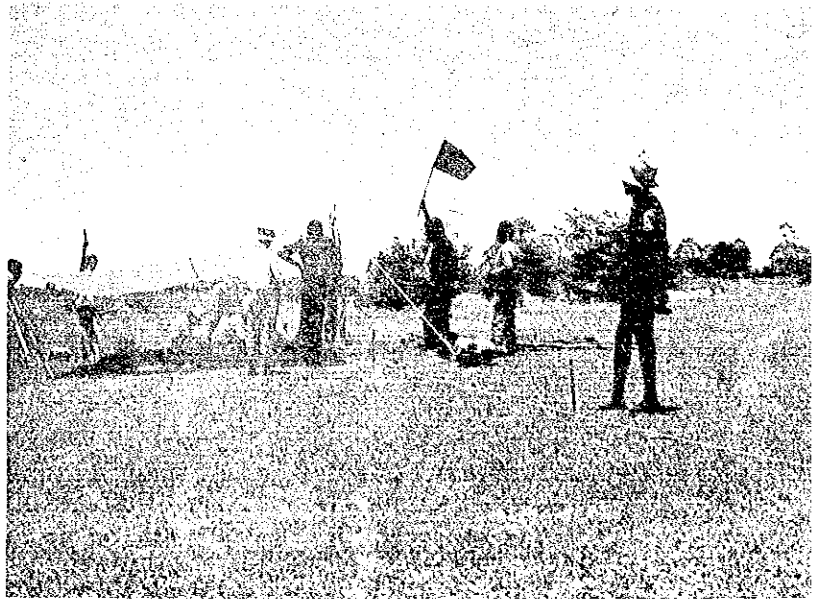


SCALE 1



PASTURE

ELECTRIC PROSPECTIVE SURVEY

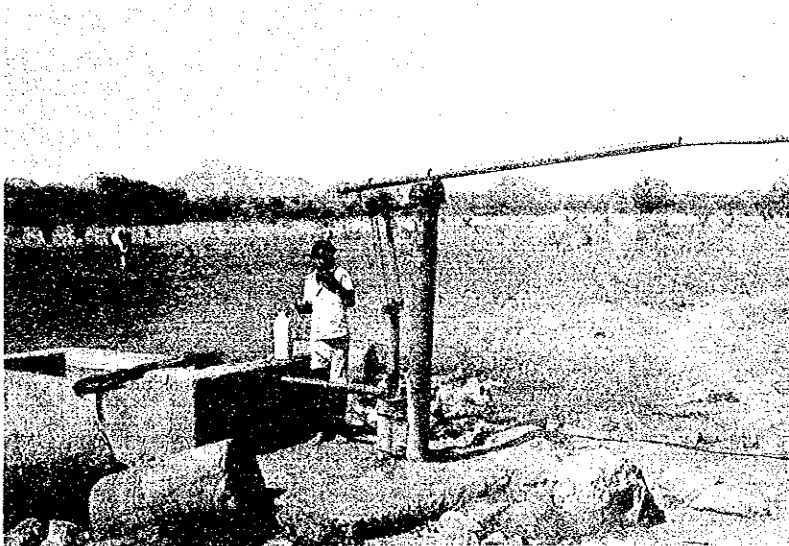


PASTURE

SERVICE CENTER



HOUSES IN COMMUNAL LANDS



HAND PUMP

WATER TAKING IN
RIVER BED



OPERATION OF HAND PUMP



LAUNDRY

TRANSPORTATION OF WATER



CONTENTS

	<u>Page</u>
PREFACE	
GENERAL PLAN MAP	
CONTENTS	
SUMMARY, CONCLUSION AND RECOMMENDATION	i
CHAPTER I. INTRODUCTION	I-1
CHAPTER II. BACKGROUND	II-1
2-1. General Description	II- 1
2-2. National Economy	II- 2
2-3. Groundwater Development and International Assistance	II- 6
CHAPTER III. THE PROJECT AREA	III- 1
3-1. General Features	III- 1
3-1-1. Location, Road and Railway Network	III- 1
3-1-2. Population and Life	III- 4
3-2. Physical Conditions	III- 8
3-2-1. Topography and Geology	III- 8
3-2-2. Rivers	III-17
3-2-3. Meteorology and Hydrology	III-19
3-2-4. Hydrogeology	III-27
3-2-5. Water Quality	III-58
3-3. Present Agriculture	III-78
3-3-1. Crop Production	III-78
3-3-2. Livestock Production	III-81
3-3-3. Farm Economy	III-85

	<u>Page</u>
3-4. Present Rural Water Supply	III-86
3-4-1. General	III-86
3-4-2. Water Sources and Use	III-87
3-4-3. Procedure on New Borehole	III-93
3-4-4. International Assistance in Rural Water Supply	III-97
CHAPTER IV. THE PROJECT	IV- 1
4-1. Objectives and Components of the Project	IV- 1
4-1-1. Objectives and Scope	IV- 1
4-1-2. Project Components	IV- 2
4-2. Project Formulation	IV- 3
4-2-1. Basic Concept	IV- 3
4-2-2. Selection of Most Suitable Plan	IV- 4
4-2-3. Rural Water Supply Programme	IV-10
4-2-4. Priority of Programme	IV-11
4-2-5. Programme of Each Communal Land	IV-12
4-2-6. Standards	IV-19
4-3. Facilities Planning	IV-24
4-3-1. Borehole	IV-24
4-3-2. Pumping Equipment	IV-36
4-3-3. Appurtenant Facilities	IV-41
4-4. Preliminary Design and Cost Estimation	IV-43
4-4-1. Preliminary Design	IV-43
4-4-2. Project Cost Estimation	IV-48
CHAPTER V. IMPLEMENTATION PROGRAMME AND OPERATION & MAINTENANCE	V- 1
5-1. Executive Agency	V- 1
5-2. Implementation Programme	V- 4
5-3. Operation and Maintenance	V- 6
5-3-1. Organization	V- 6
5-3-2. Operation and Maintenance	V- 6
5-4. Consulting Services	V- 7

	<u>Page</u>
CHAPTER VI. PROJECT EVALUATION	VI- 1
6-1. General	VI- 1
6-2. Financial Analysis	VI- 1
6-3. Social Impact	VI- 5

LIST OF TABLES

<u>Table No.</u>	<u>Descriptions</u>	<u>Page</u>
1-1-1.	Communal Lands	I- 2
2-2-1.	Gross Domestic Product by Industry of Origin	II- 3
2-2-2.	GDP per Capita and Population	II- 4
2-2-3.	International Trade Balance	II- 5
2-3-1.	International Aid in Water Resources Development at the End of 1982	II- 7
3-1-1.	Population, Household and Density	III- 5
3-1-2.	Social Infrastructures in C.L.	III- 7
3-2-1.	Stratigraphic Succession of the Project Area	III-14
3-2-2.	Mean Rainfall of Project Area	III-21
3-2-3.	Mean Rainfall of Zimbabwe	III-22
3-2-4.	Surface Water Resources in Project Area	III-25
3-2-5.	Summary of Borehole Record per Geological Formations	III-32
3-2-6.	List of Geophysical Survey Points	III-41
3-2-7.	Major Equipment of Geoelectric Resistivity Survey ..	III-43
3-2-8.	Expected Borehole Depth by Geophysical Prospecting	III-45
3-2-9.	Location of Pumping Tests of Borehole	III-55
3-2-10.	Results of Pumping Tests	III-57
3-2-11.	No. of Water Quality Test Points per Each Source ..	III-58
3-2-12.	Water Analysis	III-61
3-2-13.	Water Quality Tests (1)	III-62
3-2-14.	" (2)	III-63
3-2-15.	" (3)	III-64
3-2-16.	" (4)	III-65
3-2-17.	" (5)	III-66
3-2-18.	" (6)	III-67

<u>Table No.</u>	<u>Descriptions</u>	<u>Page</u>
3-2-19.	Water Quality Tests (7)	III-68
3-2-20.	" (8)	III-69
3-2-21.	" (9)	III-70
3-2-22.	" (10)	III-71
3-2-23.	" (11)	III-72
3-2-24.	" (12)	III-73
3-2-25.	" (13)	III-74
3-3-1.	Agricultural Production by Farm Size	III-78
3-3-2.	Agricultural Production in Project Area in 1980/81 ...	III-79
3-3-3.	Bulk of Maize	III-80
3-3-4.	National Cattle Head	III-82
3-3-5.	Numbers of Livestock	III-83
3-4-1.	Estimated Population Covered by Various Water Sources	III-90
3-4-2.	Number of Huts and Population Density	III-91
3-4-3.	Water Sources and Unit Usage Population	III-92
3-4-4.	Annual Output of New Boreholes in Midlands Province	III-94
3-4-5.	Annual Output of New Boreholes in Masvingo Province	III-95
3-4-6.	Possible ADB Project Sites, Midlands Province	III-97
3-4-7.	Estimated Project Expenditures for the Possible ADB Project Sites, Midlands Province	III-98
3-4-8.	Possible ADB Project Sites, Masvingo Province.....	III-98
3-4-9.	Estimated Project Expenditures for the Possible ADB Project Sites, Masvingo Province	III-99
4-2-1.	Estimated No. of Boreholes for Alternative Plans	IV- 5
4-2-2.	Construction Costs for Alternative Plans	IV- 8
4-2-3.	Proposed Borehole Number by 1993	IV-11
4-2-4.	Social Infrastructures and Priority Scoring Points ...	IV-14
4-2-5.	Proposed Drilling Programme by 1993/94 (Target Year)	IV-15
4-2-6.	Proposed Drilling Programme in First Three Years ...	IV-16
4-2-7.	Average Daily Water Demand for Domestic Use in Developing Countries	IV-19
4-2-8.	Water Quality Standard for Taste	IV-23

<u>Table No.</u>	<u>Descriptions</u>	<u>Page</u>
4-2-9.	Water Quality Standard for Health	IV-24
4-3-1.	Classification of Drilling Equipment	IV-25
4-3-2.	Classification of Drilling Fluids	IV-26
4-3-3.	Comparison of Drilling Methods	IV-29
4-3-4.	Casing and Drilling Diameters	IV-32
4-3-5.	Casing Materials and Specifications	IV-33
4-3-6.	Type of Borehole	IV-34
4-3-7.	Classification by Casing Length of Existing Boreholes	IV-34
4-3-8.	Casing Length to be Installed for Borehole	IV-35
4-3-9.	Drilling Equipment	IV-36
4-3-10.	Comparison of Hand Pumps (1)	IV-39
4-3-11.	Comparison of Hand Pumps (2)	IV-40
4-4-1.	Specifications of Borehole	IV-46
4-4-2.	Project Cost	IV-48
4-4-3.	Breakdown of Project Cost	IV-49
6-2-1.	Annual Loan & Repayment Schedule (1)	VI- 3
6-2-2.	Annual Loan & Repayment Schedule (2)	VI- 4

LIST OF FIGURES

<u>Fig. No.</u>	<u>Descriptions</u>	<u>Page</u>
2-3-1.	Schematic Diagram for Water Supply Programme	II-10
3-1-1.	Communal Lands in Parts of Masvingo and Midlands Provinces	III- 2
3-2-1.	Topographical Map of the Area	III- 9
3-2-2.	Geological Outline Map	III-15
3-2-3.	River System of the Project Area	III-18
3-2-4.	B/H Location Drilled by MWR&D	III-30
3-2-5.	Characteristics of B/H Drilled by MWR&D (1)	III-33
3-2-6.	Characteristics of B/H Drilled by MWR&D (2)	III-34
3-2-7.	Characteristics of B/H Drilled by MWR&D (3)	III-35
3-2-8.	Location Map, G/P Survey Points	III-40
3-2-9.	Current and Voltage Electrodes for Wenner Contfiguration	IV-43
3-2-10.	Geological Survey (JA01)	IV-46
3-2-11.	" (JB03)	IV-47
3-2-12.	" (JC01)	IV-48
3-2-13.	" (JD01)	IV-49
3-2-14.	" (JE01)	IV-50
3-2-15.	" (JF01)	IV-51
3-2-16.	" (JG01)	IV-52
3-2-17.	" (JH01)	IV-53
3-2-18.	Key diagram (1)	IV-75
3-2-19.	Key diagram (2)	IV-76
4-2-1.	No. of Boreholes Attained in 6 Alternative Plans ...	IV- 6
4-2-2.	Alternative Plans with Drilling Rig Working Schedule	IV- 9
5-1-1.	Schematic Diagram for Implementation Programme ...	V- 3
5-2-1.	Implementation Programme	V- 5
5-4-1.	Manning Schedule of Consulting Services	V- 9

LIST OF DRAWINGS

<u>Dwg. No.</u>	<u>Description</u>	<u>Page</u>
01.	Geological Map	III-16
02.	Potential 10% Yield of the Surface Water Sources	III-26
03.	Location Map of Existing Boreholes	III-31
04.	Borehole Depth and Water Level	III-36
05.	Borehole Yield Data	III-37
06.	Survey Location Map by JICA	III-42
07.	Water Quality Analysis Map	III-77
08.	Crop Production	III-84
09.	Social Condition.....	III-96
10.	Drilling Programme	IV-17
11.	Population Served with Borehole Water	IV-18
12.	Types of Boreholes	IV-44
13.	Appurtenant Facilities	IV-45

MEASURES AND GLOSSARIES

MEASURES

Length

mm	millimeter(s)
cm	centimeter(s)
m	meter(s)
km	kilometer(s)

Area

sq.cm or cm^2	square centimeter(s)
sq.m or m^2	square meter(s)
sq.km or km^2	square kilometer(s)
ha	hectare(s)

Volume

l or lit	liter(s)
cu.m or m^3	cubic meter(s)
MCM or 10^6m^3	million cubic meter(s)
barrel	31.5 gallons(U.S.) = 36 gallons(U.K.)
gallon	4.546 liters(U.K.) = 3.785 liters(U.S.)

Weight

g	gramme(s)
kg	kilogramme(s)
ton or m.t.	metric tonne(s)

Others

kw	kilowatt(s)
MW	megawatt(s)
%	percent
°C	degree centigrade
mg/l	milligramme(s) per liter
lcd	liter(s) per capita per day

ABBREVIATION

ADB	African Development Bank
WHO	World Health Organization
ZIMCORD	Zimbabwe Conference on Reconstruction and Development
JICA	Japan International Cooperation Agency
UNICEF	United Nations International Children's Emergency Fund
LWF	Lutheran World Federation
MWR&D	Ministry of Water Resources and Development
MLG&TP	Ministry of Local Government and Town Planning
MOFEPD	Ministry of Finance, Economic Planning and Development
MOH	Ministry of Health
D.P.P.	Department of Physical Planning, MLG&TP
D.D.F.	District Development Fund, MLG&TP
AGRITEX	Agricultural Technical Service, Ministry of Agriculture
P.W.E.	Provincial Water Engineer, MWR&D
C.L.	Communal Land, MLG&TP
D.C.	District Council, MLG&TP
D.A.	District Administrator, MLG&TP
G/P	Growth Point
S/C	Service Center
B/C	Business Center
H/C	Hospital and/or Clinic
GDP	Gross Domestic Product
O/M or O&M	Operation and Maintenance
H/H or HH	Household
B/H or BH	Borehole
DTH	Down-the-hole hammer drilling method
G/P Survey	Geophysical Survey

Note: Decimal point is indicated by a period(.) and multiple of thousands by comma(,).e.g. 8,372,564.19

SUMMARY, CONCLUSION AND RECOMMENDATION

A. General Description of the Project Area

A.1. Communal Lands

The study area consists of eight Communal Lands(C.L.) under six District Councils(D.C.) of the Ministry of Local Government and Town Planning. The Ministry of Water Resources and Development (MWR&D) is responsible for the conservation of surface and groundwater resources in the country and its function lies in the formulation and administration of government policy on the development of the water resources. The two provincial offices of Midlands and Masvingo of MWR&D are responsible for management of Water Resources Development and Rural Water Supply Programme in the eight C.L.'s of the Project Area.

A.2. Location and Climate

The Project Area is located between lat. 19°25' and 21°15' south and long. 29°28' and 30°58' east extending in the southeast part of Midlands Province and the west part of Masvingo Province, and is situated in the south of the country, about 400 km south of Harare, the capital of Zimbabwe. The climate in the south of the country is generally harsh in comparison with that in other areas of the country. The "Rainfall Handbook Supplement" and "Climate Handbook Supplement" published by the Department of Meteorological Services, reports the annual mean temperature of 19.2°C and rainfall of 650 mm on an average.

A.3. Topography, Geology, Road, and Railway

The Area totals about 12,400 km² in gross, extending to the west along the major road between Mvuma and Mwenezi villages.

Most of the area lies between 1,400 m and 500 m above sea level and generally slopes from north to south. The differences in the topographical expression of the major rock types are very marked. They are granites, gneisses, granulites, and schists. Main transportation facilities available between villages in the Project Area and towns or cities in outside areas are mainly secondary bus roads. The major road runs from Masvingo city to Beitridge, a border town connecting to the national road of the Republic of South Africa. The trunk line of National Railway extends along the same route as the road leading to Beitridge town and further to South Africa. Another trunk line runs between Rutenga and Malvern, the border town with Mozambique.

A.4. Population and Household

The Project Area accounts for about 7.7 percent of the total C.L. area of 162,000 km² in the country. The 1982 census shows that some 501,000 persons live in the Project Area, i.e., 11 percent of estimated 4.4 million persons in the entire C.L.'s in the country. The average population density is about 40.4 persons per km² which is 13.4 persons higher than the national average of 27 persons per km² of the entire C.L.'s. There are 86,442 households in the Project Area, implying the household density of 5.8 per km². People in the Project Area practice the traditional small scale rainfed agriculture and cattle farming. About 16 percent of the Area is cropped and the rest is covered with the trees and bushes in the undulating plain.

A.5. Social Conditions

People in the Project Area live in a cylindrical hut with mud and brick wall with thatched roof. No electricity nor water supply facilities are available. Though their living conditions are quite different and precarious as compared with urban population, their standard of living has steadily been rising. The inhabitants in the

C.L.'s generally carry out communication and official business at growth points, service centers, business centers, etc., scattered in the C.L.'s. The growth point is established in the C.L. to render the major services including governmental services, commercial transactions, and opening the agricultural product market. The growth point is therefore provided with electricity lines, water supply pipeline, and public telephone facilities.

A.6. Agriculture

The existing cultivated area in the Project Area was estimated at 0.2 million ha in 1982. Agricultural activities in the area are mainly crop production and cattle farming. The rainfed agriculture predominates due to lack of physical infrastructure, adequate water resources and supporting service for farming. The crop production centers primarily on maize, sorghum, groundnuts and cotton in the rainfed area with an average annual rainfall of 650 mm. Cattle farming in the C.L. generally contributes an important share to the farm household income.

A.7. Water Sources

About 501,000 inhabitants in the Project Area utilize the surface water and groundwater sources for home and livestock consumption. The surface water sources comprise natural main rivers, streams, and small reservoirs on the tributary rivers. Those water sources dried up in January, 1983 because of the severe drought; however, the groundwater sources are still available through boreholes of 150 mm in diameter and 42 m deep on the average as well as open wells of 1.5 m in diameter and 10 m deep. A hand pump of the reciprocating plunger type has been usually installed on a borehole and a bucket lifting with windlass device by hand is put on an open well.

A.8. Types of Water Use

The water sources are divided into three types; borehole, main river and miscellaneous sources including open well, stream and small reservoirs. The groundwater is utilized through 367 boreholes by 30.6 percent of the whole Project Area inhabitants with an average of 420 persons per borehole. Remaining 11.9 percent relies on the main rivers and 57.5 percent on the miscellaneous sources. In this connection, the emphasis is placed on borehole drilling to develop the groundwater use for their health in place of the untreated water of rivers.

A.9. Water Consumption

The per capita water consumption of about 7.8 lcd is calculated by assuming that a 15-liter bucket is carried three times a day for a household of 5.8 persons on an average. In case of two trips a day, the consumption declines to 5.2 lcd which is also the fact for some according to the hearing records obtained during the field survey. The existing reciprocating plunger hand pump has capacity of lifting about 15 lit/min of water. If operated six hours a day, it will lift about 4.0 m^3 based on the three times of two hours each in a daily operation with some 70 percent efficiency.

A.10. Drought Relief

The whole of Zimbabwe is presently experiencing a severe drought for the second year in a row. Most of the farmers are expected to have no or very little harvest this year. Large percentage of people in the C.L. is already living on drought relief. Most of the livestock in the area is also suffering from acute shortage of grazing area and drinking water, and many are perishing day after day. According to the MWR&D information, there are currently some 25,000 boreholes throughout the country, out of which about 10,000 are thought to be in the whole C.L.'s of the country.

A.11. International Aid

A report on the latest assessment of the borehole requirements made by the MWR&D in 1982 estimates that some 4,000 more boreholes are required in the whole country by the end of 1984. Several international aid and loan agreements are presently in various stages of progress and some 20 new drilling rigs will have arrived by the end of 1983. Besides the countries and agencies that agreed on the aids, the following countries and organization are presently negotiating the terms of aids with the government of Zimbabwe; Cuba, Australia, Finland, Bulgaria, Rumania, Norway, North Korea, Canada, Yugoslavia and WHO.

B. Outline of the Project

B.1. Objectives and Scope

About 69.4 percent of the people in the whole area is without safe water due to the untreated surface water. Under these circumstances, the Project aims to promote the use of groundwater in place of the untreated surface water and to aid to lessen the hard labor of water carrying for a long distance on foot with bucket on head. Consequently, the Project envisages to create healthy living environment for inhabitants as well as to secure stable cattle farming even in the drought year.

To realize the Project objectives, the following scope of work is proposed for the Rural Water Supply Programme in due consideration of the implementation programme of drilling boreholes (150 mm in diameter), installation of hand pumps, and provision of the laundry, bathing and trough facilities.

B.2. Components

In compliance with the objectives and the scope of work for the Rural Water Supply Programme, the Project components consist of (i) the engineering services in geophysical survey, preparation of final design, tendering for civil works and procurement of equipment and materials as well as supervision for Project performance, (ii) the civil works inclusive of borehole drilling, insertion of casing and slotted casing, installation of hand pump, and construction of the bathing, laundry and trough facilities, and (iii) procurement of construction equipment and materials.

B.3. Population Growth

The population growth rate of 3.6 percent is proposed by the MWR&D in November, 1982 with respect to future water demand. In compliance with this rate, the current population of some 501,000 estimated in the Project Area in August, 1982 census will reach about 1.1 million in twenty years by the end of year 2003. On the other hand, the cattle population in the Project Area is estimated at some 462,000 in 1983 in the report by the AGRITEX in February, 1983.

No growth rate is considered for the study of the cattle population from the estimated size in the report of "Economic Review of the Agricultural Industry of Zimbabwe", 1981.

B.4. Alternative Studies on Optimum Plan

To accommodate the population growth in the future, the alternative water supply programmes were studied for the target periods of 20, 15, 10, 7, 5 and 3 years with the main objectives to serve 250 users per borehole with hand pump as proposed in the "Hand Pump" of WHO and to enable the people to consume 15 lcd of water. Economic study was also conducted on the number and

types of water well rigs and varying yearly outputs. As a result, a programme of 259 borehole construction per annum is most practicable, amounting to 2,590 boreholes in total by the end of 1993 in the alternative plan taking 10 years.

B.5. Standards

Daily water consumption of 4.0 m^3 per borehole by 250 users (43 households: 250/5.8 persons per household on an average) consists of; (i) 2.0 m^3 (7.8 lcd x 250) for food preparation, (ii) 0.5 m^3 (75 lit/household x 6 households per day) for laundry, and (iii) 1.5 m^3 (250 lit/household x 6 households per day) for bathing. In addition, 2.0 m^3 per day is used for livestock in the dry season. Quality standards for the Rural Water Supply will be maintained within the allowable range of values specified by WHO, and especially controlled with respect to unsuitable water containing high rate of fluorides and nitrates.

B.6. Preliminary Design

The specifications of a typical borehole are 150 mm in diameter and 45 m in depth on an average. Cement grouting will be done in all boreholes to protect the holes from intrusion of polluted water. Casing and slotted casing will be inserted in the holes depending on the geological conditions. The hand pump will have the lifting capacity of at least 15 lit/min at 40 m deep water level, and should be easy to be operated by women or children. The facilities should provide some open space for bathing and laundry fenced by barbed wire for preventing animals from entering. The trough for livestock will be located outside the fence.

B.7. Construction Method

Technical and economical studies on drilling methods have resulted in the recommendation of the down-the-hole hammer drilling

method (DTH) for the Project. The DTH rig will be equipped so as to enable both the DTH and direct rotary drilling functions for successful drilling at least 100 m even in a very hard rock formation. The direct rotary drilling is to be used for a slightly weathered rock formation.

B.8. Project Cost

The Project cost to be incurred in three stages is divided into construction cost, procurement cost, administrative expenses, consulting fee, contingencies, and price escalation. The construction cost is composed of the direct cost, cost of temporary works, and overhead expenses. The direct cost is estimated applying the unit rates based on the prices in January, 1983.

PROJECT COST

Unit: Z\$1,000

<u>Description</u>	<u>Total</u>	<u>Stage I</u>	<u>Stage II</u>	<u>Stage III</u>
(1) Construction Cost	13,109	5,243	3,933	3,933
(2) Procurement Cost	2,786	1,393	1,393	-
(3) O & M Cost	1,069	126	363	580
(4) Administrative Exp.	762	307	233	222
(5) Consulting Fee	2,497	1,019	759	719
(6) Contingencies	2,025	810	669	546
(7) Price Escalation	30,831	3,635	10,279	16,917
<u>Total</u>	<u>53,079</u>	<u>12,533</u>	<u>17,629</u>	<u>22,917</u>

B.9. Implementation Programme

The construction schedule of total number of 2,590 boreholes by the end of fiscal year 1993/94 is divided into three stages, i.e., Stage 1: 1983/84 to 1987/88, 1,036 Nos. boreholes, Stage II: 1988/89 to 1990/91, 777 Nos. boreholes, Stage III: 1990/91 to 1993/94, 777 Nos. boreholes. The programme for each stage consists of loan application, consulting services, tendering and construction.

C. Conclusion

C.1. Population of about 501,000 or 6 percent of the total population of Zimbabwe in the Project Area will reach about 1.1 million by the end of 2003 or in twenty years from 1982. In due consideration of this population growth, the Study on Rural Water Supply Programme has drawn the following conclusion from the alternative studies on the optimum scale of the Project.

C.2. A comparative study on several alternative plans for the Rural Water Supply Programme concludes that the 2,590 boreholes for public water supply should be provided by the end of 1993 in the eight Communal Lands in order to supply the water amount of 15 lsd to 250 users per borehole. The proposed borehole type is 150 mm in diameter and about 45 m in depth, and a hand pump is installed along with bathing, laundry and trough facilities. The theoretically obtained number of new boreholes required by the end of 1993 based on the priority is given below.

New Borehole Numbers

<u>Communal Land</u>	<u>Population</u> <u>1983</u>	<u>%</u>	<u>BH/No.</u> <u>1983</u>	<u>Target</u> <u>1993</u>	<u>Proposed</u> <u>New BH/No.</u>
Chilimanzi	43,670	8.4	20	248	228
Shurugwi	43,230	8.3	10	245	235
Runde	38,760	7.5	26	222	196
Mazvihwa	18,470	3.6	6	106	100
Mberengwa	156,210	30.1	115	890	775
Chibi	142,670	27.5	111	813	702
Matibi No.1	41,280	8.0	45	237	192
Maranda	34,700	6.6	34	196	162
<u>Total</u>	<u>518,990</u>	<u>100.0</u>	<u>367</u>	<u>2,957</u>	<u>2,590</u>

C.3. To meet the quantitative requirements of boreholes by the end of fiscal year 1993/94, the implementation programme is planned in three stages. The cost of Project related boreholes is shown below.

<u>Implementation Programme</u>				
<u>Description</u>	<u>Stage I</u>	<u>Stage II</u>	<u>Stage III</u>	<u>Total</u>
° Construction				
Number of boreholes	1,036	777	777	2,590
° Construction year	83/84 to 87/88	88/89 to 90/91	91/92 to 93/94	83/84 to 93/94
° Project cost (Z\$ 1,000)	12,533	17,629	22,917	53,079

D. Recommendation

D.1. This Project is set up to attain the goal by 10 year plan of Rural Water Supply Programme. Water supply to livestock cannot be effected except only in emergency during the drought period. The reason for it is that even for humans it takes 10 years to build one borehole each for 250 people spending construction cost of Z\$24 per person. Whereas compared to the population density of 40.4 persons/km², cattle density is 34.4 head/km² which is 80 percent of the former. Unit consumption is 20 to 40 liter/head/day which is much higher than human consumption. Therefore, the water supply programme including livestock will require prohibitively high capital investment.

It is necessary for the future livestock production to take into consideration a comprehensive water development programme including surface water resources such as river water, small dams, etc. It is to be noted that the present livestock farming is depending on natural grazing and has no modern facilities. This system will suffer tremendously once a severe drought hits. The present remedy for this situation is that the water supply to livestock be made temporarily only during the drought, considering the water supply capacity of the programme.

In conclusion we recommend that a basic concept of livestock farming be established and thereafter water supply problem to livestock be restudied.

D.2. Water quality study of the Project Area has been conducted using the WHO standards. Water supply points in the Project Area is widely scattered as the villages and hamlets are sparsely situated. It is inevitable that the water quality of such water sources would also vary widely. The

characteristics of precipitation in the Area is that it gradually decreases towards the south, and the water quality deteriorates likewise in the direction of south. The results of the investigation by the Study Team on the quality of the water from Maranda C.L. reveal the following. Acceptable samples with respect to WHO standards: Zero percent out of 15 samples. Acceptability with respect to nitrate and fluorides: 40 percent. In conclusion it is recommended that the unsuitable borehole water should be replaced by treated surface water or some other suitable water source.

D.3. Public facilities related to rural water supply will be gradually installed within the scope of this Project. As water is the basic human need it is desirable that rules governing the number of beneficiaries, distribution method, etc. be established in future. Recurrent costs of maintenance for servicing, repairing, replacement of spare parts, etc. will be incurred. Modern water usage system including the water charge to cover such recurrent costs, water right, etc. should be established. Major items of management and administration of water supply system are.

- Scope of beneficiaries and rules of utilization
- Water right
- Operation and maintenance
- Collection of water charge

D.4. Together with the modernization of the water supply system, it is also vitally important to gather and arrange the accurate basic data on the actual conditions of water usage. The establishment of the following cadasters is necessary in this respect.

- Borehole cadaster
- Cadaster on water supply facilities, including number of beneficiaries and supply volume

CHAPTER I INTRODUCTION

CHAPTER I. INTRODUCTION

1-1. General

The government of the Republic of Zimbabwe made a request for technical cooperation in conducting the study on the Rural Water Supply Programme in communal lands in parts of Midlands and Masvingo Provinces. In response to the request, the government of Japan dispatched a preliminary study team to Zimbabwe to exchange views on the Programme as well as to define the scope of work of the study on the Programme. An agreement was concluded on October 29, 1982.

Following this the government of Japan made a decision through the Japan International Cooperation Agency (hereinafter referred to as JICA), the official agency responsible for the implementation of the technical cooperation programmes of the government of Japan, to dispatch the Japanese Study Team (hereinafter referred to as the Study Team) to Zimbabwe for the study on the Rural Water Supply Programme.

The objective of the study is to formulate the basic plan for the Rural Water Supply Programme. The Programme aims to supply water for domestic and livestock use, not for irrigation. The water source for the Programme will be groundwater.

The study area totals about 12,400 km² including eight Communal Lands in parts of Midlands and Masvingo Provinces. These Communal Lands and administrative District Council areas are listed next page.

Table 1-1-1 Communal Lands

<u>Communal Land</u>	<u>Area(km²)</u>	<u>District Council</u>	<u>Province</u>
Chilimanzi	1,030	Takawira	Midlands
Shurugwi	850	Shurugwi	"
Runde	980	Zvishavane	"
Mazvihwa	550	Zvishavane	"
Mberengwa	3,720	Mberengwa	"
Chibi	3,210	Nyaningwe	Masvingo
Matibi No.1	1,080	Batanai	"
Maranda	1,060	Batanai	"
<u>Total</u>	<u>12,420</u>		

In accordance with the said agreement on October 29, 1982, the work schedule of the study was set to commence in December, 1982 through July, 1983, composed of field survey in Zimbabwe and analysis work in Japan.

The field survey was conducted by the Study Team from 18 December, 1982 till 15 March, 1983. The survey consisted of collection of data and information, geoelectric prospecting survey, and preparation of basic concepts for the formulation of the Programme.

This Final Report presents the findings of the field work in Zimbabwe and analysis work in Japan in compliance with the Progress Report and Draft Final Report which were prepared in Zimbabwe and in Japan and agreed on by both the Zimbabwe authorities and the Study Team on 11 March and on 12 July, 1983.

The names of the Japanese officials concerned, the Study Team members, and the Zimbabwean main counterparts and officials contacted during the field survey period are listed below:

1-2. Japanese Officials and Study Team Members

Embassy of Japan

<u>Name</u>	<u>Title</u>	<u>Location</u>
1. Mr. Kohji Tsujita	Counsellor	Harare
2. Mr. Kenji Miyata	First Secretary	Harare

JICA

1. Mr. Nobuo Kimura	Coordinator	Japan
2. Mr. Yoshikazu Yamada	"	"
3. Mr. Tadashi Ozeki	Advisor	"

Study Team Members

<u>Name</u>	<u>Position</u>	<u>Field Survey Period</u>
1. Mr. Fujio Matsumoto	Team Leader	17 Dec.'82 to 16 Mar.'83
2. Mr. Yoshio Matsumura	Groundwater	17 Dec.'82 to 16 Mar.'83
3. Mr. Haruhiko Nakamura	Geology	17 Dec.'82 to 9 Mar.'83
4. Mr. Michio Sekine	Electric	17 Dec.'82 to 16 Mar.'83
	Prospecting(A)	
5. Mr. Masao Kojima	Electric	4 Jan.'83 to 9 Mar.'83
	Prospecting(B)	
6. Mr. Tadayuki Ukeba	Water Supply	4 Jan.'83 to 9 Mar.'83
7. Mr. Kazuki Muta	Socio-Economy	17 Dec.'83 to 16 Mar.'83
8. Mr. Ichiro Shibamiya	Well	4 Jan.'83 to 9 Mar.'83
9. Mr. Kazuo Otsubo	Cost Estimation	4 Jan.'83 to 9 Mar.'83

1-3. Zimbabwean Counterparts and Officials

Ministry of Water Resources and Development (MWR&D) in Harare

<u>Name</u>	<u>Position</u>
1. Mr. P.M. Grizic	Permanent Secretary, MWR&D
2. Mr. D.S. Dell	Deputy Secretary, MWR&D
3. Mr. A.S. Mpala	Management Operation Engineer, MWR&D
4. Ms. A. Dunets	Operation Engineer, MWR&D
5. Mr. L. Hindson	Senior Groundwater Research Officer, MWR&D
6. Dr. P. Wurzel	Resources Officer, MWR&D
7. Mr. J. Johnston	Chief Hydrological Engineer, MWR&D

Midlands Province

1. Mr. H.S. Lemmer	Provincial Water Engineer, MWR&D
2. Mr. J.A. Hampton	Deputy Provincial Water Engineer, MWR&D
3. Mr. Vallare	Geophysical Surveyor, MWR&D
4. Dr. M. Shiva	Provincial Medical Officer, Ministry of Health (MOH)
5. Mr. W.N. Mabika	Physical Planning Officer, Department of Physical Planning (D.P.P.), Ministry of Local Government and Town Planning (MLG&TP)
6. Mr. A. Sibanda	District Administrator (D.A.), Takawira District Council(D.C.)
7. Mr. G. Maguchu	District Accountant, Takawira D.C.
8. Mr. R. Mbetu	D.A., Shurugwi D.C.
9. Mr. S. Chakaipa	D.A., Zvishavane D.C.
10. Mr. Gougoh	District Officer, Zvishavane D.C.
11. Mr. G. Khosa	D.A., Mberengwa D.C.

- | | |
|--------------------------|---|
| 12. Mr. R. Ferguson | Undersecretary, Development, MLG&TP |
| 13. Mr. R. Vaughan-Evans | Provincial Agricultural Extension Officer |

Masvingo Province

- | | |
|----------------------|---|
| 1. Mr. M.G. Lotter | Provincial Water Engineer, MWR & D |
| 2. Mr. D.S. Durham | Deputy Provincial Water Engineer, MWR&D |
| 3. Dr. Chaibva | Provincial Medical Officer, MOH |
| 4. Mr. A. Mlalazi | Provincial Planning Officer, MLG&TP |
| 5. Mr. S.M. Chikasha | D.A., Nyaningwe D.C. |
| 6. Mr. C. Shiringo | Senior Executive Officer, Nyaningwe D.C. |
| 7. Mr. K.T. Mugoni | D.A., Batanai D.C. |
| 8. Dr. Munjanganja | Undersecretary, Development, MLG&TP |
| 9. Mr. J. Maswaya | Provincial Agricultural Extension Officer |

CHAPTER II BACKGROUND

CHAPTER II. BACKGROUND

2-1. General Description

The Republic of Zimbabwe is situated in southern Africa at 20 degrees of south latitude and 30 degree of east longitude. The total area is 391,000 km². The population was estimated at 7,600,000 in 1981. The country is landlocked and surrounded by four neighbouring countries. Most of the area lies on a plateau higher than 300 m above sea level. Major cities like Harare the capital, Bulawayo, and Mutare, etc. lies on the central high plateau. The country is located in the tropical zone; nonetheless, the temperature is moderate due to high elevation. The annual average temperature of Harare is 25.3°C and the annual average precipitation is about 800 mm.

The country gained independence from Britain in April 1980 after many years of civil war. The economy suffered a lot since its Unilateral Declaration of Independence (UDI) of 1965. The civil war not only hampered smooth development of the economy but caused severe destruction of the country's infrastructure which inflicted serious damages and interruptions on the rural life. The newly independent country is faced with the urgent task of reconstruction of the country, recovery of the economic soundness, and most important of all, restructuring of the dual economy between the modern and peasant sectors of the country.

About 70 percent of the country's population is dependent on agricultural income. There are three types of agricultural management. The first one is the large scale commercial farming operated mainly by the white population. The second type is the peasant farming practiced by villagers in the communal lands primarily for home consumption. The third is the small scale

commercial farming conducted within the resettlement programme areas sponsored by the government. The largest portion of the farmers are engaged in the second type of peasant farming. People in the communal lands live in the traditional African houses made of cylindrical, mud or brick walls and thatched roofs without electricity or water supply.

2-2. National Economy

The country's economy suffered from a prolonged liberation struggle which lasted for more than 10 years. The intensification of the civil war caused a decrease of capital investment on development and an increase of war expenditures, which all contributed to the economic decline. When the civil war ended and the independence was declared, the new government was faced with many difficult tasks which all required huge financing. Three-Year Transitional Development Plan was then drafted for the period of July, 1981 to June, 1984 for the purpose of solving the most urgent problems of refugees, reconstruction, land settlement and rural/agricultural development, training, and finally national infrastructure and modern sector development.

The government of Zimbabwe decided, to hold a conference to call for international assistance for rebuilding the country. Zimbabwe Conference on Reconstruction and Development (ZIMCORD) then took place in March, 1981. The total budget of Z\$3,739 million was presented, of which Z\$2,166 million (56%) was to come from foreign sources. Z\$917 million was pledged during the Conference by the attending countries and international agencies, and besides by the end of March, 1981 Zimbabwe had secured Z\$365 million, making the total Z\$1282 million.

Zimbabwean economy has a fairly well balanced and diversified structure with its mainstay in agriculture, mining, and manufacturing industries. The economy is, however, marked with

dual structure. Among the sectors of economy and racial groups there exist two categories; the modern part and peasant part. Education and vocational training programmes presently being incorporated and institutionalized in the country, this dualism is slowly being eliminated.

The nominal GDP for 1981 was Z\$4,147 million (US\$5,997 million) which means Z\$536 (US\$775) per capita. As the income distribution is very uneven due to still existing dual economic structure, this per capita value should be regarded as a mere reference. The major components of GDP for 1981 are as follows: agriculture 18 percent, mining 5 percent, manufacturing 26 percent, and tertiary industry 45 percent.

A breakdown of GDP by industry of origin for years 1975, 1979, 1980 and 1981 are given in Table below.

Table 2-2-1 Gross Domestic Product by Industry of Origin

Unit: Million Z\$								
Year	1975		1979		1980		1981	
Industry	Value	%	Value	%	Value	%	Value	%
Agriculture & Forestry	323	16.9	316	12.1	462	13.9	738	17.8
Mining & Quarrying	131	6.8	191	7.3	267	8.1	217	5.2
Manufacturing	447	23.3	679	26.0	844	25.5	1098	26.4
Others	1,015	53.0	1,422	54.6	1,743	52.5	2,094	50.5
Total	1,916	100.0	2,608	100.0	3,316	100.0	4,147	100.0

Source: Monthly Digest of Statistics, Nov., 1982, Zimbabwe

2-2-1. GDP, GDP per capita, and Population

GDP suffered towards the end of the civil war but show a definite trend of recovery after the war. The accurate size of the population has not been grasped until 1982 census. The result of the census was not yet available during the field survey period of the Study Team. According to the Monthly Digest of Statistics, November, 1982 the population as at June 1981 was estimated to be 7.6 million. It assumes that the population growth rate had been 3.3 percent per annum. The projection for future growth rate lies between 3 and 3.6 percent. Table 2-2-2 shows the GDP at current and at 1969 prices, GDP per capita at current and at 1969 prices, and population from 1975 to 1981.

Table 2-2-2 GDP per Capita and Population

Year	1975	1976	1977	1978	1979	1980	1981
GDP (mil.Z\$)	1,916	2,077	2,087	2,236	2,608	3,316	4,147
GDP/capita (Z\$)	305	320	311	323	366	451	546
GDP at 1969 prices	1,303	1,285	1,189	1,170	1,188	1,322	1,483
ditto /capita	207	198	177	169	167	180	195
Population('000)	6,280	6,490	6,700	6,920	7,130	7,360	7,600

Source: Monthly Digest of Statistics, Nov., 1982, Zimbabwe

2-2-2. Major Economic Sectors

Following are the brief descriptions of major economic sectors:

(1) Agriculture

The agricultural output accounted for about 18 percent of GDP and about 39 percent of foreign exchange earning in 1981. Major products are maize, wheat, and sorghum. As export products, tobacco, maize, sugarcane, cotton, etc., are counted. Livestock production is the second largest in Africa after South Africa.

Because of the severe drought occurring for the second consecutive year serious damages are being inflicted on both the crops and the livestock. Sizable drop in production is expected to result for the year 1983.

(2) Mining

Zimbabwe is one of the major producers and exporters of the mineral resources in the world. More than 40 kinds of goods related to mineral resources are registered. The largest six items accounting for 85 percent of the total production value of mineral resources are gold, asbestos, nickel, copper, coal, and chrome in the order of magnitude. In 1981 mineral resources production amounted to 5 percent of GDP and 30 percent of the total export value.

(3) Manufacturing

The manufacturing sector is well diversified and developed, e.g. in steel, nonferrous metals, machinery, fiber, food processing, pulp, timber, printing, etc. It accounted for 26 percent of GDP and 27 percent of export value in 1981.

2-2-3. International Trade

Exports have grown at an average of 13.3 percent from 1970 to 1981. Especially 1980 and 1981 have seen substantial increases. Although the trade balance alone reversed to deficit since 1980, the overall balance of payment stayed more or less within Z\$100 million.

Table 2-2-3 International Trade Balance

Year	(unit: Z\$ million)						
	1975	1976	1977	1978	1979	1980	1981
Export	531.3	557.4	550.8	609.3	715.7	909.2	971.7
Import	461.9	382.7	388.1	403.7	549.3	809.4	1017.5
Balance	69.4	174.7	162.7	205.6	166.4	99.8	-46.0

Source: Monthly Digest of Statistics, Nov., 1982, Zimbabwe

2-3. Groundwater Development and International Assistance

2-3-1. Groundwater Development

The country is presently experiencing a severe drought for two years in a row. Especially damages to the communal land areas are disastrous where there is insufficient supply system of domestic water and practically no irrigation facilities. Most of the farmers are expected to have no or very little harvest this year. Large percentage of people in the communal lands are already on drought relief and most of the livestock in the area is also suffering from acute shortage of grazing area and drinking water, and many are perishing day after day.

According to the MWR&D information, there are currently some 25,000 boreholes throughout the country, out of which about 10,000 are thought to be in the whole communal lands of the country. A report on the latest assessment of the borehole requirement "Drilling Commitments, Shortage of Drilling Rigs" by Management Engineer Operations, MWR&D in 1982 estimates that some 4,000 more boreholes are required in the whole country up to the end of 1984. Whereas the Ministry owns 22 rigs, mostly of percussion type, of which seven are new. There are also 41 percussion drills and three air rigs in use by private contractors.

The Ministry states, with an average performance of one borehole per a little over three weeks per rig including removal and breakdown, the monthly output is about 90 boreholes in the whole country. The reason why the crude percussion type rigs are kept by the Ministry is their ruggedness, simplicity, durability, and long life, which is compatible with the present availability of technical staff and repair and maintenance servicing facilities.

To break through the time factor in meeting urgent borehole requirements, the said report of MWR&D envisages that 4 units of

high speed drilling rigs are urgently needed in addition to the normal purchase of modern percussion rigs to strengthen the existing fleet for future requirements.

2-3-2. International Assistance

Several international aid and loan agreements are presently in various stages of progress and some 20 new drilling rigs will have arrived by the end of 1983. A list of international aid in water resources development as at the end of 1982 is given below:

Table 2-3-1. International Aid in Water Resources Development at the End of 1982

<u>Country or Agency</u>	(Unit: Z\$)		
	<u>Loan</u>	<u>Grant</u>	<u>Contents</u>
Netherlands	1,450,000	-	6 drilling rigs, etc.
Sweden	-	438,500	5 drillings rigs.
Saudi Arabia	3,500,000	-	Augment and extend the current ADB/US Aid Programme
Kuwait	7,645,000	-	One drilling rig, etc.
Denmark	-	-	Development of medium dams
France	2,150,000	-	Not yet fixed
Britain	-	670,000	7 drilling rigs, etc. and dam and irrigation project
Italy	1,450,000	-	Dam and irrigation project
EEC	-	4,460,000	Borehole construction
ADB/ADF	9,225,000	-	Water supply project
LWF	-	126,840	Construction of shallow wells
UNICEF	-	400,000	One drilling rig, etc

Note: ADB - African Development Bank

ADF - African Development Fund

LWF - Lutheran World Federation

Besides the above countries and agencies, the following countries and organization are presently negotiating the terms of aid with the government of Zimbabwe: Cuba, Australia, Finland, Bulgaria, Rumania, Norway, North Korea, Canada, Yugoslavia, and WHO.

2-3-3. Implementation

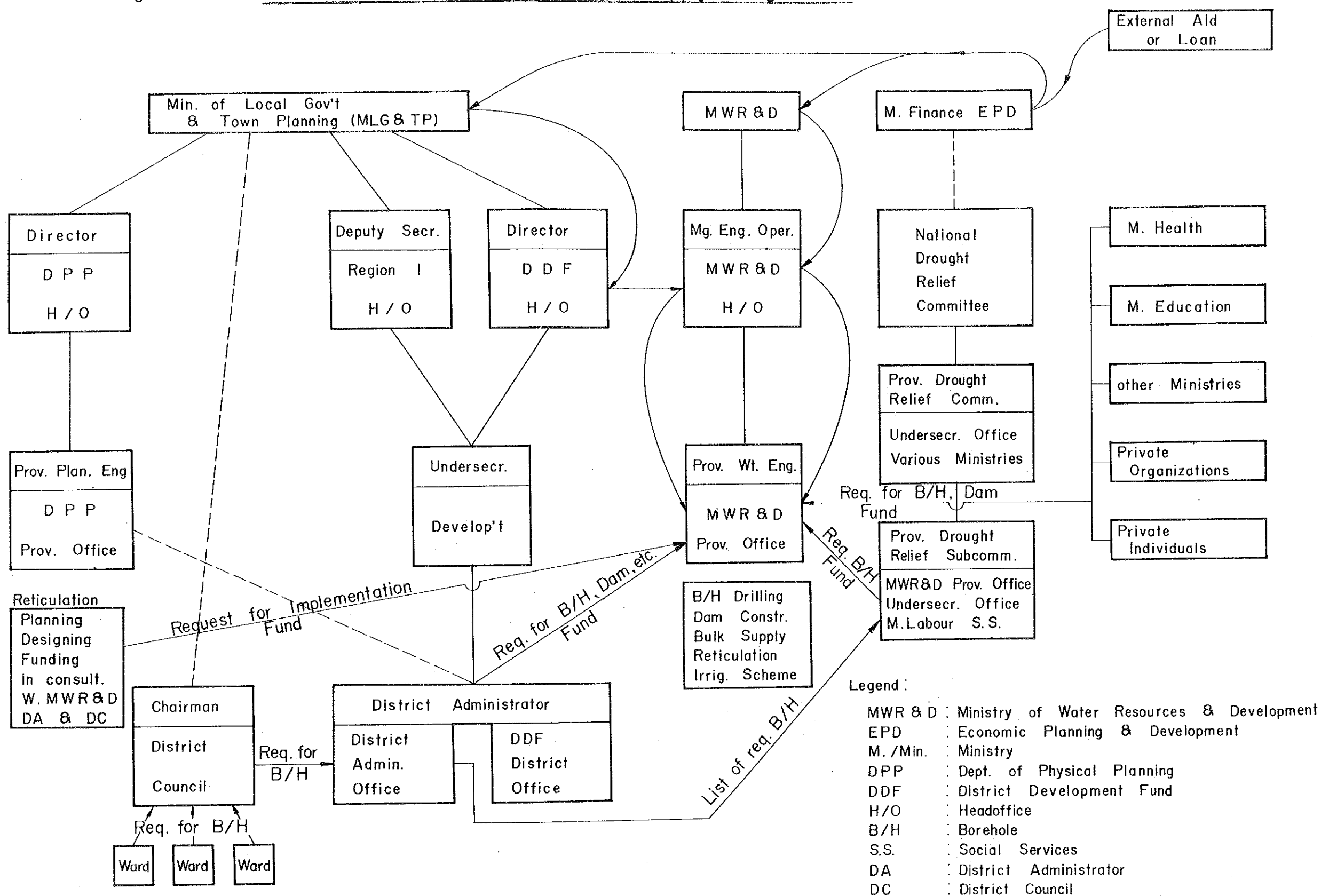
The procedures including also international aid or loan for implementation of water supply programmes are illustrated in Figure 2-3-1. "Schematic Diagram for Implementation Programme". The executing body for development of new water sources or repairs, be it boreholes, dams, water supply stations for bulk supply or reticulation, is MWR&D. Various government agencies and private organizations or individuals are entitled to request MWR&D for construction or implementation of the works or any major repairs of the existing water supply facilities. The works are financed by the respective requesting organization. The major counterpart in this regard at present is the District Administration Office which deals directly with the District Council (D.C.) which is made up of councillors elected from the wards, the smallest administrative unit in the communal lands. The District Council makes a request for new boreholes to the District Administrator(D.A.). The D.A. is the Chief of the District Administration Office and at the same time of the District Development Fund(D.D.F.) district office. He will decide on the allocation of boreholes and funds in consultation with the Undersecretary, Development of the province. He then passes the request to the Provincial Water Engineer(P.W.E.) for construction of water supply works.

Presently in the face of the severe drought, the first priority is given to the implementation of drought relief boreholes. The National Drought Relief Committee was formed and endowed with funds. At the provincial level there are the Provincial Drought Relief Committee and the Subcommittee. The former is made up of representatives of various ministries and deals with the general aspects of the drought situation. The latter consists of representatives of MWR&D, Undersecretary's Office and Ministry of Labor and Social Services and deals with the water supply problems. It selects the locations of boreholes to be drilled in consultation with D.A. The decision is then passed on to the P.W.E.

External aid or loan on water resources and development has two possible channels for implementation. At first the funds are registered in the Ministry of Finance, Economic Planning and Development. They are then passed on to MLG&TP to be incorporated in the Ministry's overall development plan. For its implementation the funds are then transferred to MWR&D. The other route is that the funds are directly entrusted to MWR&D for implementation by the Ministry of Finance, Economic Planning & Development.

If the external aid consists of technical and/or material aid only, the MWR&D will be the direct counterpart and recipient of such aid.

Fig 2-3-1. Schematic Diagram for Water Supply Programme



CHAPTER III THE PROJECT AREA

CHAPTER III. THE PROJECT AREA

3-1. General Features

3-1-1. Location, Roads and Railway Network

(1) Location

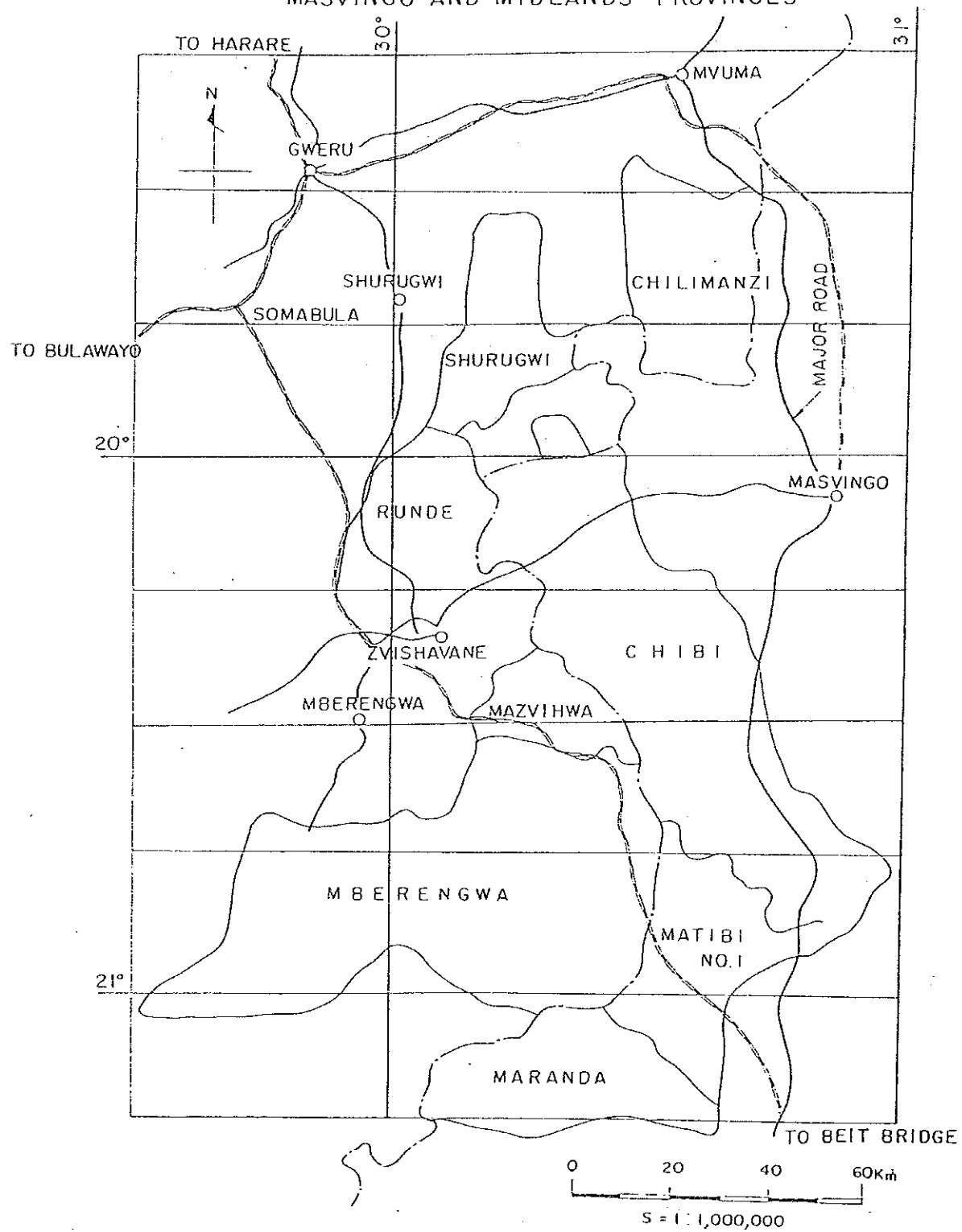
The Project Area is located about 400 km south of the capital city, Harare in the south of Zimbabwe and constitutes parts of Midlands and Masvingo Provinces. The Area lies between 19°25' and 21°15' south latitude and extends from 29°30' to 30°50' east longitude. The Project Area totals about 14,200 km², extending to the west and along the major road linking Mvuma and Mwenezi.

The Area consists of eight Communal Lands (C.L.) under six District Councils (D.C.) as given below.

<u>Communal Land</u>	<u>District Council</u>	<u>Province</u>
Chilimanzi	Takawira	Midlands
Shurugwi	Shurugwi	Midlands
Runde	Zvishavane	Midlands
Mazvihwa	Zvishavane	Midlands
Mberengwa	Mberengwa	Midlands
Chibi	Nyaningwe	Masvingo
Matibi No.1	Batanai	Masvingo
Maranda	Batanai	Masvingo

Figure 3-1-1 shows the location of the Project Area and each C.L..

Fig. 3-1-1. COMMUNAL LANDS IN PARTS OF
MASVINGO AND MIDLANDS PROVINCES



(2) Roads

There are three major National Roads running through or along the Project Area. They are all completely paved and allow high speed driving. The first road connecting Masvingo and Zvishavane runs through Chibi C.L. The second one extends from Gweru to Zvishavane through Runde C.L. The third road runs from Mvuma to Masvingo and further down to Mwenezi. This National Road crosses the northeastern corner of Chilimanzi C.L. and passes through Chibi C.L. These are the major trunk roads of access to the Project Area.

Roads available between villages in the Project Area and the National Roads mentioned above are mainly secondary roads. These are shown by thin solid lines on the topo-map scaled 1/250,000 published by the Surveyor-General, Zimbabwe. These are usually gravel paved, and motorable throughout the year.

There are also inferior roads connecting strategic points such as service centers, business centers, schools, clinics, etc. in the Communal Lands. These roads are indicated by thin dotted lines in the topo-map. Conditions of these roads are by no means satisfactory for sustaining normal vehicle traffic. During the wet season, especially after a flood, traffic may be halted for a short period. However, it would be possible to operate four-wheel drive cars during such times.

The characteristic of the road network in the Project Area is that there are more roads in the north-south direction than in the east-west direction.

(3) Railway Network

The state-run railway of Zimbabwe offers a well developed service. It connects the major cities of Zimbabwe and the national

network is linked with all the four neighbouring countries, Zambia, Mozambique, Botswana and South Africa. The major items for transportation are industrial materials and agricultural products. The railway is one of the major means of transportation for export and import.

The route which comes into contact with the Project Area is the one running from Gweru through Zvishavane and Rutenga to Beitbridge which is the border town with the Republic of South Africa. This route runs through Runde, Mazvihwa, eastern boundary of Mberengwa and Matibi No.1 C.L. Major freight of this line is the mineral ores produced from the mines located around Mt. Buhwa. This route does not serve passengers. Beyond Beitbridge this route is connected with the Republic of South Africa.

3-1-2. Population and Life

(1) Communal Land and District Council

The Project Area consists of eight Communal Lands (C.L.) in total, and these Communal Lands are under six District Councils (D.C.) of the Ministry of Local Government and Town Planning.

The Ministry of Water Resources and Development (MWR&D) is responsible for the conservation of surface and groundwater resources in the country and its function lies in the formulation and administration of government policy on the development of the water resources. The two provincial offices of Midlands and Masvingo of MWR&D are responsible for management of Water Resources Development and Rural Water Supply Programme in the Communal Lands of the Project Area.

(2) Population and Household

The Project Area accounts for about 7.7 percent of the total communal land area of 162,000 km² in the country. The 1982

census shows that some 501,000 persons live in the Project Area, i.e., 11 percent of estimated 4.4 million persons in the entire communal lands of the country. The average population density is about 40.3 persons per km² which is 13.3 persons higher than the national average of 27 persons per km² of the entire communal lands. There are 86,442 households in the Project Area, implying the households density of 5.8 per km². Population and the number of households are shown in Table below.

Table 3-1-1. Population, Household and Density

<u>Communal Land</u>	<u>Population</u>	<u>Household</u>	<u>Area</u>	<u>Population Density</u>	<u>HH Density</u>	<u>PS/HH</u>
		(No.)	(km ²)	(per km ²)	(per km ²)	(No.)
Chilimanzi	42,144	7,855	1,030	40.9	7.6	5.4
Shurugwi	41,717	7,131	850	49.1	8.4	5.9
Runde	37,399	6,214	980	38.2	6.5	6.0
Mazvihwa	17,817	3,064	550	32.4	5.6	5.8
Mberengwa	150,777	24,471	3,720	40.5	6.6	6.2
Chibi	137,707	23,795	3,210	42.9	7.4	5.8
Matibi No.1	39,837	7,670	1,080	36.9	7.1	5.2
Maranda	33,490	6,242	1,000	33.5	6.2	5.4
Total	500,888	86,442	12,420	-	-	-
Average(weighted)				40.3	7.0	5.8

Source: Census 1982

Notes: HH = Household

PS/HH = No. of persons per household

People in the Project Area practice the traditional small scale rainfed agriculture and cattle farming. About 16 percent of the area is cropped and the rest is covered with the natural trees and bushes on the extending undulating plain.

They live in a cylindrical hut with mud or brick wall and thatched roof. Generally, the Communal Lands in the Project Area are scattered with such huts. No electricity and water supply facilities are available. The huts are equipped with the bare necessities of life. Though their living conditions are quite different and precarious as compared with those of their urban population, their standard of living is steadily rising.

(3) Community Centers of Communal Land

The inhabitants in the Communal Lands generally carry out their communication and official businesses at service centers and/or business centers scattered in the Communal Lands. Among service centers six of them are called District Service Centers and have District Council Offices. They are established to perform the public administration for the inhabitants as well as function as commercial and traffic centers. On the other hand, the business centers offer facilities for the daily life of the inhabitants around the centers and outnumber the service centers even though they are small in scale.

The number of community centers and schools is shown in Table 3-1-2. A business center caters for 2,300 people and a school accommodates 1,600 people on average in the whole Project Area.

Table 3-1-2. Social Infrastructures in C.L.

<u>C.L.</u>	<u>Community Centers</u>		<u>Pop.</u>	<u>Sch.</u>	<u>Pop. per Sch.</u>	<u>Hospital /Clinic</u>
	<u>A. Service Center</u>	<u>B. Business Center</u>	<u>A+B</u>			
Chilimanzi	6	6	3,500	33	1,300	2
Shurugwi	7	14	2,000	26	1,600	6
Runde	4	6	3,700	27	1,400	1
Mazvihwa	3	2	3,600	6	3,000	0
Mberengwa	15	55	2,150	89	1,700	15
Chibi	7	51	2,400	77	1,800	5
Matibi No.1	5	17	1,800	24	1,650	2
Maranda	2	16	1,900	32	1,050	6
<u>Total</u>	<u>49</u>	<u>167</u>	<u>-</u>	<u>314</u>	<u>-</u>	<u>37</u>
Average(weighted)	-	-	<u>2,300</u>	-	<u>1,600</u>	-

<u>A. Service Center (S/C)</u>	<u>B. Business Center (B/C)</u>
D.A. office or Branch	-
Post Office	-
Police camp	-
Road camp	-
Hospital	-
Clinic	-
Secondary school	-
Primary school	Primary school
Market	Market
Hotel	Hotel
Bus Service	Bus Service
Electricity	Electricity
Telephone	Telephone
Dip Tank	-

Source; Service Centers: Dept. of Physical Planning, MLG&TP
 Business Centers, Schools, Hospitals & Clinics: D.A.'s

3-2. Physical Conditions

3-2-1. Topography and Geology

(1) Topography

Most of the Area lies between 1,400 m and 500 m above mean sea level and generally slopes gently from north to south. The highest point is Mt. Buhwa (1,627 m) in the Mberengwa C.L.

The differences in topographical expression of the major rock types are very marked. They are granites, gneisses, granulites, and schists.

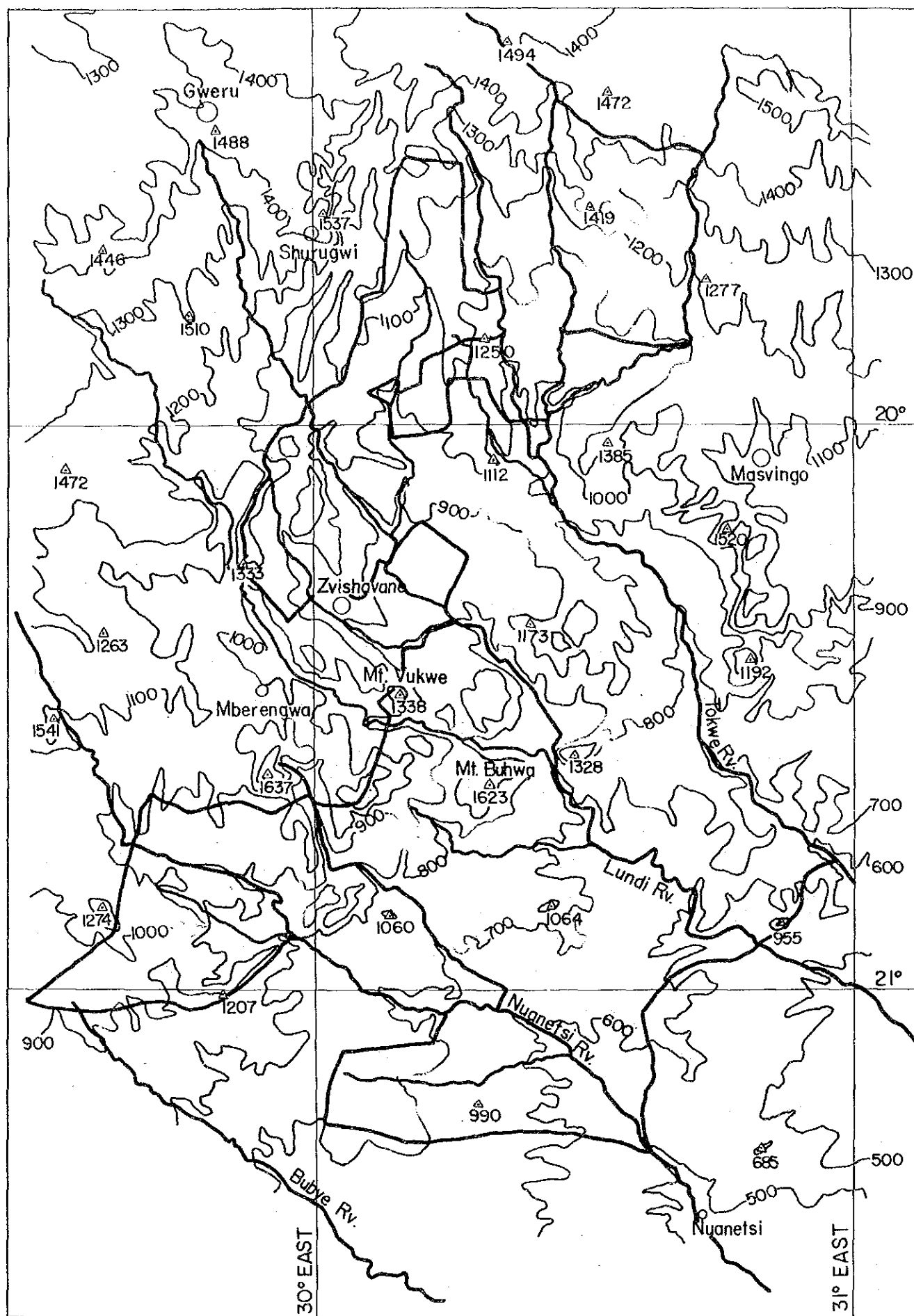
The granites are distributed in four areas, and they are composed of well wooded bornhardt, dwala, and castle koppie. The bornhardt and dwala have smooth and steep flanks formed by exfoliation, and the castle koppie forms large blocks of granite which stand on rubble covered foot area.

Older Gneiss Complex area is mainly lowlying dwala and sand veld. The schist belt which lies to the south of the Chibi Granite is the long, narrow, wooded hills and highest range in the area trends in a northeasterly direction. Mt. Buhwa, which consists of banded iron stone and jaspilites, rises 800 m above the surrounding country.

The southern part of the area which is composed of granulitic gneiss forms hilly ground, and consists of small dwalas or castle koppies.

Topography of the Area is shown in Figure 3-2-1.

Fig. 3-2-1. Topographical Map of The Area



III-9

1 : 1,000,000

(2) Geology

Geology of the Project Area consists of pre-Cambrian rocks, intrusive rocks of various ages, and Quaternary deposit. The stratigraphic succession is shown in Table 3-2-1. The geological outline of the Project Area is given in Figure 3-2-2 and DWA No.01.

i) Basement Schist Complex

Basement Schist Complex comprises Sebakwian Group, Bulawayan Group, and Beitbridge Group.

Sebakwian Group, which lies northeast of the Study Area in a small scale, consists of schists, serpentinite, quartzite, limestone, phyllite, and greenstone and has a north striking trend.

Beitbridge Group, which lies in the southern end of the area, consists of para-gneiss. These two Groups are exposed in a limited area.

Bulawayan Group, which is represented by Buhwa Mountain, lies in the center of the area and has a southwest trend, and forms long narrow ridge-like hills. This Group consists of ultramafic rock, greenstone, and sedimentary rocks. The sedimentary rocks, which are interbedded among the ultramafic rocks, consist of quartzite, banded ironstone, limestone and phyllite.

ii) Limpopo Mobile Belt

Limpopo Mobile Belt, which is made up of granulitic gneiss, is widely distributed in the southern part. This wide zone consists of mainly south dipping, tightly folded, plastically deformed strip, boudins, and dismembered remnants of Basement Schist Complex. These remnants are now mainly mafic, ultramafic and granulitic with

laminated or lensoid structure. The whole zone has a general northeast striking trend.

iii) Older Gneiss Complex

Older Gneiss Complex and Younger Granite occupy the greater part of the area. They rise on weathered pale-colored sandveld soils and are responsible for such spectacular land forms as the high domes and balancing rock features, known as dwala, bornhardt, and castle-koppie.

Older Gneiss Complex covers a large area from north to south in the area , and comprises tonalitic gneiss zone and granitic gneiss zone.

Tonalitic gneiss is commonly medium to coarse grained, banded, foliated or massive. This zone is characterized by many dykes and sheets. The contact zone of these rocks are important as a source of ground water.

Granitic gneiss zone, which is covered with flat and rolling sandveld, consists of generally fine grained, foliated, banded rocks. This zone has many fractured zone and quartz vein in north-northwest to north-northeast direction.

iv) Younger Granite

Younger Granite is distributed in four zones of the area, and is composed of the Porphyritic, the Chibi, the Shabani, the Umvuma Granite.

The Porphyritic Granite, which lies along the northern end of the Limpopo Mobile Belt, has a continuous east-northeast trending body , and forms large characteristic smooth-flanked hills. It is generally coarse grained.

The Chibi Granite lies in the center of the area with northeast trend and consists of large body. This rock is coarse to medium leucocratic and is in places porphyritic rock with rough weathered surface. This granite has two kinds of fault systems. Northwest striking fault breaks this granite into numbers of hills of considerable relief. Another fault system, striking north-northeast, has many open fissures and in places contains quartz-filled fissures and lenses.

Shabani Granite lies in the northwestern corner of the area and is typically massive, leucocratic and medium grained.

In outcrop, this granite commonly forms flat to rounded surface often associated with large rounded boulders. This rock has poorly developed foliation, but generally massive.

Umvuma Granite lies in the northern part of the area. This rock is generally fine grained but there are rare occurrences of medium to coarse grain with poorly developed foliation, but generally massive.

v) Great Dyke

Great Dyke is composed of Great Dyke and East Dyke. Great Dyke lies in a limited area of Runde C.L. and Mberengwa C.L. It consists of quartz gabbro, serpentinite and pyroxenite. East Dyke occurs discontinuously from north to south. The outcrops identified are low and bouldery and do not form the ridge feature. It is a medium grained, grey-brown quartz-gabbro. Its contact zone with other rocks is very important as a source of ground water.

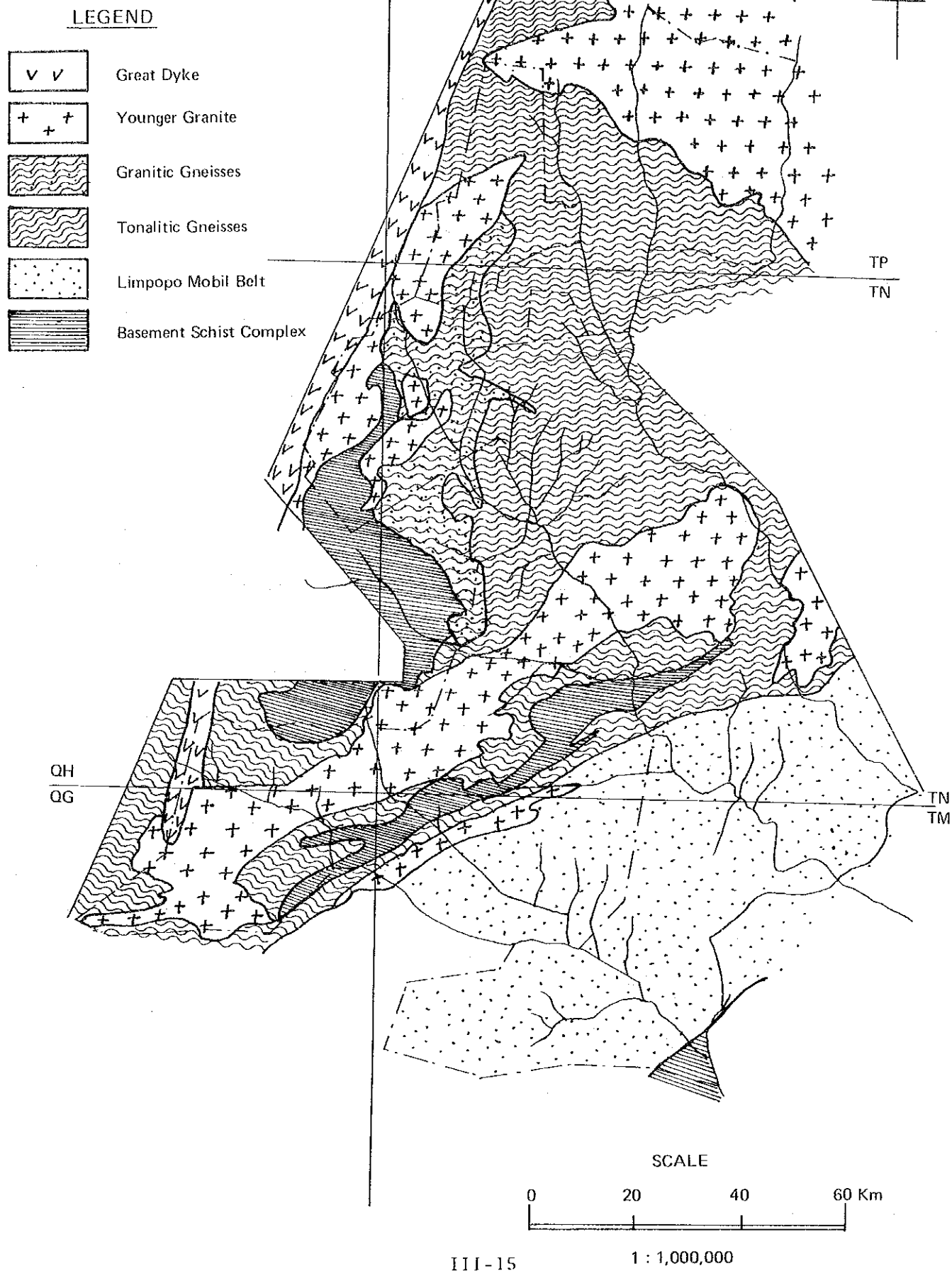
vi) Dolerite Dyke

Mainly in the tonalitic gneiss zone of the area occur a number of dolerite and metadolerite dykes in an easterly direction. These dykes are generally fine grained, partly grassy, basaltic to porphyritic, and even to vesicular types.

Table 3-2-1. Stratigraphic Succession of the Project Area

Age	Formation		Rock facies	Remarks
Recent	Alluvial deposit		Soil	thick, deep red clay
Various Ages	Quartz vein		Quartz	
	Dolerite dyke		Dolerite Metadolerite	ENE, SE trend
Pre - Cambrian	Intrusive Igneous Rocks	Great Dyke	Quartz Gabbro, Serpentinite, Pyroxenite	distributed in a small area.
		Younger Granite	Porphyritic Granite	coarse grained, has ENE trend body.
			Chibi Granite	coarse to medium grained has many fault NW & NNE trend
			Shabani Granite	medium grained, generally massive.
			Umvuna Granite	fine grained, massive.
		Mashaba Serpentine	Serpentine	
		Older Gneiss Complex	Banded, foliated, Granitic Gneiss Tonalitic Gneiss	with many dykes and sheets. has fault & quartz vein trend N, NNW.
		Limpopo Mobil Belt	Granulitic Gneiss, Granulite, Metaquartzite, Serpentine	NE trend, south dipping, many tightly folded boudin, with remnants of Schists.
	Basement Schist Complex	Beitbridge Group	Para Gneiss	exposed in a small area
		Bulawayan Group	Schists, Limestone, Banded Ironstone, Greenstone, Serpentine	has SN trend, forms long ridge, interbedded between mafic & sediment
		Sebakwian Group	Schists, Serpentine, Banded Ironstone, Quartzite, Limestone.	N trend exposed in a small area.

Fig. 3-2-2. GEOLOGICAL OUTLINE MAP



3-2-2. Rivers

The main rivers in the Area, the Tokwe, Lundi, and Nuanetzi are roughly parallel to one another and drain across the area from northwest to southeast direction.

The Tokwe river rises near the northern boundary in the Shurugwi C.L. at an altitude of about 1,480m and leaves the southern boundary in Chibi C.L. at 600m. The gradient of the river bed is about 4.9/1,000 in the area and the length is about 183km.

The Lundi river originates in Gweru and enters at 1,040m to leave the southern boundary in Matibi No.1 C.L. at 540m. The gradient of the river bed is about 2.9/1,000 in the area and the length is about 175km.

The Nuanetzi river flows into the area at 960m to leave the southern boundary on the Mberengwa C.L. at 520m. The gradient of the river bed is about 3.2/1,000 in the Area and the length is about 138km.

Most of the drainage is strongly controlled by geological structures, such as faults, folds, boudins, and dips and strikes of strata. The river system is shown in Figure 3-2-4.

Fig. 3-2-3 River System of The Project Area

